R-390A notes on alignment and overall sensitivity

Measuring Receiver Sensitivity by Chuck Rippel

There may be an occasion when its appropriate to measure and record receiver sensitivity in real terms using an accepted standard. For radio receivers, real term sensitivity is expressed as the value of a modulated RF voltage applied to the antenna input necessary to provide a 10db S/N + N figure. This means, what input voltage is required to raise audio output 10 db over the receiver noise floor.

Measuring the receiver sensitivity in the R390A is an easy, straight forward procedure. The receiver Line Level meter can even be used to help with the measurement. Here is the procedure:

1- Turn the receiver and signal generator on and allow them to warm up for 1 hour.

2- Put the receiver and generator on 4.8 mHz (or any other frequency of choice)

3- Set the initial generator output to 1μv and modulation level 1kc, 30% but do not connect the antenna input yet..

4- Set the R390A Function switch to "MGC," Bandwidth to 4kc, RF gain full CW, BFO off.

5- Set the Line Meter range switch to -10 and carefully adjust the Line Gain control for a -10db indication on the Line Level meter.

6- Watch the Line Level meter and peak the Ant Trim on receiver noise alone; readjust the Line Gain control for a -10db indication on the Line Level meter. This level is now indicating a relative level of the receiver noisefloor.

7- Connect the generator to the receiver antenna input (I use the "Balanced" input) and adjust the Kilocycle Change control to center the output of the generator in the receiver passband.

8- Adjust the RF output level of the generator to cause the Line Level meter on the R390A to read "0."

9- Note the output of the generator in microvolts. This value is the 10db S/N + N receiver sensitivity. It should be less than 0.5uv although the official specifications of the receiver call for 3 microvolts.

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Once the receiver sensitivity has been established, you can then "massage" the IF Gain (usually by dropping in nearly all the way) and tube lineup for the best recovered audio. The technique to "massage" the If gain is covered in the Technical, IF Gain section of this site. Optimizing the vacuum tube lineup in the signal part is another technique to maximize performance. Because changing them does not require re-alignment, an easy start is to work with the tubes in the signal path of the IF strip. These are the 5749W's IF amps, V-501, V-502 and V-503. The 6AK6 4th IF amp V-504 and the detector, V-506, a 5814A. With your generator set up and the receiver at step 8 above, install a replacement tube at V-501, allow it to warm up about 5 minutes and note the indication of the Line Level Meter. If it climbs above 0db, the new tube has improved gain, if not, reinstall the old tube. Repeat the same steps for V502, V503, V-504 and V-506. You may "find" a few extra db in your spare tube stores.

R390A IF Deck Alignment (Chuck Rippel)

R390's made after 1954 and those with mod 2 stamped on the IF chassis have a field change installed to the mechanical filters. Filter input and output trimmer capacitors have been added. The 4 input trimmer capacitors are found by removing the 2 square can on top of the IF chassis using the single nut in the top. The 4 output trimmer capacitors are located behind 4 holes in the left hand side of the IF deck. The IF chassis will need to be loose but still electrically connected to complete these procedures.

An accurate counter, analog VTVM and a signal generator capable of outputting 455.00 KC, is required for these alignments.

Connect the VTVM to the Diode Load bus on the rear and configure it to read a negative voltage of approximately -7vdc. Set the receiver FUNCTION control to MGC, BFO to OFF and the LOCAL GAIN control to a comfortable level. Lift and tilt the IF deck resting the front captive (green) screw over the front panel. You should be able to gain access to the mechanical filter trimmer capacitors through the large ventilation holes in the main chassis.

Locate the cable running from the rear of the IF deck to the *IF OUT* BNC connector in the rear panel, upper left side. Unplug the cable from the IF deck only. Also unplug J-513 and the one next to it. Plug the cable running from the rear IF Out jack into J-513 on the IF deck. Connect the

output of your 455.000 kc generator.

Mechanical Filter Alignment-

Set the 455kc generator output level to cause the VTVM to read about -2.5V.

With the IF deck oriented so that the bandwidth control is towards you, set the bandwidth to 2Kc and align 1 of the four top trimmers.

Adjust C-569 which is at 9 o'clock for a peak on the VTVM.

Next, align the output trimmer in the left side of the IF deck, labeled C-567

Set the BW to 4KC

Align the top trimmer, C-568 located at 12 o'clock

Align the side trimmer, C-566 located at rear, bottom.

Set the BW to 8kc

Align the top trimmer, C-570 located at 6 o'clock.

Align the side trimmer, C-565 located at front, top.

Set the BW to 16kc

Align the top trimmer, C-571 located at 3 o'clock

Align the side trimmer, C-564 located at front, bottom.

IF Transformer Alignment-

Select the 16KC filter

Set the generator frequency to 467kc. Note: The generator output should be increased until the VTVM indicates approximately -2vdc. Do not be alarmed if that level is over 0.1 volts. Adjust the top slug (secondary) of T-501 for a peak reading on the VTVM, Adjust the bottom slug (primary) of T-502 for a peak reading on the VTVM

Set the generator frequency to 443kc. Note: The generator output should be increased until the VTVM indicates approximately -2vdc. Again, do not be surprised if that level is over 0.1 volts. Adjust the bottom slug (primary) of T-501 for a peak reading on the VTVM, Adjust the top slug (secondary) of T-502 for a peak reading on the VTVM. Decrease the generator output and adjust the frequency to 455kc Note: The generator output should be decreased until the VTVM indicates approximately -3vdc.Select the 4kc filter then peak top and bottom of T-503 only

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AGC Alignment-

Verify the generator is still outputting 455.00kc. Set the FUNCTION switch to AGC and connect the VTVM between the AGC bus on TB-102 3 & 4 located on the rear panel & ground.

Adjust the generator output for a reading of approximately -5vdc on the VTVM. Peak Z-503.

BFO Alignment-

Verify that generator is still at 455.00kc

Turn on the BFO and exactly zero beat it against the 455.00 generator frequency.

Loosen the bristo spline socket on the BFO shaft coupler,
Verify that you still have exact zero beat.

Set the BFO Pitch control to indicate exactly 0.

Then, tighten the bristol socket on the non-mar clamp on the BFO shaft coupler

The filters have been aligned to 455 kc.

(When a station broadcasting in AM is zero beat, the carrier will be in the center of the filter selected).

Re-install the IF chassis in the receiver.

Setting the IF Gain Control for best performance

The most common single item responsible for holding an R390A back is not lack of sensitivity. Rather it is internally generated IF deck noise. In an otherwise properly operating R390A, the cause of this excessive noise is IF gain control being set to high. Even the mfg spec of setting the IF deck gain such that -7vdc at the diode load when fed by 150uv @455kc into J-513 is far too hot.

Here is a recently refined procedure to set the IF deck gain control. Anyone can perform the procedure whether they have access to a signal generator or not.

Procedure to set R390A IF Gain-

Once the receiver has been fully mechanically and electrically aligned, the final procedure to perform before buttoning it up is to set the IF gain control. Many otherwise very sensitive R390A's are thought not to be due to weak signals being covered by noise generated by excess IF deck gain.

Allow the receiver to warm up for at least 1 hour then:

Disconnect the antenna

Set receiver for 15.2 mHz

Set the FUNCTION control to MGC

Select the 4kc filter with the BANDWIDTH

Set RF GAIN control to 10 or maximum

Peak the ANTENNA TRIM for maximum noise as indicated on the LINE LEVEL meter

Set Line Meter switch to -10db scale

Set Line Gain control to full CW or 10.

Adjust IF gain control, R-519 to cause Line Level meter to indicate between -4 to -7 db.

Re-zero the carrier meter control, R-523

Set controls above for normal operation and reconnect antenna

Discussion:

This will yield the best compromise on all bands. I usually poll those bands which I normally spec out. Then, using an HP signal generator set for internal modulation of 800 hz @ 30%, massage the gain setting and even specific signal path tube selections for the best overall performance.

Contribution by Chuck Rippel, WA4HHG

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from EIB-836:

Variable IF Reference & Stage Gain
by Chuck Rippel
12/24/2001

Part of the secret behind the R390A's incredible selectivity and its immunity to near RF fields is found in the two tracking IF sections. The First Variable IF operates while receiving frequencies below 8 Mhz and is tuned to pass IF signals from 17 to 25 mhz. This represents the sum of the actual received frequency that is amplified by V-201 and then applied to the grid of the First Mixer, V-202. The 17.0 Mhz output from the 1st Crystal Oscillator, V-207 is also applied to the cathode of the same tube. The signal represented by that sum is directed to the tracking coils Z-213-1, 213-2 and 213-3 which are kept tuned to the correct frequency within the 17 - 25 mhz IF frequency range by the cam system. This signal is then known as the First Variable IF Frequency.

During reception of frequencies 8 Mhz and below, the composite output of the First Variable IF is routed through S-208 (front), then C-286 and is applied to the grid of the 2nd Mixer, V-203. For reception of frequencies 8 Mhz and above, the amplified recived signal signal from V-201 is routed around the First Mixer by S-206 and applied to the grid of the 2nd Mixer through S-208 and C-286. The output of the 2nd Crystal Oscillator, V-401 is also applied to the cathode of V-203. The resultant output is the 2nd Variable IF Frequency which is always between 2 and 3 Mhz. That difference is applied to the tracking coils Z-216-1, 216-2 and 216-3 which are also kept tuned to the correct frequency within the 2-3 Mhz IF frequency range by the cam system.

The 2nd Variable IF frequency is applied to the grid of the 3rd mixer, V-204 where it is mixed with the output of the PTO (V-701) applied to pin 7. The PTO tunes from 3.455 to 2.455 Mhz . The difference frequency between the 2nd Variable IF Frequency and the output of the PTO is always 455kc. This difference frequency is applied to T-208 which is tuned to 455kc. The result is the 3rd IF Frequency which is then routed from the RF deck to the IF sub-chassis through P-213 and P-218.

In analyzing a failure in the variable IF system, it can be seen that a signal related failure in the First Variable IF will result in low gain during reception of only the frequencies below 8 Mhz. A like failure in the 2nd Variable IF or 3rd IF would affect all frequencies.

Here is a quick test to see if the Variable IF stages are generally working.
Initial checks:

First Crystal Oscillator output as measured at pin 7 of V202:
Normal is approx 4V P-P
SecondCrystal Oscillator output as measured at pin 7 of V-203:
Normal is approx 3.2V P-P
PTO output measured at pin 7 of V-204:
Normal is approx 6V p-p

First Variable IF Gain Test:

Tune the receiver to 00 500, AGC OFF, VTVM connected to read voltage at the rear Diode Load point.

Inject a 17.5 Mhz signal at approximately 15uv through an RF coupled probe to E-210. This should result in a reading of approximately -5V at measured at the diode load point. This bypasses the coils Z-216-1, 216-2 & 216-3 and can be used as a reference.

Inject a 17.5 Mhz signal at approximately 40uv through an RF coupled probe to pin 1 of V 202. This should yield approx -3.5V at the diode load point.

Discussion: An indication at the diode load point of approximately 1.5V of loss is nominal. If there is loss which cannot be corrected by proper alignment of coils Z-216-1, 216-2 and 216-3 or no signal at all, change the injection point coil to coil to moving "away" from the 2nd mixer to find the failure.

Second Variable IF Gain Test

Tune the receiver to 01 000+, AGC OFF, VTVM connected to read voltage at the rear Diode Load point.

Inject a 2.0 Mhz signal at approximately 15uv through an RF coupled probe to pin 1 of V203. This should result in a reading of approximately -2.2V at measured at the diode load point. Again, this bypasses the coils Z213-1, 213-2 & 213-3 and can be used as a reference. Inject the 2.0 Mhz signal at approximately 15uv through an RF coupled probe to pin 6 of V-204. This should yield approx -4.2V at the diode load point.

Discussion: An indication at the diode load point of an increase of approximately 2V is nominal. Again, If there is loss which cannot be corrected by proper alignment of coils Z-213-1, 213-2 and 213-3 or no signal at all, change the injection point coil to coil to moving "away" from the 2nd mixer to find the failure. To align the variable IF stages, I use a different method from that found in the various military manuals. My technique yields better results by taking a systems approach and also not loading down the stage to be aligned. Its a bit lengthy to explain here but that procedure, along with many other techniques are demonstrated in the 7 hour long, R390A video tape series available from Hi-Res Communications.   Don't forget to ask about the new 4 hour addendum to the 7 hour series.. R. Charles Rippel

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Date: Sun, 12 Oct 1997 10:03:40 +0500
From: "Chuck Rippel" <crippel@...>
Subject: [R-390] R390A alignment note

The following is probably the single most important alignment component in the R390A receiver. It's relevence is not really spelled out in any of the techincal manuals I have seen but it is the real key to getting the receiver properly aligned.

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PTO tracking on the R390A is very important. Due to the tracking nature of the RF and IF circuitry, the PTO end points must be very carefully adjusted. If the PTO is "long" or "short," it will not tune in the designed 1 mHz segments that match the mechanical cam profiles which drive the slugs in the various coils. In as much as I restore R390A's, I find that PTO mis-tracking by a little as 10 kHz can noticably degrade overall performance. Don't believe it? Losten the PTO coupler then tune the radio on simple band noise. At this point, changing frequency with the KILOCYCLE CHANGE knob will only tracking the cam stacks and not the PTO. Observe that the band noise drops away at about (+-) 7 kc or so from your original frequency. That's is how tight the mechnical tracking on the '390A is.

Here is a quick check for proper PTO tracking: Let the radio warm up for about an hour.

Tune the radio down to (-) 000 and zero beat the calibrator. Next, tune the radio up and note the frequency where it zero beats. The dial should read close, say to plus or minus 3 kc's of (+) 000. If that is not the result, both the PTO end points AND the dial over run need to be reset. This is followed by setting (timing, actually) the various cams which now need to be mechanically realigned. Follow this by an an electrical alignment as outlined on top of the "Utah shaped"
plate on top of the RF deck.

Successful completion will result in the mechanics of the receiver tracking with the electronics.

Date: Sat, 1 Nov 1997 23:56:59 +0500
From: "Chuck Rippel" <crippel@...>
Subject: [R-390] Filter and BFO alignment

R390A's made after 1954 and those with "mod 2" stamped on the IF chassis have a field change installed to the mechanical filters. Filter input and output trimmer capacitors have been added. The 4 input trimmer capacitors are found by removing the 2" square can on top of the IF chassis using the single nut in the top. The 4 output trimmer capacitors can be seen behind 4 holes in the left hand side of the IF deck.

If you have a counter and a generator which can put out 455.00 KC, you can align filter network:

Connect a VTVM (NOT DVM) to the "Diode Load" bus on the rear and configure it to read negative voltage. (It'll be about -5 volts)

Locate the cable running from the rear of the IF deck to the "IF OUT" BNC connector in the rear panel, upper left side. Unplug the cable from the IF deck only. Also unplug J-513 and the one next to it. Plug the cable running from the rear "IF Out" jack into J-513 on the IF deck. Connect the output of your 455.00kc generator.

Set the .455kc from the generator to cause the VTVM to read about- - 2.5V

With the If deck oriented so that the bandwidth control is towards you, set the bandwidth to 2Kc and align 1 of the 4 the top trimmers. Adjust the one which is at 9 o'clock for a peak on the VTVM. Next, align the output trimmer in the left side of the IF deck, located at rear, top.

Set the BW to 4KC
Align the top trimmer located at 12 o'clock.
Align the side trimmer located at rear, bottom.

Set the BW to 8kc
Align the top trimmer located at 6 o'clock.
Align the side trimmer located at front, top.

Set the BW to 16kc
Align the top trimmer located at 3 o'clock
Align the side trimmer located at front, bottom.

Peak top and bottom of T-503 only!

Verify that generator is still at 455.00kc

Turn on the BFO and exactly zero beat it against the 455.00 generator frequency. Loosen the bristol spline socket on the BFO shaft coupler, verify that you still have exact zero beat. Set the "BFO Pitch" control to exactly "0" then tighten the bristol socket on the non-mar clamp on the BFO shaft coupler

The filters have been aligned to 455 kc. When you zero beat a station broadcasting in AM, the carrier will be in the center of the filter selected.

Date: Wed, 5 Nov 1997 11:08:49 +0000
From: crippel@...
Subject: [R-390] Re: R390A question

> Thank you Chuck for coming back to my call.... I have a 1st OSC problem
> in the R390A. After it gets good and hot in the chassis the osc dies.
> Sometime I can shock it back by unplugging the heated xtal assy. I
> thought I fixed this about 4 yrs ago when I first got the rcvr. Any way
> do you have any suggestions ? I am going to pull it out of the rack and
> start snooping. I have a manual and the radio never saw military service
> so the radio is really in very nice shape. TNX again FRED KC4MOP

See that one all the time as it kills wht low bands when it fails.
The fix is; its an easy. Remove the HR-202 xtal assy and:

A: Replace it (Fair Radio has replacements)

B: Take it a part and put a new 17mhz crystal in it. May as well replace the calibrator crystal while you're at it. It fails also. I favor "B" as the HR-202 assy's are getting hard to find. '390A xtals, 1st and 2nd oscillators) are dying right and left due to age. International crystal has the JAN cross reference. Take the number off the crystal case, (I know that the the R390A 2nd oscillator crystals are HC6/U) and give it to them.

From: rerobins@... (Rick Robinson)
Date: Tue Nov 18, 1997 1:18 pm
Subject: [R-390] RF alignment

My radio weekend was nearly ruined by sunny skies and temps in the high'50s. Fortunately the "honey do" list was very short so there was plenty of R-390A time.

Now that the front panel is off, here is the next bear to cross. My RF cams do not align anywhere in the 7Mcs band. Part may be my fault in my previous tinkerings, part the previous owner. All the screw heads are buggered up, so someone has been visiting this problem before.

I've been following along with Dallas Lankford's suggestions for RF alignment in some old Hollow State News issues to no avail. (I also have a 1980s printing of the Army Field Depot manual.) He suggests finding a freq where all 6 cams align and reset the Veeder-Root and assumes there will be such a spot. There is no one freq where all 6 of my cams line up properly.

What I've tried to do is find a freq where the 18-30 aligns itself and align the other 5 there and set the Veeder Root to 7.000. When I turn back to the 10 turn stop point, I'm at -7.6XX. Hosed by the PTO. To fix the 10 turn and RF cam problem, should I:

1.set the dial/PTO to the 10 turn stop below 7Mcs
2.disconnect the dial linkage to the PTO so it won't turn
3.set the 6 cams to my 7.000Mcs spot and reset the Veeder-Root
4.go back -6.965 or so for the 10 turn stop point, and recconect the PTO

If I do need to disconnect the PTO linkage, what is the best way to do so?

From: Tom Norris <badger@...>
Date: Thu Nov 20, 1997 5:51 am
Subject: [R-390] The "plus sign" cam alinement gotcha

[The plus sign gotcha, or "When 7 Mhz is REALLY 8"] A reminder to those who may have had an alignment planned, or had done an aligment in the past that went awry--

When the manual mentions the steps regarding the sync of the RF cams in the 390A the freq for this alignment is 7+000, rather that 7.000. That is, tune to 7.999, then go one more step till the red plus sign shows on the Veeder -Root counter. Then check to see if the lines marked on the chassis bisect the holes in the RF cams. Adjust as needed by loostening clamps. Very common mistake, according to those who did this for year in the military, and bit me a time or two when I first started on the things. (though not in the military). The 390 non-A has a similar cam aligment procedure, but it is done 2.000 Mhz. No pesky plus signs here. :-)

From: "Chuck Rippel" <crippel@...>
Date: Sat Nov 22, 1997 8:06 pm
Subject: [R-390] R390A "Mystery Alignment" found!

Anyone who has ever tried to align an R390A has wondered about the purpose of the 2nd trimmer capacitors marked "BAL" in the antenna trim cans. As an F.Y.I., these are the most forward cans in the tuneable slug racks. I found an old manual, TM-11-856A dated January 20, 1956 and on page 172, paragraph #164 which details their adjustment. I have not seen the procedure in any other version manual yet examined. Their purpose is to balance the "Balanced" antenna input and set up the proper relationship between the 2 sides of that input depending on frequency. A friend told me that he feels that they would be used to properly set up a DF antenna. I have heard that DF"ing was one of the primary design considerations of the '390A and that the IF deck was specially gain engineered to allow for very accurate readings. While the results for our use seem dubious at best, I have never seen an explanation of the purpose and alignment of these trimmers. If anyone wants a copy, sent me a >business sized SASE< with one unit of postage and I will photo-copy the procedure and send it to them. The procedure is about 3/4 a page long and involves some high school level algebra to calculate.

From: "Chuck Rippel" <crippel@...>
Date: Tue Dec 2, 1997 4:03 am
Subject: Re: [R-390] audio, nothing but hash from my A !

> Hello, name here is Scott and I have a problem, hope a small one, with my Motorola mfg R-390A. It was working fine then without warning all I get from the speaker is white noise/hash. Meters seems to show a signal present on most any band but there is nothing there. Anyone run into this before ? Might I ask what the fix is? or rather what your fix was as I'm sure there are probably several ! Thanks for the help and happy listening. 73 Scott

The RF deck is running away. You have a failed or loose in its socket C-227 located on the cathode of V-201. It screws into the chassis and can be seen from the top looking down between V-201 and
V-202.

From: dave metz <metzd@...>
Date: Thu Dec 25, 1997 10:24 am
Subject: [R-390] R-390A XTAL Problem

A recently post by our resident master Chuck Rippel, seemed to come back to haunt me last month. I have a great R390A that he worked over in the last year and has unbelievable sensitivity and looks after he got done with his renovation. . Anyway, this wonderful unit was stone cold on the lower bands when I turned it on after maybe being off for several months. Hmmmmm me says, I wonder if Chuck's comments about HR202 and the 17 Meg Xtal going bad would have anything to do with the problem as the tube check gave no indication of problems. . So I called JAN xtals and ordered a couple of these $20 xtals. They came in yesterday and quickly one went into the assembly. Hot dog, its running like a champ today! I would caution anyone who does this surgery to take a spring hook to the center X of the holdown device to pull it out of the way and remove the plug in assembly with your other hand. Then put in a socket or something about the same height in its place to constantly keep tension on the springs while you are working on the assembly. To rehook those springs is a PAIN! If one slips and the spring goes down into the hole, you might be looking at removing the RF Deck to recover the spring. Such a deal!

From: "Chuck Rippel" <crippel@...>
Date: Thu Dec 25, 1997 8:41 pm
Subject: [R-390] HR-202 Mysteries & Details

Dave Metz posted the failure conditions and cure for a very common R390A problem, failure of HR-202. HR-202 is an approx 1-1/4" diameter, cylindrical oven containing crystals Y-203 and Y-202. It plugs in an octal socket located at the far right hand corner of the R390A RF deck. There is a removeable spring clip affair across the top to assure that HR-202 stays in place. Having any of the two crystals within HR-202 fail can cause a lot of head scratching. Finding complete HR-202 assys becoming more difficult so rebuilding a defective one is the preferred option. The first crystal within the HR-202 assy is Y-203, the 200KC crystal for the calibrator. This crystal can fail completely causing the calibrator to not operate. More commonly, it will have drifted with age and be out of range of the calibrator adjustment, C-310. Zero beat will not be achieveable against
the alignment standard being used. The calibrator zero adjustment, C-310 is acessable through the back panel.

The cure is to replace Y-203, the 200KC crystal within HR-202.

The second crystal in HR-202 is Y-201, the 17 mHz 1st xtal oscillator. It drives V-207 whose plate is transformer coupled VIA T-207 to cathode of the first mixer, V-202. Part of the alignment procedure involves peaking T-207 during the IF
alignment.

A Y-201 or associated circuit failure will cause all bands below 8 mHz to be "dead." It is THE most common cause of that symptom. Signals from .5 to 7.999 mHz go through the first mixer, V-202 and its tracking IF network consisting of Z213-1 through Z213-3. The oscillator, V-207 is turned on by the application of screen voltage, 150V B+ through S-208 (rear) which is sourced from V-605, the 0A2 voltage regulator.

The cure, as Dave correctly noted, is to replace Y-201, the 17mHz crystal.

Note: The T-207 peak is very broad and its alignment will NOT cure a "dead" receiver.

It has occured to me that part of a very complete R390A restoration might include replacement of ALL the crystals. This not only includes the calibrator and 1st crystal oscillator as above but also the dozen or so crystals in the 2nd crystal oscillator associated with V-401.

In nearly every R390A, these xtals have drifted in frequency. A quick test is to simply zero beat the calibrator on one band then start changing bands and note the zero beat error from band to band.

However, the cost of the crystals alone would be impressive to say the least. However, they are available as Dave pointed out.

From: crippel@...
Date: Mon Dec 29, 1997 9:12 am
Subject: Re: [R-390] Posts

Easy on the IF gain.
Put the "LINE METER" control to -10
Turn the "LINE GAIN" control full on, to "10"

With NO antenna, peak the "ANT TRIM" on the internal noise generated by the RF deck and read the peak on the "LINE LEVEL" meter. (should peak up at about "0" if aligned properly)

Set the "IF Gain" pot to read about -7 db.

That should get you very close to where I end up setting them with instruments.

Note: If you cannot peak the ANT TRIM on internal noise, the radio has either a failure or out of electrical AND mechanical alignment.

From: Dan Martin <dmartin@...>
Date: Mon Dec 29, 1997 5:30 pm
Subject: Re: [R-390] Posts

Like many others, I've followed Chuck's method for "field-setting" the IF. gain pot. This adjustment varies the cathode bias and therefore gain of the 3rd i.f. amplifier tube. It is kind of a semi-fixed "rf gain knob" for the 3rd i.f. tube, doing for that tube what the r.f. gain knob on the front panel does for the cathode bias of the r.f. amplifier tube and first and second i.f. amplifier tubes.

It seems to function like a trim tab setting on a plane - it is used to compensate for aging tubes and varying amplification efficiencies of various tubes. Set your trim tab to fly straight and level, then use your r.f. gain knob to tactically vary your gain as you need. This adjustment is quick and easy to do and seems to work well. Chuck's method fixed a grossly too-strong setting on my 390A (mine was almost wide-open!)and resulted in a much quieter receiver with fine sensitivity - approaching 0.15 uv for 10 db sig-to-noise-plus-noise, as roughed out according to my trusty 606A.

This method, or a similar version, is also described in HSN Issue 34 by another reader. It is interesting that Dallas Lankford in HSN Issue 29 advises the best way to adjust this rheostat is to simply crank it all the way down, or clockwise. (I *like* alignment procedures like that!) This should yield about 10 kohms at the pot, I believe Dallas says, and as long as your pot yields about that, just keep it all the way clockwise.

What makes this interesting to me is that setting my i.f. gain, as suggested by Chuck, coincidentally also required my turning the pot all the way clock-wise! Chuck, we look forward to your posting on 390A alignment!

From: "Chuck Rippel" <crippel@...>
Date: Wed Jan 14, 1998 9:29 pm
Subject: [R-390] Mechanical Alignment Check List

This procedure is not at all for the meek and should only be attempted after a through review.

I am working on the electrical alignment document which I will post here. Before that can be attempted, the receiver must be in mechanical alignment. The reason for this is simple although often overlooked. When receiving and given frequency, the various slugs in the 2 tracking IF sections and RF section must be at a given height in their respective coils. This is determined by the profile of the cams driving the various slug racks. Also, the PTO must be outputting a specific frequency for those slug heights. To have the receiver work properly, this whole assembly must be "timed."

Here is how to check:

First and formost, the PTO must be 1 mHz long. To check this, zero beat the calibrator and use the ZERO ADJ to set the odometer readout to the bottom of the PTO's range or, XX (-) 000. Run the KILOCYCLE CHANGE control to the top of the PTO's range or XX (+) 000 and note the frequency the odometer reads when zero beat. The difference between the indicated frequency and XX (+) 000 is the error. For the receiver to work properly, the error must be less than about 1KC.

If the error is more than 1KC, you must perform the end point or "Variable-Frequency Oscillator End Point Adjustment." In the Army manual I have, it is outlined in paragraph 81 on page 119.

There are pictorials involved and I cannot post this procedure here. The Hollow State News may have some reprints available for those who do not have a manual but feel they can perform this procedure.

Do not proceed further until the PTO end points are correct.

Zero Beat the CALIBRATOR to WWV. This is easily done by first using the BFO to zero beat the receiver with WWV. Then, turn the FUNCTION control to CAL then adjust the calibrator capacitor through the rear panel and adjust for zero beat.

Next, set the ZERO ADJ clutch to the center of its range. Disengage the clutch by turning the ZERO ADJ knob CW. Rotate the KILOCYCLE CHANGE control to the CW stop. Make a note of its position. Then, rotate it to the CCW stop and again, note its position. Finally, set the knob 1/2 way between these two points.

Set the KILOCYCLE CHANGE and MEGACYCLE CHANGE controls so that the odometer readout indicates >exactly< 07 + 000. (The receiver would actually receive an 8 mHz signal at this point). Engage the DIAL LOCK.

Turn the receiver upside down so that the PTO and oldham coupler can be accessed.

Turn on the BFO and CALIBRATOR. Using the appropriate bristol spline wrench, loosen the >forward< clamp on the oldham coupler. Rotating the coupler will cause the PTO shaft to rotate and change frequency but the readout will stay the same. Zero beat the calibrator and retighten the screw. (NOTE: You should not have to move the oldham coupler more than 1/2 turn in either direction to achieve zero beat).

Check the dial over run by turning the KILOCYCLE CHANGE control up in frequency past 000. It should stop at 035. DO NOT USE THE ZERO ADJUST KNOB TO ALTER THE READOUT. It it does not indicate 035, you will need to adjust it when once the front panel is down. This is a little complicated. First, breaking the bristol-spline cap screw loose on the gear clamp which drives the odometer readout. It is directly to the right of the odometer drive. With clean hands, turn the last digit wheel so that the readout indicates 035. Re-tighten the clamp screw then rotate the KILOCYCLE CHANGE control to confirm that it stops on 035.

Re-perform the PTO zero adjustment as above.

Dropping the front panel:

Turn off and >UNPLUG< the receiver!!

Turn the receiver right side up and drop the front panel down by:
1- Remove the BANDWIDTH, BFO CHANGE and ANT TRIM knobs.

2- Removing the 8 phillips head screws on the sides of the panel and the 5 screws above and to the left of the BFO control.

3- Remove the DIAL LOCK knob, loosen the nut and turn the lock mechanism so that it disengages the brake disk.

4- Remove the phillips head screw directly to the left of the LOCAL GAIN control. This secures a wiring harness clamp to the front panel.

GENTLY, work the front panel off using steady pressure and rocking back and forth until it clears the various control shafts. It will "hinge" down on the wiring harness and allow it to rest on your workspace on its handles. Reconfirm the odometer readout indicates 07 + 0000 exactly. If not, adjust the KILOCYCLE CHANGE control as necessary.

There are a total of 6 brass cams which can be found at the front of the RF chassis. The 4 which drive the RF coils are located towards the top of the RF chassis and the 2 which drive the IF coils, toward the bottom. You must look through gaps in the gearing to see the 2 IF coils but they are easy to find. Each cam has a pointer which must line up with a mark on the RF chassis. From this point on, review this procedure before loosening ANY of the clamps. If you don't fully understand or are not comfortable the concepts, do not attempt to proceed. If the cams do not line up, there is a bristol spline cap screw on each that can be loosened so the cam can be positioned properly. The IF cam on the bottom left is the most difficult. It can be positioned by first loosening the bristol cap screw on the 3rd cam/gear assy from the right of the receiver. Poke a screw driver or pointed awl through the gears and postion it correctly.Once the cams are completely aligned with their panel marks, re-install the front panel by reversing the procedure above. You can calibrate the BFO PITCH control by turning in the calibrator signal, setting the BANDWIDTH to .1 and tuning the KILOCYCLE CONTROL for a peak on the carrier meter. Turn the BFO on and rotate the shaft for perfect zero beat and install the knob with the indicator line at "0" The heart of getting an R390A to work properly is to have all 6 cams line up perfectly with their chassis marks when the receiver indicates 07 + 000 on the odometer, the PTO is zero beat at 07 + 000 and its end points within 1 kc and the dial over run set to 35 kc at each end. Do not proceed with the electrical alignment until these conditions have been met. Chuck Rippel, WA4HHG

From: "Chuck Rippel" <crippel@...>
Date: Sat Jan 24, 1998 2:04 am
Subject: Re: [R-390] No Cal. Signal on 16MC

> I have a R-390A that doesn't have a calibration signal in the 16MC band position. All other bands have a signal, some stronger than others. Even after peaking the Ant. Trimmer. Also, the frequencies vary from band to band. Hopefully some of theses problems can be corrected through alignment.

The band is dead because Y-413, the 9.5 mHz crystal is not oscillating. Put a scope on P-415 the output of the crystal deck and see. Should be about 2V p-p.

From: crippel@...
Date: Mon Feb 2, 1998 5:35 am
Subject: [R-390] R-390A IF gain Setting Technique

> About a month ago Chuck Ripple had suggested an easy method for settting the >IF gain on the R-390A. I tried it.. Mine was set way too high.. NEW RADIO.. the >difference was dramatic!! Later cleaned up the IF deck. Tubes went back into >different sockets. The radio was 'mushy' again. Found the tube swaps had changed >the gain. Reset the gain and the radio came back to life.

Glad it worked so well for you. I continue to be amazed by the performance of these receivers. This past Sunday, I was able to actually hear programming from the New Guinea regional SWBC outlet R. Enga transmitting on 2410. It is very rare for that station to be copyable on the East Coast. Moreover, the R390A pulled recordable audio off the signal at least 50% better than my state of the art, Watkins-Johnson HF-1000A. The most common single item responsible for holding an R390A back is not lack of sensitivity. Rather it is internally generated IF deck noise. In an otherwise properly operating R390A, the cause of this excessive noise is IF gain control being set to high. Even the mfg spec of setting the IF deck gain such that -7vdc at the diode load when fed by 150uv @455kc into J-513 is far too hot. I see it time and time again. Because everyone is going to ask, here is a review of the recently refined procedure to set the IF deck gain control. Anyone can perform the procedure whether they have access to a signal generator or not. I have made one refinement since it was last posted:

Procedure to set R390A IF Gain-

Once the receiver has been fully mechanically and electrically aligned, the final procedure to perform before "buttoning it up" is to set the IF gain control. Many otherwise very sensitive R390A's are thought not to be due to weak signals being covered by noise generated by excess IF deck gain.

- Allow the receiver to warm up for at least 1 hour then:

1- Disconnect antenna
2- Set receiver for 15.2 mHz
3- Set "Line Meter" switch to -10db scale
4- Set "Line Gain" control to full CW or "10."
5- Adjust IF gain control, R-519 to cause "Line Level" meter to indicate between -4 to -7 db.
6- Re-zero the carrier meter control, R-523
7- Set controls above for normal operation and reconnect antenna

Discussion:
This will yield the best compromise on all bands. I usually "poll" those bands which I normally spec out. Then, using an HP signal generator set for internal modulation of 800 hz @ 30%, "massage" the gain setting and even specific signal path tube selections for the best overall performance.

RF Deck Test-
I also encourage you to do a quick test that will verify the condition of your RF deck and state of alignment. The procedure is as follows:

1- Disconnect the antenna

2- Set the "Line Gain" and "Line Meter" controls for a relative -5 db indication on the "Line Level" meter.

3- Adjust the antenna trimer for a relative peak on the "Line Level" meter and note the position of the control.

Discussion:
An R390A with a properly operating RF deck is capable of peaking on its own internal noise as indicated by the "Line Level" meter. Further, that peak with no antenna connected should be coincident with the "Ant Trim" control indicating "0." Having the peak not occur at all indicates an RF deck failure or poor/improper alignment. Additionally, improper alignment can also be the case when the noise peak as indicated by the "Line Level" meter not coincident with the "0" (+- .5) position on the "Antenna Trim" control.

From: "Chuck Rippel" <crippel@...>
Date: Wed Feb 4, 1998 12:40 am
Subject: Re: [R-390] R390 Alignment

> My question is even if I moved gears around if I set the read out to 7 +000 and line >all the cams up with their alignment marks is that correct, can it be that easy. I >removed the PTO and it was set at 00 -963 or kilocycles turned fully >counterclockwise. If my cam setup procedure was correct can I now just return the >readout to 00 -963 replace the PTO and start my electrical alignment. Any >comments will help Tnx Ben

You are doing this a little backwards but no matter. It will only mean you have to perform a step twice. If you "loose" where the PTO is, you need a counter to set things up properly. Set everything up by aligning ALL of the cam gears at their chassis marks at 07 + 000 and the output frequency of the PTO measured at the connector on the end of the PTO cable to be 2.455 mHz.

After that, don't align ANYTHING until the PTO end points are set. When the endpoints are properly set, center the "Zero Adj" in the middle of its range and set the readout again to 07 + 000 and touch up the cam alignment. Lock the dial down, loosen the forward clamp on the Oldham coupler and set the PTO to output 2.455.

Once that is done, then and only then can you do the electrical alignment properly. Failure to perform the above will result in less than acceptable performance.

Date: Tue, 23 Feb 1999 16:02:18 -0800
From: dma@islandnet.com
Subject: Re: [R-390] [R390] Questions about IF and RF Alignment

>-I noted that the manual makes reference that some of the IF decks are >"stagger tuned", the implication being that some are not, is this true?

Yes. An early Army manual I have makes no mention of this. Later manuals seem to recommend it. Stagger tuning gives a more symetrical bandpass, which results in better sound on AM signals. There is no lack of gain in this amplifier and the mechanical filters should be allowed to set the bandpass shape - thus there is no advantage to peaking the i.f. at 455 kHz.

>-Any tips or tricks in carrying out .....ARMY Manual......is a bit vague about this.

It's very straightforward as long as you follow the instructions and have the right equipment. Also note that several manual versions have an error in the little table that gives you the tuning sequence for the I.F. coils. The T502 secondary (top slug) is missed out entirely in the right hand column, which if no one noticed might result in less than stellar performance. There is a mistake in the instructions for aligning the first variable i.f. in some manuals. In b2) the frequency of the generator should be 18.25 MHz,not 18.75 MHz as written.

>RF Deck:

>-Not sure if I can word this clearly, but here goes. When carrying out the alignment on the RF deck, the manual suggests the receiver be calibrated at the lower frequency (the one which the slugs are adjusted at), and then zero beat againist the signal generator. Why is this not carried out on both ends of the adjustment. For example should one use the internal calibrator at 550KC, then adjust the signal generator frequency for a zero beat, then do the same at 1100KC? Or is it bettter not to use the zero adjust function of the R390A, and just send the signal generator to the specified frequency, and adjust the 390A frequency for a zero beat? I assume that the manual procedure was used due to the ambigious nauture of the analog signal generator. I use a HP 8640B and the digital readout leaves little room for error.

Others have done this many more times than I, so advice may vary! Assuming the PTO is correctly set (end-point, etc.) and the mechanical cams are set correctly, I follow the instructions in the manual fairly closely. However, I set the rcvr on the suggested alignment frequency, bring the signal generator to that frequency and zero beat it to the rcvrs BFO by adjusting the KHz knob. THIS ASSUMES THE BFO HAS BEEN SET RIGHT! My sig gen (an HP8601A) is harder to adjust than the rcvr is, thus this approach. Your sig gen is better than mine so you may be able to do it the other way round. What's critical, IMHO, is that the rcvr be close to the alignment frequency shown in the manual, but that the sig gen be right on the rcvr center frequency.

I think your comment about why they do things the way they do (ever tried this with a URM-25D - I have!) is right on the mark.

The RF alignment is tediously repetitive, but it's gotta be done carefully for max performance. Many coil problems can become evident when doing the alignment: if the slug ends up at the top or bottom of its range, and you're still not at optimum - you probably have a capacitor or other problem inside the can; if the trimmer won't peak, or seems to jump - you have a trimmer with the movable part stuck to the fixed part, and the whole thing is turning - or you have a cap where turning it results in the rotor actually popping away from the contact underneath the bakelite strip that

holds it all together. And so on!

Date: Tue, 23 Feb 1999 22:48:44 -0500 (EST)
From: Norman Ryan <nryan@duke.edu>
Subject: Re: [R-390] [R390] Questions abt IF and RF Alignment

The posting from which the above was snipped is full of good advice on alignment procedures. Here is some detail on the errata:

The NAVSHIPS 0967-063-2010 manual of 15 April 1970 reflects these corrections. The Army TM 11-5820-358-35 of 8 December 1961 does not.

To amend the latter, go to page 113 and insert "T502 secondary (bottom slug)" under "T501 primary (bottom slug)" and bracket it to the 443 frequency.

Then go to page 116 and change line b.(2) to read "18.25" instead of "18.75."

Other editions may have the same errors. The above mentioned Army TM is probably the most widely distributed and in the hands of most of those who have a manual.

An errata list would be a nice addition to the FAQ. :-)

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Date: Tue, 23 Feb 1999 21:55:12 -0600
From: Dallas Lankford <dallas@bayou.com>
Subject: Re: [R-390] [R390] Questions abt IF and RF Alignment

I've never seen an R-390A with an IF which was not stagger tuned, including Collins R-390A's from the first R-390A contract.

Date: Wed, 24 Feb 1999 11:14:42 -0500
From: "Bruce J. Howes KG2IC" <kg2ic@amsat.org>
Subject: Re: [R-390] [R390] Questions abt IF and RF Alignment

With all due respect for your extensive background with the R390A, I have to differ with you.

The '67 EAC that I aligned last night did not have the stagger tuned IF, I could only peak it at 455. I attempted to follow the procedure in the ARMY manual that outlines the stagger tuning at 467, etc but found I could only peak the IF transformers at 455.

The Stewart Warner from the previous night did indeed have a stagger tuned IF. Not sure what the difference is, or how to tell them apart unless you actually attempt to peak the transformers, and find that they only peak at 455. I am going to do my Collins unit tonight, wonder what that one is?

Date: Sat, 05 Jun 1999 12:32:51 -0500
From: Nolan Lee <nlee@gs.verio.net>
Subject: [R-390] ceramic filters and stagger-tuned IF's

Actually, there were only between 400 and 500 R-390A receivers that had their IF decks equipped with ceramic filters. There were all part of the 1960 EAC contract. I have one of the IF decks, it's marked as follows:

ELECTRONIC ASSISTANCE COPR.
PART NO. 4-0039
ORDER NO. 23137-PC-60
SERIAL NO. 479 MFP
The filters are all made by Clevite and are marked as follows:
TL-2DS-2ATTL-4DBAT
TL-8D16AT
TL-16D25AT

I know of only two other people that each have one of these decks. One still has all four of its ceramic filters and one has three ceramic and one mechnical filter. Most of these decks were "pulled" and either junked or refitted with mechnical filters after the Govt inspectors found out that EAC had deviated from the specifcations and used them. They aren't very common. If you have one of these, or the specs on those particular model number Clevite filters, please drop me a note.

As far as the stagger-tuning, the contract number and serial number that this was was first implemented is mentioned in the December 8th 1961 edition of TM 11-5820-358-35 at the top of page 4. The earliest reference that I can find to it is the June 7th 1957 Change 4 for the January 1956 TM 11-856A.

Basically, the 363-P-54 1954 Collins contract receivers with Mod 1 on the IF deck were stagger-tuned and all receivers after serial number 599 of the 1955 Collins 08719-P-55 contract had the T-502 through T-503 IF transformers stagger-tunned at the factory.

Date: Sat, 05 Jun 1999 14:25:22 -0400
From: antipode <antipode@ne.mediaone.net>
Subject: Re: [R-390] Dirty but not so quick total setup

Maybe this has been addressed earlier, but what is the difference between stagger-tuned IF's and those that are not with the R-390A? Can a person be misled during an alignment process if it is not known which generation of radio is being aligned? If so, how does one differentiate these two schemes since there are many "Heinz 57" '390A's out there?

Date: Sat, 05 Jun 1999 18:50:14 -0500
From: Nolan Lee <nlee@gs.verio.net>
Subject: Re: [R-390] Dirty but not so quick total setup

>Maybe this has been addressed earlier, but what is the difference
>between stagger-tuned IF's and those that are not with the R-390A?

There were a couple of different variations of transformers on the IF decks, but all can be stagger-tuned. I've got the original IF deck for my 1955 Collins that predates the SN range of the factory stagger-tuned ones by about 400 and it did just fine. I'd sone a couple of my spare Collins IF decks that are old enough to not have the trimmer caps for the mechnical filters and they did fine too.

>Can a person be misled during an alignment process if it is not known which generation of radio is being aligned?

No. The "generation" of the IF deck shouldn't affect it at all. Peaking the mechnical filters is a different story on the real old decks without the trimmers though.

>If so, how does one differentiate these two schemes since there are many "Heinz 57" '390A's out there?

Actually, the older decks will all be either Collins or the first (1954) Motorola contract. I've got a few of them, but as a rule, you don't see them that often anymore. I wouldn't worry about it, it's not an issue.

R-390A IF Transformer Alignment
Dallas Lankford
January 1988

The R-390A IF transformers T501, T502, and T503 are stagger tuned in order to provide a flat IF passband for the wider mechanical filter bandwidths. The shields for T501 and T502 are usually marked with both T501 and T502. T501 is actually the first IF transformer to the front of the mechanical filters, and T502 is the second on the side in line with T501. T503 is the third IF transformer, on the front edge of the IF subchassis, offset from T501 and T502. The top and bottom cores of the

IF transformers should be adjusted for maximum signal as described below. R-390A manuals procedures for aligning the IF transformers are complex. My method below is easy.

With the calibrator turned on, tune to a calibration frequency that is free of signals, say 2100 kHz. Set the selectivity switch to the 0.1 kHz position and tune for maximum signal level. Reset selectivity to 4 or 8 kHz, and turn on the BFO and set the BFO tone to a low frequency, say 50 ^÷ 100 kHz. Turn on the line meter and adjust the meter for mid scale by adjusting the line level control and meter control. I generally set the meter switch to the 0 position rather than the +10 or ^÷10 position.

Next adjust both cores of T503 for maximum meter reading. If your IF transformer shield does not have a hole in the top of the shield, you will have to make a hole in its top, or better, use another IF transformer shield which already has a hole in it. A suitable alignment tool is the white tool in Radio Shack^"s TV Alignment Tool Kit, Cat. No. 64-2223B (or the older TV Alignment Tools, Cat. No. 64-2223). This step aligns T503 at 455 kHz, assuming that the crystal filter is centered at 455 kHz. It is unlikely the 455 kHz crystal will be off more than a kHz or two, which is entirely acceptable for stagger tuning of this sort.

After T503 is adjusted, set the line level control to 0 (minimum line level meter reading), and turn off the line meter. Reset the BFO to zero beat. Set the KCS frequency 12 kHz below the current frequency. Let^"s say your R-390A is currently tuned to 2102. Then you set the R-390A to 2102 ^÷ 12 = 2090. Turn on the line meter and adjust for about 1/3 scale reading. You probably will not hear the BFO pitch, and you will probably have to use the most sensitive meter setting, the ^÷10 position. The meter reading will tend to be unstable, moving around.

Adjust T501 top and T502 bottom for maximum meter reading. Because the meter needle is unstable and moving around, the maximum reading will not be precise, but because this is a stagger tuned IF alignment, you can get close enough even with the meter needle jumping around.

After finishing the adjustment of T501 top and T502 bottom (in the paragraph above), reset the line level control to 0 and turn the liner meter off. Finally set the KCS frequency 12 kHz high (in this hypothetical case to 2114). Turn on the line meter and adjust for about 1/3 scale reading. The meter will jump around as before.

Adjust T501 bottom and T502 top. When finished reset the line level meter to 0 and turn the line level meter off.

Your R-390A IF is now stagger tuned per the manual specs.

The theory behind my IF alignment is well-known: use the calibrator signal to align the IF. It assumes that the center frequency of the 455 kHz crystal filter is reasonably close to 455 kHz. You can check this by tuning for maximum signal in the 0.1 kHz bandwidth at a calibration point, and the switching to the 2 and 4 kHz bandwidths and observing the selectivity curves by watching the carrier meter as you turn the KCS knob. The 0.1 kHz bandwidth peak should be in about the center of the 2 kHz filter and 4 kHz filter passbands.

My alignment procedure may not work at all if the previous owner has modified T501 and T502 and/or seriously misaligned them. You may at first suspect that I got the KCS settings wrong. But if you study an R-390A manual, and do a little arithmetic, you will find that setting the KCS frequency 12 kHz below a calibration point puts the calibration signal at 467 kHz in the IF strip, while setting the KCS frequency 12 kHz above a calibration point puts the calibration signal at 443 kHz in the IF strip. It is, of course, possible that T501 and T502 were replaced in your unit by a previous owner or by a military technician, and that the transformers were reversed. I have done the above alignment procedure on five different IF decks, and four aligned as I have described. In fact, none of the IF's really needed alignment; i.e., none of the cores required more than half a turn (except for one IF with cut Q-spoiling resistors which was pealed at 455 kHz). To determine if your IF needs alignment, tune across a calibration point in the 8 and 16 selectivity positions. If the carrier level reading is reasonably constant from one end of the passband to the other end of the passband, your IF does not need alignment.

Date: Thu, 30 Sep 1999 13:32:02 -0400
From: "Chuck Rippel" <crippel@erols.com>
Subject: Re: [R-390] Alignment, etc.

> Respected reflector-members,
>
> A couple of questions that have arisen: When aligning, the manual points
> one to J104, the balanced input. Does it matter which input is used for
> the signal generator? I realize that there is about 10dB difference
> between the two inputs.

Yes, it asbolutely does. First, make the modification that the military did to that input. Its easy. If you go to the WWW site, there is a treatise and pictures of feeding the balanced input. Set that up, align the gear and front panel knob for the antenna trimmer per the book then and only then make the RF alignments.

Gene and I have discussed the test equipment discussion. I will work on that.

That subject was covered fairly extensively in the first R390A video but putting it up on the www site for wider distribution makes sense. However, a picture is equal to 1000 words and anyone who is serious about using and keeping up their own R390A should have both the original videos and the update I did just last year about this time.

Date: Thu, 30 Sep 1999 11:40 -0700 (PDT)
From: rlruszkowski@west.raytheon.com
Subject: Re:[R-390] Alignment, etc.

I spent 8 years as a 33B20 33C20 33C40 33H40 doing R390/A maintenance. In all those years at several stations around the world and at the school house I never seen an extension cable for any of the R390 sub assemblies. By the 1960's it was discovered that putting a deck on an extended cable caused more problems than it was able to fix. For the IF we just undid the band width and BFO shafts. Tip the deck up on end in the chassis and plug it back in. The little BNC to Big BNC adapter on the rear panel that has the 455Khz output was recabeled to the IF 455KHz input. We had a couple of wood blocks that we had cut in the craft shop to set under the deck in the chassis to get a better fit. From time to time a real problem pops up. The best item is a 7 and 9 pin tube extender. these little gems put your tube up on a 2 inch extender and has a set of test points around it for the tube pins. Every one with fire bottles needs a 7 and 9 pin model. These things really are what got used to trouble shoot receivers every day on the shop benches. You would also like a good pair of tube pullers. The tong type will get down to those Little BNC connectors on the decks. See pictures from Chucks pages for RF input. It shows the correct side to ground and the other side feed. If you have the Tri ax to D 90 degree connector it takes care of the issue for you. You can then put a D to BNC on that. I use a length of twin coax from the receiver into a balanced antenna tuner. That works great up front to reduce some of the out of band noise load that would other wise hit the front end of the receiver. And it lets me match a wire antenna to the receiver.

What you really want is: Any good tube tester that will test the tubes in the R390. this just gets the crude shorts and out right dead ones out of the way. Next any good VOM hung across the audio terminal board will do. you also need a 600 Ohm resistor to do the load. Your VOM should have a DB scale on it. This works for the power level and signal to noise ratios. Any audio generator may be needed every now and then. Most audio problems can be resolved with crude measurements of every part on the chassis for shorts and low temperature burns. (Some bad tube pulled to much current through a resistor for some time. Not enough to smoke it or discolor it but enough to change its value a bunch. Next you want a RF GEN with a metered output. You want to get 150 Micro volts in to the IF deck, - 7 volts on the diode load, and more than 30 dB on the audio output across the 600 ohm load. Un plug the RF generator into the IF and get more than a 30 dB drop in noise. If you do not get past this test your R390 needs tubes. The tubes may pass tester but you are failing this noise.

(Some other notes on the reflector here tell us a lot better sound is available if some value other than -7 volts is used on the diode load. Once you get past this noise test use those numbers in your final tweak.)

Swap the 5749's around you will find the order changes your signal to noise. Acquire a few extra tubes over time. put the bad lot in the output end. Swap your stock into the first IF one at a time and find the noise performance of each tube. Put the best ones in the first IF and work to the audio. Test all the tubes you can get when ever you do a maintenance procedure and put the best ones in you can get. In the RF deck you will do the same things with the 6C4's. The BFO noise is a place for the poor tube you need to use. Put a good (second best)one in the VFO (PTO). Do the same kind of noise test on the audio tubes. You looking at the noise (no generator attached) to signal plus noise (generator attached) You are doing a comparison test. From the tubes available here today which ones are less noisy. Then with a rank order for each type of tube plug them in to get the best overall receiver performance you can with what you have available. Operators would bitch about a bad receiver. We would take it to the shop. Watch it fail signal to noise. Do a noise test on the tubes. Re-arrange the tubes and it would pass in great shape. The operators though we had done wonders. If you are on good main power you may work around the ballast tube. I wired 6.3 to unused pins on the ballast tube socket and put some jumper wires in the socket to run the PTO filaments at 6.3. Diodes across the 25Z6 is also a popular mod. Again I used diodes across un used pins on the 25Z6 sockets and jumpers in the socket. If I get my hands on the old tubes I can pull the jumpers out of the socket and just plug the tubes back in with no other changes. The wires and diodes are under the chassis out of sight.

Once you get the IF, BFO and audio up to snuff you can move over to the RF deck. You can use the calibration tone and do signal to noise with that. It can also be used on the IF and audio tubes. All you need is a 600 ohm resistor and AC volt meter. Use calibration and standby for testing.

For the RF deck a good spine tool is more important than the RF generator. Remember you are trying to get those slug racks to tune flat across their respective band. Use the cal tone to get the receiver close to the frequency you need for the alignment point you are on. Beat the generator against the BFO. Closer is do able with better and more gear. But you can get real good results with not much. Not only is the R390's and R390A's great receivers but they are real easy to maintain.

We would tweak the receiver and BFO to WWV. and then zero the calibration oscillator to that. I had a counter and liked to count the BFO to 455. Using a tube extender and probe on the end a coax test lead to the counter. Use the dB meter on the output. Go to the Crystal filter band switch setting. Peak the 455 through that filter and zero the BFO against that. It close.

You can trim the PTO range against the calibration oscillator. However unless it is way off just leave it alone until you can get a counter and trim the band spread very close. Other than a counter to do the PTO and BFO the a RF generator (AN/URM25), a tube tester (TV7), and a volt meter (TS505) is all you need to keep these receivers going at full military specifications. I think the power meter we used was a TS382. It just has a set of resistors built in to act as different impedance loads and a meter scaled in Db.

Jee, Clemens This got long winded. Roger KC6TRU San Diego

Date: Wed, 20 Oct 1999 16:32:05 -0400 (EDT)
From: JOHN_SEHRING.parti@ecunet.org (JOHN SEHRING)
Subject: [R-390] RAMBLE ON RX SENSITIVITY

I see some talk about achieving ultimate sensitivity with R-390/A.

The MW & SW bands are a very noisy place from a variety of sources. Except when using a very short antenna, below about 21 MHz, you will be noise limited by external (coming from antenna) noise not receiver noise, *unless* your receiver is extremely insensitive. The latter would take a very weak RF amp tube and/or severe misalignment of front end. (The front end, the 1st stage, is where the ultimate sensitivity of a receiver is properly set.)

In fact, even an rx with no RF stage, just a decent 1st mixer, does just fine in sensitivity below about 14 MHz because there's so much noise on the bands. The real game is performance on MW & SW is strong-signal & strong-noise environments. That takes a different set of requirements. Extreme sensitivity is not one of them & in fact makes that worse!

The 6DC6 used in R-390A (and Collins 75S-*, Halli SX-115, others?) as an RF amp was designed specifically to reduce cross- & inter-mod effects. Notice that only 1 RF amp is used in the rx's mentioned above. Multiple RF amps are more prone to off-freq, strong sig probs. The trend in rx design has clearly been away from multiple RF amps. In fact, the trend has extended to whole rx designs to use fewer rather than more RF & IF amps. I'm talking 1950 - 1965 time frame here. For example, the extraordinary lumped selectivity of mechancial filters (& relatively low loss) has given lots of selectivity with fewer stages. Each active stage gives yet another opportunity for non-linear effects that compromise strong signal handling capabilities.

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Date: Wed, 20 Oct 1999 16:56:31 EDT
From: Radiomatt@aol.com
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

I disagree in part. I use my R-390 on MW DXiing (Euro split frequencies) in favor of my 390A for several reasons:

1) The mech filters "ping and ring" on splatter

2) The extra RF stage allows for 3 tuned circuits in the front end, and the reduced gain of each stage keeps the tubes away from operating near the non-linear ends of the curves

3) The six IF stages have a similar benefit, the gain is distributed more evenly. In fact, the cummulative selectivity is so high that "swamping" resistors are used inside the IF cans to broaden the passband a bit. The gradual implementation of increased selectivity as the signal goes from stage to stage keeps the audio from getting "hard" (this is obviously a technical term, :-)) compared to the 390A where all the IF filtering is pushed into one filter.

Call me old fashioned....but Anyway, until you compare side by side, you'll never know (I have 2 of each!!)

Date: Wed, 20 Oct 1999 22:19:45 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

While the MW and SW bands ARE noisy on the average, its a shame to set the threshold by a receiver and thus fail to utilize those periods where the noise is lower. Remember noise is a time varying commodity. Both short term and long term there are great variations in noise. Its not a great idea (though the current crop of west Pacific rim receivers do just that with their own internal noise generators in the form of phase noise from synthesizers and computers) to set a receiver mds by the receiver noise that can occasionally be above the temporary antenna noise level unless you want to waste that period of low noise.

Like others have mentioned, the Tchsbyshev response curve of the mechanical filters is prone to ringing. That's SOP for Tchebyshev filter curves. Always has, always will be. The skirts and corners of the IF response created by multiple IF transformers are not as extreme and so do not ring as much, and have more linear phase response near the corners. That's why the mechanical filter is NOT used in the DF versions of the 390A.

In my experience the 455 Khz 2.1 KHz bandwidth Collins filter will ring long enough on noise spikes from power line noise that the output of the filter will show NO damping between power line voltage peaks. And when hit by lightning static it turns what could be a click into a CRAAAAASH.

My receiver for HF for stormy times is a crystal controlled converter and a BC-453 that gets its selectivity from loosely coupled transformers at 85 Khz. With it I hear clicks for lightning static and can continue to copy. With a 75S3B on the same antenna at the same time I heard crashes and could not copy the signal I wished. It is all in the phase response of the filter. The mechanical filter is NOT better, nor are most of the crystal filters sold for consumer radio equipment. It is possible to create filters with adequate shape factors and improved time response. Listen to a Tentec (they all use the same filters). 75 meter static is heard as clicks, not crashes.

Most of the problems of receiver non-linearity are in the mixer stages. Tentec's Corsair II which I'm using these days uses a diode ring mixer with lots of local oscillator drive and the RF and IF stage (before the filter to give the ring mixer the broad band termination it needs to have a great dynamic range) are Norton transformer feed back amplifiers. Those stages are probably linear to +10 dBm output. No receiving tube can do that. Third order intercept probably +25 dBm output. Ulrich Rohde's favorite circuits. Then the IF gets to the 9 MHz SSB filter that has a bit of slope on the sides and rounded corners and doesn't ring so much.

It can be done with sand state hardware, better than tubes because the diode ring mixers have better dynamic range than any old single ended tube mixer on both ends of the dynamics. A tube mixer might have a NF of 22 dB while the diode ring should only be 7 or 8 dB. And the diode ring might handle +5 dBm if ordinary, +10 or 15 dBm input if built for really strong signals. The tube mixer won't handle better than probably -25 or - -30 dBm for the same amount of intermod. So its dynamic range is some 45 dB poorer.

Date: Thu, 21 Oct 1999 12:30:11 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

24 poles of crystal filtering need not be bad but generally is. It's easier to make a crystal lattice filter with a Tchebychev frequency and time response than a Gaussian frequency and time response. The pass band of the Gaussian filter is a lot like the bell curve, no sharp corners in the frequency response curve. But its the best for passing pulses.

I believe its the Gaussian response that results from multiple under coupled IF transformers that makes the BC-453 handle noise well.

Tentec uses ladder crystal filters and they are easier to make with rounded corners than lattice filters and I notice they ring less.

As an experiment adding selectivity to an APA-10 I first made a 5 or 6 MHz ladder crystal filter using equal valued capacitors which is the typical design for squareness. It rang badly when swept (I think maybe at 20 Hz sweep rate) and in a panadapter that would not be useful. When I redesigned the ladder filter for a Gaussian frequency response I could sweep it many times faster (at least 60 Hz, maybe 120 Hz) before it rings. The capacitor values have a wide range, but it works well. That's a project I should finish some decade, adding a second narrow IF for looking at VHF converter outputs in the 28 Mhz region.

I've not had the chance to compare 390 to 390A, but I'd suspect the 390 would beat the mechanical filters though it won't have the sharp corners on the pass bands. I don't recall the SX-96 that my dad and I bought as novices in 1956 or maybe 1955 had much of a problem turning static into crashes, and it used multiple IFs to get relatively square cornered pass bands. Its trouble was that the case was made of slightly heavy tin cans and the local oscillator would jump more than the pass band width when we dropped a pencil on the table. Some bracing of the dial cutouts and stiffening of the cabinet bottom with a slab of 1/8" steel has helped considerably. And shortening that one coil mounting screw that pushed up against the middle shield of the tuning capacitor helped a lot too. Long about 1965, I mentioned my findings on mechanical filter ringing to the engineer in Cedar Rapids in charge of customer follow up for the S-line and he commented, "So that's why all those about me with Collins give it up, when there's static that I hardly notice on my HQ-129."

Date: Thu, 21 Oct 1999 17:12:57 -0400
From: "Joe Schreiber" <jschreiber@adelphia.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

OK... I understand what you're saying about high rate CW ringing tight filters, but I was wondering more about whether a good DSP receiver, like the HF-1000, would handle static crashes noticeably better than one with conventional, especially mechanical filters. Most of my listening is on the tropical bands, and you're absolutely right about the annoying crashing static on my R-390. It's much worse than on the SP600. I never realized why this is so, but your ringing mechanical filter explanation makes sense. So I figure, a good DSP receiver with little filter ringing should really handle the static well. I wonder if anyone has made this observation.

Date: Thu, 21 Oct 1999 15:44:27 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

I only have the data from the filter ringing on CW presently available. I figure the relative bandwidths for the same ringing at the same CW speed is a good indicator of ringiness of the filters. The audio DSP receiver suffers from being after some sort of crystal or mechanical filter in most all uses and so has to contend with the crashes and can do little about them. I have the DSP-59+ on a Tentec Corsair II now and without it enabled the short clicks of static is noticeable. I've not tried the filter's noise reduction or filtering much yet with this receiver. Most of the time the DSP isn't as much help as it was on the TS-130. The bandpass tuning of the Corsair II and a 500 Hz CW filter take care of so much QRM that I've not reached for the DSP much.

Whether a DSP receiver would handle static depends on the filter design in the DSP whether it emulates a crystal/mechanical filter or works to have much lower ringing. A DSP filter can be poorly designed using minimum poles to get the classic filter response curves that we've found poor but the receiver makers don't understand yet that are poor.

I was about to build a receiver until I found the Corsair II had Ulrich Rohde's favorite circuits. Its much faster to buy one than to build from scratch!

Date: Thu, 21 Oct 1999 20:21:38 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

> I have been using a Kachina 505 transceiver for listening for the last
two
> years. This is a double conversion receiver with a 15 KHz roofing filter
at
> 75 MHz and the dsp IF at 40 KHz. Static sounds like static in all of the
> bandwidths. The filters are very sharp with shape factors very close to
1:1.
> They are a FIR type dsp filter. I do not here any ringing in the CW filter
> bandwidths. I don't know what type of dsp filters are in the HF 1000/A.
You
> might ask Chuck Rippel, I know that he has an HF 1000A.
> Perhaps this just muddied the water.
>
> Kurt Holbrook

> ----- Original Message -----

Kurt, do you hear clicks or prolonged crashes from lightning? Do you hear a buzz or continuous hash from line noise?

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Date: Thu, 21 Oct 1999 19:41:19 -0700
From: "Kurt Holbrook" <radiouser@uswest.net>
Subject: Re: [R-390] RAMBLE ON RX SENSITIVITY

Answers to your questions. Lightning crashes are sharp and distinct but more than a click. Line is more of a buzz. I do get some line noise that is hash, but that type of line noise wipes out all of my receivers.

Date: Fri, 22 Oct 1999 11:52:43 -0400 (EDT)
From: Norman Ryan <nryan@duke.edu>
Subject: Re: [R-390] 2nd IF frequency?

First, we're talking about the Army manual TM 11-5820-358-35, right? On page 116, paragraph 76b, step (2), the signal generator setting should be 18.25 mc, not 18.75 as printed. Also, back on page 113, the chart is missing a line. Under "T501 primary (bottom slug)," add "T502 secondary (bottom slug)." This is for stagger tuning the IF's which will enable the wider bandwidth filters, 8 and 16 kc. Hope these and other amendments make it into the R-390A/2K edition.

Date: Fri, 24 Dec 1999 15:31:21 -0500
From: "Randall C. Stout" <rcs1@sprintmail.com>
Subject: [R-390] Signal generator connection questions

I would appreciate some info/advice on how to best couple my HP606A to the R-390A, both for RF and IF alignment.

The HP is designed for termination into a 50 ohm load. Is the balanced antenna input too far off? The HP output will go up to 3V, so I would think it can overcome a modest mismatch. The HP uses BNC connections. I have a a BNC to C connector which would make the connection to the unbalanced input easy, but will have to rig up something for the balanced input. Chuck mentioned to just connect it the same way he shows the antenna feed connection on his web page. How careful do you need to be with the cable length and degree of shielding. Do you need a double shielded(braid) coax, or even a hardline cable? Fair sells some misc. hardline cables, and I thought of getting one of those.Thanks for the input. I hope to get the R-390A aligned this weekend, but want to do it right!
Randy Stout

PS> Hey Nolan, don't tell me you use the left over cable that came with your telephone poles to connect your URM-25!!

Date: Fri, 24 Dec 1999 15:00:54 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Signal generator connection questions

Unless you find that turning down the signal generator doesn't reduce the signal detected by the receiver, single shielded coax will be adequate. I think probably the 606 is fairly well shielded, but I've not tested them to really sensitive receivers.

Date: Tue, 4 Jan 2000 18:09:04 -0500 (EST)
From: JOHN_SEHRING.parti@ecunet.org (JOHN SEHRING)
Subject: [R-390] R-390A SENSITIVITY MEASUREMENTS

Am away from my tech refs at home... would someone please give me the self noise of a 50 ohm resitor at room temperature thru, say, a 3 kHz bandwidth?

How does this compare with -141 dB (0.08 uV) noise floor reported for a 390A? Just curious.

Ultimate sensitivity is not the most important receiver spec except for permanent use with a very short antenna. Pursuit of it often compromises (much) more important specs such as performance in the presence of very strong adjacent (or further off-frequency) channel signals. The R-390 may
be an exception but of course its design (& cost) are "extreme."

Date: Tue, 4 Jan 2000 20:40:06 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A SENSITIVITY MEASUREMENTS

I calculate the resistor noise voltage as .05 microvolts RMS for a 50 ohm resistor and 290 deg K. I have been getting sensitivity measurements in the 1/3 microvolt range on my R-390A, but I have to agree with you that less than 0.1 is pretty hard to believe. And, I always see about a 20 dB increase in noise when I connect my outdoor antenna.

Date: Tue, 04 Jan 2000 22:11:18 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] R-390A SENSITIVITY MEASUREMENTS

Or used as an IF for VHF through microwave converters where maximum dynamic range needs to include minimum gain to the IF receiver. Having a

noisy IF receiver makes the converter have excessive gain which simply raises the strong signals that much more to the detriment of system dynamic range.

Date: Wed, 5 Jan 2000 09:16:52 +0200
From: <yrjo.hamalainen@thk.fi>
Subject: RE: [R-390] R-390A SENSITIVITY MEASUREMENTS

Matched terminal in front of a receiver in temperature T delivers power P = kTB, where

k = Bolzmann's constant = 1,38*10E-23
T = temperature in K
B = bandwidth

For a 3 kHz bandwidth in a room temperature 290 K we get power 1,2E-17 into
the receiver, which is 0,025 uV into a 50 ohm input.

Date: Wed, 16 Feb 2000 15:17 -0800 (PST)
From: rlruszkowski@west.raytheon.com
Subject: [R-390] semantic soliloquy

You can do all the tube-subbing in advance. Here you are only testing tubes in the same common circuit to rank there performance against each other. You do not need much alignment after changing tubes. You are a boat anchor owner and this is your hobby. You should be able to tweak through your receiver in less than 3 hours back to front.

Military standard was a receiver on forever. Never turn it off. Once a month do a spot check of signal to noise. At a field station we had a set of known stations. We walked around with a TS585 audio meter with a phone plug on it. You could plug it in to the front panel and roll through the frequency list. Some spots were on station some spots were off station. If the spots gave meter reading that we OK in range the receiver passed monthly. 10:1 signal + noise to noise. 24 x 30 = 720 operating hours.

Every 720 operating hours check your receiver against your last alignment values.

Every six months of operating hours. 720 x 6 = 4320 hours do a full tube check and realignment.

Do the IF deck first. 150UV into it 100 Mili watts out on the back panel terminal strip. 30 DB signal + noise (modulation on) to noise (CW signal). You need a good 30DB here. Crank the diode load voltage back from -7 volts for the 100 Mili watt (.1 Watt) output. You can get over a 1/2 watt out on the back panel. But that's noise and distortion. You will get less power out the front head phone jack because there is some circuits in the receiver. If you need the .1 watt to your phones, take it off the back panel terminal strip. Do not crank up the IF gain to get more at the phone jack. This add distortion and noise. There be millions of Ditties who were able to use these receivers with these set ups just fine.

After you get the IF tubes arranged for noise, do the IF filters. pull the can lid off and just do each on top. Lift the IF deck and do the side caps if your receiver has them. Maybe your receiver has holes in the chassis side wall for them. Put the lid back over the filters. Go through the cans if your cans have holes on top. This is done infrequently. (Once in your life just to get an understanding) Spend some dollars on the CD and read the manual. Once every thing in the IF deck is aligned for peak output reset the If gain as above.

Once you are putting RF into the antenna input you can align the 100 Hz and 1000 Hz input can on the IF deck. Watch out for the AGC can alignment on the IF deck. You do some cans in manual gain and some in AGC.

You can align the second and third IF by setting the receiver to the given frequency and putting the signal generator into the antenna input. Set the signal generator to the receiver frequency. Rock the generator to your best peak. Then rock the receiver to the max. peak. You will be close here. Then
align the 3 slugs or caps at the frequency.

Do the BFO, PTO and Calibration adjustments at this point. Check the mechanical alignment.

You can do the crystal oscillator deck from the cal position of the front panel. I like to do a Signal generator on each mHz. At the end when I check signal to noise on each mHz I align the crystal cap once more.

When you change the tube in the deck, Adjust the transformer first one frequency. This puts the whole collection back at peak. Some where one frequency will be weaker than the rest. Here adjust both the transformer and cap for the best you can get. Now leave the transformer alone. Go back and adjust all the caps again for the new transformer setting. Adjust the 17 Mega hertz transformer once. Adjust the 455 RF deck output transformer once.

Do the RF deck at this point.

When you get done, go back and do all of this again. Once you get a receiver into peak adjustment it will stay there for a long time. More than one pass does help. So once a year you should spend a day doing your receiver.

The R390/A manual does not cover adjusting the antenna trim cap on the very front of each RF band filter bank. There are 2 caps on that front can and the book only deals with the back one. The R390 manual covers the topic.

End point adjustment of the PTO is not covered in the R390/A manual and is covered in the R390 manual.

Find a resistor pair 125 /2 = 62.5 Ohms. 47 to 75 ohms. plug one into each input of the balanced antenna input. feed the other end of both resistors at the same time from the signal generator. Use any point in the band. peak up the generator and receiver to the same frequency. Adjust the front antenna trim cap for max. output. The first time you do this right, the improvement in receiver performance may be shocking.

Date: Tue, 04 Apr 2000 21:14:23 -0700
From: "William L. Turini" <Turini@hamanuals.com>
Subject: Re: [R-390] Calibration Problem?

Took the can apart, there are two xtals there, both marked with the correct freq

> Loose crystal in socket.......... reseated both xtals
> Loose can in socket. took the can out and replaced it
> Crud on contacts. cleaned them up

> Bad crystal. looks like the only option. Which one? Is there a test point where I can measure the frequency? I believe there was an e-mail about the xtals failing and a suggestion that it might be a good idea to replace them.

> Cold solder joints. possibly

Date: Wed, 05 Apr 2000 09:01 -0700 (PDT)
From: rlruszkowski@west.raytheon.com
Subject: [R-390] Calibration Problem? More.

The 17 Mhz crystal is for the third conversion of 0.5 to 8 up to 17 to 25. The other crystal is 200Khz (100Khz?) for the calibration oscillator. This would be the one to change. Do you have an Gen. that will tune to 200Khz and a scope or AC meter that will measure 200Khz? run a volt of 200Khz through the crystal and measure the output. As you tune the generator

through the resonance of the crystal you will get a peaked output. The frequency will not be exact out of circuit on the bench. But it will test the Crystal for you. Next you can pull the can. Set the receiver over 8Mhz so the 17Mhz osc is not in use. Inject 100Khz into the correct pin of the octal socket and use this to pull the calibration oscillator onto frequency. If this test works, I would go for a new crystal. I have not been following this mail thread real close. Did you attempt to adjust the calibration frequency with the back panel adjustment? Tune WWV at 15 or 10Mhz. Peak it in the .1Khz band pass of the If deck.
This get you to within a 100 Hertz. Turn the BFO on and zero it to WWV. Switch the receiver over to CAL. Stick you flat blade screw driver through the back panel and tweak the CAL Adjust (Its a small variable cap mounted in the back of the RF deck chassis) to zero the cal tone against the BFO. This should get you within a 100 Hertz of zero across the receivers range. You can radiate your signal Gen. against WWV at 10 or 15Mhz and zero beat it. Then using the second or third harmonic on 30 Mhz. Use the PTO to max the signal in the .1 IF band pass. Beat the BFO against that signal. Then zero the cal oscillator against the BFO. This should get the calibration oscillator to within a few hertz all the way up to 30Mhz. You ask about test points. Locate a 7 pin and 9 pin tube extender. These things have a set of contacts around them that let you measure the tube pin signals and voltages from the top of the deck. This was / is the standard method of test measurement for boat anchors in general. You can make them your self from a pair of tube sockets and some stiff copper wire. Roger KC6TRU San Diego

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Date: Tue, 18 Apr 2000 07:55 -0700 (PDT)
From: rlruszkowski@west.raytheon.com
Subject: Re:[R-390] Questions

>But, how much test equipment am I going to need.......

Of course more is better.......................
A signal generator 455Khz to 30Mhz.
You would like it to modulate a 400 or 1000 tone.
You would like it to have a metered output.
Metered output lets you repeat tests.

A voltmeter.
You would like it to get down to 1 volt Ac
You would like it to get up to 500 volts DC.

An ohmmeter.
This is likely part of the volt meter.

A tube tester.

You need not own one of these.
You just need to know where one is still accessible at a parts store.

Anything else you can build up.
You can build meter scale expanders.
You can build attenuators if necessary.

The standard is a AN/URM25 Signal generator. $35.00 at Murphy's in San Diego. No cover. No adapters. It works. Shipping is extra.

Analog meters are better than digital meters as you do alignments.
30 volts AC and 10 volts DC are the ranges most used.

The TM will talk about measuring the 455Khz output.. A load resistor, a diode, a small cap and a DC meter will do this for you. You are looking to adjust thing to a peak and absolute values are not required. Absolute frequency is not required. The 0.1 band width is 455Khz crystal. the narrow band filter is 800 Hertz. By putting 455 Khz into the IF deck with the 400 Hertz modulation you can get 455 within a 100 hertz. you can beat the BFO against that. You can align the PTO against WWV. You can adjust the PTO spread against WWV. You can adjust the calibration oscillator against WWV. You can get just as good an alignment this way as you can with a freq.. counter and generator.

In the field, the ASA taught us to do it with an audio level meter (17 volts and a 600 ohm resistor), a DC volt meter (-7 volts on the diode load) and a signal generator (read off the air signals and 455Khz into the IF deck). Thousands of folks did it this way for 40 years. And some of us are still doing it.

Date: Fri, 14 Apr 2000 08:10 -0700 (PDT)
From: rlruszkowski@west.raytheon.com
Subject: [R-390] Need TM and service tips.

Inspect the cap that separates the B+ from the mechanical filters.

Inspect the filter supply caps in the audio deck.

Proper prior planing prevents poor performance.
Changing these parts is the best cheapest insurance there is.

You have an early R390A. So the IF deck is straight tuned. If this procedure drives your IF deck into oscillation, then the deck is not as old as we think and it is stagger-tuned. Tune T501 T502 and T503 top slug for max output.

Stagger-tuned
T501 Top   T502 Bottom 442KC
T502 Top   T501 Bottom 467KC
T503 Top   T503 Bottom 455KC

Listen to the audio output and adjust the side panel BFO trim for most gain just before it goes into oscillation.

Lift the cover off the IF filters and see if you have trimmer caps. Pull the IF deck and see if you have trimmer caps on the side of the deck. If so you just trim these up for max through put. your model may have none, top only or both. One per filter. 2,4,8,16

At 0.1 band width you are going through a 455khz xtal in the can at the back left corner. You way lift the cover and check that the crystal is there. Using the 0.1 will get your signal generator with in a 100 Hertz to center it on 455Khz. trim the cap on top of the can. Once you get the Rf deck going you set the band width to 1 and trim the slug in this can for that band width.

Doing Z501 for the AGC is coming later. Just let it set for now.

Using the back panel BNC to mini-BNC adapter for the 455KC output. Disconnect P513 and P518. (RF to IF deck mini-BNC cables) from the IF deck. Move the IF output cable over to P513. You can now use the back panel BNC to inject 455KC into the IF deck.

Use 150 microvolts. (0.000015 volts)455KHz. CW. You will need -7 volts on the diode load (Function switch set to MGC). This is about mid range on the IF deck

Gain Adjust Resistor.

On the rear panel locate pin 6 & 7 of the Local Audio Out. Hang a 600 Ohm load resistor across these two pins. Using a meter with a Power scale and dB scale (TS382) you will need about 30 dB out and 500 milliwatts (0.5 watt) You can use any AC meter and do the math for power and dB conversion.

For 150 microvolts 455Khz 30% modulation you must have.- -7 volt diode load. 0.5 watt or more Local Audio power and the dB equivalent power. (17 volts 600 ohm)

You need a 30dB difference in the signal plus noise to noise ratio. 150 microvolts modulated to 150 microvolts un-modulated (CW) for the IF and audio deck. MGC. BFO off. Audio Max RF gain max and 2Khz band width.

Work on this until you get it. (tube noise is the problem, new tubes are the solution) Tube order will help. Put the lowest noise tubes to the early stages.

Use the 7549 from the PTO and BFO to plug in the IF 502 and 503 sockets. Then you can try all you other tubes against these in the V501 socket. put your best tube in V501 second best in the PTO next best in V502. The 6AK6 's get the same treatment. Use the limiter to compare the 5814's turn the limiter on at 2 and compare all the 5814's Put the best one in the diode. 2nd best in the limiter. put the poor ones in the AGC and IF output.

When you get the IF up to par you can start on the RF deck. Poor signal sensitivity is antenna and alignment. Noise is tubes. 2 micovolts in the antenna should get you a 20dB signal to noise from 0.5 to 30Mhz. If your receiver is not putting out for you then you have some work to do. 10db at 4 microvolts passes military expectations and is considered operational.

You get through the IF deck, write back. Let us know how you are doing. As you get specific questions we will get specific responses.

Date: Fri, 14 Apr 2000 10:32:42 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>
Subject: Re: [R-390] Date: Mon, 14 Feb 2000 08:59:06 +0100

If you haven't replaced the leaky paper capacitors they could easily account for poor sensitivity. Along with that you need to test the tubes for proper gain to be sure they aren't the limiting factor. Its common in these receivers for weak tubes and leaky capacitors (and resistors with values drifted way out of tolerance by age, environment, and heat) to cause poor performance. Alignment is only indicated when a tubes in aligned stages are changed or when fixing the other ills of poor capacitors, resistors, and tubes doesn't restore the performance or if its known that someone has twiddled alignment. To put it more succinctly, "Alignment has NEVER fixed a faulty radio." It just adds to the tasks.

Check the archives of this mailing list for lots of discussions on capacitors, resistors, and tubes. The manuals are available from Jeff on CD-ROM for $10. There's no excuse for not having them.   73, Jerry, K0CQ

Date: Sat, 29 Apr 2000 16:09:38 -0400 (EDT)
From: "Paul H. Anderson" <pha@pdq.com>
Subject: [R-390] 390A sensitivity measurements with URM-25D and URM-25F

When I follow procedure Q1 - Measure Receiver Sensitivity in my manual (navships 0967-063-2010) using my crappy URM-25D, I seem to get a reasonable sensitivity of 3uV @ 750KC on my blue stiper 390-A. Because my URM-25D is flaky, noisy, and stops working after it gets too warm, I prefer to use my URM-25F. When I do the same procedure, using what I think are the correct settings on the URM-25F (I have no manual on either), I am unable to get measurable sensitivity with manual gain control. If I flip to AGC, I hear the 400 or 1000 cycle tone no problem. If I use MGC and set the signal generator to what I think is 100uV, I cannot hear any audio, although I can flip the BFO on, and beat against that.

Is this telling me something about my radio, or my ability to operate my URM-25F or both?

The URM-25D, despite being in poor shape, makes sense with everything it does. The URM-25F doesn't seem to... Any advice would be welcome. Pointers to user manuals for either or both might be useful, too.

Date: Mon, 4 Sep 2000 17:10:13 -0400
From: "Walter Wilson" <wewilson@knology.net>
Subject: Re: [R-390] Low bands dead, but now resolved

From the "Collins" listserver:
> Be careful when hooking up your signal generator to your receiver. My
> signal generators (HP-608, URM-25D) want a 50 ohm load for output
meter
> accuracy. The 50 ohm external resistor completes the voltage divider
> that is in the generator. If the generator is not terminated into a 50
> ohm resistor, you develop twice the voltage at the output. This makes
> your receiver look twice as good as it actually is. Common terminations
> are a male/female bnc combination with an internal 50 ohm resistor in
between (to ground).

I have found this to be the case, and I've constructed a little voltage divider so the URM-25 sees 50 ohms and the R-390A sees 120 ohm. Then you have to multiply by a factor to get the voltage delivered to your R-390A. I'll try to dig out some information if you have the URM-25x. BTW, all the sensivity measurements in the website were taken with this compensator in the circuit. There was a standard military issue that did this in a small little enclosure, but mine is homemade.

> Dumb question, but can you summarize how to check the sensitivity?
I've
> heard guys on the group talking about this measurement a lot, but I'm
not
> sure how to measure it. I realize it's a measure of the minimum amount

of
> signal that produces some change somewhere, but what is the change? Is it
a > certain amount of voltage rise at some point (diode load?) in the receiver
> when a signal of a certain level (eg. 1uV) is applied to the input?
>
> I'm pretty sure this is in the manual, but somehow the procedure doesn't
> stick in my mind. Can you "nutshell" it for me?
>
> Also, I notice by the chart on your website that the sensitivity tends to
> get better as the signal rises. This seems backward to me, but it seems
to be the same findings I'm seeing on my rig. I would think they would tend
to perform better at the lower frequencies. Is this usually true in these radios?

Date: Mon, 4 Sep 2000 16:59:07 -0400
From: "Walter Wilson" <wewilson@knology.net>
Subject: Re: [R-390] Low bands dead, but now resolved

You referred to the sensitivity charts on my website (R-390A page, bottom). I noticed too that the sensitivity seemed to improve at the higher frequencies. Also notice that the sensitivity is lower in the centers of the bands, and gets worse at the band edges. No real surprise there. I use a URM-25F signal generator, and I'm sure it needs a good calibration to give more accurate readings, but here's the general procedure that I use:

1. Connect a good AC voltmeter (VTVM preferred) to the audio output jacks on the back of the radio. (We are going to measure signal to noise ratio through the whole receiver all the way to the audio output terminals)

2. I go ahead and connect the signal generator and zero beat the frequency that I'm testing. Then I turn the signal generator output all the way down (off) at the lowest setting. Calibrate the signal generator output for the frequency range that is used (if you're using the URM-25 or similar sig gen)
and set the audio at 400 Hz and 30% modulation.

3. Put the R-390A in MGC mode with BFO off (we will measure AM sensitivity). Set the ANT TRIM at 0 and RF gain at maximum. I use the 4KC bandwidth for my measurements. Increase the Local Gain until the measured AC voltage output from the audio output is about 1 volt. This is your base level noise with no signal injected. [Note: In saying set the ANT TRIM at zero, I've made the assumption that you have aligned the radio

(probably with the same signal generator) with
the ANT TRIM control set at zero during alignment. If so, the signal should peak at the zero setting,]

4. Now increase the output of the signal generator until the measured voltage increases by a factor of 3. If you chose 1 volt for base level noise, then increase the output until you get 3 volts AC. The output of the signal generator is the sensitivity reading for this frequency, expressed as 10 dB signal + noise / noise (S+N / N).

This method is primarily taken from Chuck Rippel's 7-hour video series on the R-390A. I hope I've outlined it correctly enough for general purposes.

Date: Wed, 6 Sep 2000 08:35:13 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Low bands dead, but now resolved

Okay, I understand. I figured my example was too simple! I'm copying the list as others may benefit. The URM-25 is seeing 66 ohms in parallel with 211 ohms which is almost exactly 50 ohms.

```
  o-------------o-------------o
  |            |            |
  |            |            |
  |            |          91 ohms  ------
  |            |            |          \
URM-25      66 ohms         |          211 ohms
  | (50 ohms)  |            |          /
  |            |      R390A (120 ohms) --
  |            |            |
  |            |            |
  o-------------o-------------o
```

The R390A is seeing 91 ohms in series with approximately 28.45 ohms (the
URM25 and 66 ohms in parallel) which is almost exactly 120 ohms.

Pretty neat. I'll have to construct one of these. Thanks for straightening me out on this one!

Date: Wed, 06 Sep 2000 17:13:25 -0500
From: Randy & Sherry Guttery <comcents@mississippi.net>
Subject: Impedance matching [was [R-390] Low bands dead, but now resolved]

On considering the above - a couple of thoughts occurred to me: 1) the fact of what the R-390 "sees" is irrelevant - it only matters what the generator "sees" - and consequently "delivers" to the R-390. If we were dealing with reactive components (in the generator, etc.) then a true impedance match would be required - but here - the only thing we're interested in is delivering a "known" signal to the receiver under test. Some givens - what we're working with here: In most constant impedance sources - the output is fed through a resistance of the desired impedance - and "expected" to be terminated by a like resistance - in this case the output of the generator is fed through a 50 ohm resistor -- so that half the output's stage is dropped across this resistor - and half appears across the "load". The "problem" with a R-390's higher input impedance is that it doesn't drop as much as a true 50 ohm load - so the input to the 390 is higher than designed. To examine what's going on - let's first talk about how generators "do their thing" (again in general; - while individual designs may vary a bit - the fact that they are designed for a 50 ohm load is a "given" that makes individual details of how they get there moot): Lets take a specified output voltage of 1VRMS. That means the generator is delivering 2VRMS to the output resistor - which is hooked through the output attenuator (which is in feed-thru at this setting) directly to the output jack. (the 3VRMS output setting is usually a "boost" output that also by-passes the attenuator). Since both the output resistor and the load are 50 ohms - 1VRMS is developed across the load. So you can see that if 2V is applied to the output resistor and an R-390 for a load - you have: 2V / (50 + 120) = 11.76470588 ma across the r-390's load - developing 1.41176VRMS vs. the intended (and indicated) 1.0VRMS. Any "sensitivity measurements" would make the R-390 look much better than it really is; while selectivity would suck.

So... The above circuit (one quoted by Barry) with the original values does two things... it provides a (nearly) 50 ohm load presented to the generator - so that the voltage across the 91 ohm + 120 R-390 is 1 volt. However the second thing it does is create a drop across the 91 ohm that "eats" part of our 1V. As noted - this delivers approximately .57 volt to the R-390... a pain in the tail to calculate from the generator's settings. I posted a change in values that would deliver .5VRM - much easier to calculate - but still delivering much less voltage to the R-390 - and worse - in the real world - much more susceptible to variations in impedance within the R-390 throwing our measurements off. So taking the "musings" a step further - why not just make sure that the "load" of the receiver and some parallel load - equal 50 Ohms - and therefore - deliver the Generator's full output to the receiver - Something like:

```
 o--------------o--------------o
 |              |              |
 |              |              |
 |              |              |
```

```
  |          |          |
URM-25      85.71 ohms  R390A (120 ohms)
  | (50 ohms)   |          |
  |          |          |
  |          |          |
  |          |          |
  o-------------o-------------o
```

(a 91Ω & 1500Ω in parallel comes close enough to 85.71Ω).

Here the generator still sees 50 ohms as a load - so delivers to the R-390 the desired (and indicated) voltage from the generator... Since we're dealing with pure resistance (in the generator and the "parallel load") - and since the receiver makes up less than half the "load" shifts in impedance, reflections, etc. have a very minimal effect.

Then enters: REAL LIFE... the R-390's input impedance isn't that accurate - isn't that stable - and has some reactance to it. so----

Remember - the above is from the view-point of the attenuator being out of the circuit - (1VRMS range on most generators). However - as the attenuators are designed to feed 50 Ohms - their dependence on a non varying load becomes more critical because they add series resistances to divide the voltage across between their scaling resistors - and the load. -

So while the above circuit is good for that high range (with a total of 50 ohms "source") - the previous circuit - with it's lower "parallel load" resistance - and isolation provided by that additional 120 Ohms in series with the receiver - make it a more desirable circuit over all. And since the delivered voltage is exactly 50% of the "indicated voltage" on the generator -- it doesn't wear you out figuring out what the actual levels are. So this then becomes the better circuit all around.

```
  o-------------o-------------o
  |          |          |
  |          |          |
  |          |        120 ohms  ------
  |          |          |        \
URM-25      63.25 ohms         |         240 ohms
  | (50 ohms)   |          |        /
  |          |      R390A (120 ohms) --
  |          |          |
  |          |          |
  o-------------o-------------o
```

(a 68 Ohm and 910 Ohm in parallel comes close enough to 63.25 Ohms).

For most of us - either the circuit above (we'll call it the 50% divider / matcher) or the slam dunk circuit before it (the cheapskates special with it's 100% signal delivery) will provide adequate accuracy -- usually as good as or better than the rest of our equipment is capable of. If I were to be interested in really "nailing down some numbers" on one of these sets - I'd get a custom transformer wound with a 1:2.4 ratio -- But since nothing else I've got can claim that kind of accuracy - - what would be the point?

The vast majority of R-390's I've aligned - I've run the generator straight into the 390 - and just made a mental note that the readings were not to be taken literally - and tweaked them up just fine. This has been the case both with my HP606B --- and with the HP8640's I used while I was still in the Navy (one got them in mid '75 - and it didn't take long to spoil us!).

Date: Mon, 11 Sep 2000 17:46:18 -0400
From: Dennis McLaughlin <dennism2@ix.netcom.com>
Subject: RE: [R-390] URM pads

I also build a matching unit. Used a 64.9ohm and 97.6ohm 1% 1/4 watt metal film resistors. If you do the math this works out to be a 50.25 ohm load on the generator and 125.8 ohm source impedance to the radio with a 5.01 dB loss (0.562 times).

Note: When you use your generator to do the trouble isolation table 5-5 in the NAVSHIPS manual don't terminate the generator with 50 ohms. Leave is unterminated. You will actually be applying twice the voltage listed in the table. I found this out the hard way.

Date: Mon, 11 Sep 2000 18:44:56 -0400
From: Dennis McLaughlin <dennism2@ix.netcom.com>
Subject: RE: Impedance matching

Reading the Army and Navy manuals makes you wonder if the people that wrote the manual knew what they were doing or none of this makes any difference Example: Army manual TM 856A Paragraph 94 Over-all Receiver Gain Test step c. states "....connect generator through Electrical dummy load DA-121/U to the balanced antenna connector. ....etc.

If a DA-121/U is a box with two resistors in it, a 68 ohm and a 100 ohm and it matches a 50 ohm generator to the 120 balanced antenna input. The input impedance of the radio from MIL Spec MIL-R-13947B is 125 Ohm BALANCED input. So how do you feed a balanced input with an unbalanced source without a balun? If you use the DA-121/U doesn't it ground one of the balanced input connector pins? Then isn't only half of the input transformer driven by the DA-121U and generator? Then wouldn't the impedance be 125/2 or 62.5 ohms.

Other error I've noticed are the IF gain tests. Procedure 95 (TM 856A). Use a MX-1487. I think this is a 50 ohm feed through terminator. Sounds good. Connect your 50 ohm generator to the 50 ohm feed through terminator then to J513. Set the generator to 150 uV. The input impedance to the IF chassis must be high. Navy NAVSHIPS the same (6.2.8). Both procedures adjust gain for -7 volts on the diode load terminal.

Army procedure 105 Stage Gain Charts
For -7 volts on the diode load terminal. 1st if ampl grid (V501) Signal generator output (microvolts) 100 to 200. The procedure tells you to inject the output of the generator through test lead CX-1363. Does the test lead load the generator at 50 ohms and capacitively couple the signal to the grid? If it doesn't load the generator then the applied voltage will be 300 uV. I don't think C501 will drop the voltage in half. At 455kHz the reactance of C501 is about 70 ohm.

On considering the above - a couple of thoughts occurred to me: 1) the fact of what the R-390 "sees" is irrelevant - it only matters what the generator "sees" - and consequently "delivers" to the R-390. If we were dealing with reactive components (in the generator, etc.) then a true impedance match would be required - but here - the only thing we're interested in is delivering a "known" signal to the receiver under test.

Some givens - what we're working with here:
In most constant impedance sources - the output is fed through a resistance of the desired impedance - and "expected" to be terminated by a like resistance - in this case the output of the generator is fed through a 50 ohm resistor -- so that half the output's stage is dropped across this resistor - and half appears across the "load". The "problem" with a R-390's higher input impedance is that it doesn't drop as much as a true 50 ohm load - so the input to the 390 is higher than designed.

To examine what's going on - let's first talk about how generators "do their thing" (again in general; - while individual designs may vary a bit - the fact that they are designed for a 50 ohm load is a "given" that makes individual details of how they get there moot):

Lets take a specified output voltage of 1VRMS. That means the generator is delivering 2VRMS to the output resistor - which is hooked through the output attenuator (which is in feed-thru at this setting) directly to the output jack. (the 3VRMS output setting is usually a "boost" output that also by-passes the attenuator). Since both the output resistor and the load are 50 ohms - 1VRMS is developed across the load.

So you can see that if 2V is applied to the output resistor and an R-390 for a load - you have:

2V / (50 + 120) = 11.76470588 ma across the r-390's load - developing 1.41176VRMS vs. the intended (and indicated) 1.0VRMS. Any "sensitivity measurements" would make the R-390 look much better than it really is; while selectivity would suck.<snip>

-
Date: Mon, 11 Sep 2000 21:30:49 -0500
From: Randy & Sherry Guttery <comcents@mississippi.net>
Subject: Re: Impedance matching [was [R-390] Low bands dead, but now resolved]

> Reading the Army and Navy manuals makes you wonder if the people that wrote the manual knew what they were doing or none of this makes any difference. Example Army manual TM 856A

I'll return to this question in a moment...

> If a DA-121/U is a box with two resistors in it, a 68 ohm and a 100 ohm and
> it matches a 50 ohm generator to the 120 balanced antenna input. The input
> impedance of the radio from MIL Spec MIL-R-13947B is 125 Ohm BALANCED input. So how do you feed a balanced input with an unbalanced source without a balun? If you use the DA-121/U doesn't it ground one of the balanced input connector pins? Then isn't only half of the input
> transformer driven by the DA-121U and generator? Then wouldn't the
> impedance be 125/2 or 62.5 ohms.

No... the result is something less than 125 ohms (since shorting one side of the transformer to ground effectively shorts out one of the input capacitors) - but not very much less than 125 ohm - and certainly much higher than 62.5. What you suggest would be (partially) true were the transformers input winding(s) center tapped - with such centertap grounded... but they are not - only the capacitors are affected. Neither the "loading effect" nor detuning are serious in this instance.

> Other error I've noticed are the IF gain tests. Procedure 95 (TM 856A).
> Use a MX-1487. I think this is a 50 ohm feed through terminator. Sounds
> good. Connect your 50 ohm generator to the 50 ohm feed through terminator
> then to J513. Set the generator to 150 uV. The input impedance to the

IF
> chassis must be high. Navy NAVSHIPS the same (6.2.8). Both procedures
> adjust gain for -7 volts on the diode load terminal.
> Army procedure 105 Stage Gain Charts For -7 volts on the diode load terminal.
> 1st if ampl grid (V501)   Signal generator output (microvolts) 100 to 200.
> The procedure tells you to inject the output of the generator through test
> lead CX-1363. Does the test lead load the generator at 50 ohms and
> capacitively couple the signal to the grid? If it doesn't load the
> generator then the applied voltage will be 300 uV. I don't think C501 will
> drop the voltage in half. At 455kHz the reactance of C501 is about 70 ohm.

C501 certainly won't drop hardly any signal - as it's in series with some pretty high impedance stuff. While I'm not familiar with the MX1487 specifically - it likely is a simple resistor load that insures the proper signal size (in this case) 150UV.

Back to your first question:
> "if the people that wrote the manual knew what they were doing or
> none of this makes any difference."

They knew what they were doing: 1) writing for a person that was trained in only the very basics. They weren't dealing with engineers, etc. - just your average Joe just out of high school. 2) they weren't writing a procedure for calibrating these receivers - just insuring they were working pretty good - meeting some minimum level of performance. The generators in use were only moderately accurate (even when they WERE calibrated).

As I noted in a previous post: For most of us (those who are interested in just insuring that our receivers are performing well -- i.e. not "spectacular!") making sure the signal applied to the receiver is just strong enough to allow tuning / tweaking - yet not so strong as to overload... gets us the performance we desire - while not "tweaked to perfection" our receivers still kick butt..

While it's fine for those who wish to wring out every uv of sensitivity, etc. out of their sets to go to extraordinary extremes to do so... most of us just want a receiver that performs well --- which any 390/1/A tuned / tweaked to those procedures will do.

Date: Mon, 16 Oct 2000 16:51:47 -0700
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>

Subject: Re: [R-390] <8 Mhz Low sensitivity...

From 4 June 68 through 10 Oct 75 I more or less make an occupation of feeding and caring for R390/A in very large numbers. As all these receivers were 25 years younger then than now, there could be few little things that just are not as up to snuff today as they we back then. I do not think the 1MHz and <8Mhz bands are on the short list.

Any day any time back then a R390/A would get you 4UV sensitivity and 20:1S+N / N With work the receivers would go 2UV or 4Uv and 30:1 I seen receivers that were at 4UV and 40:1 (not every day).

I just expect these receivers to do as well today. High bands will do better than the bottom 8. .5 -1 and 1-2 were as good as and thing else under 8. Any band under 8 would do 4UV and 20:1 signal to noise or we would not let it off the bench.

Time after time its really an IF deck problem. you do need 150UV straight from the AN/URM-25 into the IF deck at 455KHz and a 30:1 signal to noise with -7 on the diode load. IF you do not have that go no further until youget the IF deck into shape. Back then it was tubes, tubes, tubes, and then the tubes. It was noise in tubes noise in the tubes and some times it was just noise in the tubes. Today we add old caps to the problem list.

Then in the RF deck, week bottom ends were noise in the tubes. Or most likely noise in the tubes. Some times it was alignment and noise in the tubes. We never did care what the tubes measured in the TV 7 tube testers because the tester did not check for noise in the tube. Hang an AC volt meter across the audio output and a 600 Ohm resistor for the load. Start measuring the voltage. Hang a DC meter across the diode load.

Put 150 UV into the IF or 4 UV into the RF and start measuring. CW noise AM mod 30% Signal plus noise. Pick a tube any tube and swap every tube of the same type spare you have into that socket. set the IF gain to 7 volts on the diode load. (every tube will have different gain and forget that for now) measure the tubes signal to noise. (volts with modulation / volts with CW) Put the best value tubes to the front end and go around again.

New out of the box tubes will have more noise than used tubes. Old tubes will have more noise than new new tubes. Put the best ones forward. Put the new ones at the end of the line. Throw the noisy ones in the trash. Heating them with a lighter will help take out gas and get the noise down a bit. This will not cure a bad tube, But it can help get you by until you can get a new tube. If you need one or two to make the set, light up all the better of the poor lot and test them all to get the best responding one or two you need to make the set. If you have not cooked a couple for experience try the bluest ones for starts. I use a cotton wick alcohol lamp to heat mine with. I have melted the glass and watched it implode. I have also cracked a few tubes going in to the heat to fast. I like to do them in the near dark to watch the glass turn red. I hate hot glass I can not see.Cooking them in the tube tester with a higher filament voltage does not work!! And that's the truth. I hated to install a new 6DC6 these new tubes would always be nosier than a 6 month (7x24) old tube.

Jordan there is no know reason why your bottom 8 should not perform at least this well..

Today their are lots of old caps and resistors to deal with. 25 Years ago it was tubes, tubes, tubes. Today my biggest pain is still getting good tubes, good tubes and a set of good tubes.

I really wonder if the lack of gain below 1 mhz isn't built-in... perhaps to make up for the added QRN below 8 mhz, and due to the added mixer stage... I have tried massaging the tube line-up for all the mixers, which helped, but it is still less sensitive below 8Mhz...everything seems to check out OK as far as levels and values are concerned, so I really wonder...

Date: Mon, 16 Oct 2000 18:38:33 -0600
From: Jordan Arndt <jordana@nucleus.com>
Subject: Re: [R-390] <8 Mhz Low sensitivity...

Hi Roger... I am not too concerned about the noise figure below 8 Mhz.... I still get very good sensitivity below 8 mhz, ~ 1.2 uV , which is good useable sensitivity for the lower bands, but it doesn't compare with the ~ .8- 1.0 uV sensitivity above 8 mhz... the difference in gain is obvious...but it is still very sensitive... even after replacing the now infamous C-275 with what the Schematic and the ECO calls for (.0033 uf , which brought the sensitivity up substantially), there is still too much of a difference... I have even gone to the point of replacing the 17-25 mhz IF cans one at a time with the same difference noted... I recall seeing a letter in an old HSN about someone who actually went so far as to change the taps for the < 8 mhz bands, which in his case brought the S/n up to near flat line from .5 to 32 mhz...C-327 has been replaced, most of the caps and all of the resisitors that even looked funny were also replaced.... I went through the RF deck and individually swapped out tubes with at least 6 of the same type and left the best S/n tubes in place... (you guys should try some of the CV-133 and 6135 tubes for the mixers..!!!) P.S. the note about the above mod is from HSN no. 5 March 1984....

Date: Mon, 16 Oct 2000 19:12:57 -0300
From: Guido Santacana <laffitte@prtc.net>
Subject: Re: [R-390] <8 Mhz Low sensitivity...

There seems to be differences among receivers. I have two EACs that show basically a linear response in all bands but I have seen others that don't, even EACs too, Even after recapping an older nonA, I have not been able to make the lower bands as sensitive as those above 8Mhz. It will be interesting to see more opinions on this thread specially from those that handle a lot of these receivers.

-

Date: Sun, 17 Dec 2000 15:53:45 -0500
From: Al Solway <beral@videotron.ca>
Subject: [R-390] Low Sensitivity Need Help

The first attempt at alignment of my R-390A blue stripper is complete. There are a number of week tubes but this does not seem to be a problem. Sensitivity is about 2uVs on all bands. On bands 01 through 07 the sensitivity drops to greater than 30uV after 15 minutes to 1 hour of operation. This only happens when going from band 08 to 07. Sensitivity on band 00 is always very good as are the bands above 08. Going back to band 08 or above and then back to 07 restores sensitivity for 15 minutes to 1 hour.

The 17 Mhz from the 1st Crystal oscillator is always present. The sensitivity of the IF Amp is always good. I have removed the RF Deck and checked operation of S201 through S208 and all appears normal to me. The mechanical/electrical synchronization is what the book says. One thing that to me could be a problem is that when changing the band switch above 08 there is an occasional popping sound as the indent mechanism goes through the indent. That's about all the details I have. Sure hope somebody can help. This radio performs so well on all the bands except those mentioned.

This is my first attempt at restoration and the first R-390A worked on or used.

Date: Sun, 17 Dec 2000 17:52:02 -0600
From: Dennis Clemenson <dclemenson@stellarnet.com>
Subject: RE: [R-390] Low Sensitivity Need Help

I would be suspicious of the 17 MHz oscillator. I have my RF deck on the bench right now after I traced intermittent low sensitivity on the bands below 8MHz to that oscillator. You can put the rcvr in standby and measure the dc voltage on E209 to check it.

Mine shows -7.8 vdc when it is good and as low as -1.0 vdc or less when it is bad. I think I have mine traced to the 100pf capacitor, C327, across the

T207 primary. I can make the problem go away with freeze spray on that capacitor and usually bring it back with a hair dryer.

As long as I have the RF deck out of the radio, I am replacing the three brown beauty capacitors as well. And updating the value of R210 from 56K to 220K. My deck seems to have the other production changes already in place. I am checking the other resistors and cleaning up the bandswitch contacts with DeOxit while the deck is out.

I'd rather not take it out again for a long while.

Date: Sun, 25 Oct 1998 20:07:36 -0800
From: Philip Atchley <ko6bb@elite.net>
Subject: Re: [R-390] RF sensitivity

You may want to be carefull about increasing the sensitivity, RF front end design has many variables. (Noise, IMD, etc) The r-390a already has an above average "quite" noise floor, better than many of your supersets. If you really want more "rf gain" you may be much better with an outboard "Amplified Preselector" such as a Lowe, Palomar, Ameco or even an MFJ unit. The Lowe is by far the best (and the costliest) . That way you can switch it out when not needed.

Date: Tue, 27 Oct 1998 11:09:24 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Audio Chassis - Hi Fi

When it's detected a preamp has no benefit, its time to forget the preamp. Because it that case it always has detriment causing the unwanted signals to be stronger making intermod and interference worse. The raw sensitivity figures for the 390 are generally very good (look at the sherwood engineering page for independent measurements). Most good receivers are hurt by preamps, not helped.
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ate: Tue, 27 Oct 1998 17:21:29 -0500
From: "Steve Murphy" <k8vo@flyingbeers.org>
Subject: Re: [R-390] preselector/RF amplifier

Years ago, I tried to improve the performance of my R-390A through the use of a preselector. The first unit I tried was the MFJ, I forget the model, but it's their super-duper one that I think they still sell. Performance was, shall we say, less than acceptable. At the time I lived a few miles from some 5000 watt AM stations-not exactly powerhouses, and they swamped the thing something awful. Even after moving about 20 miles from these transmitters, I still was getting overload from AM stations. Basically, the thing was useless.

The second one I tried was homebrew, my own design. It didn't suffer from the overload of the MFJ unit, and was somewhat useful on the higher frequencies, but really wasn't worth the time and the effort to build.

At the time, I was actively DXing the tropical bands, particularly 60m. For this application, it doesn't really matter how sensitive the receiver is (after a certain point,) because you are fighting high levels of atmospheric and environmental noise. Using external amplification doesn't help the signal to noise ratio at all in these cases, it just increases everything equally.

The best solution lies in improving the antenna system. There are times when the usual longwires just won't cut it.

Date: Thu, 8 Feb 2001 22:33:27 -0800
From: keith <khgrant@ix.netcom.com>
Subject: [R-390] R390A Cal level?

When I go through the frequency calibration procedure, the CAL level on my carrier meter barely moves the meter. The meter seems fine, I can get large deflections on strong stations; its zero is set properly. BW control is set at 1, BFO at zero, Ant trim adjusted to peak what little deflection I get on the meter.

Adjusting KC knob to find the peak. At maximum I seem to get less than 10 db on the meter. Is this a normal level? If not, what should I look at?

Date: Fri, 9 Feb 2001 12:08:31 -0500
From: "Jim Miller" <jmille77@bellsouth.net>
Subject: Re: [R-390] R390A Cal level?

When I first got my 390A, its cal level was low also, maybe 1-2 units on the carrier meter. And "strong" stations would read mid scale. After a lot of work, re-capping, alignment, and cleaning, mine now gives 50 dB, except on 7Mhz where its 40 dB (I'm still working on that band).

And those "strong": stations now read 3/4 scale or more. I did also find about 5 bad resistors, including one in the calibrator circuit, replaced all the old black capacitors everywhere, etc..

My Army manual says 40 dB is the typical minimum for the cal level. Some replacement meters tend to read low also, but not that low.   Unless you have a calibrator problem, I would suspect yours needs some TLC.
N4BE

Date: Wed, 11 Apr 2001 08:21:03 -0700
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>
Subject: [R-390] Working Blind

A lot of the 05H CW operators worked blind. It was all touch and sound. The guys copied in near dark rooms. The lights were just more heat and power. The guys touch typed on the mills (upper case only manual typewriter) and never looked at the dial when they were tuning.

The CAL will spot every 100Khz for you. As you really do want your receiver to be linear you may want to have the PTO aligned real good by one of the guys. As you go from Mhz to Mhz each crystal in the mixer will be a few cycles off. As you change bands, you will want to use the CAL and zero adjust to set the dial onto the frequency of the band. If some of the crystals for the bands you want to use are way off (more than 100 Hz.) you can swap crystals until you find one that is closer in frequency. Ask around here on the reflector for your specific needs. You never can tell how a specific crystal will work in a specific receiver. If its close in one receiver it will likely be good in any receiver. Ask for the ones you need. We can see if we can do a swap with you to get you a real close set so you do not need to CAL every time you change the Mhz band. Peaking the crystal osc deck caps will not move the frequency. You will need to swap crystals to get better results. Have some one do the single side band mods, the solid state diodes in the power supply mods and the ballast tube mod for your receiver.

Is it truly linear, i.e. a specific number of turns means a specific freq change?

Some of the PTO's are straight to within 10 cycles at any point across the 1Mhz band. But like crystals it a mater of selecting the best of the available lot.

PTO's can be adjusted. Most are very straight. You can do a CAL at 100Khz point and roll the Kc knob up or down a 100Khz by feel and "know" you are on the frequency.

I have an idea to use the "cal" position of the function switch as a tuning aid. How does this work?

Turn the BFO on. Set the BFO to zero. Roll the receiver to any 100Khz dial reading. Switch from AGC or MGC to CAL. you should get a near zero beat. Screw the zero adjust knob down to let the KC know move with out changing the dial count. Move the KC knob to zero beat. You are on frequency at that Mhz and Khz dial setting. Release the zero adjust knob. Set the function switch back to MGC or AGC. Set the BFO to off or the desired offset. When the CAL is on the antenna relay opens and drops the antenna input, so the CAL osc dose not radiate on the antenna. You can then roll the Khz up or down from the 100Khz cal point to your frequency. The receivers work real good. You can count dial turns, detent stops (Mhz) or 100Khz cal tones and get to any 100Khz. Then you can get to a specific frequency by the feel of the Khz knob.

There is a micro dial for the BFO. It is round and has no feel for the zero point. You likely will want just the standard BFO knob. You can get a bump installed on you front panel to help you spot the BFO to zero. Straight up is close but you may want something with a more sure feel. The other knobs are OK as is and should not give you any trouble.

I have a Kamtronix converter on my line audio into a computer. I use that to copy TTY and packet stuff. You are typing to us on the keyboard so you must have some form of text to you interface device. I do not know how you would tune the receiver blind to get good copy.

There is a lot of SSB and CW out there to work with.

>My name is Gary Lee. I am currently studying for my tech license with
>plans to pass the code test as well. I have been an swl for many years. I
>developed a love of boat anchors when I had my novice ticket about 20
years
>ago. One more bit of background, I am totally blind.

I have a few questions for the list.

1. Last week I went to fair radio and looked at a 390a. I believe I can operate this receiver efficently. I like the idea of the stops, and tuning in 1mhz bands. Also the lenier feel of the kc change control. Is it truly leniar, i.e. a specific number of turns means a spicific freq change?

2. If all is well, I plan to buy a 390a for my hf receiver. I would like some pointers for a good low to medium power hf transmitter to go with the 390a. Remember I am blind and therefore must have something I can tune reliably. Any ideas? I think I would prefer another boat anchor.

3. I have an idea to use the "cal" position of the function switch as a tuning aid. How does this work?

4. Any operating tips for using this receiver without sight? I don't mind if it is a little extra work.

I will stop now. Thanks for any help.

Date: Thu, 12 Apr 2001 09:17:25 -0700
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>
Subject: [R-390] Picking Crystals.

>Tell me more about getting the crystals closer. I am way off on some bands
>but thought it normal. I have a spare R-390A and a spare deck from ATC last
>week for $27 to work with. The deal from ATC can't be beat. Prices dropped
>a few bucks and free postage. Barry

Barry, ask Barry, no not that Barry the other Barry.

We know the resistance in a resistor can be within 20% of the value markedon the case. Pretty much the same with Crystals. However the tolerance is much better than 20%. We select resistor pairs or sets to get a balanced circuit. We select not for exact value but for equal value. The same with crystals. We are not selecting for exact frequency. We are selecting to get a set with about the same small error. Then as we change Megahertz bands and change the second converter crystal, each crystal has close to the same small error from the exact design value. Thus each Megahertz band "looks /sounds" to be very close in frequency and little if any zero adjustment is needed as we change bands. Of course we want to get the PTO aligned so we do not need to use the zero adjust as we tune from one end of a Megahertz band to the other end of the band.

So as we switch from band to band and we find one band that is out cal by some kilohertz or so the crystal becomes a candidate for swapping. There is nothing wrong with the receiver. These things are normal. The receiver is up to Mil spec. By swapping crystals between the ones of the same value that you have, you are just looking for the one with the least difference from the other crystals.

Get all you crystals to gather. Open every thing up and collect all the spares. Set one or your R-390's up in the Cal mode. Switch across a few band and find the best group of bands that lay close on the same zero beat with out changing the PTO setting. Lock the dial.

Now you want to get every band to zero beat. By swapping crystal in the 2nd converter. Remember the 17Mhz crystal for the bottom eight bands. You do want to get a close 17Mhz crystal so you get a minimum shift between the double and triple conversions. Starting at 8Mhz listen to the zero note you get. Swap all the crystals you have for that band. Select for the closest zero beat. Play with the trimmer cap. It will not change frequency. It will change output level. Now select between the crystal with best output level and best frequency. Make some hard choices. Repeat this process on each Mhz band.

When you are done you should have two sets of crystals. The very best set is in your receiver. These yield the least zero beat difference on each band in the Cal mode and provide a good output level. The second best set laid out on the bench ready to go back into your second receiver. Then you have a lot of spares.

Do not lose those second and third choices. These may be way off against your select set. However in the next receiver and in the next select set they may be dead on best choice. Remember we are not going for exact frequency here. We are going for a set that sounds all about the same. The PTO will offset the inexact value just like it has in every receiver since day 1.

To tell you I have a crystal and its high or low against my set means nothing. Because we do not know where my set is centered. The nice thing about getting a whole deck is you may get a pretty good matched set. That set may or may not mix well with your current set. They will work to well within Mil spec what every. Like you said. I though that variation was normal. Feel free to use what you have and pass them around as spare parts.   Roger KC6TRU

Barry, did this make sense?

Date: Fri, 20 Apr 2001 10:22:30 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: [R-390] Of Signal Generators and Sensitivity Tests

I attempted Walter's test last night on my R90A. I have a problem, though, being able to perform the test correctly. My signal generator's lowest setting is 2.5uV. If I set the no-signal voltage to 1V, when I inject the signal, the voltage jumps way beyond 3V which, hopefully, it should do being as the 3V level should be somewhere around 1uV or less.

Without a way to infinitely control the generator's output from 0uV up, is there a way to interpolate the reading I get to determine sensitivity?

In other words, can I take the audio voltage I get at 2.5uV signal generator level and translate that back to the 3V level?

If there's not a way to interpolate the results (assuming it's probably not a linear calculation), then what about using a second attenuator?

I'm using an AN/TRM-1 that has two generators in one (V/UHF and HF).

Can I cascade the attenuator from the VHF to the attenuator in the HF to attempt to lower the output voltage? I'm not crazy about this method in that it still is a step-wise method instead of having an analog adjustment.

Any suggestions? Thanks, Barry - N4BUQ

Date: Fri, 20 Apr 2001 14:30:12 -0500
From: "J. G. Kincade" <w5kp@swbell.net>
Subject: Re: [R-390] Of Signal Generators and Sensitivity Tests

Barry, I keep a couple or three sizes of 50 ohm attenuators handy on the bench for occasions such as this. A 10 db would be just dandy in your situation. Low power units for receiver work are not expensive if you scout around, I see them pretty frequently at hamfests. Just check them out if you can before buying to ensure some jerk hasn't keyed up 100W through one of them while it was connected to his transceiver. I happen to like to work with power levels/dbm's instead of microvolts for receiver measurements anyway, it always made more sense to me. A carryover from my ancient military electronics tech background, where we used mostly MDS (minimum discernable signal) for receiver sensitivity measurements, probably because the method was generally applicable across the board from comm gear to radar and IFF receivers, and the measurements are simple and fast to perform. Also, we were generally interested in the delta compared with the last time an MDS test was done, or with a set baseline value, instead of quantitative measurements. If we coundn't get at least a -130 dbm MDS out of a countermeasures receiver, for instance, it might fail to smell an incoming object in time to allow you do something about it, which could be really bad for you and your shipmate's health in the Taiwan Straits. :-)

Date: Fri, 20 Apr 2001 21:44:12 -0700 (PDT)
From: John Kolb <jlkolb@cts.com>
Subject: Re: [R-390] Of Signal Generators and Sensitivity Tests

>Actually it would be 1V to 3.16V for 10 db, instead of 3V, but 3V is close enough.

If you place a 20 db attenuator in the line, you reduce the output voltage by a factor of 10, ie, 0.25 uV as the minimum output level. A 40 db attenuator, or a pair of 20's in series would give you a 100:1 attenuation, 0.025 uV output.

My receivers used to measure infinite sensitivity - I put my Heathkit lab RF generator on the far side of the room, set the voltage level to minimum, tuned them to the receiver freq, and the audio increased about 30 db. This was without a coax cable between the generator and receiver. 30 db gain, with 0 uV input = infinite sensitivity, right?

The issue, of course, is leakage from the generator. To measure sensitivities down at 1 uV and below requires extremely well shielded generators. Generally to be accurate, it also needs double shielded coax, particularly, if using additional attenuators in the line between the generator and receiver. If using leaky coax for the connection, RF can leak out through the shielded cable between the gen and the 40 db attenuator, and back in through the shielded cable between the attenuator and and rx. In my case, the attenuator of my Logimetric sig gen is shot, so I have to run a 3V signal out of the generator into a external HP attenuator. It's easy for a 3V signal to leak a number of uV's out through the coax shield.

Rather than unplugging the coax to get a 0V signal into the receiver to set the reference level, I generally tune the receiver slightly off freq to set the 1V output noise level, then back on freq for the 3V level. That way, I don't worry about leakage from the sig gen affecting the reference level setting. While 20 kHz or so off freq, now unplug the cable, and insure you do not have wideband noise out of the sig gen affecting the reference level.

Date: Mon, 23 Apr 2001 09:02:25 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: [R-390] More signal generator questions

To maintain a correct output carrier level, my signal generator has a variable resistor that is used to vary the voltage to the oscillator's plate circuit. This adjustment is used to place a carrier level meter pointer at a reference mark. When this reference mark is set, the output from the attenuator should be at the correct uV level.

I hooked the scope to the output of the attenuator (across a 49 ohm resistor
- - the closest I had to 50 ohms) and set the level to the reference mark. At the 100K uV setting on the attenuator, I set the calibration pot to a 0.28Vp-p (assuming 100K uV is an RMS value).

At that point, I switched to a different band and set the reference mark. Here, the scope showed a marked decrease in voltage level (about 1/3). Switching to higher bands showed further decreases in the output even though I am able to adjust the carrier level to the reference mark.

A little circuit explanation might be in order. The plate of the amplifier runs through a series LC circuit to a branch point. One leg of the branch goes to a 535 ohm resistor to the attenuator. The other branch goes to a 1N34 diode through some resistors to a shunted meter (the carrier level control).

Is this decrease in signal level at the higher frequencies normal? I wouldn't think so. Does this indicate the attenuator is defective?

On another note, is it normal for 40-meter broadcast signals to make the sensitivity tests nearly impossible on that band? When I connect the R390A to the signal generator via a coaxial cable, I can't find a clear place to set the 1V no-signal level. It's like the coax or the signal generator are acting like an antenna. Is this abnormal?

Date: Mon, 23 Apr 2001 09:33:14 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Of Signal Generators and Sensitivity Tests

Okay, just so I have it straight: the reason we are choosing a 1:3.16 voltage ratio is we are setting up a 10dB increase in the output level and whatever signal provides this 10dB increase is the definition of sensitivity. Is this correct?

On a side note, when I tried the tests on the higher frequencies, I had a difficult time getting a 1V no-noise reading at the output terminals. It seems the noise decreases so much at the higher frequencies that getting one volt of hiss is pretty much full volume. Is this typical?

Date: Mon, 23 Apr 2001 09:59:49 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: [R-390] RE: More signal generator questions

Perhaps to state it more succinctly: With the same input voltage, the output of the attenuator seems to decrease with an increase in frequency.

Someone suggested it might be b/w of my scope. It's a TEK 561A. Shouldn't that get me to at least 10 Mc?

Date: Mon, 23 Apr 2001 08:05:58 -0700
From: "Bob Tetrault" <rstetrault@home.com>
Subject: Re: [R-390] More signal generator questions

As long as you can set the ref level don't worry about the changes from band to band. And do try to use double-shielded coax as well as a good ground, especially between Rx and SigGen, as well as using the two units off one well-grounded power source. This will help with the 40M BC interference, though the big guys can have extraordinary sig strengths.

Date: Mon, 23 Apr 2001 13:47:28 -0700
From: "Bob Tetrault" <rstetrault@home.com>

Subject: Re: [R-390] RE: More signal generator questions

I misread your earlier post. Absolutely, it is not normal that the output of the attenuator should decrease with increasing frequency, even though the reference level is met. Within the design bandwidth of the signal generator, such as a URM-25, the attenuator should be flat within 1dB or so. What the reason is is much harder to say. Possibly your scope is the culprit; calibration of the probe against the square-wave calibrator should be checked, it is easy to be off and have significant attenuation at high frequency. Especially, be careful to use a 10X probe with a BW much greater than the signal generator. 1X probes are typically down 3dB by 15MHz at the most. Other than the scope, you've got some diggin to do. What kind of generator is it?

Date: Mon, 23 Apr 2001 18:37:34 -0700 (PDT)
From: John Kolb <jlkolb@cts.com>
Subject: Re: [R-390] RE: More signal generator questions

The way scopes are specified, the published bandwidth is not the highest freq the scope is flat to, but the freq where the display is reduced 3 or 6 db. Thus the 561 will be quite a bit smaller at 10 MHz, even with a flat generator. Nice scope, by the way, as long as you don't need to look at much RF.

Date: Fri, 27 Apr 2001 12:03:43 -0400
From: "Chuck Rippel" <avsl@erols.com>
Subject: [R-390] Re: sensitivity

<snip> What can I help you with on that process? The 10db S/N + N procedure and formula is fairly standard world wide bor both AM and SSB with the exception of the modulation percentage. F'instance, the JIS (Japan Industry Standard) consumer standard is 50% modulation and the R390A spec (Mil Spec at the time) is 30% modulation.

The procedure requires that the receiver AGC re turned OFF and an audio meter connected to either the line or local output. I follow Dallas Lankfords suggestion and use the LINE output. The receiver is connected to the generator, the ANT trimmer peaked then the signal source turned off (my HP as a switch). Then, the VFO is moved about 50khz from the generator output and the audio meter set to a value -10db below 0.

Set the receiver VFO to the generator frequency, enable the output, center the signal in the passband of the receiver and advance the signal output of the generator and advance the generator RF output until the audio meter increases 10db and reads 0.

The number on the generator attenuator represents the level in microvolts for an AM signal to achieve the 10db S/N + N sensitivity figure when the audio meter reading is coincident 0.

This is essentially the method published by Dallas Lankford some years ago and published in Hollow State News. However, I don't rely on the internal audio meter when I actually record the specs of a given receiver. Dallas, as I recall, from old HSN issues, used an external meter when he wanted to offer documented data.

My meter of choice is an HP-400 audio meter. There are several variants and I believe my specific model is an HP-400EL but don't hold me to that number. If anyone wants to know, drop me a note and I'll share the exact model.

If you don't immediately hear from me this weekend, that is because my super-dooper @home cable is still not working. The mail server was down last night and was still down this morning. Hope that helps.

Date: Sat, 30 Jun 2001 01:57:52 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: [R-390] alignment

Alignment is the process of making all of the tuned circuits tune to the proper frequency for operation throughout the tuning range of the radio. Antenna and RF tuned circuits have to resonate at the frequency indicated on the dial, or the gain from tuning will be less than it could be. The oscillator tuned circuit has to resonate at exactly the dial frequency plus or minus the IF frequency, or the signal out of the mixer will be down on the skirts of the antenna and RF resonances. The IF amplifiers all have to be tuned to the IF frequency, or the overall gain will be reduced. And that's just for a tabletop superhet, with a single ganged variable capacitor. An R-390 class receiver is considerably more complicated, but the same principles apply. You have to worry about centering in a pass band instead of just peaking, especially in the IF, because the peak is broad. Then there is the oscillator, on a different shaft that is geared to the mechanical marvel that runs the slug racks. What I'm taking too much space to say is that if you're gonna align any radio, you've got to align all of it. Aligning the PTO so that a frequency counter would track the mechanical counter is a good thing to do. But if you don't align the slug racks, you won't get R-390 performance. The set didn't get its fine image rejection by having RF stages broad enough to tolerate misalignment between oscillator and RF frequencies. And then there's the variable IF ... Sure, things age, and not just the cores. That's why they put the alignment instructions in the manual.

Date: Sat, 6 Oct 2001 20:15:52 -0700
From: "dave faria" <dave_faria@hotmail.com>
Subject: [R-390] Sensitivity Measurement

GE list. I have just finished aligning a 390 non "a". I think there is a technique for measuring sensitivity in microvolts. The radio I just finished aligning required 1.5 microvolts or less to get a peaking signal on my meter. I think its doing pretty good but, am just curious if it meets original specs. Some where I think I read use a 600 ohm resistor across the audio out and input enough RF signal to get 10 volts peak to peak with the audio gain at full. Then cut back the RF gain to 1 volt peak to peak. The RF required to give 1 volt peak to peak was considered the sen. of the radio. Is this correct ???

Date: Sat, 6 Oct 2001 23:22:04 -0700
From: "Bob Tetrault" <rstetrault@home.com>
Subject: RE: [R-390] Sensitivity Measurement

One Volt p-p across 600 Ohms is much stronger than the noise floor, which is what you or anyone else is trying to measure when chasing sensitivity. The idea is to find the signal level that just doubles the meter reading on the output, whether it is across 8 Ohms or 600 Ohms. That signal level is called the minimum discernible signal, or MDS. Then you can increase the signal level until you get 3.16X he meter reading. That signal level equals a signal that is 10dB above the noise.

The 3.16 multiple of the MDS works out to 10dB over the MDS after all the logs are calculated.

The output impedance that the voltage meter is hooked up to is immaterial as long as you remember that you are after ratios: The ratio of minimum discernable signal to 10dB above. The microvolts corresponding to MDS is a valid number as well, since many operators are capable of CW copy at the MDS level.

Date: Sun, 7 Oct 2001 10:04:50 EDT
From: DJED1@aol.com
Subject: Re: [R-390] Sensitivity Measurement

I've used the audio meter to make the measurement- This procedure reflects the commonly used measure of sensitivity which is the microvolts required for a 10 dB signal plus noise to noise ratio with a 4 Kc bandwidth.

Set the receiver to AM reception, manual gain control full up, and 4 Kc bandwidth. At the test frequency, set the signal generator up with AM modulation of 30%. Then turn the generator all the way down. Then set a reference using the noise only of -10 dB on tha audio meter. Increase the generator until the audio meter reads 0 dB, and the microvolts on the signal generator is the 10 dB sensitivity. The receiver is, if I recall, specified at 3 microvolts, but typical numbers for a well- adjusted radio are well under 1/2 microvolt.

Date: Mon, 08 Oct 2001 18:31:28 -0500
From: Dallas Lankford <dallas@bayou.com>
Subject: [R-390] Sensitivity & MDS Measurements

MDS is not the signal level that just doubles the meter reading. Rather, it is the signal level that increases the meter reading by 1.41. According to Rohde, et al. (Communications Receivers, 2nd Ed.), for SSB and CW, the sensitivity for a 10 dB S+N/N ratio is found by increasing the signal level from 0 to whatever signal level causes a meter increase of 3.16 (the increase is not from the MDS) where the receiver is tuned away from the signal so that a 1000 Hz tone is heard (measured by the meter). For AM (again, according to Rohde, et al.), a signal modulated 30% is increased until the difference between modulation on and modulation off (without changing the signal level) is 3.16.

Date: Mon, 8 Oct 2001 17:41:59 -0700
From: "Bob Tetrault" <rstetrault@home.com>
Subject: RE: [R-390] Sensitivity & MDS Measurements

That was a mistake on my part, in the sense that a meter reading doubling was meant to imply a voltage change that would be equivalent to a 3dB change (a doubling), which would be the 1.41 multiple over zero input. It is interesting to note that the measurement error using my imprecise "meter doubling" language relative to what was originally posted would still be substantially reduced. In fact it would be reduced to a value only 3dB worse than the correction noted here, irrespective of equipment variations and calibration errors.

Date: Mon, 08 Oct 2001 20:48:07 -0400
From: Bob Camp <bob@cq.nu>
Subject: Re: [R-390] Sensitivity & MDS Measurements

True if you are looking at the scale that is calibrated in volts rather than in db. I find it a lot easier to use the db scale for this kind of stuff. It makes the math a lot easier.

Date: Mon, 08 Oct 2001 21:15:38 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Sensitivity & MDS Measurements

> MDS is not the signal level that just doubles the meter reading.
> Rather, it is the signal level that increases the meter reading by 1.41.

Is it more than a coincidence that 1.41 (or rather, 1.414) is double 0.707, the factor to convert from peak AC (sinewave) to RMS?

According to Rohde, et al. (Communications Receivers, 2nd Ed.),
> for SSB and CW, the sensitivity for a 10 dB S+N/N ratio is found by
> increasing the signal level from 0 to whatever signal level causes a
> meter increase of 3.16 (the increase is not from the MDS) where the
> receiver is tuned away from the signal so that a 1000 Hz tone is heard
> (measured by the meter).

3.16(23) is the square root of 10 as in the 10 dB, right?

For AM (again, according to Rohde, et al.), a signal modulated 30% is increased until the difference between modulation on and modulation off (without changing the signal level) is 3.16.

Is that the same Rohde as in Rohde & Schwarz, the German electronics manufacturer? Just curious -- about that as well as the numbers..

Date: Mon, 08 Oct 2001 20:35:09 -0500
From: Dallas Lankford <dallas@bayou.com>
Subject: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

I wish it were true, but it isn't. The R-390A AM sensitivity using a 4 kHz BW for a 10 dB signal plus noise to noise ratio tends to be around 1/2 microvolt for an R-390A that is within specifications (= performing correctly). This is what you will get if you have a "checked good" R-390A and follow the standard procedure for measuring sensitivity (the one I described earlier from the classic book, Communications Receivers, by Ulrich Rohde, et al.). If, on the other hand, you follow an incorrect procedure, such as increasing the signal level up by 10 dB from the noise floor, then you will get some outrageously "good" (but nevertheless wrong) sensitivity values, on the order of 0.13 microvolts. And there is even another even more outrageously "good" but also wrong) method, which gives even better values, on the order of 0.075 microvolts. None of this changes the fact that the correct AM sensitivity for an R-390A using a 4 kHz BW and 30% modulation is about 0.5 microvolts.

Date: Mon, 08 Oct 2001 20:44:59 -0500
From: Dallas Lankford <dallas@bayou.com>
Subject: Re: [R-390] Sensitivity & MDS Measurements

> Is it more than a coincidence that 1.41 (or rather, 1.414).............

1.41 is 1.4125375, not 1.414. 1.41 is the inverse LOG of 3/20. It is the voltage form of saying that the power increased by 3 dB, or that the power doubled.

> is double 0.707, the factor to convert from peak AC (sinewave) to RMS?
> According to Rohde, et al. (Communications Receivers, 2nd Ed.),

> > for SSB and CW, the sensitivity for a 10 dB S+N/N ratio is found by
> > increasing the signal level from 0 to whatever signal level causes a
> > meter increase of 3.16 (the increase is not from the MDS) where the
> > receiver is tuned away from the signal so that a 1000 Hz tone is heard
> > (measured by the meter).

> 3.16(23) is the square root of 10 as in the 10 dB, right?

3.16 is 3.1622777 = square root of 10. But that is not the right way to look at it.
It is the inverse LOG of 10/20. <snip>

Date: Tue, 9 Oct 2001 04:45:29 -0700 (PDT)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

All folks have to do is state the basis for their sensitivity measurements to clean the mess up. As you know it is meaningless to say that a rig has a 0.5 uV or a 0.12 uV sensitivity unless accompanied by the basis, such as MDS or 10 dB S+N/N, etc.

Unless this is done, its like asking a runner, "how far can you run in an hour?" and getting an answer like "11.1". Well, 11.1 what? Furlongs? km? The 11.1 may be correct, but really meaningless without the basis.

Date: Tue, 09 Oct 2001 08:27:37 -0400
From: Bob Camp <bob@cq.nu>
Subject: Re: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

Nit picking time ..... I guess the only thing I would argue with is the use of "right" and "wrong" for the various measurements. I think that "standard" and "non-standard" are a bit better terms as far as the measurement techniques. Any of these measurements are fine as long as you qualify them and only compare each to data collected in a similar manner. The method of measure will *always* affect the outcome of the measurement.

I do have a major problem with collecting the data by one method and then comparing it to data collected by another method. This is especially bad when you then come up with statements like "four times better than specification". That comparison is wrong and dead wrong, you can't compare data made by two different techniques that way. The measurements are fine, you just can't compare them to each other.

There was a great article in CQ back in the 1950's about this and I'll see if I can find a copy. Time to put the soap box away again ...

Date: Tue, 09 Oct 2001 08:31:32 -0500
From: Dallas Lankford <dallas@bayou.com>
Subject: Re: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

I have been nit picked. Can I still use "right" and "wrong?"

Date: Tue, 09 Oct 2001 08:39:03 -0500
From: Dallas Lankford <dallas@bayou.com>
Subject: Re: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

These different (wrong) bases for measuring AM sensitivity seem only to have appeared in this group. Elsewhere, the standard for measuring AM sensitivity has remained the same for perhaps 50 years, with the exception of modulation percentage, which was changed by AOR for the 7030 (to 70%) to make its AM sensitivity seem better than it really is. R. Netherlands said they defended the change of modulation depth because of audio compression techniques used by some (many?) MW and SW broadcasters which supposedly increase the effective sensitivity of received signals. However, I have not found that to be the case. The 7030 is insensitive.

Date: Tue, 09 Oct 2001 10:43:22 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

> I have been nit picked. Can I still use "right" and "wrong?"

By all means, just as long as you're not trying to be "politically correct" about it. ;-) I suspect the method that produced the reading that produced the original spec on a properly functioning receiver would be the right way -- as you explained. However, every now and then (every other day) in human history, some wrong way -- or maybe some other way (am I trying to be politically correct? I'll have to get that fixed.) -- anyway the wrong way becomes so popular it becomes another "standard" by virtue of the dynamics of democracy or maybe even "might makes right." Remember "music power" in the days of the escalating Hi-FI wattage wars? It was that vs. the more accurate RMS rating. Can't recall right now, but I think there was a third method that was in between. Anyone remember? Anyhow, on a completely lower mental plane, the "best" number is determined by the Madison Avenue Rule. "The method which yields the highest or lowest number, depending on which sells more, is the best number, right or wrong." It's axiomatic, gentlemen. I do remember that at the height of the Wattage Wars, there were ads for stereo-hifi equipment that showed two or three wattage ratings to keep all the bases covered. Letsee now, if I remember my Music Power formula .... goes something like this -- If you can hear it in the same room, it's 100 watts, the next room -- 250 watts. If you can hear it outside -- megawatts. RMS might be 15 or 20 watts. The 20 watts RMS were per-channel -- the Music Power was caveat emptor. Y'know -- there was a time when nit-picking was a nice thing to do for somebody -- like a major favor. What ever happened to that? <scratch, scratch> ;-) Going very retro, Barry

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Date: Tue, 9 Oct 2001 11:26:40 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

So, perhaps there should be an R390 factor that, when multiplied by our "de-facto" standards, reveals the "real" sensitivity value?

Date: Tue, 9 Oct 2001 12:35:00 -0400
From: Tom Leiper <twleiper@juno.com>
Subject: [R-390] AM Sensitivity Much Less Than 1/2 Microvolt

My system is quite simple. I have never been able to detect a signal on any receiver that I could not also detect with my R-390, although one expensive ricebox had a slight advantage in copying tough signals with fancy notch filters and tunable IF, etc.

But as far as pure sensitivity, and especially sensitivity while maintaining extremely high selectivity, none has ever been better than the R-390 Non-A. So I will score this one at ".25 microvolt" simply because that's what the others claim and I can detect modulated CW signal well below that level as supplied from a URM-25. My SP-600s are almost as sensitive as the non-A, but nowhere near the selectivity. However, throw a CV-157 on it and you have the finest band cruising receiving system ever made. As to the R-390As, they have not been able to match the sensitivity of the non-A in normal conditions, but in certain interference conditions they have had an advantage due to the sharp filter skirt.

So I'll give the SP-600s and A's a half microvolt, and anything else isn't even worth scoring, especially if you fire up a T-368 somewhere in the neighborhood. Which leads to another aspect of sensitivity, namely which band you are talking about (and whether she prefers ribbed or nubby).

Many receivers will reduce or bypass RF amp sections on the lower bands simply because the gain is not necessary, and mixers alone often are enough at VLF bands. So, what you really need to do is measure your R-390A at the middle and both ends of every band (to allow for osc injection variations) and plug all the data into your handy-dandy ACME R-390A super-duper sensitivity plotting software and crank out a chart that shows that you really should have heard that signal, but you must not know how to operate the equipment. In other words, a failure of the "chair to control panel" interface unit.
I like my system better.

Date: Wed, 10 Oct 2001 14:06:14 -0700
From: David Wise <David_Wise@phoenix.com>
Subject: RE: [R-390] Sensitivity & MDS Measurements

> According to Rohde, et al. (Communications Receivers, 2nd Ed.),
> for SSB and CW, the sensitivity for a 10 dB S+N/N ratio is found by
> increasing the signal level from 0 to whatever signal level causes a
meter increase of 3.16

I.e., 10dB. 10dB is a 10x rise in power. Since power is proportional to voltage squared, the corresponding voltage ratio is sqrt(10) or 3.16 .

> ... where the receiver is tuned away from the signal so that a 1000 Hz
tone is heard (measured by the meter).

"Tuned away"? Wouldn't that cause inaccurate readings at narrow receiver bandwidths? Are you sure they didn't mean "where the receiver *BFO* is tuned away from the signal so that a 1000 Hz tone is heard"?

> For AM (again, according to Rohde, et al.), a signal modulated 30% is
increased until the difference between modulation on and modulation off (without changing the signal level) is 3.16.

I have been suspicious of the manual's sensitivity procedure, because if you start at no signal and gradually add carrier (modulated or not), the noise increases a lot. (It increases rapidly at first, then tapers off above a few uV.) This gives IMHO an inflated figure, because at the 10dB point, what you've added is mostly noise. All it has going for it is simplicity. I inadvertently reinvented the Rohde AM procedure about a week ago. I increased carrier until switching the modulation on and off caused a 10dB change. This strikes me as a better figure of merit for voice recovery.

A data point: My R-390A currently gives 0.5uV for the manual's procedure at 4kHz bandwidth, and 1.2uV for the Rohde AM procedure at 4kHz bandwidth.

Date: Wed, 10 Oct 2001 15:40:55 -0700
From: David Wise <David_Wise@phoenix.com>
Subject: RE: [R-390] Sensitivity Measurement

Unless your attenuator is something special, this is probably not 0 signal, and your reading will look better than it really is. I'm using an HP 608D, which has a nice-looking coaxial probe attenuator calibrated in dBm down to about -130 and a Very Shielded oscillator module, and full CCW still puts out a detectable signal.

Of course it does -- this kind of attenuator has a logarithmic response, and you'd have to crank it literally forever to get all the way to 0. I just switch bands instead. I wouldn't be surprised if the same attenuator is used in the 606B. About the URM-25 I couldn't say. Just a data point.

Date: Wed, 10 Oct 2001 19:54:16 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: RE: [R-390] Sensitivity Measurement

>.. I'm using an HP 608D, which has a <snip>

The 608 attenuator is a "waveguide beyond cutoff" type. A pick up loop with 50-ohm source resistance slides in a waveguide which is very small compared to the wavelength of the signal. The result is an output level logarithmic with respect to the linear motion.

>I wouldn't be surprised if the same attenuator is used in the 606B................

The 606 attenuator is a ladder network of fixed resistors. The thing is built in a special casting that implements the ladder, houses the resistors, provides the needed isolation and constitutes the switching mechanism.

>About the URM-25 I couldn't say.

I think that the URM-25 attenuator is like the one in the HP 606 but I'm not sure.. for certain it is not a wave guide beyond cutoff type.

Date: Wed, 10 Oct 2001 19:33:54 -0700
From: "Bob Tetrault" <rstetrault@home.com>
Subject: RE: [R-390] Re: R-390/A FC-7 mod

Just a clarification: I've been lucky enough to have a very sensitive R-390A, fully
FC-7'd, and have never lugged the RF deck out more than once to clean it within an inch of its life. I have no idea what the sensitivity would be if I

reverted to pre-FC-7.

I can conjecture that, given that it was implemented to quell some spurious oscillations in the screen parasitics, that it is quite possible for such oscillations to degrade sensitivity.

Date: Thu, 11 Oct 2001 09:09:50 -0700
From: David Wise <David_Wise@phoenix.com>
Subject: RE: [R-390] Sensitivity Measurement

> The 606 attenuator is a ladder network of fixed resistors. <snip>

Ah-hah! If I had a 606 I'd have known this. I presume that there's also a pot to vary the output within each attenuator step. It had better be shielded like nobody's business. The slightest leak will inflate your sensitivity figure. I still recommend switching bands. Is the ladder network frequency-compensated?

Date: Thu, 11 Oct 2001 12:51:49 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: RE: [R-390] Sensitivity Measurement

(this is all from memory, I may have some details wrong) There is a level control on one stage of the RF amplifier chain. It lets you set the level of the main RF output at which point there is a high level detector. The detector (a 6AL5, I think) feeds the "output level" meter. You set the output level to a calibrated mark and then can vary it downwards from there.

>It had better be shielded like nobody's business.

The control operates the screen voltage on an amplifier tube.. the HP generators are among the best examples of shielding and isolation in existence.

>The slightest leak will inflate your sensitivity figure.
>I still recommend switching bands.

I don't think you get zero output if you turn it all the way down.. yes switching bands, or tuning off frequency is a good thing when you are setting the reference level for sensitivity measurements.

>Is the ladder network frequency-compensated?

No. but it IS made with excruciating attention to detail. Here are some aspects I remember:

- heavy cast aluminum housing machined to close tolerances
- braided rf gasket employed in the cover
- non-inductive resistors specially made for the application
- type BNC or N connectors, with output cable mechanically joined to the housing to reduce leakage
- double shielded coax or even hard line at the output.
- proper attention to the switch elements and shafting
- self shielding switch rotor that forms shielding for the un-used stages of the attenuator

and on and on...

Date: Thu, 11 Oct 2001 20:40:17 -0400
From: Bob Camp <bob@cq.nu>
Subject: Re: [R-390] Several items

Hi,   Remember you asked .... :)

Sensitivity is no different than a lot of things in electronics. There have been numerous ways to measure it over the years and even different things that people think of as sensitivity. Also like a lot of things it gets *very* confusing when non-standard measurements are used. The reason we try to standardize stuff is so that everybody will know what we are talking about without having to read long posts like this one.

The original sensitivity measurements where what we would today call gain measurements. They would crank the volume control up all the way and measure the audio output from the radio. As they cranked up the input signal the audio would go up to the point that they somehow defined as full output. This gave you an input number for full output from the speaker.

After a while tubes got cheaper and their gain went up. You could actually afford to use several in a radio. Once you could do that the day arrived when a radio would produce a lot of noise out with no noise in. At that point the previous measurement of sensitivity stopped making much sense. It didn't stop it from being used, it just stopped it from being very useful.

Even today many people will compare two radios and decide that one is better than the other because it is louder. Unless you have a major hearing problem that's probably not the best way to do it. You can always make a radio louder by hooking up an amplifier either on it's input or it's output. If you do have a hearing problem then there are better ways to address it than just simply turning everything up real loud.

As WWII came along the electronics business grew up a lot. One thing that government contracts taught you was to read and meet specifications. You can see a major change in the way radio ads describe equipment if you grab a radio spec from 1930 and compare it to 1950. Along with all of this came a tendency to specify things the same way the government did. This didn't make it right or wrong, just standard. Of course the government took a dim view of non-standard ..... What they decided they wanted to measure was the ability to copy a signal with the radio. They fiddled around a bit and after some testing pretty much decided that if a cw signal was 10 db above the noise (10:1 signal power to noise power ratio) that it was copyable. It also appeals to an engineer's sense of mathematical correctness to keep things at nice even ratios. After fiddling around a bit most designers found that the old designs with monstrous amounts of audio gain really didn't make much sense. What you wanted was a radio with reasonable gain and good noise figure. This is still pretty much the way we look at it today. The loudest radio isn't the one you want. The one you want is the one with less noise so you can hear the signal.

So far so good, but then they started to notice that radios have other things that go wrong other than just sensitivity. One major thing is overload. The way you reduce overload is to put filtering in front of your gain stages and mixers. That's the way both of the 390's do it. The problem with filtering is that it is lossy. You can not make a narrow filter without it being lossy. The loss in the filter directly takes away from the radio's noise figure. This is all physics and there isn't much of a way around it with normal materials.

What this forces you to do is to trade off sensitivity for overload performance. That's what all the front end coils are doing in your rf deck. They are not there to improve the sensitivity. They are there to improve the overload performance. The radio would be more sensitive if you put a very simple match network between the antenna and the grid of the rf amp. The problem is that the overload performance of the radio would get worse. The overload / sensitivity trade off stuff is why the military radios actually got less sensitive as time went on. They chose to trade sensitivity for overload. In most applications they found that the thermal noise off of their antennas was high enough that sensitivity wasn't helping them much. They did find that with all the RF flying around their sites that overload was (and still is) an major concern.

You can fool yourself with almost any test, but here's one to run on your '390. Disconnect the antenna lead and peak up the antenna trimmer. Notice how high the audio level meter goes when you do this. Now hook a reasonable antenna back up and re-peak the trimmer. I'll bet that the audio level meter is more than a little bit higher than it was before. Generally around here I see at least a 10 db increase when the antenna is connected and the band is open. Often the antenna is > 20 db above the radio noise. What that more or less tells you is that the last 10 db of sensitivity in the radio isn't doing you much good.

The next step is tough to do but can be very impressive if you have an attenuator handy. Wire in the attenuator and set it to 10 db. Next find a nice loud mashy sounding overload product. Once you hear one they are generally pretty easy to recognize. To make it easy you need one that is really getting the carrier meter going. I generally find them in the 5 to 7 MHz region at night. Now crank the attenuator up by another 10 db. If you have a third order overload product it will drop by 30 db. In other words you traded off 30 db of interference for 10 db of sensitivity. If the 10 db sensitivity wasn't helping any then it was hurting your ability to copy at that point by 30 db. That's a pretty big trade off.

This whole overload / sensitivity thing also gets into how the AGC works on your radio. When they designed these radios they spent some time looking at how the overload performance and sensitivity related to each other as the AGC cut in. This is what makes it so tough to substitute tubes in one of these radios. It's awfully easy to mess up the AGC.

Now aren't you glad you asked ..... :)

Date: Fri, 12 Oct 2001 21:37:57 EDT
From: DJED1@aol.com
Subject: Re: [R-390] Sensitivity Measurement

The URM 25 attenuator is not a wavegide below cutoff- it's a resistive power divider. I know that the signal is not detectible on my R-390A when I crank the attenuator all the way down. An alternative is to shift the signal generator off frequency.

Date: Thu, 6 Dec 2001 09:00:32 -0800
From: David Wise <David_Wise@phoenix.com>
Subject: Meter Cal (was RE: [R-390] Re: Baluns)

(Note: I didn't hear you compare below-8 to above-8.)

ISTR that the meter starts moving at around 1uV. If you take that to be 0dB, 100dB would be 1uV * 10**(100/20) or 100mV. You are reading higher than expected. Either the meter is off (and it's normal for it to be off by 5-10dB somewhere on the scale), or your generator is leaking. If it's not a lab-grade unit, it almost certainly is leaking and radiating all over the place. Some generators are also quite sensitive to termination impedance. My Triplett (no accuracy claimed!) expects 75 ohms; its output doubles if it's open-circuit. How are your determining the generator's output? Finally, if the generator output isn't shielded all the way to the antenna connector (balun included), there can be false pickup there too.

Date: Thu, 6 Dec 2001 09:43:06 -0800
From: "Bill Smith" <billsmith@ispwest.com>
Subject: [R-390] Re: Baluns

>From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
>1000uv = 0.001v, not 0.01v, right?

Whoops, yes! Well, then the carrier meter reads 100 at 0.01v (10,000uv) We have more than a few very strong MW AM stations. A friend of mine has a crystal radio which drives an old speaker horn. One of the local stations can be heard anywhere in the room.

Date: Thu, 6 Dec 2001 10:26:37 -0800
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>
Subject: [R-390] Intermod problems.

Your are OK here. Now you should either crank the 100uv down to 4uv. With 30 % audio mod (400 Hz recommended 1000Hz ok) or use an attenuator between the gen. and the receiver it the gen output is not well incremented. set the IF gain to give you -7 volts on the diode load (BFO off). MGC, RF gain max, limiter off, bandwidth to 2Khz. You know like it says in the TM or the Y2K manual or on Chuck's or David's web pages. The audio output should be about 1/2 watt (likely more than 0.5 not less than 0.45) Now you can turn the audio mod on the gen. to get a CW signal. you want a 20 db drop in output on the audio output. Do your own math it you are using an AC meter and 600 ohm resistor to find the change in voltage that should occur.

20db was the shop standard min to push a receiver off the bench
30db is very doable and a goal worth working for.
40db has been done.

I am not saying Dave and Chuck got that on every band on every receiver they ever worked over. But. Mine ain't there yet. I did see them in service. Not everyday. And the difference in signals heard on receivers that have been worked is readily hearable in side by side test between receivers that do 30db on the generator and receivers that do better than 30db on the generator. Read the Y2K and the wed pages. Chuck offers up some procedures to set the -7 volts to a better performance value for actual use.

We just all use the TM procedure as documented and taught in school as the standard test for reference and comparison. If you tell us you set you

receiver up for test IAW and found yada yada, then we can compare it to our life experience
and offer up ideas.

So now you want to get serious about your signal plus noise to noise ratio. This is where you start weeding your internal problems out of your external problems.

Will your generator put out 455Khz for you? Do you have the adapters so you can easily put 150uv of 455Khz into the IF mini BNC jack (Where the RF is cabled to it)? Receivers had a short IF output cable and adapter to BNC on the back panel. Shop practice was to move the output cable to the input jack and feed the IF deck from the generator that way. If you do not have the parts on your receiver, Murphy has an alternate cable for a $1.00.

You are looking to inject 150uv into the IF deck and get 30db signal to noise in that section of the receiver. If you can not get the IF and audio to make this test, you will never get 20db from the antenna to audio output.

By adjusting the generator to pass the 455 through the .1Khz bandwidth 455Khz crystal in the IF deck you can get the generator close enough for government work. You can also zero the BFO against that generator setting and have a BFO close enough for government work.

The extra conversion stage below 8Mhz is a common place to have problems. Either weak signals or extra noise.

Your best 6C4 and 5749 for that stage is worth it if your interest is under 8Mhz.

This is where you discover that there are things in tubes not checked by the tester and that are important.

Bill, Over time the R390 owner operators have recorded a lot of good knowledge that has come across this reflector. The Sysop has done an outstanding job of getting that knowledge into the archives where you can read it. A bunch more of the fellows put the Y2K manual together and share it with us all.

Go get the archives and the Y2K manual and read them. paging through all the header stuff is boring, but the gems in there make it worth your time. On the back side of that life experience will be a fellow who knows a lot more about an R390 receiver and is ready to get a lot more enjoyment from the awesome possession and R390 is.

Ain't nothing I have had or seen that returns more to me day after day than my receiver. Best toy I have ever had.

Date: Thu, 6 Dec 2001 15:15:59 -0800
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>
Subject: [R-390] Warning Modern Math is use here. Not suitable for all viewers.

>I'm not sure what you mean by a 20db drop by turning the audio mod on the >gen. to get a CW signal. Perhaps it is in the book."Bill Smith" <billsmith@ispwest.com>
....
Bill, if you had an AN/URM25 signal generator on your bench it would offer you CW, 400, 1000, and Ext modulation. as output options.

The AN/URM25 has flavors from none to H. More than the R390 and R390/A pair.

CW is flat no modulation RF
400 is AM modulation with a 400Hz tone
1000 is AM modulation with a 1000Hz tone

External modulation lets you inject an audio generator and provide a AM modulation at any audio frequency you may want. You can vary the modulation level from 0 to 100%. 30% is called out in the original TM's for the R390 & A. You can plug a microphone into a AN/URM25 and have a nice 0.2 watt AM transmitter anywhere between 300Khz and 50Mhz.

With a CW (flat RF out of signal generator) signal into the receiver, the audio output should be a nice low level noise (20db in power below what ever a 1/2 watt of power is) The CW signal excites and converts all the stages between the antenna and the output. What ever this level is the noise level. Now turn the signal generator modulation on. The receiver output should be 1/2 watt. this is the signal output level or the receiver. Or signal plus noise level because the noise is still there. The two measurements give the noise to signal plus noise ratio. Or the signal to noise ratio. Its really the difference in power (db) between the two readings.

Now this whole thing is dependent on what frequency you use.
The IF bandwidth you use.
The signal generator power setting used.
The percentage of modulation used.
The modulation frequency used.

So by convention there is the standard TM setup that nails all these variables down to what was a military go, no go test for the receivers. You did the test just like it said (not real clearly) in the TM. You looked at the output meter. you flipped the switch on the signal generator. The output meter reading dropped more than 20db and you were done. Or your receiver was still failing and you had work to do. The test was conducted at 2 alignment points on each RF band. 0.5-1, 1-2, 3-4, 5-8, 9-16, 17-32. It took us 4 (or more) hours to do this to a receiver. Every receiver go this twice a year. It was also allocated 1 hour per month for monthly.

You worked 6 days on two days off (trick) 46.65 tricks a year 365 /8 you had 4 tricks day, swing, mid and off 273.75 days
30 days of leave
243 days to work 8 hour day
1950 hours per year
18 hours per receiver per year 10 months and 2 semi
1 33B20 (Receiver Repairman) or 31E20 could service 108 receivers a year for a full time job. 1950 / 18 = 108

If my trick at Torri Station Okinawa had 15 Receiver Repairmen and 14 Teletype Repairmen, how many R390/A could have been at Torii Station and receiving proper service? About every 4380 operating hours you need to put about 8 hours into your receiver for maintenance. It will not need tubes that often, but about every 4000 to 5000 hours of on time you need to check.

Back to this signal-to-noise.

You just can not get more than about 0.9 watt out of the audio. 0.5 is the expected value. So if your going to improve the signal to noise difference. You have to get less noise and better sensitivity. You get less noise by creatively selecting for quite tubes. So cap changing may get less noise (for your life time a one time gain) To get better sensitivity better alignment.

This will get you up to military standard and better.

4uv or less of RF with 30% modulation into the antenna should get you a 1/2 watt of audio out as signal plus noise.

Turn the CW off and the output drops. Like the AM station goes to dead air (no modulation) as opposed to the AM station falls off the air (lost carrier). This difference between a 1/2 watt of audio and no audio (noise) should be at least 20db of audio power.

Minimum detectable signal. How low can you go. How far under 4uv can you go and still get 1/2 watt of audio power out? Sensitivity When you turn the modulation off at that signal level, how far down under the 1/2 watt level did the output of the receiver fall to? Signal plus noise to Noise Number.

When your receiver has a fair set of tubes and a good alignment you will expect 4 uv sensitivity and 20db differnce between signal and signal plus noise.

Now hook up your antenna. How much junk signal gets in the antenna, through the RF, through the IF and into the AGC detector and carrier level meter?

How much good signal gets out of the audio into your ear?

Antenna
How do you best intercept the signal and get it transferred into the receiver while rejecting as much of the unwanted signals present that if not rejected, filtered off, or balanced out will become inter modulation products in your ear?

Subject: Re: [R-390] R390A / R390 help
From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com>
Date: Thu, 24 Jan 2002 09:50:14 -0800

>Hello Everyone, I have a question, how does the R390 and R390A compare as to >sensitivity? 73's
....
From 68 through 75 I took care of many thousands of R390/a and a few R390 all around the Pacific Rim. I have found either species of receiver to be about equally insensitive to GI's, Sailors, Marines and Airedales. When falling on fingers and feet I have never know a receiver to apologize for the clumsy act. The receivers are prone to popping a tube filament open at the most inopportune time without a care as to how it impacts our plans. The receivers will split a gear clamp or strip a spline screw at the thought of a maintenance procedure These receivers can be as insensitive as any other living pet. I think the 47 Ohm resistors in the R390 power supply circuit can treat you with even more contempt than any cat I have known. Textbook-wise the receivers are equal in receiver sensitivity. Having cared for and watched op's use them for years of military service the two are so close you can not tell them apart. An R390 and an R390/A set up side by side in rack and coupled to some of the best antenna the military could build yields equal number of signals. One is not more hard or hearing than the other. The mechanical filters in the R390/A ring. The stock R390 sounds a little better on AM than the R390/A The two stage R390 RF does not produce any better response in the head phones than the single 6DC6 in the R390/A RF amp. Ethiopia, Turkey, Berlin got the first R390's. The R390/A went to Viet Nam, Okinawa, Japan, Korea. I had R390's in

Korea with 28 Volt DC power supplies that were run off the 28 Volt truck generators. We had gas engines and heavy duty generators in the 2 1/2 ton trucks. The trucks had cargo boxes (vans) mounted on them and filled with radio's. You could run the radio's off the truck generators (batteries). We also had smaller engine generators that used a lot less gas and were much quieter than the truck engines. These things were mostly in retirement by 1971 in Korea. But hey there was a war on over there and had been since the early 50's so we were ready to go to the field. Worry not if its a R390 or R390/A, you do not have enough of them either way. Keep what you can get.

Date: Sun, 03 Mar 2002 21:16:02 -0500
From: Chris <r390ch@bellsouth.net>
To: r-390@mailman.qth.net
Subject: [R-390] R390 receive and frequency readout alignment question

At the moment I have my radio tuned to 4965 khz here. It's actually reading 4967. What I want to know is exactly how I can readjust this reading to become accurate above each 500 khz part of the bands. It seems that after 500 khz (not just 500 khz on mw band) and up is tuned it is off by almost 2 or 3 khz. I don't have a problem with recieving signals all that much as I was hearing Radio Angola on 4950 clear as a bell tonight.

Date: Sun, 3 Mar 2002 18:41:53 -0800 (PST)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: R390 receive and frequency readout alignment question

Chris, A couple of things. . . . Sounds like your PTO may have the classic long error, i.e. it may require more than 10 turns to put out its spec 1000 kcs. If this is the case your PTO needs this simple endpoint adjustment. Refer to an online manual (same for the 390A). For any given calibration point, even with the error you described you can recalibrate at the nearest 100 kcs point by doing this.

1) place the dial at an even 100 kcs calibration point (like 5000 in your case).
2) turn BFO to ON
3) crank your zero set knob all the way in
4) turn calibrator to ON
5) rotate the dial until you hear a zero beat.
6) Then CAL OFF, BFO OFF, zero set cranked back out.

Now you should be calibrated for 5000 and nearby freqs, even if your PTO is long on the endpoint adjustment. The error you described is very common with PTO aging. It is actually present at lower freqs, it just

appears to be worse at higher freqs if you calibrate at a low freq. If you calibrate at 5000, it will be worse at a low freq. It can be corrected easily with the endpoint adjustment in the manual.

From: "Jim Temple" <jetemp@insightbb.com>
Date: Thu, 7 Mar 2002 15:09:07 -0500
Subject: [R-390] Alignment help.

I have owned a "massacre" R-390A since the end of Dec '01. Since that time I have spent many, many hours in cleaning, recapping, and generally solving one problem that reveals another problem. The solved problems generally relate to cleaning out the intrusive dirt and grime from the storage. Many problems have been solved by reworking grounds and intermittent contacts, as well as a few noisy caps and resistors. I am at the point where only the alignment remains, I think. What I am experiencing is this:

1. The equipment I have is a good freq counter, VTVM, and Heathkit signal generator. All work fine, except that as the alignment progresses, the radio becomes so sensitive at the higher bands, that the signal generator will not attenuate enough to keep the diode load at approx 7-8 volts. At this point I have been reducing the radio RF gain to reduce the voltage present at the diode load point. This works fine, except that the higher bands are ALIGNED WITH THE RADIO RF GAIN REDUCED to about 1:00 position. Now, after alignment, with the RF GAIN CONTROL UP FULL, the lower bands work fine and the antenna peak control is fine. However, the higher bands seem to overload and oscillate with a screeching or motorboat putting sound. When detuning the antenna peak control the overload seems to reduce somewhat, but with rotation of the antenna peak control, there is much popping and static.

2. I am getting the impression that the alignment must be performed with the RF gain control up full, and the signal generator attenuated enough to present a diode load voltage of about 7 volts or so. If peaked with the radio RF gain reduced, my impression is that, after peaking, a normal RF gain position will introduce overload at the bands that were aligned with the RF gain reduced.

SO NOW MY QUESTION.......... Does the overload, screeching, and motorboat putt sounds seem to be a true alignment problem (obtaining an attenuator), or is there a remaining component problem that is preventing a good alignment???

Thanks for your past advice, and am looking forward to completing the restoration of this great radio.

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Alignment help.
Date: Thu, 7 Mar 2002 14:14:32 -0600

Are you aligning the IF deck along with the RF deck?
Sounds like the IF gain is too high.

From: "Jim Temple" <jetemp@insightbb.com>
To: <r-390@mailman.qth.net>
Subject: Re: [R-390] Alignment help.
Date: Thu, 7 Mar 2002 15:34:52 -0500

Yes, the IF deck aligned like clockwork.......filters, agc, and stagger tuned. Very straight forward. Of course, the signal is injected directly into the IF deck. My confusion is whether or not the sensitivity will be affected. so radically, with the position of the RF gain control during RF alignment. After the IF deck alignment, I can only approximate the 150uF input to obtain the baseline 7volts diode load. Perhaps this is a critical baseline to set before the RF alignment? I have been setting the IF gain control about 1/8 to 1/4 turn clockwise from full. Would this affect the final sensitivity so radically?

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Alignment help.
Date: Thu, 7 Mar 2002 14:39:55 -0600

Not sure, but that setting sounds a bit high for the IF gain pot. You might want check Chuck Rippel's site for a procedure for setting the IF gain. I don't have as much experience with this as others on the list, but it does sound like an IF gain problem (which is what I was referring to when I said IF alignment -- I was including setting the gain as part of the procedure).

Date: Thu, 07 Mar 2002 14:37:10 -0700
From: Jordan Arndt <jordana@nucleus.com>
Subject: Re: [R-390] Alignment help.

The method I use to set the IF gain is by listening to white noise, and using the line level meter with the line terminated with a 610 ohm resistor... all I do is adjust the IF gain control to a point just before the carrier level meter 'takes off '...try it and you'll see what I mean... Motorboating sounds more like a capacitor problem than anything else, and it could perhaps be due to the failure or leakage of the 2uF cap on the IF deck.. does this occur on all settings of the AGC switch..?

From: "Walter Wilson" <wewilson@knology.net>

Subject: Re: [R-390] Alignment help.
Date: Thu, 7 Mar 2002 17:11:34 -0500

An AGC problem was my first thought as well. With a strong signal output from your signal generator, how many volts do you get on the AGC terminal (back panel) to ground? I'd expect about 9 volts or more (voltage will be negative). An easy way to check the 2uF AGC capacitor is to first inject a constant signal with AGC on fast, and note the carrier level. Move the AGC switch to med and slow, and note any change in the carrier level. If the carrier level indication drops in the slow position, your 2uF cap is leaking a bit. You'd probably also notice this as a change in the AGC voltage as measured at the back panel.

From: "Ed Zeranski" <ezeran@concentric.net>
Subject: Re: [R-390] Alignment help.
Date: Thu, 7 Mar 2002 20:36:49 -0800

>Does the overload, screeching, and motorboat putt sounds seem to be a true
>alignment problem (obtaining an attenuator), or is there a remaining
>component problem that is preventing a good alignment???

I aligned MANY R390 and R390A radios at the Long Beach Naval Ship Yard, shop 67, back in the late '60s and what you state was not normal.....nor has it been on any sets I've workrd as a hobby since. Sumtin' be busted!!

From: "Bill Smith" <billsmith@ispwest.com>
Date: Thu, 7 Mar 2002 22:47:58 -0800
Subject: [R-390] Receiver Overload?

I wonder what experts think... I experience RF overload on the BCST band. I think I mentioned same when I first obtained the receiver. After detecting leakage from E207 on several bands (measured high resistance to ground when it should have measured open), I replaced mica capacitors in Z202 and others and the problem seemed to go away. But now it is back. Symptoms are (1) intermod on BCST band.

I wish to listen to a Los Angeles station from the SFO Bay Area, but with the antenna hooked directly through a small balun to the balanced input, the station is obliterated. If I feed the antenna through a lossy antenna tuner and balun, signal is heard fine.

Local stations will pin the Carrier Level meter. Not hard, but meter will extend beyond 100. I have measured many resistors in the RF section by testing between the B+ and tube pins, all seem close to values listed in the schematic. Same with screen and cathode resistors. I get 9-10 volts from the agc terminals with strong signals, so there is apparently plenty of AGC voltage.

I attached a RF choke to the tip of the VTVM DC probe and verified the same AGC voltage is present at E206 and E207. Does this sound normal, particularly the 100+ reading from the Carrier Level meter? Otherwise, all seems normal (I have removed the IF module and verified all seems well in that section). Any suggestions are most welcome. I will next attach a strong signal generator to the unit and get better measurements.

From: "AI2Q Alex" <ai2q@adelphia.net>
Subject: RE: [R-390] Alignment help.
Date: Fri, 8 Mar 2002 10:26:42 -0500

My thoughts as well. I've never seen an unstable R-390A due to misalignment. I worked on many of these sets when I was a 31E20 Spec.-5 Field Radio Repairman in Unc Sam's Signal Corps during the mid-1960s.

Date: Fri, 08 Mar 2002 11:38:23 -0500
From: James Miller <JamesMiller20@worldnet.att.net>
Subject: Re: [R-390] Receiver Overload?

This happened to mine once when I had inadvertently contaminated the insulated gear shaft on the antenna trimmer control. The antenna trim capacitor (inside the can) rides on the AGC line at the first RF amplifier. If the capacitor has contaminants on it (such as from the wrong kind of spray or moisture) or if oils or cleaner spray has gotten absorbed by the insulated gear shaft at the top of the radio, then it will drag the AGC down (at the RF amp).

This could be your problem. You should never lubricate the antenna trim geating or the insulated shaft. If it has gotten oil on it, a good non conductive oil/moisture displacement spray will be needed (Like "Big Bath"). Even using the wrong kind of contact cleaner spray or Deoxit to clean inside the trimmer can has caused weird things on mine (with th AGC). It is a very high impedance circuit so it doesnt take much.

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Receiver Overload?
Date: Fri, 8 Mar 2002 13:06:57 -0800

> Bill it still sounds like you are fighting a AGC problem.

I wonder. I can turn the RF gain down, and recently adjusted the IF gain control. The intermod doesn't seem to be related strongly to either. In other words, the intermod is still there even if the RF gain is turned all the way down, and the IF gain didn't make all that much difference, though at higher levels the intermod worsened. I am listening around 1070 khz. I don't know yet if the problem is aggravated around that frequency, but I suspect it is. By the way, I tried tuning at 1070 and also +0.070 (or close) and experience the same problem, so it doesn't seem to be a problem with the 1MHz RF position.

> I would do 2 things first take a look at the 2 mf cap which is the big one on the IF >deck and then make sure there is nothing wrong with the antenna trim on the RF >deck that will cause havoc with the AGC .

The 2 mf cap was replaced with a polyester mylar some time ago. The original caps were both leaky. I was able to open the case of one of the caps and fit the new 2mfd inside.

> That antenna trim has a lot to do with the AGC circuit and that will cause your signals coming in to over load. I have serviced and refurbished many R 390a and I am currently working on 67 EAC unit as we speak. It would be nice if you had spare decks that way you could isolate the problem quickly .

>Let me know and the group know if you find the problem.

Not so far. I inspected the fibre shaft, but it didn't look contaminated, and the section where it fits through the chassis was clean. The insulating washer against the chassis looked ok also. I then used a VTVM to measure the resistance of the AVC circuit. Couldn't find any leakage whatsoever (tested using a 100MOhm indication). Also rechecked the IF module but found nothing wrong. Thanks for the suggestions!

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Fw: [R-390] Receiver Overload?
Date: Fri, 8 Mar 2002 13:48:03 -0800

The AVC voltage at the RF trimmer cap shaft is exactly the same as pin 4 on the back panel. (Listening to a local AM station, AVC voltage was -7.5 volts in both cases.)   Carrier meter reading is 90. By the way, I think a question arose regarding antenna connections.

I am presently feeding the antenna into the balanced input through a small home-made torroid balun. I tried the unbalanced input, but aside from a slight signal loss, the signal (and noise) is the same. Intermod improves if I only hook up one of the two wires from the balun to the balanced input, but then that can be explained by the attenuation of the input.

Date: Fri, 08 Mar 2002 18:03:49 -0700
From: Jordan <jordana@nucleus.com>
Subject: Re: [R-390] Receiver Overload?

Me thinks you have a problem with the Balanced antenna input transformer... Grease, dirt, a cold solder joint... or something in the capacitor... I've had that happen before... try the "C" input and see if it is still present... the transformers are very easy to remove if you need to check the guts...

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Receiver Overload?
Date: Fri, 8 Mar 2002 19:54:50 -0800

Yes, AB6MT :-) I do have a 160 meter dipole antenna, and this has always been a good radio location. It might also be interesting to hook up the spectrum analyzer in Communications Monitor to the antenna and see if I can determine just how much energy is out there, and where. But that doesn't (yet) explain the receiver's operation. Think the next step is to hook up a 'scope and a signal generator and see what I can reproduce.

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Receiver Overload?
Date: Fri, 8 Mar 2002 23:31:57 -0800

Good question, James. I get about 30 on the Carrier Meter, but apparently lower on the lower bands. I will have to check the calibrator - it is underneath, so I haven't done much with it. I recall tweaking it, perhaps I had better look at it more carefully. I had dismissed it because it looks like it is coupled to the receiver with only a 2pf capacitor. But I suppose even a component of that sort can go bad. Possibly there is something strange going on with the multivibrator circuit too. At any rate, can't do it tonight, will have to tackle it in the future.

I agree the receiver is operating as if one tube is running wide open. But I have checked the tubes in the RF section - I used an RF choke in series with the VTVM DC probe to look at AGC voltages at the 1st and 2nd RF stages. All is well, and looked at the AVC voltage on the antenna trimmer; good there also. I have checked through the IF circuitry and can't find anything to complain about there, either.

I would think, though, that if the problem was AVC, that backing down the RF control would improve the overload/intermod (don't know yet which it is). But backing down the RF control, while reducing the sensitivity of the receiver, does not affect the noise. Interesting, though, switching the

Function switch to CAL does reduce the noise and allows the station to be heard. Of course that is likely because the input relay has disconnected the antenna when the Function switch is in the CAL position.

By the way, there is still signal leakage through relay K101 when it is activated by switching the Function switch to CAL. Pulling the unbalanced input (although nothing is connected to it) reduces the signal as shown on the Carrier meter, but does not silence the receiver. Pulling either one of the balanced antenna BNC connectors (J110 or J111) does remove the signal. Will have to look into that also, although that could simply be a factor of a ground loop between the back panel and the balancing capacitors in T201, T202, ect. (Gads, those caps are a bad idea!)

Anyway, thanks for the suggestion, and will keep looking. Might be interesting to pull the BNC out of the calibrator and see what happens.

<from the Web site on Radio Netherlands re SINPO>

As soon as reception reports started flowing into radio stations, some kind of internationally recognised codes were introduced. These were needed not only to standardise report writing, but to be able to compare one report with another. The first, and most popular was the SINPO code, in which each letter stands for a specific item, and each is rated from 1 to 5. Full details are given below.

S-Signal	I-Interference	N- Natural Noise	P-Propagation Conditions	Overall merit
5-Excellent	5-None	5-None	5-Excellent	5-Excellent
4-Good	4-Slight	4-Slight	4-Slight disturbance	4-Good
3-Fair	3-Moderate	3-Moderate	3-Moderately disturbed	3-Fair
2-Poor	2-Severe	2-Severe	2-Severe disturbance	2-Poor
1-Barely Audible	1-Extremely strong	1-Extremely strong	1-very poor	1-useless

Whilst the above may look impressive as well as concise, it will soon become evident that the SINPO code is very subjective. Somebody may rate a signal as 33232 whilst someone else might rate it as 44333. Likewise, although the original SINPO code did lay down technical specifications for each number (i.e. a number 3 in the P column meant a fixed number of fades per minute) these are hardly ever adhered to by reporters. Nor is it advisable to use the so called 'Signal Strength' meter to judge signal strength. No 'S' meter on a communications receiver under US $600 in price is anything more than a tuning indicator. The 'S' meter reading is usually dependent on the setting of the RF gain control, so use your ears, not the needle, to judge signal strength. You may also find references to the "SINFO" code in some literature. In this case the 'F' stands for Fading, instead of 'P' for Propagation, but the two codes are essentially the same.

It is also clear that many listeners cannot distinguish between the 'I' which stands for man-made interference, the 'N' which stands for natural atmospheric noise, sent to me that used SINPO rather than SIO. FAR more in fact than stations that used SIO. AND my very "professional" logging program (DXtreme Reception Log 2002) uses SINPO and it won't let you enter a logging without at least something in those 5 blocks (defaults to all 5's). Then, when you print a reception report in the appropriate language of the station it inserts that SINPO into the report along with an explanation. But of course for it to mean anything you have to carefully analyze it and say, "now was that interference actually QRM or QRN" etc and rate the respective blocks (I & N) appropriately. It actually gives MORE information than SIO, especially if you also include a written description of interference, fading etc. And the only block that I let the "S" meter (on an R-390 the carrier level meter) influence is the "S" (Signal) letter.
and the rating for 'Propagation' is not often understood. There are some books and periodicals that maintain the SINPO code as being the only one for DX reporters. However, from a station's point of view we suggest the following, simpler, code which is used by most professional monitoring stations around the world.

The SIO Code

S-Signal Strength	I- Interference (of any type)	O-Overall merit
5-Excellent	5-No interference	5-Excellent
4-Good	4-Nil or very slight	4-Good
3-Fair	3-Moderate	3-Fair
2-Poor	2-Heavy	2-Poor
1-Useless	1-Extreme	1-Unusable!

You can see that the SIO code is based on the SINPO code, but in a simpler form. The use of the SIO code, as opposed to the SINPO code, does not give the station the impression that you are an inferior reporter.

The Backward Secret to the SIO code!

Most books that cover the subject of reception report writing have a very simple method of evaluating a signal. First, they say, judge the signal strength, then look at the level of interference. Finally, fill in the 'O' column by taking the average of the two numbers, and rounding down to the nearest whole number. So if the 'S' was 3, and the 'I' was 4, the 'O' rating would automatically be '3'. This is very misleading! Instead, you should work backwards. First evaluate the overall rating of the signal Is it 'listenable' or difficult to hear? Give it either 1, 2, 3, 4 or 5. Now examine the reasons for your 'O' rating. The signal may be weak (i.e. a 2) but if there is no interference on the signal, you simply have to turn up the volume control to enjoy the programme. Thus an SIO rating of 244 is not impossible. Likewise a signal of 442 is possible. This might occur if the signal was strong, there was no interference, but the audio being broadcast was heavily distorted due to a fault in the transmitter. Listen around on the bands, and you will find a wide variation in the audio quality being broadcast. Being critical may alert a station to a problem. It is often very difficult to judge when measurements are made at the transmitter site.

If you give an 'Interference' rating of either 1, 2 or 3 in your report, then you should explain why (as our example does in the "Technical Remarks' column). If there is interference on the received signal, note the following details:

a.Is the interference signal of the same frequency (so-called co-channel?). If it is, then as you move the tuning knob, the signal you want, and the interfering signal, will be tuned out together. If, however, the interference get stronger as you tune either up or down the band, the interference is probably coming from an adjacent frequency. It helps to indicate whether the interference is coming from a station on a higher or lower frequency than the one you are interested in. For example, if you are listening on 9895 kHz and a station on 9890 kHz is causing interference, the interference is from a station which is lower in frequency. In the interference station is a jamming signal (a buzzing sound designed to deliberately interfere with an international broadcaster) when this should be noted too. Fortunately, jamming levels on shortwave

have dropped considerably in the last few years, except in Asia and the Middle
East.

b.Local weather conditions do not generally affect shortwave broadcasts, with
the exception of local thunder storms in your area. These may cause loud
'crashes' which spoil reception. If this affects your 'I' (Interference) rating, then
note elsewhere that this was due to local thunderstorms.

<end of Radio Netherlands explanation>

From: "Phil Atchley" <k06bb@elite.net>
Subject: Re: [R-390] S-Meter?
Date: Tue, 29 Jul 2003 19:47:16 -0000

Yes, I found that to be rather simplistic myself. I've actually had some relatively inexpensive receivers whose "S" meters were calibrated better than some of the more expensive ones. NOT all, but some such as some of the mid range Hammarlund sets etc. I guess that meters that "glow in the dark" don't count as "S" meters but are only good for tuning for maximum signal !) AND, not to beleaguer the point too much or venture too far OT (of R-390s), I found their mention of using "SINPO" as indicating you're an "inferior reporter" rather obnoxious. I've been using it for nearly 50 years (over 45 anyway) AND I have had a lot of "blank report forms" that were printed by the stations themselves

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Date: Sun, 10 Mar 2002 09:25:34 -0500
From: Bill Cotter <bcotter@pop.uky.edu>
Subject: [R-390] LONG: Alignment, Overload and Distortion

I read with interest the problems you have been dealing with, and they seem to be one of the tougher R-390A repair issues. I have been struggling with a very similar, and possibly related set of problems. I have an EAC that behaves in the most peculiar way and has given me fits in trying to correct the problem. This receiver is a '67 EAC sn#3669, and has been recapped, rebuilt and aligned.
Here's what's going on:

Pick a strong station on any band, say 17mHz (problem occurs on all bands). Tuning into the station and the carrier level is around 90-100dB. With the RF gain at 10 and the AVC on, filters in the 8kHz position the station sounds fine as long as there is no selective fading. When fading occurs and the signal dips down to say 70-80dB, distortion begins. When the level falls to 30-40dB, severe distortion appears until the signal rises above 70dB or more. Tune in a weak station around zero to 10dB and it is fine until it gets stronger, upwards of 30-40dB.

Ok, figure it's the AVC, right?

Go to MVC, and tune back in on the strong station. Now the signal jumps way up and I need to drop off the AF gain dramatically. With the RF gain full open, the signal is fine until fading occurs, signal level drops, and the distortion creeps in once more. While looking for that RF Gain sweet spot, I notice that as I advance the RFG from say 5 towards 10, an odd thing occurs. The volume through the speaker increases as I approach 10. Right around 8 the volume
suddenly drops 20db or so (gain-compression??), and distortion begins. Increasing the control further the volume increases along with the distortion. The distortion is worse when the carrier meter is in the 10-30dB range.

Now, I haul it up on the bench.

TEST 1 - IF Chain and AVC

Connect the HP-8640B to the IF deck J-518, HP-427C HiZ VM to the AVC line, Fluke DMM to the RF gain line, and a HP-332A Distortion analyzer to the Diode Load line. Dial in 455kHz +/- to peak with the filter at 100Hz, return selectivity to 8kHz, and 30% modulation at 1,000Hz. Controls AGC Fast, RFG wide open, and the following results (all AC Vrms):

AVC ON

Vinput	Vdload	Vavc	Distortion
10uV	0.75v	-0.6v	18.0%
100uV	1.00v	-3.5v	12.5%
1mV	1.5v	-8.4v	13.0%
10mV	2.0v	-14.9v	13.5%
100mV	2.75v	-20.6v	14%
1V	3.5	-27.0	14%

All looks fine from the AVC operational point of view.

Now to test the influence of RF Bias on the IF-AVC system, in the MVC mode. The RFG control is set at different positions and RF bias is measured at the RFG point on the rear panel. Two different input levels (100uV and 1000uV) are tested. The results:

AVC OFF - MVC

Vinput	Vdload	Vrfbias	Distortion
100uV	10.0v	1.0v	14.0%
100uV	6.0v	2.0v	14.5%
100uV	3.8v	3.0v	14.0%
100uV	2.5v	4.0v	15.0%
100uV	1.9v	5.0v	14.0%
100uV	1.5v	6.0v	14.0%
100uV	1.1v	7.0v	14.5%

AVC OFF - MVC

Vinput	Vdload	Vrfbias	Distortion
1000uV	16.5v	4.0v	35.0%
1000uV	17.0v	5.0v	22.0%
1000uV	14.5v	6.0v	18.0%
1000uV	12.0v	7.0v	16.0%
1000uV	9.5v	8.0v	15.0%
1000uV	6.0v	10.0v	14.5%

Conclusion, the IF deck seems to be operating fine below 1000uV input at 6vdc and higher bias. However, as the bias decreases (RF gain control advanced towards 10) the distortion increases. Only if the input was held below 1000uV, will the IF deck function normally. This 'sweet spot' would be found by increasing the generator level with the RFG wide open until the distortion sharply rises above the 14% average.

Does anyone know offhand the signal level upper-limit entering the IF deck??

TEST 2 - Overall receiver test

Connect the HP-8640B to the antenna C-connector, HP-427C HiZ VM to the AVC line, Fluke DMM to the RF gain line, and a HP-332A Distortion analyzer to the Diode Load line. Dial in 17.5mHz, and 30% modulation at 1,000Hz. Controls AGC Fast, RFG wide open, and the following results (all AC Vrms):

AVC ON

Vinput	Vavc	Dist'n	Meter
1uV	-2.2v	12.0%	15
3uV	-3.3v	5.5%	22
10uV	-4.5v	4.0%	35
30uV	-5.7v	3.5%	42

100uV	-6.8v	4.0%		52
300uV	-7.6v	4.0%		60
1mV	-8.4v	4.5%		70
3mV	-9.2v	4.5%		78
10mV	-9.8v	6.2%		80
16mV	-10.5v	25.0%	81	
30mV	-10.6v	45.0%	82	
40mV	-10.7v	35.0%	85	
50mV	-10.8v	40.0%	89	
66mV	-11.2v	22.0%	88	
100mV	-11.6v	8.5%		90
300mV	-14.9v	14.0%	100+	
500mV	-17.9v	**%	100+	
800mV	-21.3v	9.0%		100+
1V	-23.0v	10%		100+

As you can immediately see from the results above there is a spot in the input-range where the distortion rises dramatically, then falls off. The AGC action and the carrier meter both follow the received signal flawlessly through out the range.

....

I have done all the usual first steps: tighten connectors, DeOxit sockets, swapped tubes with known good tubes, etc. I also swapped in a second identical EAC IF deck and had the same listening results. What I am wondering about now is the possibility of parasitics in the RF AMP, or a breakdown of a component (ie: mica cap, etc). Any suggestions would be appreciated. All results will be posted for the benefit of the group.

From: "Peter Cade" <butrosg@bellatlantic.net>
Subject: Re: [R-390] Receiver Overload?
Date: Sun, 10 Mar 2002 15:16:33 -0500

I am ignorant of many of the differences between the 390 and the 390A, so if this is a well known fact, duh..sorry to waste your time........... My 390A measures about 1.5 meg from the antenna trimmer shaft to ground, with the IF module unplugged (P112). A quick look at the schematic shows that there's a 1.5 meg resistor (R234) connected between the trimmer rotor and ground. The rotor also goes to the AGC line via a 270K resistor (R201). With P112 plugged in, the resistance at the rotor drops to about 470K. I have grease and stuff on the helical trimmer gears, and don't seem to have any problems with AGC weirdness.

From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] LONG: Alignment, Overload and Distortion
Date: Sun, 10 Mar 2002 15:41:02 -0600

Hope you are getting some good suggestions, but in case we're all waiting for someone else to step in, I'll make a basic suggestion:

Have you set the IF Gain pot on the IF Amp Assy? The Navy manual says to change the RF cabling so that the IF Out jack is connected to IF In on the IF Amp. Supply 150 microvolts at 455 KC, 30% mod to the external IF Out jack. Set Function to MGC and RF Gain to 10. Adjust IF Gain for -7 VDC at the Diode Load terminal, not the AGC voltage. See the Manual for further details.

Since the RF Deck has only one stage of gain (the other tubes are oscillators and mixers) it seems unlikely that the IF Amp would see as much as 10 millivolts input, but I don't know the design input range. Perhaps the Technical Report has it. Usually, distortion comes from clipping, which can be from core saturation. In the 390A, it can also come from overdriving the mechanical filters. Does anyone know the design input range for the IF Amp?

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] LONG: Alignment, Overload and Distortion
Date: Mon, 11 Mar 2002 09:40:31 -0800

Now that sounds like a tough one! I'd look at the mixer stages, particularly oscillator injection voltage, but that is merely a guess. Ideas? You might have two problems, and see one, then the other with different signal levels. Also, check resistor values throughout the set, some resistor may have opened up somewhere (esp. B+ dropping or decoupling resistor) and stages are over-reacting somehow to make up the difference. From what you describe, it sounds like the set is operating normally when there is little or no AVC voltage, and it sounds like the set may not be operating normally with a strong signal, but the signal is getting through anyway. In between you hear distortion, where some stage is affected by AVC but can not operate normally. Sounds like a "fun" problem to troubleshoot. You'll feel great when you find it! :-)

Date: Mon, 11 Mar 2002 14:07:47 -0500
From: Bill Cotter <bcotter@pop.uky.edu>
Subject: [R-390] Distortion troubleshooting

Thanks for the suggestions, Bill. The idea of two problems has crossed my mind. Probability suggests that two un-related faults occurring at the same time would be significantly less likely than one problem causing two symptoms. All this is academic until the root cause is found. In the mean time, I'm trying to rule out what the problem is NOT. Of all the suggestions I've received, two suggestions dominate:

1) Limiter misbehavior - Tonight I plan to settle the Limiter suggestions by breaking the coax connection in the IF deck and picking off the audio (diode load) before any coax cable breakdowns can occur. The distortion analyzer will provide the numbers for comparison, and a signal tracer will allow me to hear the results.

2) AVC misbehavior - The distortion problem occurs with the AVC-OFF, zero volts on the AVC line. For the moment I feel confident ruling out any issues in the AVC amp, det, RC, etc department. I have also placed this IF deck in another receiver, and it worked well. Installing the second IF deck in the bad receiver made no difference in the problem.

There still exists a region in the RFG control range that produces severe distortion for a given signal. That range shifts downward with stronger signals and upward with weak signals. This tells me there is a signal level factor in the equation. The IF Gain has been set during alignment, but it can be retested for accuracy.

One theory that sounds appealing to explore is the parasitics possibility, is sounds so mysterious and ghostly. The second is an internmod problem in the mixers. Chasing both of these may cost long hours of bench-instrument time, and since the RF deck would have to be removed, I think there is a better path to take first.

That's the one you suggested of examining all the resistors and capacitors for out of spec condition. Along with examining all solder joints, connections and, the grounds of all shields, sockets and posts. To all that replied - Thanks,

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Date: Mon, 11 Mar 2002 14:08:01 -0500
From: Bill Cotter <bcotter@pop.uky.edu>
Subject: [R-390] Distortion Troubleshooting

Even though the IFG was set during final alignment, I will try to set it the 'Navy Way' with the sig gen input. I am pleased to learn 150uV is the setting range, that makes the operating range likely to be closely above and below this number.

Your reasoning about the stage-gain in the RF section would substantiate this idea. I will go about setting the IFG in this manner, and testing afterwards should lead towards either the IF deck or RF deck as the source.

Date: Mon, 11 Mar 2002 21:38:59 -0500
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Distortion troubleshooting

This is a pretty dumb idea, but have you tried swapping tubes around -- not just subbing in new ones? They say that too hot a tube is problematical for
the PTO -- could that be the case elsewhere, as in the RF deck?

May also be a tube or two with particularly non-linear gain, maybe somewhat microphonic - stuff that doesn't necessarily show up on the tube tester. If you're drawing new ones from the same batch, the problem may apply to all or most of the run, whereas you have a well behaved, broken in older tube in the working circuit. Another dumb question -- did you try tapping the tubes
as you stepped through the signal level testing?

Before you pull the RF deck, you might want to try some voltage measurements at the tube socket pins using a tube extender or two -- or use the wire-wrap technique. Don't rely on the voltages shown in the manual -- I would A-B them between the two RF and IF decks you have, looking for gross clues at the various signal levels.

'Nother dumb one: Did you check to make sure the RF gain pot is the correct one - ohms/watts/taper? Might have been subbed out at some point.

Also, as has often been suggested -- give the tube socket screws a twist to clear any bad ground tie points that may have some resistance, capacitance -- or maybe even, uh diode-ence?

Date: Mon, 11 Mar 2002 21:48:38 -0500
From: James Miller <JamesMiller20@worldnet.att.net>
Subject: Re: [R-390] Distortion troubleshooting

On the Collins list someone recently told the story of a 6U8 that tested very good on a tester, but was actually TOO sensitive. The elements had changed shape or spacing in some manner giving the tube excessive gain. Of course it tested real good on a tester, but behaved poorly in the circuit.

Another thing to consider is bad plate, screen or cathode resistors in the tube circuits. In my case I had both an IF and RF deck where resistors that carried power/current (i.e. plate or cathode, sometimes screen) had aged due to over heating and drifted way out of tolerance. Could a bad cathode resistor cause a tube's grid AGC action to not perform properly?

-
Date: Tue, 12 Mar 2002 10:26:21 -0500
From: Roy Morgan <roy.morgan@nist.gov>

Subject: Re: [R-390] Distortion troubleshooting

..................appealing to explore is the parasitics possibility,...........

- Not necessarily. (removing the RF deck)
- Get a scope onto the test points along the RF chain.
- Listen to the signals inside the radio with another radio. (Put the antenna wire near or around the tube of the stage you want to listen to.)
- Hook a little wire onto the grid pin of a tube and connect to that.
- Feed modulated signals from your signal generator into the test points with
- preceding tubes pulled out.
- Watch the audio output on a scope.

Subject: Re: [R-390] Receiver Overload?
From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Fri, 8 Mar 2002 09:39:04 -0800

>Does this IMD occur with both antenna inputs..? 73 de Jordan...

Jordan, The difference in circuit and receiver performance between the two antenna inputs presents such a mix that using this criteria to judge a trouble shooting procedure on is not easy. When we do dial the antenna gain of peak, does the IMD decrees faster than the signal loss? This could then be excess RF hitting antenna. Then OK so how do you identify the over load signal frequency. It may or may not even be a broadcast signal doing the overloading. Just getting up the connectors to do antenna testing it is a problem. We need to think on this a bit. Even on a meter test for oiled antenna shaft isolators it is hard to get a reading that reflects what is happening at RF. You ask a real good question. I just do not think with every thing I have in my shack I can make a good assessment and report out an answer on my receiver. Please do not drop this subject. I suspect I have it in my receiver. I am afraid the solution will come from doing a by the step ABC process to inspect test and replace until problem is solved. I feel we are stuck with observing the problem and realizing it is between the antenna and the grid of the 6DC6. More observation and front panel testing is not going to further isolate the problem. I can be wrong on this. Now after we check the voltages at the test points, how do we use the deviation high or low to properly conclude what has changed in the circuit so we replace parts to bring the circuit back into design limits. Thus fixing the observed IMD problems. I think some of us have high AGC voltages and IMD and do not understand there is or were is the problem. As an aside, I now have an IF deck where the gain is just hot as hell. The signal to noise is good. From my days on the bench, I just know this deck has a problem. It is not normal. It is just two good.

How do we check and decide if an IMD problem is internal or external?

Roger KC6TRU

Subject: Re: [R-390] Alignment help.
From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Fri, 8 Mar 2002 08:23:30 -0800

>All works fine, except that as the alignment progresses, the radio becomes so >sensitive at the higher bands, that the signal generator will not attenuate >enough to keep the diode load at approx 7-8 volts. At this point I have been >reducing the radio RF gain to reduce the voltage present at the diode load >point. This works fine, except that the higher bands are aligned with the radio >RF gain reduced to about 1:00 position. Sincerely, Jim73, KF4ICZ

Jim, There is no reason the signal generator needs to be connected directly to the receiver. When we want to measure signal to noise and stuff, OK you need a setup where you know what is happening. But for the alignment, what ever, works OK. If your signal generator leaks to much to get you down to 1uv, you just are not going to do 1uv testing.

Put your real antenna on the receiver, string some wire off the signalgenerator to get a signal coupled into the receiver antenna. Your not going to radiate more than 1 watt from the signal generator, so do not worry about QRM. Vary the signal generator output and antenna to wire coupling to get the lowest usable signal level you can. Low level just lets you find a sharper point in the alignment of any slug or cap your adjusting.

Jordan says, The method I use to set the IF gain is by listening to white noise, and using the line level meter with the line terminated with a 610 ohm resistor... all I do is adjust the IF gain control to a point just before the carrier level meter 'takes off '...try it and you'll see what I mean...This is a good way to finish up, or set the IF gain if you do not have a signal generator with known output level. What good does it do to tell you to put 150 uv at 455 into the IF and adjust for -7 volts if you can not establish what 150 uv is on your bench. Jim, you have more than enough hardware and wetware in the shack to get your R390 up to snuff. Motorboating sounds more like a capacitor problem than anything else, and it could perhaps be due to the failure or leakage of the 2uF cap on the IF deck.. does this occur on all settings of the AGC switch..? 73 de Jordan...

OK, so you have at least one more problem to find. Stay with it, once you get the problems out two things happen. You become a very happy radio owner / operator / listener. Future problems occur one at time and can be

fixed one at a time.   Roger.

Date: Tue, 12 Mar 2002 15:03:02 -0800 (PST)
From: Joe Foley <redmenaced@yahoo.com>
Subject: [R-390] RE: [Boatanchors] Peristent, annoying, intermittent, elusive QRN problem: help please!

In a case like this it would be quick work to have a radio tuned to the "noise" while turning off breakers one at a time. Of course, that only works if you have some idea of where the circuit runs in the house. Don't forget the aquarium heater!

Subject: Re: [R-390] Tube Info Needed..
From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Mon, 25 Mar 2002 13:05:46 -0800

>............where to put the best tube in the radio. Where you can put the weakest tube. Where to put the most stable tube.   TKS Gary

Gary, What is is the question here. after you have checked all your tubes in the 390
What did you check? How did you check it. All the tubes? This is a 3 stage process.

Stage 1 find all the tubes you can and check them on a tube tester. Throw the bad ones away. What is a bad tube? How will your tester know? How will you know?

Stage 2 sub the tubes into the receiver to find the best low noise tubes.

Start with the 5749 6AU6 IF Deck tubes.
Use the very first If amp.
Sub them all in to find some good ones.
Put the good ones into the deck.
Check all the tubes again to rank them.
Put the very best most quiet one in the first IF
Put the second in the PTO
Put the 3rd in the BFO
Put the next best ones in to IF strip down the IF chain.

Do the 6AK6's next.
Put the best one in the IF deck
Put the 2nd best one in the audio chain you will
Listen to (may or may not be the phone output)
Put the 3rd best one over there on the other audio.

Do all the 5814's into the audio link.
Pick a socket where both sides of the of the tube is being used. Do not use the limiter. Do not use the diode detector.
Put the best ones in the audio chain.
Fill the AGC and limiter last.
AGC is not listened to.
Limiter is mostly off.

Do the 6C4,
Do the 6AK5's
Do the 6DC6.

Turn the lights off and look for the pretty blue glow inside the bottle. These will first become test spares until you acquire enough tubes with out blue glow to test your tube set. If you are desperate (who is not) there is a zippo process to conduct on the pretty blue glow ones to get the glow out of the bottle. Then these tubes become trash. If you are desperate (who is not) there is a zippo process to conduct on the pretty blue glow ones to get the glow out of the bottle.

Stage 3 install the best of what you have.

All ways put the best tube to the front end. Injecting a signal and metering signal plus noise to noise will provide a better test than the tube tester will. Start with 150 UV (what ever [need not be calibrated]) into the IF deck and get a 30 db difference in signal plus noise to noise in the If audio deck. You can hang an AC volt meter and 600 ohm resistor on the line out put. Do some math and determine what the voltage should be and difference is. signal plus noise is 455Khz with 30% mod at 400 - 1200 hertz. noise is 455 Khz is CW on the signal gen. 455 Khz is peaked into the 100 Hz .1 crystal filter of the IF deck.

You need 0.5 watt into a 600 ohm line load.
You need -7 volts on the diode load.

If you can not set these 3 things up, the If deck and audio deck are below specs and nothing in the RF deck will overcome the problem. In the RF deck, just use the best tubes you can get. The first time you set the test up with 4 -5 UV into the antenna and measure the line out with the signal generator on and off to see the ratio, and then swap a tube, any tube, and see what the difference is, you become a believer for swapping tubes in socket for performance. You can use WWV and watch the meter bounce between carrier and tones if you do not have a signal generator.

From: "Jim Temple" <jetemp@insightbb.com>
To: <r-390@mailman.qth.net>

Date: Tue, 26 Mar 2002 19:12:09 -0500
Subject: [R-390] Fw: Alignment help. (update).

I have finally found some more time to work on my R-390A. I have received several good suggestions, but find that I am stalled because I have no tube socket test adapters (for testing voltages and resistances). I have discovered that testing most voltages is impossible without some of these adapters. Before I can proceed much farther, I need at least one of the 9pin and 7pin tube test adapters. Perhaps someone on the list will assist me in obtaining the adapters needed to proceed, efficiently, with test measurements. Someone must have a few spares that they will sell.

Date: Tue, 26 Mar 2002 18:15:13 -0600
From: mikea <mikea@mikea.ath.cx>
Subject: Re: [R-390] Fw: Alignment help. (update).

You might give Fair Radio a call. If that fails, send me a note.

From: "Jim Temple" <jetemp@insightbb.com>
To: <r-390@mailman.qth.net>
Subject: Re: [R-390] Fw: Alignment help. (update).
Date: Tue, 26 Mar 2002 21:04:13 -0500

The tube test adapters have been found. Thanks for the suggestions and offer to get some to me. I will be back after getting some voltages. So long for now.

Subject: Re: [R-390] Fw: Alignment help.more
From: "Roger L Ruszkowski" <rlruszkowski@Raytheon.com>
Date: Wed, 27 Mar 2002 09:01:33 -0800

Jim, What are you doing to an R-390/A? Since I was drafted and school trained as a repairman in '68 with 8 years in service doing it daily with a year as Instructor and now an owner, I have jus never needed tube extenders to fix an R390 or R390 /A. The voltage get measured with the tube out of the socket. If you need to do injection, pull the next tube up and with a cap to isolate B+ from your signal generator, inject into the plate pin of the tube socket.

You can stand the receiver up on either end and lay any deck out on the bench and get under it to work on it live. You can drop the front panel and work it live. The PTO comes out and can be worked held in hand.

Pull the diode load jumper. Inject some audio into (60 cycle hum) into the audio deck and get both audio paths sounding the same. (power will not be equal because of the attenuator in the line side)

Put 455 into the IF deck and get it all working.
Do the RF deck mechanical alignment.
Get the band switch sync correct.
Get the crystal deck switch sync right.
Find the bands that work,
Work the bands that do not.

If you do not have the parts to adapt the mini BNC to the signal Gen, put a cap on the wire lead and inject the signal Gen into the last test point of the RF deck. (use a whole lot less than 150 UV because it will get amplified in the last mixer) The last test point is a grid of the the last mixer (6C4).

You will make more progress measuring resistors gone high in value. doing visual inspection for bad solder, and replacing suspect caps by the number.

Once you get to a tube stage, It works, It does not work. If your trying to decide if one tube stage is OK not OK by measuring signal level in and out. you are really going at it will out regard to what Elmer's have learned about these receiver working on them several a day years at a time for now nearly 50 years.

In the mid 70's after 20 years of prime time big time use, I was still found that, there is no good table that says what the stage gain of any stage should be. It has big gain. If big gain is not found fix it.

You can read all about calibrated AN/URM - 25 signal generators all week. That is no where near a standard. It just says a tube device is adjusted close. You can read all about calibrated volt meters. That is no where near a standard. It just says a tube device is adjusted close.

We will talk about signal to noise like it was dead on, Its just whatever we got on the bench that day.

Once you get to a bad stage. Working from the head phones to the antenna, you go in and do some voltage checks, this will find the smoked resistors. You then do a very good eyeball. You know where you are looking and why you are looking there. You have isolated the problem to a bad stage. It is bad because it does not have a big gain as expected.

Get the ohm meter out and point to point verify every thing in the circuit.
Crud in deck short.
Cold solder joint.
Broken wire.
Over value resistor.

The caps are killing us after 50 years.
You can not measure then, most have a lower resistor parallel path.
So by the number you just swap them all out.

1 It is a 50 year old R390
2 Experience has shown these item to be problems in these receivers
3 A practical affordable test is not available to most owners.
4 Testing exceeds return on investment.
5 It is just been shown time and time again to do the replacement.

I am not saying change every cap on the bench.

You front paneled your receiver down to one two or three tubes. (Yes Alice, you can do that to an R390 or R390/A) You jammed a signal generator into a plate pin or two. You have decided a stage is suspect.

So now your under the deck and hunting in a circuit between two plate pin. This one is good. This one is bad. That is a fixed number of parts in a fixed space.

List your problems here and get some specific help. Quit trying to solve and reinvent it all by your self. It is more fun that way. I do agree.

What is your real objective?
Do you want some tube extenders, or do you want to fix a receiver?

Roger KC6TRU San Diego.

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Fw: Alignment help.more
Date: Wed, 27 Mar 2002 13:31:18 -0600

Perhaps tube extenders aren't a must-have, but I have used them in the R390A. When I set the bfo to 455kc (with the knob at 12-o'clock), I use the extender so I can tap off the circuit to a counter.

Perhaps there are other ways to set the bfo, but I use this one. The counter isn't sensitive enough to pick up the signal without physically touching the pin.

Yes, you could do this with the IF module outside the radio, but I just find this easier. I wouldn't discount the need/use of tube extenders entirely.

From: "Claudio Spiritelli" <oldradio@tin.it>

Subject: RE: [R-390] Fw: Alignment help.more
Date: Wed, 27 Mar 2002 21:01:38 +0100

I think this is the most realistic way of fixing the receiver. Since this was always my way, I was afraid to say it loud and clear. Thanks Roger

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From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Wed, 27 Mar 2002 12:05:00 -0800
Subject: [R-390] tube extenders

>I wouldn't discount the need/use of tube extenders entirely..........

Truth be known I do have a pair of each. I do use them. But I sure would not let the lack of them prevent me from continuing to work on a problem until I could have some in hand. I sure would never suggest some else can not work on an R390 with out them. I was taught and did work on and did teach and did supervise a lot of other repairmen, to day after day, problem after problem, get in, find it, and fix it without tube extenders. Now remember this was the Army, 200 Hundred years of tradition unhampered by progress. No doubt better ways. No doubt not the only way. I am in favor of getting on with what we got and not setting around waiting for more materiel to arrive.

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] tube extenders
Date: Wed, 27 Mar 2002 14:23:14 -0600

Agreed. More than one way to skin an R390A... By the way, you said the voltage levels can be checked with the tube out of the socket. How do you check grid or cathode voltages without the tube in place drawing grid current through its respective resistances? In some instances, isn't this impossible?

Subject: RE: [R-390] tube extenders
From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Wed, 27 Mar 2002 13:01:35 -0800

Snip.. .... How do you check grid or cathode voltages ....

Now you want me to remember something.

A. we did not advocate tube extenders.
B. there were numbers in the TM.
C. we had a TS505 meter.

I think the meter was to measure the pins with no tube in the socket. Some one asked if tubes could be pulled with the power on. I think the numbers in the TM were for the expected voltage to be found on the pin when the tube was out. Thus no one reading the TM would have any clue what voltage was seen on the pins when the tube was in and operating. You have no clue from the TM what would be seen with a scope and you had not clue what you would find checking under the deck with a meter From the way the TM reads, you could pull a tube and read the voltage on the tube pins. So you can operate the receiver with tubes pulled out. Should you turn the receiver off before you pull the tube? Some one jump in here with the Y2K manual before Barry has to hurt me.

What about operating with one 26Z5?
What about the 6080's?
What about the voltage regulator.
What does the TM say to do for the OA2?
Measure 150 on the test point.
What is listed for the pin voltage in the TM?
Is it 150 or the unregulated voltage?
Or does the TM say do not do that?

From: "fritsche" <fritsche@email.msn.com>
Subject: Re: [R-390] Fw: Alignment help.more
Date: Wed, 27 Mar 2002 16:17:55 -0600

Hi Roger, I tend to agree with you about the tube extenders. Not worth the effort to try and locate or roll your own. Never had to use one back in those late 1960 days. In fact I don't think we even had any that I remember at K-14. But, if a fellow has the rig and wants to do stage gain checks. What the hey, its his radio and time and money. Just another hobby like ham radio or anything else for that matter.

From: G4GJL@aol.com
Date: Thu, 28 Mar 2002 15:02:08 EST
Subject: [R-390] R392 Tune up

Does any one know of there is a guide to the realignment of the R392 PTO assembly online? The 390 resources are plentiful. Perhaps the 392 PTO is not too different?

From: "Jim Temple" <jetemp@insightbb.com>
Date: Fri, 29 Mar 2002 18:38:41 -0500
Subject: [R-390] Alignment

I did the alignment, before my latest excapade, and it went well. However, I estimated the 150uV needed to obtain the 7volts diode load. The signal generator is a Heathkit that has no meter, so the output is not calibrated. I measure the frequency with an HP freq counter, so I have accurate frequencies. I know that a calibrated output is not needed for any of the alignment, except to set the 7volts at 150uV. Can the 150uV output be accurately measured with a VOM?? I think the output to be measured is RF voltage, so would a small RF detector, such as what is in the ARRL handbook be suitable and accurate enough for the purpose. Well, the receiver is still stable after 20min's burn in. He. He. Thanks for any input.

Subject: Re: [R-390] Alignment
From: "Roger L Ruszkowski" <rlruszkowski@raytheon.com>
Date: Mon, 1 Apr 2002 10:08:08 -0800

>I did the alignment, before my latest escapade, and it went well. However, I estimated the 150uV needed to obtain the 7volts diode load. ....
<snip>

Go read Chuck Rippel's page on how to set the IF gain. Chuck Rippel, WA4HHG A "must see" collection of R-390A information http://www.r390a.com/ A lot of owners do not have calibrated test equipment to set up the -7 volts. This procedure provides the best setting that really works in real life with your receiver at your Qth and your antenna. Roger.

P.S. If you want to meter the Sig Gen. Then use a good tight metal box with high impedance detector (active amp) and meter. Put your own attenuator into the box. Measure the sig gen at full (near full) output in the meter box and then use your step attenuator to reduce the output to the level you need. Consider it easier to meter a big voltage than a small voltage. There is also the load impedance to consider in the metering. A scope that will get you down to mill volts (AN/URM 25 is only 0.2 volts max) and some math would let you measure the sig gen full voltage into a fixed load resistance. You may want to meter the signal gen one time at specific frequencies and then judge where to set the knob to get about what you need.

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Alignment
Date: Mon, 1 Apr 2002 17:50:23 -0800

Hi, Jim A couple of observations. 150uV is .000150 volts, which could be difficult to observe on a VOM, at least on an analog meter type. Typically a one volt signal is fed through a switched attenuator to obtain a calibrated signal.

Regarding the Heathkit, is it a SG-8? I used one for years and used it to tune up all sorts of equipment, from AC-DC radios to 450MHz two-way radio. For a general purpose signal source, or a local AM transmitter (play music through your radio) they are great. However, they really aren't calibrated. Here are a couple of things to consider. First, the oscillator is a modified multivibrator, with a pulse-shaped output. Much of the output energy is at harmonics of the fundamental, so even if you were able to measure the voltage, the reading will probably be misleading because much of the energy is at frequencies other than the fundamental. To be meaningful, the generator should produce a low-distortion sine-wave. Remember that a diode detector is a peak reading device, that is the detector rectifies the waveshape, and a following capacitor stores the resultant voltage. With little or no load, the voltage will probably represent the peak voltage of the waveshape (less 0.7 or 0.2 volts lost in the diode). Actually there are a number of variables in a RF diode detector, but that is another story.

Another issue is shielding. Although you need a relatively strong signal (150uV), the SG-8 and similar generators leak signal through the cabinet, out through the line cord and through the mounting feet. :-) Just moving around can affect the signal pickup in the receiver.

Also, although probably not an issue here, the output impedance of the SG-8 is a total unknown, which manifests itself in SWR (radiation) on the output cable as well as generating an unknown match to whatever you connect the cable to. The attenuator (switch and pot) are for all purposes useless, as they are not shielded, and are not an effective design to attenuate RF signals.

In short, the generator is fine for applications where you can place the unit next to the device you are working on, and tune with whatever signal the equipment picks up, but it is a difficult device with which to make any sort of measurements. Any attempt to modify it or overcome the SG-8's serious weaknesses make me reflect, today on April 1, of all the times I have embarked on a modification project to make a pearl out of a rock. I ended up with a broken, bruised rock every time. ;-)

From: "Jim Temple" <jetemp@insightbb.com>
Subject: Re: [R-390] Alignment
Date: Mon, 1 Apr 2002 21:37:12 -0500

Hi Bill, The signal generator is a Heathkit IG-102, the next generation from the SG-8. My main concrern was how critical setting the -7 volts @150uV, IF Gain was in completing the alignment. It now occurs to me that I only have the test equipment that I have..... and I must estimate to the best of my ability with what I have. In the future, perhaps I can accumulate calibrated test equipment. I recently received a good suggestion, in response to an observation by me that my generator would not attenuate enough when directly attached, to not directly couple the generator to the antenna input, which would attenuate the signal through AIR SPACE. A good compromise for a calibrated, small signal generator. (My signal generator would not attenuate enough without reducing the RF GAIN control). So, the bottom line is to use what I have to the best of my ability and align with the best guesses I can, while reviewing some of the excellent web pages available. And this lists' opinions. Thanks for all the help.   Jim

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Date: Mon, 06 May 2002 23:43:26 -0400
From: Gary Carter <gcarter01@triad.rr.com>
Subject: [R-390] Alignment Problem on R390A?

I just recently acquired an R390A produced by Capehart. In trying out the receiver I've noticed that when I start tuning towards a strong AM signal I start detecting the station's audio anywhere from 8 to 16 kHz away from it's center frequency (using either the 4 or 8 kHz filters). When I'm almost at the center frequeny of the station the receiver sounds like it suddenly "captures" the signal to it's full strength, almost like tuning in an FM signal. Is this due to misalignment or errors in tracking?

I'm new to this reflector, and although I've been in ham radio for twenty eight years, I've been one of those dreaded "appliance operators" that you've heard so much about. Even though I've been known to successfuly recap a radio by the "cap by numbers" method,

I am trying to learn how to work on and understand the workings of this equipment correctly. Be patient with me. I am going to ask a lot of simple "electronics 101" questions from time to time, and I know how frustrating that can be for some engineering types out there.

Just remember, we all have to start somewhere, and I'm willing to learn if you're willing to teach.

Date: Wed, 8 May 2002 04:56:57 -0700 (PDT)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] Alignment Problem on R390A?

I'll take the coward's way out and recommend a complete alignment for your radio. I've never received one of these that did not need alignment. Make a by-the-book pass through it and I'd wager that your problem goes away.

From: "AI2Q Alex" <ai2q@adelphia.net>

Subject: RE: [R-390] Alignment Problem on R390A?
Date: Wed, 8 May 2002 09:19:51 -0400

One more word: alignment is one of the best ways to evaluate and troubleshoot the set. It'll show you where any problems are in a methodical rear-to-front (audio to RF) manner.

Date: Wed, 08 May 2002 20:21:40 -0400
From: Gary Carter <gcarter01@triad.rr.com>
Subject: [R-390] R390A Alignment Problem

Thanks to all who responded to my questions! The general consensus seems to be in favor of a thorough re-alignment. One respondant said he too had a Capehart R390A and his does the same thing. In looking closer at the carrier meter while tuning in a strong AM station using the 4 kHz filter I did not notice any dip in the signal level right before the signal is "captured".

The audio can clearly be detected a good 8 to 16 kHz away from the center frequency. I downloaded the "Y2K" R390A manual last Sunday evening, with the intention to print it on the HP Laserjet 4Si at work. With my cable modem connection at home it took just 25 seconds to download the whole manual. Printing it duplex on the HP4Si took 1 hour 15 minutes! I'm glad I only have to do that once.

From: DCrespy@aol.com
Date: Wed, 12 Jun 2002 20:16:41 EDT
Subject: Re: [R-390] Signal Generator wanted

Hollow State News had an article (...Issue 34, article by Charles Taylor) about performing the alignment with the calibrator and "off the air" signals. The only tricky part was the variable IF. I have done it in a pinch and it works. His procedure does everything except the 455 kHz (excuse me.. "kc") IF. Reprints were (used to be, may still be) available from Ralph Sanserino at : sanser@GTE.net

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From: G4GJL@aol.com
Date: Thu, 13 Jun 2002 04:46:09 EDT
Subject: Re: [R-390] Signal Generator wanted

I can verify that this technique works well in 2002 over here in England! I just went through all but the 455kc alignments on my Blue Streak III project without as much as a glimmer of power on the signal generator! In my case this was more out of laziness and inability to lift the sig gen onto the bench due to medical conditions, but I often use this method as a first pass at alignment of a rebuilt rig. In the specific case of my 390A, I would find it hard to believe that audibly better performance could be achieved even with instruments. It sounds so great in its present state!. Unless there has been major surgery in the final IF, I would suggest there is no likely significant improvement in performance to be had by touching the final 455kc IF, with or without instruments. Those mechanical filters define the bandwidths and shape factors very convincingly any how.

Date: Fri, 21 Jun 2002 11:41:51 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] DA-121/U Dummy Antenna

>I would appreciate it if someone would tell me where there is a schematic
>of the DA-121/U dummy antenna

Dallas, HSN Issue 23 page 2 has an article on the DA-121/U. I do not know what that article says. Is that in the URM-25 manuals? The normal "dummy antenna" is specified in the RMA standard from the 1930's. You may find the details in a General Radio manual for the Model 1001A standard signal generator. On the other hand, you may be referring to the balanced dummy antenna - that I don't know much about.

Date: Fri, 21 Jun 2002 14:03:18 -0400
From: Norman Ryan <nryan@intrex.net>
Subject: Re: [R-390] DA-121/U Dummy Antenna

..........DA-121/U dummy antenna .... Hello, Dallas, I opened up my DA-121/U and found two 1/2 W 5% tolerance carbon composition resistors configured as shown:

```
          100
    >---|---\/\/\/---<
GEN     |           REC
        >
        <  68
        >
        |
ground              Hope this helps.
```

Date: Fri, 21 Jun 2002 14:11:36 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] DA-121/U Dummy Antenna

It looks to me (without doing any math) that the thing presents to the generator a 50 ohm load and to the receiver a 125 ohm load. there will be

some loss in this: that is the receiver will get less than the microvolts indicated on the generator.

--
From: "Dallas Lankford" <dallas@bayou.com>
Subject: Re: [R-390] DA-121/U Dummy Antenna
Date: Fri, 21 Jun 2002 17:43:21 -0500

Yes. And if one uses a 50 ohm signal generator, and measures the R-390A sensitivity by reading the signal generator setting, the number one gets will be about 0.636 lower than the voltage across the antenna input. Here I am assuming that the signal generator is connected to the R-390A through a
UG-971/U (with no impedance matching or adapter). So the method I have recommended previously is wrong too. That's really amusing. The numbers I have been getting should be multiplied by 1.57. And that does not necessarily give accurate values. What one really has to do is measure the antenna input resistance at the frequency where one measures sensitivity.

From: "Dallas Lankford" <dallas@bayou.com>
Date: Sun, 7 Jul 2002 14:28:48 -0500
Subject: [R-390] R-390A 10 dB S+N/N AM Sensitivity

There has been a lot of confusion about how to measure the AM sensitivity of a
R-390A. Unfortunately the manuals have contributed to this confusion. The 1970 Navships 0967-063-2010 manual has a sensitivity measuring procedure on pages 4-2 and 4-3 which involves setting the signal generator (URM-25D) to minimum output. This is equivalent to the method of turning the signal generator on and off which is used at several web sites to find the 10 dB S+N/N ratio. However, the Navships manual does not mention a 10 dB S+N/N ratio, but rather a 10 dB rise, which it is. What the Navships and web sites measure is the 10 dB S+N1/N2 where N1 is the no-signal receiver noise, and N2 is the noise due to the signal and receiver. Also, the 50 ohm impedance of the signal generator is not matched to the 125 ohm nominal (100 - 300 ohms) antenna input impedance (through a UG-636A/U and UG-971/U) of the R-390A. Consequently, the signal generator reading is not the number of microvolts that appears across the R-390A antenna input. The Army manual TM 11-5820-358-35 gives a Sensitivity Test, not a procedure for measuring the 10 dB S+N/N ratio. The earlier Army manual TM 11-856A in paragraph 166 has what it calls an AM Sensitivity measurement procedure. However, there are at least two things wrong with it: (1) a DA-121/U attenuator (8.9 dB) two way match (52.2 ohms to 128.8 ohms) is used between the URM-25D and R-390A, and (2) the 0.8 volt noise

indication in step (f.) is not maximized with the antenna trimmer, nor is its value checked after the signal generator is adjusted for 2.5 volts, as it must be.

Here is a correct method for measuring the AM sensitivity of an R-390A.

I measured the real component of the R-390A antenna input impedance by connecting a 250 ohm 2 watt Clarostat composition pot in the signal path, and used a UG-971/U (twinax to C) and UG-636AU (C to BNC). The 10X scope probe was connected across the 636. The 25D was set to some convenient value that could bee seen on the scope. The signal was peaked (as seen on the scope) using the 390A antenna trimmer. The pot was adjusted so that the scope read half the open circuit voltage (the voltage from the antenna input side of the pot when disconnected from the antenna input). The value of the pot was read using an accurate voltmeter, call this value R1. The R-390A antenna input resistance is R = R1 + 50 at that frequency.

I may have gotten the high end numbers a little too high previously. My scope method is probably not all that accurate because there is quite a bit of uncertainty as to the half the open circuit voltage. A true RMS voltmeter might be better. Now I am getting 180 - 220 ohms for the high values. Previously I got up to 300 ohms. The low values still come in around 90 - 100 ohms. Low values were found at 1.001, 1.999, and 3.999 MHz. High values were found at 1.5, 4.5, and 5.5 MHz.

I used a TEK 2465B (cal traceable to NIST), and a rebuilt (by me) URM-25D (calibrated by me using my 2465B and a precision 50 ohm terminator).

I used 2 feet of RG-58A/U to connect the 25D to the 390A, and a BNC-T connector adapter with a short stub coming out of one of the females of the BNC T for clipping the 10X probe to. I measured the voltage across the 390A antenna input (UG-971/U and UG-636A/U) to get a correction factor to multiply the 25D reading by. Then I measured the S+N/N ratio as if the impedances were matched (which they weren't).

My method for measuring sensitivity for a 10 dB S+N/N ratio involves turning the modulation ON and OFF (NOT turning the signal generator ON and OFF or tuning the R-390A away from and back to the signal generator). I could use a voltmeter on the diode load, but it is more convenient and about as accurate to use the LINE LEVEL meter. I adjust the meter and signal generator repeatedly if necessary, peaking the ANT TRIM at each resetting of the signal generator output level, until the meter reads 0 VU with modulation on, and the meter reads -10 with modulation off.

At 4.5 MHz, with the antenna input resistance measured as 187 ohms, using the 4 kHz BW, and a correction factor of cf= 1.57 (cf = 2R/(R + 50), where R is the measured antenna input resistance of the R-390A at the frequency where the measurement is being taken), with AGC off, and 30% modulation, I got a reading of 0.5 microvolts on the 25D for a 10 dB S+N/N ratio. Using the correction factor, the voltage across the UG-636A/U was deduced to be 0.785 microvolts. So the input power was P = (0.785)^2 x E-12/187 = 3.3 x E-15 watts, or -114.8 dBm. The sensitivity looks a lot better when you convert it to dBm. If you had a 50 ohm receiver with a -114.8 dBm sensitivity for a 10 dB S+N/N ratio, that would be 0.41 microvolts. Not shabby. Note that this is also quite close to the uncorrected 0.5 microvolt measurement above

I also used a broadband matching transformer and got a slightly better sensitivity, namely -115.2 dBm. This suggests that matching with a broadband transformer does not change the results very much.

My R-390A was a bit weak at the top end of the 4 MHz band, coming in at -109 dBm at 3.9 MHz. Maybe I need to go in there an up the 2 pF coupling capacitor in the double tuned circuit between the RF amp and MIXER? We'll see.

From: "Dallas Lankford" <dallas@bayou.com>
Date: Mon, 8 Jul 2002 06:35:46 -0500
Subject: [R-390] AM Sensitivity Addenda

There is a typo in my previous posting. When referring to the signal generator (NOT modulation) OFF/ON I wrote S+N1/N2 but then identified N1 and N2 reversed. N1 should have been receiver noise plus noise due to the signal, and N2 should have been receiver noise alone.

Coincidentally, late last night I received an e-mail copy of John Wilson's May 2002 Short Wave Magazine article, "Simply The Best?" In the article John has a detailed discussion of why it is incorrect to turn the signal generator off and on, (or, equivalently, detune and retune the signal generator or receiver) when measuring the 10 dB S+N/N ratio. This would be a nice article to have on someone's web site if SWM would approve.

Date: Wed, 14 Aug 2002 16:51:37 -0400
Subject: Re: [R-390] Dynamic Range Measurements
From: Thomas W Leiper <twleiper@juno.com>

>The other problem is that having done the measurements you then have
>to convince the world that you did them right.... The point is that in
order to

>be believed you need to do more than just one or two tests on one radio.

I just throw all the test equipment out the window and see how the rigs compare when trying to copy crappy signals in a noisy world. Tops for CW has been, and always will be the 51J4 (or 75A4) with the deadly combination of both mechanical AND tunable crystal filters at your fingertips. Being able to notch out adjacent interfering signals is a big plus for CW. Yeah, the audio stinks, but you can get good AM audio AND selectivity in the rough stuff with an SP-600, which is easier by far than any of the others to cruise around and find those strange little signals in the first place. But, once you find that DOD channel or pirate station, there is none better than the R-390 to lock the channel in and leave it there for a few weeks or months... and if you hang a CV-591 on the ass end so much the better. So much for all the testing and theory, the bottom line is that different rigs serve different missions. Regardless, you will never copy any signal of any mode better than I can with my souped-up SP-600 and CV-157 motosyncrodetectoleviathon combo.

From: "David Faria" <dave_faria@hotmail.com>
Date: Tue, 10 Sep 2002 19:35:34 -0700
Subject: [R-390] Sweep Generator Alignment

GE List. Would there be any benefit to aligning the IF of a 390a or non "a" using a sweep generator? If so how would one be connected? I have an opportunity to pick up a 4mhz sweep/function generator.

Date: Wed, 11 Sep 2002 05:55:46 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] Sweep Generator Alignment

A sweep generator is used in conjunction with an oscilloscope to display amplitude vs. frequency. It will present a "picture" of the shape of a tuned circuit. The sweep generator is connected to the input of the device under test and the O-scope to the output (through a demodulator). The sweep generator is also connected to the horizontal input of the scope. They are commonly used to align fixed tuned circuits, like the 455kc. IF(or TV IF). I don't know how useful a 4Mhz. generator would be since the signal will have to pass through the entire receiver and this would not present a valid "picture" of the IF. If the price is right they are fun to play with.

Date: Wed, 11 Sep 2002 12:32:42 +0200
From: "Bryce Ringwood" <BRingwoo@csir.co.za>
Subject: Re: [R-390] Sweep Generator Alignment

I have a Philips sweep generator operating at 4 MHZ. You have to have a signal generator operating 455kHz above or below the 4Mz as input, as well as a 50 volt sawtooth from a scope timebase. You connect the Rx detector to the vertical input of the scope and the resulting swept output from the sweep generator to the IF stages you want to align. Other sweepers may have a different configuration. Remember that the selectivity curves presented are usually to a log scale, and your display will probably be linear. I used the setup with a Tek 549 storage 'scope on an AR88, which was rather upsetting, since all the different selectivity settings peaked at different centre frequencies when I displayed them on top of one another :(Maybe the other listers can give an opinion on whether it would be worthwhile repeating the experiment on the 390A with its mechanical filters ?

Date: Wed, 11 Sep 2002 07:37:47 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Sweep Generator Alignment

You inject the signal into the front end of the radio. Say you tune it to 600 KHz and also set the sweeper to 600 KHz. Then hook the sweeper to the antenna input of the radio. You hook a scope channel to the diode load output on the back of the radio.The sweep output of the sweeper goes to another scope channel or the trigger output of the sweeper goes to the trigger input of the sweeper. A storage scope is a good idea since you will be sweeping at a rate of 10 Hz or less. An alteranate hookup would be to unplug the IF input and inject the signal directly into the IF deck. The disadvantage of that is you will not be able to properly set up the first coil on the deck and you need a cable with one of the weird little connectors. You can get around both problems, but why.....

The Wavetek's are nice little sweepers. I have several various models of their stuff and use them from time to time. I generaly look at them as audio gear rather than RF. I don't know why I do, that's just me. The oscillators in them are R/C based rather than L/C or crystal based. That limits the stability of the output. I would not recomend trying to set up the CW crystal filter with one :)

Subject: RE: [R-390] Sweep Generator Alignment
Date: Wed, 11 Sep 2002 08:01:11 -0400
From: "Veenstra, Lester B." <Lester.Veenstra@lmco.com>

Yes if it can do a slow stable sweep and you have a useful way to see the result of that slow sweep. Inject via the grid test point of the mixer prior to the IF.

Subject: RE: [R-390] Sweep Generator Alignment
Date: Wed, 11 Sep 2002 08:14:05 -0400
From: "Veenstra, Lester B." <Lester.Veenstra@lmco.com>

To clarify, inject the nominal 455 kHz sweep via the grid test point of the mixer prior to the IF. Thiis allows the IF deck to see its correct impedance on the input for correct alignment of the mixer and the first IF stage. If you are lucky you can use a storage display specan on the IF output to see the result, or as previous posts have suggested, the diode load voltage to an o-scope is a more universally practical method. In a dim light you should be able to see the longer persistence trace on the scope.

From: Helmut Usbeck <vze2gmp4@verizon.net>
Date: Mon, 4 Jan 1988 04:31:02 -0500
Subject: [R-390] poor man's sweep generator

I've been using a program called Spectrogram, www.vistualizationsoftware.com, for a while now. What I do is run the program, and take the output of the r-390A or any other receiver and input it to the soundcard of my computer. For a signal "injection" tune to a spot where there are no stations. Use the noise input from the ant. or a diode noise generator. One will see the bandpass of the filters displayed on your computer screen. I've used this with several receivers to compare bandpass of filters slopes of filters and also to adjust them. Yes, there is an improvement.

Subject: RE: [R-390] poor man's sweep generator
Date: Wed, 11 Sep 2002 09:57:23 -0400
From: "Veenstra, Lester B." <Lester.Veenstra@lmco.com>

Agree, this works well, use a peak hold mode if available-

Subject: RE: [R-390] Sweep Generator Alignment
From: Richard.McClung@Dielectric.spx.com
Date: Wed, 11 Sep 2002 13:18:13 -0700

There are two documents that describe the procedure for sweep aligning the IF strip of the R-390(*) receivers.

-U. S. Army Security Agency Training Center Student Text, ST-32-151, Visual Alignment Procedures for the R-390 Receiver
-U. S. Army Security Agency Training Center Student Text, ST-32-152, Visual Alignment Procedures for the R-390 and R-390A Receivers

There is a schematic for a test fixture to utilize in aligning the IF strip in the ST.

Date: Wed, 11 Sep 2002 17:18:23 -0700 (PDT)
From: Rodney Bunt <rodney_bunt@yahoo.com>
Subject: [R-390] Sweep Generator Alignment

I have a HP-8601a sweep generator. It uses a voltage controlled oscillator and is quite stable. It has a "symmetric" sweep IE: it sweeps equally up and down from the center frequency. For Xtal Filters (or others) I find the center frequency of the crystal by putting the "peak" of the trace on the oscilloscope in the center of the sweep. Then I turn off "sweep" the resultant center frequency is the center of the Xtal bandpass, I use this frequency to tune the rest of the IF, I have found Xtals up to 5Khz off frequency. So using this method you end up with the IF and the Xtal filter in alignment, and a very usefull Xtla filter/phasing combination. For "stagger tuned" IF's you use the xtal center frequency and sweep "symmetricaly" and obtain the correct bandpass shape on the scope.

Subject: RE: [R-390] Sweep Generator Alignment
From: Richard.McClung@Dielectric.spx.com
Date: Thu, 19 Sep 2002 14:38:49 -0700

Since I have received numerous requests for the below information I am sending Al Tirevold a copy of:

"U. S. Army Security Agency Training Center Student Text, ST-32-152, Visual Alignment Procedures for the R-390 and R-390A Receivers" for him to post to the R-390 FAQ URL.

-

From: Al Tirevold <tirevold@mindspring.com>
Date: Thu, 26 Sep 2002 20:41:00 -0400
Subject: [R-390] ST 32-152

Rich McClung's copies of ST 32-151 and ST32-152 arrived today. They appear to be nearly identical. I scanned in the ST 32-152 "Visual Alignment of Radio Receivers "R-390/URR and R-390A/URR" and placed it on the FAQ site. The document is 9.1MB in size. The URL is: http://www.r-390a.net/ST-32-152.pdf Unless someone has an urgent need to see the -151 document, which covers only the R-390 (Non-A), I will dispense with scanning it. Contact me directly if you would like to procure a scanned .pdf file. ALSO: If you sent me feedback from the Y2K-R2 manual or provided pictures, etc. for inclusion in the next version, please re-send them to me. I suffered a failure of both a hard drive AND the attending backup utility...(so much for store-bought code..I now have written my own).

From: "Tom Warren" <wwarren1@nc.rr.com>
Date: Sun, 29 Sep 2002 10:34:22 -0400
Subject: [R-390] 390A tuneup

Roger, Latest numbers from my tuneup of a Motorola 390A IF deck (tubes selected for best SNR at 150 microvolts input at 455kHz) and Collins 390A RF deck (6DC6 and 3 6C4 mixers chosen for best SNR):

IF deck SNR at 150 microvolts, 455kHz, URM25 fed directly into IF deck per TM,

400Hz modulation at 30%

Bandwidth	SNR
16kHz	27.8 dB SNR per TM method, 0dBm

with no modulation

8kHz	27.7 dB SNR
4kHz	30.5 dB SNR
2kHz	30.2 dB SNR

Hooking up the Collins RF deck to the above Motorola IF deck then yields:
Test conditions - URM fed directly into RF deck (no 50-120 ohm matching attenuator),
4 microvolts from the URM at 750 kHz, 400 Hz modulation at 30%

Bandwidth	SNR
16kHz	23.7 dB SNR
8kHz	25.4 dB SNR
4kHz	27.4 dB SNR
2kHz	28.6 dB SNR

Also at 2kHz bandwidth and URM feeding the 390A directly (no 50-120 matching attenuator), 400Hz modulation at 30%, I get about 0.35 microvolt for 10dB SNR Further, when I use the 50-120 ohm matching attenuator from the URM25 into the 390A and 4 microvolt input, 750kHz carrier freq, 16kHz bandwidth,400 Hz modulation at 30%, all per the -35 TM method, I get 14.9dB SNR. I think I am about as "there" as I can get with my current set of tubes. I'm a little disappointed that I can't get more than just over 30 dB SNR from the IF deck. However, I am getting a reasonable amount over 20 dB SNR for the RF deck/IF deck combination at all IF bandwidths. Is this time to quit the fussing and start listening to the receiver for pleasure?

Date: Sat, 4 Jan 2003 18:54:19 -0800 (PST)
From: John Kolb <jlkolb@cts.com>
Subject: Re: [R-390] kilocycle/megacycle movement

Not well shielded? Yes you might say that :) I used to measure a 0.1 uV S+N/N on one of my receivers, with the Heathkit on the other side of the room, and without a cable connecting the generator to the rx :) However

for alignment where you are just adjusting things for peak reading, the absolute level doesn't matter, and most receivers can be aligned using their own xtal calibrator to provide signals to peak on. For medium output levels, using 50 or 100 uV to set an S-meter to exactly S9, for example, the leakage wouldn't be high enough to affect accuracy on a well constructed Heathkit - a poorly constructed lab generator could be horrible.

Subject: RE: [R-390] kilocycle/megacycle movement
Date: Mon, 6 Jan 2003 10:22:09 -0800
From: "David Wise" <David_Wise@Phoenix.com>

Agreed. If you have the radio's internal crystal calibrator tuned to WWV, you don't actually need a signal generator for alignment except to confirm you're in the right 100kHz "bin".

Subject: RE: [R-390] 100Khz calibrator and alignment
Date: Mon, 6 Jan 2003 12:14:02 -0800
From: "David Wise" <David_Wise@Phoenix.com>

We're in "violent agreement". A good generator outdoes the calibrator. If you don't have a generator handy, or it's a really bad one, the calibrator is the better bet for all except the antenna coils.

From: "Tom-WB3AKD" <wb3akd@arrl.net>
Date: Fri, 10 Jan 2003 09:07:15 -0500
Subject: [R-390] 390 swept alignment:

Probably no news for most of you here but having done the "manual" IF alignment some time ago and having the sweeper hooked up, I muscled the 390 over to the bench and swept it. I found the shapes to be unsatisfactory, so went through the procedure with the sweeper: Moved the LC pass bands over to where the crystal filter was centered then tweaked the shapes up a bit. Much nicer sound now. I am now fully sold on the sweep procedure.

From: "Tom-WB3AKD" <wb3akd@arrl.net>
Subject: Re: [R-390] R-390 Related Activities
Date: Fri, 10 Jan 2003 11:04:09 -0500

Well, I used the HP 3336B which was far better than I expected for this purpose. Its a sweeping synthesizer that goes up to 20.9 MHz or so. There are 3 on the "E" for under 200. I have a couple of 8601A's but haven't tried them. I like being able to program the start and stop frequencies.Only problem with the 3336B is that the output does not go below about -72 dBm which is too high if you're driving the font end of the receiver. Additional attenuation is required but that is not too big a deal. Procedure is here : http://www.r-390a.net/ST-32-152.pdf although I just winged it for now. I'll have to try this procedure sometime as it was where I got the idea.

Date: Sat, 11 Jan 2003 12:53:42 -0500
From: Jim Brannigan <jbrannig@optonline.net>
Subject: [R-390] Alignment question

I changed the 3rd mixer back to a 6C4, checked the mechanical alignment and am now warming up the URM-25 and R-390A. For the RF alignment the manual refers to using an electrical dummy load, a DA-121/U. This is not part of the URM-25 pack. Is this necessary or should I just use a 50ohm load? If it is necessary, does anyone have the values used in the dummy load?

Date: Sat, 11 Jan 2003 17:09:50 -0500
From: Glenn Little <glittle@awod.com>
Subject: Re: [R-390] Alignment question

A google search for DA-121/u produces only three hits. The last is a thread from this reflector that shows how to build one. It consists of a 68 and a 100 Ohm resistor and is used as an impedance transformer.

Date: Sat, 11 Jan 2003 18:04:54 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Alignment question

More or less the answer on the dummy load on the URM-25: Most signal generators are 50 ohm devices. That unfortunately can mean two different things. Either they are designed to run into a 50 ohm load -or- they are designed to run into a 50 ohm load AND they have a 50 ohm output impedance. A Measurements model 80 is a good example of a generator that is set up to drive 50 ohms but does not provide a 50 ohm output impedance. You have to put a pad on the output to make it have a 50 ohm output impedance. This turns out to be important for a rather odd reason. Changing a resistor in parallel with part of a tuned circuit probably will change the resonant frequency of that circuit. This was one of the things they used to teach everybody in school. Then along came Sputnik ..... In the case of the R-390 what the dummy load is doing is providing a match between the generator and the input of the radio. It's there to ensure that the radio is set up running out of the same impedance as the antenna distribution system it is connected to.

The next question obviously is - are you running a 120 ohm balanced antenna distribution system ? If so - WOW! - you need the dummy load. If not - join the club - you need something different. Most of us these days seem to use 50 ohm single wire coax rather than 120 ohm balanced coax to hook things up. The 120 ohm balanced stuff is great and very useful; it's just not what we use anymore. In order to properly set up a R-390 for 50 ohm coax you need to strap the input of the radio or use a matching transformer. There are threads on each back in the archives.

Once the radio is more or less set up to run 50 ohms you then use a 50 ohm output impedance generator to align the radio. If you decide to set up for 75 ohms and use cable TV stuff then you need a 50 ohm to 75 ohm pad between the generator and the radio. Chuck's good old R390 videos explain all this (except for Sputnik) a lot better than I can. Hope that makes at least some sense ...

From: "Tom Warren" <wwarren1@nc.rr.com>
Subject: Re: [R-390] R-390 Related Activities
Date: Sun, 12 Jan 2003 08:52:02 -0500

I'd sure like to hear more about your experience with aligning the 390A with the sweep generator. Moving the LC passbands over to the the crystal filter center frequency will not make a difference as to sound quality since presumably you mean the sound quality when listening to an AM or SSB signal in the 2, 4, 8, or 16kHz bandpass mode when the cryslal filter is not being used. HOWEVER, moving the LC passband to center on (say) the 8kHz filter and then fussing with the LC passband to get better passband symmetry throughout the whole IF strip indeed should make a good bit of difference. On one of Chuck's tapes (the ones I just sold), he talks about using an audio distortion analyzer on the output of the AF deck to then tune the IF-LC filters to then minimize the distortion. Presumably he is linearizing the phase response of the IF-LC-Mech Filter bandpass as best possible and thus reducing the distortion. My very limited experience is that there's lots of ripple (no pun intended with Chuck) (like 1.5-2.5dB) over the passband of the Mech Filters and I'm terrified to think what the phase response is through the IF strip. Not good is the first answer supported by the passband amplitude ripple. So bottom line is that I'm interested in your experience with the sweep generator method of alignment. I'm just now getting my two 390A's (my pristine EAC'67 and a depot dog, mostly Motorola) up to electrical specification (many, many capacitor, IF can, Mech Filter, and resistor replacements later) so that maybe I can take on some of the nuances of alignment. So far alignment has yielded over 23-25dB SNR (Roger Ruszkowski likes at least 20 dB) at 4 microvolts input over the entire 32mHz frequency range (oh well, the top two bands are a bit weaker, but who the heck listens to anything there anyhow?).

From: "Tom-WB3AKD" <wb3akd@arrl.net>

Subject: Re: [R-390] R-390 Related Activities
Date: Sun, 12 Jan 2003 09:56:35 -0500

I have not swept my (A) yet, as the mechanical filters pretty much define the passband. I ressurrected an R-390 last fall and have been tinkering with it on and off over the past few months and that is the one I sweep aligned as the audio was not all that hot and I had used the CW alignement technique from the Tech Order. Once I set up the sweeper to check the bad 8KHz mech filter I had opened up and fixed, I just went ahead and checked the () while the sweeper was set up.

I must have messed up the CW alignment or else the procedure is just inadequate because even the shap of the xtal filter was pretty bad. I went ahead and adjusted the 0.1 pass band so it was symetrical (the capacitor on the top of Z501. Now, mind you, I was monitoring the IF output jack with the scope and not the Det output tha the ASA procedure calls for. That helps to get rid of the delay effects that cause multiple humps.

Anyway, once the xtal filter looked good, I went to the 2KHz position and started squeaking the transformers over the the same center frequency as the
xtal filter. This meanse that I won't have to retune the receiver too much as I decrease the BW on a weak signal during operation.

After the 2 KHz was looking good, I widened the various BW and retweaked to keep the pass band centered and to keep the humps even. I basically just messed around 'til it looked good. Sounds much better now as there is less receiver induced distortion.

As for the (A), the mech filter by itself, definitely has a bumpy passband and some experimentation yesterday suggests that the external capacitors largely just resonate the end transducer coils. Adding the capacitors increased the amplitude, but did not significantly change the passband. Bumps look to be 2 dB or so, as you said. I have not muscled the (A) over to the Lab bench for sweeping but will do that soon as I am curious how the NIB 8KHz filter I put in there looks in situ with (presumably) all the right parts. One thing I am trying to do is evaluate the quality of the repair on the old filter befor I bake it out and seal it up without actually putting it back in the receiver. My guess is that with all the high Q resonators in a mechanical filter would make the phase response squirrel-ly and that would be good for increased audio distortion, although from listening to it either it is not all that bad, or my ears are not all that good. Given that the DF system version of the R-390(A) (whatever the designation is) changed out the mechanical filter IF strip for an LC filter IF strip, my guess is that the phase distortion is certainly measureable, if you care that much.

Since the HP 3336B generator is GPIB controlable, I'll probably make some serious attempt to make a bunch of automated measurements on the pass bands in a few months or so after I clear all the backlog of other things and have time to do the software and calibrate the setup. An interesting science project, if nothing else. I'll post the response curves or links thereto, when it happens.

Probably more discussion than you were looking for.

From: "Steve Hobensack" <stevehobensack@hotmail.com>
Date: Sun, 12 Jan 2003 10:22:14 -0500
Subject: [R-390] sweep alignment

What type/brand of sweep gen would be good? What is the hook-up? How would one install markers at 447 and 463kc? Thanks

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Date: Sun, 12 Jan 2003 10:52:03 -0500
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] Alignment question

Glenn, I did find the schematic for the dummy load and Bob, the radio will be used with a 50 ohm system so I put the URM-25 50 ohm load in line, strapped the input connector and tuned it up.

Overall impression: This R-390A was last aligned over 10 years ago. It sees fairly light use. Aligning the tuned circuits amounted to a "touch-up" as they were not far off. The biggest change was in the variable IF"s and this was due to restoring the 6C4 third mixer.The most noticeable difference came from changing the audio coupling caps to, 0.033's, the audio sounds much better.

While it is on the bench I will run through the alignment again, then add the CV-591 for a final test. I am going to compare the CV-591 vs. an Eldico SBA-1 and see which one goes back into the rack.

From: "Tom-WB3AKD" <wb3akd@arrl.net>
Subject: Re: [R-390] sweep alignment
Date: Sun, 12 Jan 2003 10:52:04 -0500

I'm using an HP 3336B which is a synthesized level generator. This is a fairly smart box that allows you to set start and stop frequencies and its as dead on as you would ever need at 455. Also has a sawtooth output for driving the X-axis on the scope. I;s seen the for < 200 on the big "E". Paid $50 buck for mine at a hamfest, but if I keep the top cover on, it sometimes won;t boot. Havent figured out what that's about yet.

Down sides: Weird output connector (WECO) adaptor about 15 bucks at Trompeter.   Minimum output level -72 dBm which means you need additionalattenuators to get the level down to run the IF at max gain. Also has no internal mod source although will amplitude and phase modulate with external audio source.

Up side: GPIB compatible (if you're into automation): coverage from audio tol 21 MHz in teensy steps. Up to 60(?) MHz output on the back with no level control.

Can specify sweep range very precisely which is a big plus for sweeping IF's and filters etc.

A pretty $#/^-Hot tool from my point of view. I once used it to verify the sampling rate on an A/D converter. Took 256000 samples of 1KHz, did an FFT (that took a while) and then looked for which BIN the peak showed up in. Worked great and shut down the weenie that was trying blow up our test procedure.

Setup:

3336B (via attenuator) drives IF input (Alternately the antenna input but better to use IF input) at low level (keep from saturation the IF when in MCG mode at Max RF gain). Sweep output from 3336B drives X-axis of Tek 475 scope. IF output from Rx drives the V-axis of the scope.   Sweep time of 10 ms for wide BW but need to drop it down to .1 sec for xtal filters.
My two pence. 73   Tom WB3AKD

Date: Sun, 12 Jan 2003 11:14:38 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] sweep alignment

Here's the basic problem with sweep alignment on the R-390 - you have to go *slow*. A number of people have given this a try and most of us oddly enough have used the 3336 or one of it's cousins. In this case passband ripple = narrow peaks in the filter = narrow band stuff in the filter = long time delay in the filter.

It's the same reason you don't normally see mechanical filters in the IF of a FM radio. The only way to be sure you are going slow enough is to keep slowing things down until the result doesn't change.

Start with a sweep of just the passband. Don't worry about the entire filter response. Try something like 30 seconds for the 2 KHz filter and see what you get. Back it off to two minutes to be sure that the result is correct.

From there you can speed it up to the point is begins to look weird. Since you can't do anything about the response of the mechanical filters some of this may not be needed. The only thing you can do anything about is the tuned coils in the IF strip.

You may be able to set them adequately with a sweep speed that does not properly display the response of the IF.   Take Care!

From: "Tom-WB3AKD" <wb3akd@arrl.net>
Subject: Re: [R-390] sweep alignment
Date: Sun, 12 Jan 2003 11:22:42 -0500

Bob, What are you observing the output with?

From: "Jerry Kincade" <w5kp@direcway.com>
Subject: Re: [R-390] R-390 Related Activities
Date: Sun, 12 Jan 2003 12:42:29 -0600

Since the subject of sweeping receivers and filters has come up again, and at the risk of getting my typing hands severed at the wrist for mentioning this, I put my pet HP-3325A up for sale on that awful unmentionable place yesterday. Much like the 3336B, the 3325A is an outstanding sweeper up to 20 mHz if anyone wants to get into this test methodology.

Date: Sun, 12 Jan 2003 15:40:14 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] sweep alignment

When I went through this I just did it the easy way and hit it with a network analyzer. I forget the model but it's the one that goes to 11 MHz and then you switch the cables to get it to go to 22 MHz. If

I remember correctly Dave Medley did it the same way. Later on I tried it with a 200 MHz network analyzer and ran into the same set of issues.

Date: Sun, 12 Jan 2003 16:58:06 -0800 (PST)
From: Rodney Bunt <rodney_bunt@yahoo.com>
Subject: Re: [R-390] Alignment question attenuator...

I built a 10:1 attenuator with 50 Ohm in an 125 Ohm out. So for any measurements just add -10db for attenuation in the "matcher".

Here is the circuit.   10 db Attenuator

6 Ohm   97 Ohm

```
50 Ohm in O----\/\/\/\/------O------/\/\/\/\/----O 125 Ohm out
                             |
                             |
                             \
                             /
                             \  56 Ohm
                             /
                             |
                             |
          O-----------------O-----------------O
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From: "Kenneth G. Gordon" <keng@moscow.com>
Date: Sun, 12 Jan 2003 17:29:17 -0800
Subject: Re: [R-390] sweep alignment

Rat own, as they say. I use a cheap B&K Sweep/Function generator and a Textronix 7000 series scope. I've used the sweeper method with several receivers and it is my method of choice to align them. I have not yet tried this method on a TRF, but I don't see how it can not work with that either. It will be interesting to see what I get with the TRF. As Bob says, the secret is to sweep VERY slowly. If your scope doesn't have a long persistence phosphor, set the scope brightness to as bright as you can and still have it in focus, and turn out the room lights. Use a flashlight or similar to see the adjustments.

From: "Kenneth G. Gordon" <keng@moscow.com>
Date: Sun, 12 Jan 2003 17:45:23 -0800
Subject: Re: [R-390] sweep alignment

> What type/brand of sweep gen would be good? What is the hook-up? How
> would one install markers at 447 and 463kc? Thanks ......Steve....KJ8L

I suppose you have had answers to this question by now, but I thought I might add my experiences with this method and make a few suggestions: First of all, for 455 KHz IFs, I use a cheap B&K Sweep/Function generator, and an old Tektronix 7000 series scope. YMMV.

1) I connect the output of the sweeper to the input of the 1st mixer in single-conversion sets. In the R-390, you should connect it to the input of the mixer stage which feeds the IF strip.

2) Connect the sawtooth output of the sweep generator to the external horzontal input of the scope.

3) Connect the receiver's output (usually either the detector output or the

1st audio output) to the vertical input of the scope.

4) Set the SWEEP RATE of the sweep generator to as slowly as it will go.

5) Adjust sweep generator output level, receiver output levels, and scope controls to get as clear a visual representation of the IF passband as possible.

If the scope persistence is not very long, you will probably have to set the scope brightness to a fairly high level and turn out the room lights. You can use a small spot light or goose-neck desk lamp set to shine into the receiver so you can see what to adjust. If your sweep generator puts out a triangle wave instead of a sawtooth, you will get a double mirror image of the IF passband. MOST modern sweep generators do a pretty good sawtooth.

Lastly, for markers, you will have to build or otherwise aquire either a crystal controlled oscillator with crystals for the two marker frequencies you want above, or an extremely accurate signal generator (HP-8640-B or similar) and connect it to the input of the first mixer stage simultaneously with the sweeper.

However, since the actual IF frequency is a function of either the crystal filter crystal frequency, or the mechanical filter center frequencies, crystal markers are kinda moot.

Date: Mon, 13 Jan 2003 08:04:52 -0500
From: "Veenstra, Lester" <lester.veenstra@lmco.com>
Subject: RE: [R-390] sweep alignment

Or use a Storage_Normalizer such as HP-8750 which digitizes a slow sweep XY signal and displays it as a fast sweep XY out to a scope.

Date: Wed, 15 Jan 2003 19:06:27 -0500
From: MURPH <rickmurphy1001@earthlink.net>
Subject: [R-390] T- 401

What is the proper way to align T-401? I peaked mine at 22mc with a DVM between E210 and ground with the function switch in standby. Then peaked all trimmers on the module at their appropriate frequency.

Date: Wed, 15 Jan 2003 21:45:06 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] T- 401

That's been a debate here for as long as there has been a list. A few things people agree on:

1) Don't touch it after you have started peaking trimmers

2) If you run out of range on the trimmers moving T401 may help

3) If all the trimmers are in range (not at max or min) then there may be room to fiddle T401 At that point the best advice is to peak it for your least sensitive band *if* you can do that and still keep all the trimmers in range.

Date: Thu, 16 Jan 2003 18:13:18 -0500
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] T- 401

The Rippel site says to peak all crystal trimmers, then peak T-401 at 10Mc. (as a compromise)

Date: Tue, 28 Jan 2003 09:23:24 -0800
From: Dan Merz <djmerz@3-cities.com>
Subject: [R-390] 390/390a alignment

Hi, I noticed the generator connection points for i.f. alignment of the 390a and 390 non-a differ. The 390a puts the signal into the i.f. chassis input whereas the 390 puts the signal into the grid of the 3rd mixer. I can imagine this is because the 390a mech filters offer a degree of isolation not in the 390 but wonder if there is some other reason. Is the connector on a 390 non-a at the insertion point E210 (grid of 3rd mixer) the same type as E211 on the 390a, or is it a BNC connector? All this wondering came up as I started going thru the i.f. alignment descriptions for the two radios, and that for the R-725, to align the 390 non-a chassis I put in the 390a radio. thanks, Dan.

Date: Fri, 31 Jan 2003 15:47:21 -0500
From: "Veenstra, Lester" <lester.veenstra@lmco.com>
Subject: RE: [R-390] 390/390a alignment

Injecting on the grid of the previous mixer isolated the signal generator's load impedance from the tuning of the 455 IF input stage. The result is a better alignment of the IF.   Les K1YCM/3 (CTM1)

From: "Barry Hauser" <barry@hausernet.com>
Subject: Re: [R-390] alignment assistance for an R-390A beginner
Date: Tue, 4 Mar 2003 07:28:31 -0500

Greetings Antero and Welcome Aboard! Also apologies to the List as I think I just hit the send button before typing anything, so there will be one of those reply posts with no reply in it.

>this is the first, but probably not the last time I write to you.

Well, I hope someone writes to the group -- it's been too quiet lately. ;-)

>I have just recently acquired an R-390A receiver from Fair Radio. Having my
background in >humanities (linguistics), I chose the "checked" option in hope of a working unit.

That makes good sense. Something to keep in mind about Fair Radio. They are true to their name. This is a good time to look over the receiver carefully for any missing or broken parts, just in case they missed anything. In particular, check for any broken shaft clamps, but also any missing hardware, etc. Make sure the receiver is truly working on all MC bands. If a few are not, it is probably a bad crystal. Fair is good about replacing any missing or defective parts and it is usually not necessary to return a bad part to get replacements..

>After having paid almost another USD 550 for shipping, ...

Wow! I suppose that was for air freight. At some point you might want to get a repro tag for the front panel depending on what the receiver mostly is. However, it seems it is the traditional "depot dog", so a generic tag might be most appropriate. They can be mailed in an envelope for about 80 cents US postage.

>I resisted the temptation to apply power to it before I had changed the critical capacitors in the >IF subchassis (C-531, 547, 549, 553).

A good move.

>Obviously, I also had to make the necessary changes in the power supply for our 230 VAC. >Further, I have now changed all the capacitors in the AF subchassis listed on KK4DF's >homepage.

Also good.

>At this point, the receiver is working surprisingly well, ...

A small digression: Now that you have an R-390A, with all its substantial knobs, etc., the Drake's tuning knob may feel particularly cheesy (cheap/light) by comparison, if you have not yet "upgraded" it. This is done by filling the hollows with something like steel balls and glue or by substituting the tuning knob from an Icom R-72, which is available from Icom as a replacement part.

>Of course, my R-390A probably has who knows how old tubes and it probably
is not perfectly >aligned, which brings me to, yes, alignment issues:

It would be good if you could acquire or borrow a good tube tester. While you can simply substitute known good tubes, some replacements require an alignment. It is also important to check replacement tubes for shorts before using them. A short in a tube can cause other damage.

>I can at the moment adjust the frequency display to indicate the correct frequency as described ....specifically, I can't move the KC knob to the right (higher frequencies).

It seems that -- provided all the cams are lined up at 07 990 -- you might simply adjust the reading of the counter with the gear on the counter shaft. However, the +/- 35 kHz will be off at the ends of the 10-turn stops of the KC shaft. It would seem that you should be able to adjust for that with the appropriate clamp on that shaft. But first .... Do you have the Bristol (spline) wrenches of the correct sizes?

>So, as you notice, I'm a bit confused as to what setting affects what other settings and what the >correct order of doing things is. ....

The alignment procedures are all in the manuals, however they presume going
from start to finish, beginning with a full mechanical alignment. There isn't much in the way of isolated, individual "tweaking" instructions, because the receiver is so complex mechanically, and so much is interdependent. The only way to assure that the receiver is running at peak performance is to go through all the steps. It seems as though you have been very thorough, however, it might be a good idea to do some more checking. For example, is the PTO fairly linear over its range? In other words, is the dial accuracy about the same at the low and high ends of the bands?

Did you allow the receiver to warm up completely? Might take an hour or two for best results. If you have not already done so, "walk through" the full alignment as much as possible without changing anything. You can do some alignment just using the crystal calibrator, however, it would be better to have a signal generator available. A modest unit will be good enough, however, for accuracy, a frequency counter should be used along with it. The small pocket-sized counters are sufficient. Hopefully, someone else on the list can suggest a simple adjustment -- perhaps just the coupling on the PTO.

However, any quick fix may throw something else off, even slightly off peak and you will not be getting maximum performance. Considering the investment you already have made, the accuracy you seek and the fact that you are an R8B owner, I suspect you'll be shopping for some test equipment very soon ;-). I only spent one day in Helsinki a few years ago on a Scandinavian cruise, and I do not remember too much of what I saw through the tour bus window, so have no idea as to availablilty. Typically in the US, a suitable signal generator can be purchased for under $100. A new, small frequency counter typically sells for under $75.

Radio Shack used to have one that went on sale for less than that. A signal generator with the built in accuracy required generally costs more that the sum of the two. You may be able to borrow these -- and possibly borrow the guy that owns them.

I am sure there are sources in Europe where the base price might be higher, but shipping and customs would be less. You don't need an oscilloscope. Hope this helps. Barry

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Date: Tue, 04 Mar 2003 16:34:45 +0200
From: "Bryce Ringwood" <BRingwoo@csir.co.za>
Subject: Re: [R-390] alignment assistance for an R-390A beginner

Dear Antero, Welcome. The majority of the group are in a different time zone and will offer their wisdom when they awaken. I'm afraid my advice to you would probably cause a furore as there are others who know much more about the 390A than I do. There is a wealth of information in the pearls of wisdom http://www.r-390a.net/Pearls/

The R8B can be used to adjust the frequency and end-points of the PTO, and also to check the 1st Oscillator crystal frequencies are correct. The 455kHz IF strip must be in approximate alignment, so I would tackle the RF stage next. I'm not sure how you would proceed without some sort of signal generator. I just use an ancient signal generator (Clough-Brendell w/lethal PSU) and set its frequencies accurately with a digital Rx. Now there's one thing I'm not understanding - "Medium Wave Sensitivity". In the evenings here, stations can be heard from quite long distances on Medium Wave, but there's a huge level of background noise - much of man-made from TVs and goodness only knows what else, but the level of atmospheric noise is around S5 on all my Rxs. Most of the local stations pin the meter. (Again on all Rxs). The question then, is does sensitivity matter much above 10 MHz or so ? and should I buy a Drake R8B ?

Best wishes - Bryce

From: "Drew Papanek" <drewmaster813@hotmail.com>
Date: Tue, 04 Mar 2003 15:50:16 -0500
Subject: [R-390] Alignment Assistance

<snipped> I can't move the KC knob to the right (higher frequencies)...

Cam setting seems to be about right (you mentioned alignment of timing marks at 7990 KC). With zero adjust in the center of its range, can you get about 35 KC overtravel at both ends of range (7-965 to 7+035)? If so, then reset PTO shaft to receive indicated frequency with zero adjust in center of range. If you cannot get 35 KC overtravel at both ends, reset position of large gear on KC knob shaft (with zero set in center). Then reset PTO shaft. Of course, it would be desireable to set PTO endpoint adjustment for 1 MHz in exactly 10 turns. The R-390 series tracking preselectors and tunable IF's are quite selective. If you carry the above process too far, sensitivity will suffer. It would be well to electrically align those sections. In the 1-2 MHz band, for example, sensitivity is noticeably reduced when PTO mistracks by 10 KHz. Drew

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Date: Tue, 04 Mar 2003 22:29:11 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] alignment assistance for an R-390A beginner

Once you get it all tuned up and running right the R390A should do better than the R8B below about 10 or 12 MHz. From there up to roughly 22 MHz they should run equally well. The Drake *might* do a little better above 22 MHz. A lot depends on how well each radio is working.

Date: Wed, 5 Mar 2003 08:06:27 -0600
Subject: Fw: Re: [R-390] alignment assistance for an R-390A beginner
From: windy10605@juno.com

Also, be sure and use the twinax connector (fed by coax) for the antenna. Definite improvement in sensitivity.

Date: Thu, 06 Mar 2003 10:19:07 -0500
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: [R-390] Algnment

Hello all. I recently acquired an R-390A. I have replaced all the electrolytics and recapped the AGC and AF areas. Z503 was open so I replaced it (twice after learning a valuable lesson about Q) and I have gone once through the alignment. It sounds pretty good and the response seems to be at specification. Question: the manuals don't seem to say anything about setting the crystal oscillator plate coils T401 and T207 nor aboutsetting the RF amp input coils from the balanced input. Can anyone shed some light on this for me?

Date: Fri, 07 Mar 2003 14:04:53 -0500
From: K2CBY@aol.com
Subject: [R-390] Alignment - Gord Hayward Question

Of the three questions, T207 is the simplest to align. Set the Megacycle control to any frequency below 8 MHz. Put an RF probe (or a scope probe) on the cathode of V202 and peak L403 for maximum output at the 17.00 MHz crystal frequency.

T401 is a different story because L234 has to resonate over the complete range of frequencies from 11.0 MHz to 34.0 MHz with only the values of the shunt capacitors switched from band to band. The simplest answer is if each of the trimmer capacitors peaks the output signal don't fool with it. The only time it has to be adjusted is if one or more of the trimmers has to be set to maximum or minimum capacitance to get a peak. (In other words, the screwdriver slot of the ceramic trimmers should NOT be perpendicular to the front panel.) Ideally, the slug of L234 should be set so all the trimmers are somewhere around mid-range when adjusted for peak output. TH-5820-358-35 sort of buries the procedure for adjusting the antenna balance trimmers in paragraph 122 on page 164. I connect a 62 ohm carbon resistor from each side of the balanced antenna jack to the hot lead of a signal generator that has been terminated with a 125 ohm load. Follow the procedure in subparagraphs "a" thru "e" and "g" of paragraph 122. Adjust the "BAL" TRIMMERS C201A, C205A, C209A, C213A, C217A, and C221A for MINIMUM indication of the meter collected to the DIODE LOAD terminal with the front panel ANT TRIM knob peaked.

From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: Re: [R-390] Alignment
Date: Sun, 09 Mar 2003 17:05:13 -0500

Gord, I feed my r-390a using the balanced input and tv ribbon. I adjusted the balancing trimmers this way: I put the main dial to the center frequency of the respective rf coil. I put two matched 150 ohm resistors in series across the balanced antenna input. I attached a signal generator to the center of the two resistors and ground. I injected a weak signal and adjusted the balance trimmer for a dip (null)on the carrier meter. It was quite sharp. Do this for every rf coil and also peak that coil (the other adjustment)by grounding one side of the balanced input and feeding a weak signal to the other side. Be sure the front panel antenna trim control is near zero and/or the two red dots on the gears are aligned.
.....Steve...KJ8L

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bDate: Mon, 07 Apr 2003 16:10:21 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Distortion

>..probable cause for an R-390A going into distortion when the RF gain is turned up above 5?

1) Remove all tubes substituted for the originally specified ones in attempt to make the receiver "hotter". Replace with the correct tube(s). Do not delude yourself in thinking that a higher gain tube is going to make the radio work better.

2) Make sure your IF gain adjust pot is not set too high. See Chuck Rippel's site for the instructions on how to set it.
specifically: <http://www.R390A.com/html/gain.html>
Which I quote here to make it REALLY easy for any one wanting to do this (parentheses are mine):

Procedure to set R390A IF Gain: (by Chuck Rippel)

Once the receiver has been fully mechanically and electrically aligned, the final procedure to perform before "buttoning it up" is to set the IF gain control. Many otherwise very sensitive R390A's are thought not to be due to weak signals being covered by noise generated by excess IF deck gain.

Allow the receiver to warm up for at least 1 hour then:

1- Terminate the antenna input (put 120 ohms across the balanced terminals, or ground one and put 50 ohms from the other to ground)

2- Set receiver for 15.2 mHz

3- Set the "FUNCTION" control to MGC

4- Select the 4kc filter with the "BANDWIDTH"

5- Set "RF GAIN" control to 10 or maximum

6- Peak the "ANTENNA TRIM" for maximum noise as indicated on the "LINE LEVEL" meter (If you get no peak you have other problems, most likely alignment.)

7- Set "Line Meter" switch to -10db scale

8- Set "Line Gain" control to full CW or "10."

9- Adjust IF gain control, R-519 to cause "Line Level" meter to indicate between -4 to -7 VU.

10- Re-zero the carrier meter control, R-523

11- Set controls above for normal operation and reconnect antenna

(12- Please report to the list what success you had with this.)

(What this does is set the IF gain so that with the audio and RF gain full up, you get a modest but discernable noise from the front end, the first RF amplifier. The overall gain of the radio is enough so you can hear any, repeat any signal that is just below, at or just above the noise of the radio itself. And, the IF and AVC system can manage the gain of the various stages of the radio to keep distortion to a minimum. Each stage of the radio is pulling its fair share without being run at too much gain. No stage overloads more than necessary or at a signal level lower than is optimum.) Roy

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From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Distortion
Date: Mon, 7 Apr 2003 14:12:41 -0700

Is this also a good procedure for the R-390?

Date: Mon, 07 Apr 2003 17:26:26 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] Distortion

Generally, it is a good procedure for all receivers. The first stage should set the noise level for the entire receiver. If a signal won't pass the threshold of first stage it won't be heard. from a snowy NY (in April, Grrrrr) Jim

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Subject: RE: [R-390] Distortion
Date: Mon, 7 Apr 2003 14:28:33 -0700
From: "David Wise" <David_Wise@Phoenix.com>

Roy mentioned tubes and IF gain. I'll add C551, the AGC filter cap. It's frequently leaky. If the problem clears up when you switch AGC to FAST, that's it for sure. If it gets better but doesn't go away, check C548 too.

From: "Jim Miller" <jamesmiller20@worldnet.att.net>
Subject: Re: [R-390] Distortion
Date: Mon, 7 Apr 2003 17:56:17 -0400

The geared shaft going into the Antenna Trim can is at a high impedance...it "sees" the front end AGC line. If you mistakenly lubricate the gearing and saturate the phenolic sleeve, it may begin to show enough conductance to drag down the AGC line. Some people mistakenly lubricate these gears and saturate the sleeve...not a good idea. Get a trichlorethane or equivalent moisture displacement spray and clean off the shaft and gears, especially the phenolic sleeve under the gear.

From: "AI2Q" <ai2q@adelphia.net>
Subject: RE: [R-390] Suggested Test Equipment for R-390A Alignment ??
Date: Wed, 9 Apr 2003 10:16:27 -0400

The URM-25 and other generators like it are really FB, and I have a URM-25 on my bench, but the fact is that you can align an R-390 or '390A very adequately with an old Eico or Heathkit signal generator too. Other companies made these low cost instruments too, and they're all adequate for an acceptable job on R-390 Series receivers.

Date: Wed, 09 Apr 2003 11:36:32 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] Suggested Test Equipment for R-390A Alignment ??

I also have a URM-25 and like it. However the older generators also did a good job. The calibrated output and attenuators are useful for trouble shooting.

Date: Thu, 10 Apr 2003 16:46:01 -0700 (PDT)
From: Randy Zelick <zelickr@biohazard.pdx.edu>
Subject: Re: [R-390] Suggested Test Equipment for R-390A Alignment ??

Speaking of generators, I have a very nice HP 8640B, the source that several folks have been praising. Indeed, I like mine very much and would agree that it is probably the best generator I have owned. One advantage of this design (a cavity resonator) is the high spectralpurity. It can be a plus when tuning selective filters. You can get high output without a lot of spurs only 30 dB down that can lead to misalignment. But here is an issue with my unit: It leaks RF!!! Has anyone else had this experience with an 8640?? I can't believe it is supposed to do this, yet I can find no fault with my specimen. It is lot leaking out the attenuator, which is well calibrated down to 0.1 microvolt. Rather it seems to be leaking out the case. Switching off the RF using the little slide switch next to the output connector does not affect the leakage. Thanks for any suggestions.

From: "Glen Galati" <eldim@worldnet.att.net>
Date: Thu, 10 Apr 2003 18:11:22 -0700
Subject: [R-390] HP 8640B RF Sig Gen Leakage???

What are you using to discern the RF leakage from the case of your 8640B?

Is the leakage coming from a particular section or is is uniform over, across, around, etc. the generator? I'll present this to our resident 8640B expert and see what his experience, and thoughts are. In the interim, I will try to duplicate your case with my HP 8640B as soon as I hear from you, and what you are using to measure this leakage with.

Date: Thu, 10 Apr 2003 18:19:08 -0700 (PDT)
From: Randy Zelick <zelickr@biohazard.pdx.edu>
Subject: Re: [R-390] HP 8640B RF Sig Gen Leakage???

Here is the routine: I tune up a radio, say a VHF unit, and measure sensitivity. Then I disconnect the generator and hook the radio to a small shop antenna. Presto - an on-channel carrier. Run the 8640 attenuator to zero, or switch off the RF, carrier still there. Change frequency of the 8640, carrier gone... switch off the 8640, carrier gone.

Date: Thu, 10 Apr 2003 21:51:36 -0400
From: Kim Herron <kherron@voyager.net>
Subject: Re: [R-390] HP 8640B RF Sig Gen Leakage???

I used to have the same problem with my HP-606B. On the higher freqs is where the problem showed up. Never did find the problem, though I suspected the line bypass caps and the grounding network in the shop. I haven't checked my HP8640B on VHF freqs (above 100 MHz) but I do know that it does not do that at 30 MHz and down. Here's a thought, though. Are you using an external
timebase that has a leaking cable connected to it?? I did discover some cables that decided that the shielding wasn't good in and I replaced them.

From: "Jim Miller" <jamesmiller20@worldnet.att.net>
Subject: Re: [R-390] HP 8640B RF Sig Gen Leakage???
Date: Thu, 10 Apr 2003 21:35:38 -0400

Actually I have noted that with mine using a 390a. The 390 is so sensitive that it picks up even low leakage.

Date: Sat, 12 Apr 2003 16:07:31 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] HP 8640B RF Sig Gen Leakage???

Another way to do the same thing is to use a VHF or UHF pager. They are amazingly sensitive. Back when I was with Motorola they would go over each new generator with a pager before they would trust it for leakage. There are two basic ways to get a generator to radiate: One way is to feed signal back down the supply line. This is fairly rare in the case of stuff like the 8640. Most of what comes back out the line cord is fixed frequency stuff rather than the variable output frequency. It can be a problem in generators that are a bit simpler in design. The second way for the generator to radiate is a defective shield. It may be a piece of coax or a coax connector. It probably is a cover plate or push on cover. After years of maintenance things don't always get put back on quite right every time. Also things like emi gaskets get dirty or bent. Eventually the generator starts to leak. Here's another thought -

Do you have a military version of the 8640? If so it's only rated for leakage if it's still in the big ugly yellow tub. I don't know why that's true, but I"m told it is.

Date: Sun, 13 Apr 2003 22:48:24 -0700 (PDT)
From: Randy Zelick <zelickr@biohazard.pdx.edu>
Subject: [R-390] update: HP8640B RF Sig Gen Leakage

Thanks to all who made suggestions to remedy the generator leakage problem. It looks like the leak is plugged! Here is the tale....

I made a sniffer out of some double-shielded coax and a miniature antenna at the end. Then I tested the generator at 440 MHz where the problem was the worst, using a very sensitive 2-way radio as the detector. There was RF floating around the case at different points, but the worst leak by some margin was coming out along the shaft of the freq calibration knob. This is the tiny knob just to the right of the frequency display. If you turn it, the "uncal" light comes on. Next to that is a little hole for frequency calibration. So I popped the hood to look for problems. This 8640 is quite a nice one, just a year out of cal with the stickers still over case screws. Clean as can be inside. So rough use and/or corrosion was not a likely issue. I took the cover off the frequency counter section which is also where the calibration control shaft enters. Inside there is a small spring leaf that grounds the shaft, which became immediately suspect. It was already clean, but I cleaned it more and added a little stabilant. Still RF leaking out. Then I re-surfaced the edges of the casting which forms the cover of the counter section and tightened all the screws down. Still leaking. Finally, I made my own shaft grouding gizmo from a piece of shim bronze. I captured it with the screw that faces front and holds the two halves of the counter case at their seam just right of the display. The other end I notched so it would rub against the shaft. Unlike the HP grounding shim, mine is mounted on the outside of the counter case. No leak!! I sniffed all around the 8640 and discovered that in addition the top cover must be very well secured, otherwise more minor RF leaks present in the interior get out. These leaks seem to be coming from several sources, which I did not track down. But with the outer covers in place, I realized satisfactory behavior. The bottom line? I am a bit perplexed. Here is a generator of the highest quality and certainly appears as though attention was paid to every detail of construction. Solid castings held with many screws, gold plated circuit boards, best coaxial interconnects, and so forth. My specimen is extremely clean, unmodified, unabused and yet *barely* can keep RF from leaking out. Only with every little detail of grounding perfect does it not radiate. No overdesign there! I might speculate that the counter is the problem. The 8640 started life with a slide-rule frequency display (the A model) and likely was retrofitted with the digital counter to make the B model. Perhaps it was just too early in the days of RF counter design to seal all the RF leaks. Just for fun I ran the generator with the cast lid completely off the counter module. GOBS of RF pour out. C'mon HP! As I final note I want to plug the perverse obsession I have of saving little mechanical parts from cannibalized equipment. There is an old military transit case in the corner of my shop where this variety of schmutz accumulates. I'm sure it will be the first thing my kids pitch in the dumpster when I go to the big test bench in the sky, but it took but a few minutes of rooting through the six inches of levers, pawls, shafts, couplings, washers and (very) etc to come up with the magic grounding shim. So there you have it. Cheers, =Randy=

Date: Wed, 16 Apr 2003 18:35:11 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] update: HP8640B RF Sig Gen Leakage

Hey, good job!!! This is the same sort of thing they used to have to do back at Motorola on the same gear fresh from HP. The bottom line seems to be that most people don't check really low levels with this kind of gear.

Date: Wed, 16 Apr 2003 20:00:21 -0500
From: mikea <mikea@mikea.ath.cx>
Subject: Re: [R-390] update: HP8640B RF Sig Gen Leakage

Maybe this (leakage) is why I keep running out of attenuator when I try to do sensitivity measurements on my R-390.

Date: Fri, 18 Apr 2003 15:28:40 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] update: HP8640B RF Sig Gen Leakage

Any time you are working on a sensitive radio it's a good idea to check for stray pickup. The R-390 isn't as well shielded as it might be and as this thread has demonstrated there are problems with signal generators as well. A simple quick check is to pop the coax off of the generator and then touch the shield of the cable to the chassis of the generator.

That way you have the same ground loops set up when you do the check as when you do the test. If all is going well you should be able to crank the generator output up fairly high before you hear anything in the radio. You should not be able to hear a difference when you power cycle the generator. If you fail the test then a quick solution is often an attenuator at the input to the radio. This obviously will only work if the signal is getting in through the antenna and not if it's coming in through the power cord.

If it's still a problem then simple separation of the generator and the radio often helps. Filtering type rfi/surge suppressors also can come in handy. None of this is specific to any one R-390 (A or not an A) or HP-8640. All are usually good pieces of gear. Any of them can have problems and it's a good thing to check when you are doing work. It can save a *lot* of time

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Here is some related stuff from the Collins reflector that has some use for us.... remembering that 74A4's employ a simple 500kc Xtal filter unlike our R-390A's setup... also nice advice from Dr. Jerry........ ed.

Date: Mon, 07 Jul 2003 14:11:44 -0400
From: Bill Russell <wgr@adelphia.net>
Subject: [Collins] 75A4 sensitivity

This might be a long question..... I have a 75A4 that exhibits a lot of background noise. I will try and explain. The 7 deadly caps have been replaced by the previous owner although the value is larger than the originals. When I got the radio, it would overload very easily. I found that the IF transformer for the AGC amplifier was way out of adjustment and I had very little AGC voltage. After alignment of this IF can, I now have plenty of AGC voltage and no more overload but the gain of the radio seems very high.

With the IF gain control set at minimum and the s meter sensitivity also set at minimum, I always have a noise level of at least S9. When I remove the antenna, the S meter will fall to 0 but as soon as I connect the antenna its back up S9 or more. When I set the AF level for a comfortable listening level on a fairly strong station, the background hiss is very annoying. Its not noisy band conditions because when I switch to my SP600 or NC303, the band is quiet. As a matter of fact, my SP600 S meter will read about S1 but the A4 will read S9 to 10 over!!! Remove the antenna and back to 0 on the S meter and the background hiss will drop but I think its still noisy.Any ideas will be greatly appreciated. Thanks much, Bill Russell

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Date: Mon, 07 Jul 2003 17:54:01 -0400
From: Ed Tanton <n4xy@earthlink.net>
Subject: Re: [Collins] 75A4 sensitivity

One quick thing you could do that might isolate it to a stage: if you have a level-adjustable signal generator, you might set it to a microvolt or so, on a fequuency of your choice, and take a 'scope look at the individual stages as the signal comes in and goes out. If you can find a stage where it seems to suddenly show a lot of 'stuff' on top of the sine wave, or the gain just seems a whole lot more than the previous stage(s), then perhaps that'll narrow things down for you.

Date: Mon, 07 Jul 2003 17:14:22 -0500
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@isunet.net>
Subject: Re: [Collins] 75A4 sensitivity

What does the 75A4 have for RF stage? IF stages? Are they the original types? Is the screen bypass on the RF stage paper or disc ceramic and are its leads short? Also the plate feed bypass? Is there a 100 ohm resistor in series with the grid? If the screen bypass has short leads and is a disc ceramic, and the plate supply bypass is the same, and it has the right RF tube (no 6EJ7 or 6EH7), then I suspect a VHF parasitic oscillation. Adding a 100 ohm resistor in series with the control grid may help. It would help to be sure that the input tuning is actually to the signal frequency.

Date: Tue, 08 Jul 2003 09:11:23 -0500
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@isunet.net>
Subject: Re: [Collins] 75A4 sensitivity

I don't agree that alignment is a good diagnostic. The only radios that really need alignment are those that have been "aligned" by persons with a screwdriver and poor knowledge of alignment procedures. I believe that a radio should be made to work, find the bad capacitors, the fried resistors (and the old black beauties can often overheat screen dropping resistors) and the badly drifted resistors, and only then the alignment be tweaked if the performance is bad, as Bill found by poor AGC performance. When there is a circuit problem, such as a bad bypass capacitor, proper alignment may not be possible and may lead to misalignment, e.g. increasing signal at the detector by detuning the AGC IF stage. There has been a myriad of mods for the A4 in the magazines. Occasionally one was good, many were bad. RF tube substitution with something having 5 times the gain would give the symptoms Bill experienced. Namely oscillation.

Date: Tue, 08 Jul 2003 08:31:57 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [Collins] 75A4 sensitivity

To expand on Jerry's comments: Any boatanchor radio, Collins or not, is at least 30 years old and may have seen hard service and have been subject to dubious modifications by several previous owners. It is worthwhile to carefully check the radio against the schematic and determine if the modifications add to the functionality of the radio (in my opinion, most do not) and if they were done to "good construction" standards. Does the work look like the factory wiring? If not, fix or remove it. Every time I service a radio, I check and record the tube socket voltages and resistance. On an unmodified radio they should be within 20% of the values in the manual. I use an Excel spreadsheet to record the values. The spread sheet is set up like the tables in the manual, with empty cells for the measured values. Some simple formulas compare the measured values with
the factory (or last measured) values and let me know if I have a potential problem. A complete alignment is necessary and is also a good diagnostic tool.

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Date: Fri, 11 Jul 2003 08:23:13 -0500
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@isunet.net>
Subject: Re: [Collins] Need Advice - KWM 2A Transmitter Problems

After cleaning all the bandswitch contacts with a quarter drop each of DeoxIT, you need to attack the Erie 8-50 trimmers for each band switch position. They have a tendency for their internal connection from shaft to terminal (accessible on the bottom side) to go open. DeoxIT should work there too, but the necessary twisting to break down the oxide will destroy the alignment. It is also possible that the ceramic may be stuck making rotation difficult of impossible. Then replacement may be necessary.

I'm NOT a fan of test by alignment. Some of the slug tuned coils especially are fragile and the fiberglass has roughened the threads over the decades and one too many turns locks the slug and then breaks the coil form loose (if the epoxy hasn't already failed from old age) cause far more problems than if the coil was just a little off perfect alignment.

Date: Fri, 11 Jul 2003 10:49:58 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [Collins] Need Advice - KWM 2A Transmitter Problems

If the trimmer won't tune the circuit or has a limited range (there should be two peaks 180 degrees apart) then they are a candidate for repair or replacement. I've had success repairing stuck trimmers. Remove the small retaining ring on the bottom of the trimmer. VERY carefully take it apart and clean. That will usually do it. On a few, I used a very small amount of

rubber cement
to hold the stator in place.

Date: Fri, 11 Jul 2003 08:43:09 -0700 (PDT)
From: Glen Zook <gzook@yahoo.com>
Subject: Re: [Collins] Need Advice - KWM 2A Transmitter Problems

Actually, the small ceramic trimmers are very easy to clean. You remove the spring clip that holds the capacitor together. All you have to do is to use a small screwdriver or small needle-nosed pliers to compress the clip and slide it off of the post that comes from the top section of the trimmer. You do not have to unsolder the wiring which makes reassembly very easy.

Remove the top and the rubber gasket. Usually the gasket is "stuck" to the top. Carefully peel the gasket from the top. Carefully remove the flat plate from the top. You will probably have to use an "X-acto" knife slipped between the top and the plate (or a single-edged razor blade works quite well). Normally just "touching" the seam between the plate and the top will cause the plate to be released. Do this very carefully so that you don't break the ceramic. "Freezing" of the plate to the top is the most common problem of these capacitors. What happens is that when the two parts are "frozen" together the plate turns as well as the top and you cannot ajust the trimmer. If the assembly turns very far in this "frozen" condition then you loose contact with the lower portion of the capacitor and no connection is made (the capacitor is effectively eliminated from the circuit). Use alcohol to clean the flat plate as well as cleaning the top and the gasket (you might also use one of the contact cleaners but make sure that no residue is left behind). Allow to dry completely (about a minute, or so, when using alcohol). Replace the gasket on the portion that is still attached to the unit making sure that the opening in the gasket allows the spring contacts to come through. Next put the flat plate on the top with the plating on the plate showing outwards. Then reinstall top making sure that the center of the plating on the plate makes contact with the spring contacts. Finally, hold the top of the capacitor in place and turn the unit on its side. Slide the spring clip back onto the stud from the top making sure that the little positioning "dimple" mates again to the phenolic base of the capacitor and that the clip "locks" into place.

Of course you will have to do a complete realignment of the unt, but 99.9% of the time you will have restored the capacitor and it will function completely normally. Clean all of the capacitors before turning the unit back on. What I do is to record the value of the capacitor at each position (there are 2 or 3 values of capacitors used, not just the 8-50) and take all of them apart to clean. Then reassemble putting the correct value capacitor in the proper position. You will have to segregate the plates in terms of values as well since they are different between the various absolute values before cleaning. It takes longer to read these instructions than it takes to disassemble, clean, and reassemble the capacitor. I have done this to many hundreds of these ceramic capacitors in all sorts of rigs including the S-Line, KWM-2 series, etc. So far, I have been "lucky" and haven't broken a single flat plate (but, my time is coming!).

--- "Dr. Gerald N. Johnson, electrical engineer"<geraldj@isunet.net> wrote:

You need to attack the Erie 8-50 trimmers for each band switch position. They have a tendency for their internal connection from shaft to terminal (accessible on the bottom side) to go open. It is also possible that the ceramic may be stuck making rotation difficult of impossible. Then replacement may be necessary.

Date: Sat, 12 Jul 2003 16:30:55 -0700
From: Leslie Groberman <ghibli@shaw.ca>
Subject: R388 alignment

More on good alignment of R388. The IF is 500kc, so the easiest way of getting good alignment is to **put a counter on the IF out**. Then tweak the IF adjustments with as low a signal as possible with an input that results in the IF signal being 500kc +/- 100 hz. Use a scope as a signal strength meter. When you have gotten all you can out of the IF (you may have to go over the IF 3 or 4 times) then you can move onto the rest of the radio. The crystal filter should come in right on the button, and the BFO can easily be set for the middle of the range.(that is, the capacitor that tunes the BFO is pretty close to mid-range) The rest of the radio should go along without any surprises. Just peak the individual trimmers for the top end of the appropriate band. When all is said and done, it helps to plot amplitude versus frequency of the radio (this is easy with a counter on the IF out) and you can see the IF, what the crystal filter does and otherwise have some perverse fun with a 50 year old hulk that should come in at less than 1uv for 10db Sinad. It goes without saying that the ONLY problem with the radio is the alignment.

Date: Fri, 11 Jul 2003 10:49:58 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [Collins] Need Advice - KWM 2A Transmitter Problems

If the trimmer won't tune the circuit or has a limited range (there should be two peaks 180 degrees apart) then they are a candidate for repair or replacement. I've had success repairing stuck trimmers. Remove the small retaining ring on the bottom of the trimmer. VERY carefully take it apart and clean. That will usually do it. On a few, I used a very small amount of rubber cement to hold the stator in place.

Date: Sun, 13 Jul 2003 10:25:09 -0500
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@isunet.net>
Subject: Re: [Collins] RE: Collins digest, Vol 4 #184 - 5 msgs

It's better to select the IF frequency by setting the crystal filter for its most narrow position using the switch and phasing control and set the signal generator to that very narrow crystal filter frequency. You can check it with a counter, but its probably not precisely 500 KHz because of crystal manufacturing tolerance and long term drift.

Date: Sun, 13 Jul 2003 13:01:47 -0400
From: "Joel R. Hallas" <joel.hallas@snet.net>
Subject: Re: [Collins] RE: Collins digest, Vol 4 #184 - 5 msgs

The alignment you propose may give a good IF response for SSB and CW, but I think it may be too sharp for good AM reception. My 51J4 does not have the 6 KHz filter (anyone got one for cheap?), and in order to provide that kind of bandpass for the 6Kc position (jumpered across with a coupling capacitor and grid resistor, as I remember), I had to do a fair amount of stagger tuning. I would suggest use Les' proceedure as a starting point, then compare the bandpass with the crystal filter out with the curves in the manual and see what you get. If it's narrower or sharper than spec, stagger tune transformers a bit each side to try to match the desired passband. Note any change in sensitivity (I suspect not much) and decide what's more important, but I'm happy with what I got.

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end Collins stuff

Date: Mon, 18 Aug 2003 10:54:17 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Initial progress and Questions

... I'd like to take some baseline >measurements of sensitivity ...

Duplicate the setup called for in the R-390A manual if you want to be "authentic". Make believe your Model 80 is a URM-25. It has the same output requirements, I believe, but do check this.

> ... I can build a pi network with a 50 ohm input and a 125 ohm output and a >balun to balance it to the radio, but it this necessary or overkill?.......................

It is overkill, unless you really want to know what's going on at the input terminals under balanced conditions. Likely a simple toroid with carefully counted windings would do the job... BUT: The actual input impedance of

the radio varies with many factors: band, frequency within the band, adjustment of the input circuits, et. al. Soo, you'd need to arrange a swamped termination/input circuit combined with the balanced toroid to really know the input voltage with any certainty. Example: the output attenuator acccessory device supplied with the GR 1001A Standard Signal Generator had a division ratio of 100:1* and an output impedance of one half ohm*. Readings indicated on the instrument were divided by 100 to get the actual voltage. The one-half ohm value made variations in receiver input impedance have no or little effect on the voltage developed.
* I may remember these values incorrectly, but the basic idea is correct.
There can and has been much discussion on the actual voltage presented to the R-390A receiver input terminals by using the manual procedures and test equipment (URM-25). In my opinion, the methods specified give sensitivity numbers that are somewhat optimistic. But, the method did accomplish the goal of determining if a receiver was within "specifications" or if it needed work.

> The generator is a Measurements Model 80 with calibrated attenuator and 50 ohm output.

If I remember correctly, the Model 80 needs a cable terminated in 50 ohms in order to create at the termination the voltage indicated by the panel controls. This is the case with the URM-25, HP 606 series, and many other lab grade signal generators. This is not necessarily the case with the GR 1001A.

Date: Mon, 18 Aug 2003 20:33:47 -0700 (PDT)
From: John Kolb <jlkolb@cts.com>
Subject: Re: [R-390] Initial progress and Questions

Sounds like a 49.5 ohm resistor in series with a 0.5 ohm resistor.

From: R390rcvr@aol.com
Date: Thu, 4 Dec 2003 19:34:27 EST
Subject: [R-390] Felton Electronic redesign of R-390A

Does anyone have experience with the above mentioned company. He makes some pretty impressive claims, but I haven't heard anyone ever mention him or his work. http://www.feltondesign.com/ Thanks for your input!

From: "James A. (Andy) Moorer" <jamminpower@earthlink.net>
Subject: Re: [R-390] Felton Electronic redesign of R-390A
Date: Thu, 4 Dec 2003 18:29:55 -0800

I have no experience with his engineering work - I am sure the receivers

are remarkable devices, and I am sure his work is top-notch. But his reported sensitivity figure of .012 microvolts across 50 ohms can't possibly be true. Please refer to my "noise and sensitivity" page at:
www.jamminpower.com/main/noise.jsp

The short version is that a 50 ohm resistor at room temperature will exhibit a .0266 microvolt "thermal noise" voltage. This has been known for decades. A sensitivity measurement reports the voltage that is 10 dB above the base noise floor. The absolute minimum sensitivity possible with a 50-ohm load would be 10 dB above .0266 microvolts, which is about .084 microvolts. That
is the theoretical limit - the actual sensitivity is probably much higher than that.

James A. (Andy) Moorer
www.jamminpower.com

P.S. - even a receiver with a 100-200 microvolt input sensitivity is an incredible receiver! No reason to inflate (deflate?) the numbers beyond physical limits.

Date: Thu, 04 Dec 2003 20:16:06 -0800
From: Dan Arney <hankarn@pacbell.net>
Subject: Re: [R-390] Felton Electronic redesign of R-390A

Andy, You overlooked one thing Felton has the Almighty's power, just ask him. All of the rest of us know NADA. He defies all of of the rules.According to him none of us in the restoring business know anything about R-39XX or anything about quality of workmanship. He has all of the answers. Donde esta his track record???

From: "Bob Tetrault" <r.tetrault@comcast.net>
Subject: RE: [R-390] Felton Electronic redesign of R-390A
Date: Thu, 4 Dec 2003 23:00:30 -0800

Don't forget the 10db decrease in bandwidth (3500 to 350Hz) which goes directly to the bottom line. A zero noise figure receiver with a 1 Hertz bandwidth would have a sensitivity of -174dBm. Make that 500Hz BW and the sensitivity goes down by 27db (10*log500) to -147dBm. Add in the typical and conservative noise figure of 5dB for a well adjusted 390 and you're at -142dBm. That's MDS, mind you. Figure on 10db S/N and you have -132dBm. With a coherent (product detector) system, this is very typical performance figures for 390's but outstanding for modern communications receivers. Open up the BW and the sensitivity is reduced accordingly. When you realize a typical 20kHz two-tone IMD IP3 at 10dBm for the 390's you have a truly remarkable rig. (easy there, Hank, we know, we know). The dBm-BW approach is the method used by every coherent detection engineer in the world. When you convert from dBm to microvolts the numbers are startlingly small, yet nonetheless true. Mr. Johnson is still there, but his contribution has been reduced by the reduction in bandwidth. I remember working on the early Bell Labs specs for cell phones back in '82 and being unimpressed with a sensitivity spec of -112dBm until I found the references for required receiver BW to be many tens of kHz (inaudible control tones)... they all reduce to the -174dBm/Hz baseline. Every time.

Date: Thu, 4 Dec 2003 21:15:59 -0800 (PST)
From: John Kolb <jlkolb@cts.com>
Subject: Re: [R-390] Felton Electronic redesign of R-390A

I'm not saying Mr Felton's figure is accurate - it doesn't take much signal generator leakage at all to cause inaccurate measurements, but his 0.012 μV figure was for minimum discernable signal with a 350 Hz IF bandwidth and 250 Hz audio filter. That should make the 50 ohm resistor noise a little less than 0.01 μV, dividing 0.266 by the sq rt of 3500 hz/350 hz. My receivers routinely measured < 0.1 μV sensitivity with a Heathkit Lab Generator on the other side of the room, without a connection between the rx and the sig gen.

From: "DAN COTSIRILOS" <dcsfree@worldnet.att.net>
Date: Wed, 31 Dec 2003 19:05:44 -0800
Subject: [R-390] R-390A off tuning

I have a EAC R-390 like brand new it was working perfect and I don't know what I did but now it tunes on all bands exactly 50 kc off! For example 10 mc www tunes in on 9950! All I did was take off the bottom cover remove some cobwebs and turn it back and this is what I found. Any ideas? can it be adjusted back somehow? Dan

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From: "Glen Galati" <eldim@worldnet.att.net>
Subject: Re: [R-390] R-390A off tuning
Date: Wed, 31 Dec 2003 17:52:08 -0800

Just to be certain, Tune to your center calibration point and tighten 'ZERO ADJ' Knob, ZERO BEAT Receiver and 'unlock Zero Adj Knob'. Tune in WWV and check Zero Beat. Oh, by the way, make sure the BFO is set to ZERO. I'm doing this from memory as I haven't had my receivers on in ten years :~(, and I would surely follow the procedure outlined in the Operation Manual.

Date: Wed, 28 Jan 2004 10:05:03 -0800
From: Dan Merz <djmerz@3-cities.com>
Subject: Re: [R-390] HSR-2 vs 390a

Hi again, thanks for all the attention to my question regarding this homebrew receiver vs the 390a. I have corresponded with the author a few times and see that his appreciation of the 390a is extensive and that he would never say his homebrew "runs circles" around the 390a. But on the other hand he has raised another question in my mind regarding the proper operation of a 390a. Keep in mind that I have a 390 i.f. chassis in my own set so my remarks concerning its operation are for that configuration at this point.

Putting the original chassis back in may be relatively simple but it's not something I do casually or want to do very often, even for comparison purposes.   But as I recall, the other i.f. chassis did not operate much differently with respect to what I discuss below.

So... the matter of hiss , as we call it, came up. This is the noise that occurs when the r.f gain is turned up all the way with the antenna disconnected. On my receiver (and the author's 390a which he no longer owns), with the rf gain up all the way with the antenna disconnected, there is a noticeable hiss, or background noise. The hiss is greater with the bfo on and increases in magnitude as the bandwith is switched to wider settings.

The hiss doesn't move the S meter. I took this as normal and typical of most radios. It's not so loud that I considered it a problem but maybe it is. The author thought this was the thing about the 390a that interfered with reception of weak signals. My question this time: is this a normal adjustment of the 390a and does this exist in your well-adjusted receiver? I typically do not run the rf gain wide open because of this and usually operate on ssb between 12 and 3 o'clock on the rf control. I think on strong AM stations, the set works well with the rf gain wide open and I never notice the hiss.   I performed the standard alignment procedures on my set awhile back but if this hiss is unusual I may start looking for a fix.

Dan.

Subject: RE: [R-390] RE: HSR-2 vs 390a
Date: Wed, 28 Jan 2004 11:34:29 -0800
From: "David Wise" <David_Wise@Phoenix.com>

Today, rejection of interference is much more important than sensitivity. The latter is a lot easier to measure (that is, if you don't mind being wrong, see the old metrology threads), which is why you see it done so much.

There's no way a naked 6BE6 can compete with the R-390A's image- and adjacent-channel rejection.

Date: Wed, 28 Jan 2004 16:25:51 -0500
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] HSR-2 vs 390a

Hiss or internal receiver noise is generated by the mixers and amplifiers in the receiver. This is quite normal. The first test of a receiver is to connect an antenna to the input terminal. The ambient noise level should be louder than the internal noise of the receiver. If it is not, than the first RF stage is not amplifying properly (usually).

Date: Wed, 28 Jan 2004 16:35:02 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: [R-390] Receiver Sensitivity Measurements

R-390 folks, The below rant was instigated by a question from Randy Stout I hope it is at least interesting to folks on the list:

> Could you please give me a simple explanation of impedance matching for
> connecting a 50 ohm signal generator (8640B) to the balanced connector on the R-390A.

I can give you an outline of the factors involved. I've been wanting to write a rant on this topic for some time, so here goes:

Signal Generator Termination:

Most modern signal generators will deliver the indicated output voltage only if the output, including any connecting cable, is terminated with 50 ohms. At low frequencies, this can be done at the output connector but at higher frequencies it must be at the end of a 50 ohm cable. "Low frequencies" means where the cable is, say, less than 5 percent of a wavelength. At 30 mc, the effect of SWR on the cable may change the voltage at the output end if the cable is of some length and is mis-matched.

Recommendations:

1) Carefully read the manual for your generator to understand what conditions are needed for correct output voltage indications.

2) Provide the proper cable (low leakage coax) of the correct impedance (50 ohms) with correct connectors.

3) Use a flat load or attenuator of appropriate impedance at the termination end of the cable.

Notes:
1) The GR 1001A has fairly unique output termination requirements. The source impedance is not the same for all attenuator settings. Read the manual if you are using one. As far as I know, the HP 606 and later generators all require a 50 ohm termination to indicate output voltage correctly.

2) The URM-25's all need 50 ohm terminations also.

Signal Generator Leakage

All signal generators leak to some degree. This means that when you set the output attenuator and level adjustments for very low output levels, say 10 microvolts or less, signals that leak out of the generator by paths other than the output connector can be significant sources of error. One fellow reported that he measured his R-390A receiver sensitivity at about 5 microvolts. Trouble is that the Heath signal generator he was using was across the room and not connected to the receiver at all!

Recommendations:

1) Do not use Heath, Eico, or similar signal generators and expect to get meaningful results at very low signal levels under any circumstances.

2) The GR signal generators and any by HP or other professional grade makers will likely do well if properly used.
3) TEST for generator leakage. Put a modest antenna on the radio, a good load on the generator at the output connector, set the generator for one microvolt, and see what you can hear. A more severe test is to use a little loop or hank of wire at the end of a coax as a moveable antenna and "sniff" around your signal generator with the receiver RF gain wide open. Then put the load at the end of the connecting cable you intend to use and sniff some more. Running a terminated cable at a generator output of a volt or so will let you estimate the shielding performance of the cable. You may need to clean and reseat grounding and shielding features of your generator to reduce any leakage you find.

4) Use a matched attenuator at the end of very good coax for testing. This minimizes the exposure to any existing leakage at the input to the receiver. One path for signal leakage is: radiated signal from the generator enters a poorly shielded connecting cable and adds to the signal from the attenuator in the generator. For the R-390A, this might mean building an attenuator in a metal box that has a twinax connector on it. Do not trust any coax supplied by a popular company that used to supply electronic parts and pretty much only sells tv's and cell phones now.

Load Presented by the Device Under Test

The load that the device under test (the rf input terminal of your R-390A) puts on the generator load or attenuator matters a lot if you want to know the actual input voltage. If the receiver is actually 50 ohms (very unlikely in the R-390A) then it can be the proper termination for the generator cable. Since it is both likely NOT 50 ohms, and you are unlikely to know what it really is, other methods must be used if you want to be reasonably assured of the actual voltage at the input terminals.

Recommendations:

1) Understand the input impedance of the device under test, at least to the extent that you don't assume what it is.

2) Use methods to reduce the effects of variable and unknown input impedance. Specifically, use a low output impedance voltage divider at the input to the receiver. A little shielded box, two resistors and two connectors will do the job nicely (at HF frequencies.)

> I want to do reliable and comparable SN ratio measurements, so I can
> track how my receiver behaves following alignment and other tweaks, such
> as tube replacement, IF gain adjustment, etc.

Reliable, can mean a couple of things:

1) If reliable means that you can to be pretty sure of the actual receiver input voltage, you need to use a low output impedance voltage divider at the receiver input, and test for generator leakage.

2) Reliable can mean repeatable. To get repeatability, use good equipment, careful methods, and keep good notes (and never transmit into the output of
your signal generator with a transceiver!)

Comparability can mean a couple of things also.

1) It can mean consistent results from time to time. If you are careful in your setup and methods, you should be assured of consistency of results over time at your place.

2) It can mean assurance that you can compare measurements made with your
set up with those made with someone else's. In order to compare your results with those of other people, you may want to use pretty much the

same methods they use. In the case of the R-390A, using military manual procedures, this means grounding one side of the balanced input, using a 50-ohm load at the receiver end of the cable connecting the generator to the receiver, and accepting the errors that the variable input impedance and mismatch are introducing.

Tracking changes in receiver performance due to alignment, tweaks and tube changes can be as simple as just using the same setup for RF signal input every time. This means carefully using the same equipment in the same way, based on notes and records. You may choose to use the manual procedure, or its equivalent with the gear you have, or you may choose to make a more careful setup to be more assured of the actual receiver input voltage.

Recommendation: choose one of the below:

1) Use the manual procedures. If you don't have a URM-25 in good shape, use any more modern signal generator with an understanding of its termination requirements.

2) Use a reliable generator but use an attenuator with a low ouput impedance to establish a better-known receiver input voltage.

3) Do both, and compare results.

>I also would like to generate numbers that can be compared to other
>peoples, using best principles of measurement.

Unfortunately most folks who have R-390A's don't use the best principles of measurement, depending on what we mean by "best". They use the methods specified in the manual(s). Those methods are just fine for military situations with the goals of performance checking to determine suitability for service, and are very good if we want to compare numbers from two or more different people/places. They leave something to be desired if what you want to do is accurately measure such things as receiver sensitivity.

Recommendation:

1) Carry out the methods in the military manuals as closely as you can. See if leakage is contributing to your sensitivity measurements.

2) If you want to compare your measurements with those of other folks, find
out as exactly as you can what setup they used. Duplicate their methods as closely as possible, including any sources of error.

Miscellaneous observations:

1) Measuring rf voltage accurately is far more difficult than most folks realize. An accuracy of 5 percent is achievable with good equipment and very careful procedures. Accuracies of 3 percent or so are questionable under almost any circumstances. Accuracies of one percent are almost impossible anywhere. Careful reading of the specs of modern signal generators will give you an idea of the voltage accuracy they offer. Accuracy of rf voltage measurements is not normally an issue in receiver sensitivity. The difference between 1 microvolt sensitivity and 1.02 microvolts is seldom important. Whether we have one micovolt at the antenna terminal or one tenth of a microvolt is much more important, and in my opinion deserves looking into. Most signal generators depend on the following three assumptions (at least) for proper indication of output voltage level: a) the rf voltage is reliably measured or set at some high level, such as 2 volts b) the attenuator is working as it is supposed to: c) the attenuator and connecting cable are properly terminated. And at low output levels, the assumption is that leakage is minimized.

2) Measuring RF voltages directly at very low levels is nearly impossible. Calculating what we expect them to be is much easier, and is about all we can do.

3) Noise and interference from the environment may affect sensitivity measurements. Almost none of us have access to an RF shielded room to make measurements in.

4) There have been reports that re-soldering the RF path connections in an R-390A with silver bearing solder improved the sensitivity. I for one would like to hear of carefully documented experience with this.

5) If I remember correctly the R-390A receiver sensitivity measurements are made with the RF gain at maximum (and AVC off.) Thus, the setting of the IF gain adjustment may make a difference. Presumably, receiver sensitivity measurements should be made after the IF gain is properly set. If the IF gain has been cranked up to the point where the IF sections are contributing significant noise, measurements of receiver sensitivity are questionable.

6) In receivers such as the R-390A, it is the first, and possibly the second, RF amplifier that completely determines the sensitivity of a receiver if it is set up according to normal design intentions. That is, the IF section and mixers contribute very little to the noise against which the RF input is being compared.

7) One way to detect leakage in a setup is to move your hand or a metal sheet, possibly grounded, around the generator and receiver. Also, move the connecting cable(s). Any variations in measured receiver output indicate that RF is getting into the receiver by some path other than through the path from generator attenuator output to receiver input. (This method is especially useful in UHF and microwave situations.)

8) The input impedance of the R-390A is specified to fall within a range. Mil-R-13947B (which specifies the R-390 "non-A") states:

"3.13.3 Antenna input impedance.- The rated input impedance for the balanced input circuit shall be 125 ohms. In the range from 500 kc to 16 mc, the measured input impedance shall not be less than 50 ohms nor greater than 375 ohms; for the range from 16 mc to 32 mc the measured input impedance shall be not less than 100 ohms nor greater than 700 ohms."

(I don't have corresponding specs for the R-390A/URR.)

9) With the URM-25, it's very easy to get leakage. Simply connect your plastic cased counter to the "RF OUTPUT X200K" connector. With any generator made by Heath, Eico or of similar design, you get lots of leakage just the way the thing is.

10) The use of a low-output-impedance voltage divider at the receiver reduces the impact of odd receiver input impedances. Even if the receiver input impedance varies from 50 ohms to 700 ohms, a 10:1 voltage divider with an output impedance of 5 ohms will deliver an output voltage very near one tenth of the input. The 100:1 divider with an output impedance of 0.5 ohms will do even better.

Possible conditions with the R-390A: Lets take a look at some possible scenarios when measuring the receiver sensitivity of an R-390A.

A very bad case:
- The signal generator in use has some leakage and the coax being used to connect the generator to the receiver is has poor shielding (or worse yet unshielded wires are used). The connectors in use are not all that good and allow for the leakage signal to enter the cable. This combination contributes a third of a microvolt of RF at the receiver end of the cable.

- The cable is connected to the receiver with a UHF-to-twinax adapter, with
no terminating load on the cable other than the input impedance of the radio.

- The input impedance of the radio happens to be 200 ohms at the test frequency.

- The receiver is in quite good alignment and actually has a sensitivity of about six tenths of a microvolt actual rf signal voltage at the antenna input.

Here is what is going on in this situation. The signal generator's output impedance is 50 ohms. The generator is creating twice the indicated output voltage, with the assumption that the output is terminated in 50 ohms. The actual load of 200 ohms forms the expected voltage divider to deliver four fifths (0.8) of the voltage at the termination, not one half (0.5), thus an error of 30%. The actual voltage is 30 percent higher than indicated. The operator makes the measurement and arrives at a signal generator setting that produces 10 db signal plus noise to noise ratio. What might the indication be? About point one nine microvolt. The leakage is contributing three tenths of a microvolt. The actual attenuator contribution to the signal is three tenths of a microvolt, but the generator indicates 0.19. So the proud owner reports 0.19 microvolt sensitivity when it is actually 0.6. If the actual sensitivity was a little better (say 0.4 microvolt), and the generator leakage a little higher, the proud owner might report sensitivity way below that. Another contribution to error (that may or may not have ever happened) is speaker impedance variation if the output voltage is measured across a speaker load. Many speakers have a resonance somewhere in the low audio range, and it could be close enough to the 400 cycle or 1000 cycle modulation frequency to cause trouble. Even without pronounced resonances, actual speaker impedance can vary over a range from one third to four times the nominal impedance. Increased impedance at the test audio frequency, combined with the moderate output impedance of the receiver audio output would increase the measured audio voltage at that frequency. The noise is broadband and spread over the audio spectrum and the test modulation frequency is enhanced by the resonance of the speaker load.

A bad case in the other direction:

- The signal generator has very low leakage and good coax and connectors are in use.

- The actual receiver input impedance is 25 ohms at the test frequency

- The coax in use is not terminated at the receiver and SWR on the coax is such that the voltage at the receiver is slightly less than would be expected.

- The audio load is purely resistive with no resonance errors.

- The signal generator actually modulates 25 percent not 30 percent as expected.

In this case, the signal generator will indicate a voltage higher than the actual sensitivity of the receiver. The measurement might be about 0.9 microvolts or more for a receiver that actually has 0.6 microvolt sensitivity. The voltage divider formed by the load and the generator's attenuator output impedance will deliver two thirds of the indicated voltage. RF leakage and speaker resonance contribute little to the measurement. The weak modulation level makes a higher rf level necessary to generate the needed audio signal

A case of good conditions:
- The generator has very low leakage.

- The coax in use is moderately short and has very good shielding.   All connectors are good and a minimum of adapters is used.

- A 10:1 or 100:1 voltage divider is in use at the receiver antenna jack and properly terminates the cable.

- A resistive audio load is in use.

- Indicated modulation level is accurate.

In this situation, a number of good things are happening. The generator is properly terminated and well shielded coax is in use. The voltage divider at the receiver both reduces leakage into the receiver input terminals and divides any leakage into the cable by 10 or 100. We can have good confidence that the numbers arrived at are pretty good. Here are my suggestions for things that others can carry out and report on:

1) Build and use a termination/divider of 10:1 or 100:1 ratio, either inside a twinax connector or in a small metal box with a well-installed twinax connector. (A 50 ohm resistor and a 0.5 ohm resistor will get you very close to 100:1.) Use high quality coax either well fastened to the box or with very good connectors on ether end (Type N perhaps) and appropriate connector on the box.

2) Build such a termination with a toroid to match the 50 ohm cable to the nominal 125 ohm balanced input of the receiver.

3) Assemble a setup with a leaky generator, unshielded connecting wires, or poor coax, and compare results with a well designed setup.

4) Compare results at 30 mc with a long mis-matched cable and properly matched cable. Note that a quarter wavelength gives maximum impedance transformation and this length is about 8 or 9 feet at 28 mc. for foam coax.

5) Find a speaker with pronounced resonance at 400 or 1000 cycles and see if it causes different results compared to a resistive load. Use of a 600 ohm to voice coil transformer tuned by a capacitor at it's input might simulate this situation with little trouble.

6) Investigate the RF Input coil balance adjustment circuit. The input circuit of the R-390A has a fixed and a variable capacitor to establish the balance. Intentionally ground the fixed capacitor side and vary the capacitor adjustment to see if it affects the RF sensitivity measurement.

7) Intentionally make a set up that includes:

- Generator leakage in the range of the receiver actual sensitivity.
- (Possibly with a URM-25 with a radiating wire attached to the high level rf output connector.)
- A well aligned and sensitive receiver.
- Unmatched generator load.
- Leaky or unshielded connection from generator to receiver.
- SWR effects in the generator to receiver coax or wire.
- Somewhat high modulation level
- Speaker load resonance.

It might be possible to measure a receiver sensitivity below 0.01 microvolt!

From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] HSR-2 vs 390a
Date: Wed, 28 Jan 2004 19:48:28 -0600

Again I am a little late checking my mail today and this may have already been addressed....

The issue in question here is the proper setting of the I.F. gain pot internal to the radio. Lots of folks believe that if there is a gain knob higher has got to be better. In actuality there is a setting for the I.F. gain that is lower than the manufacturer published setting that results in much improved overall sensitivity.

I have found the same to be true of other radio's...such as the R-1051 series. I have found while experimenting with the alignment settings that a decrease in I.F. gain in that radio would make the difference between a

0.5uv 10db over noise sensitivity and a better than 1.0uv 10db over noise measurement. The problem with the R-1051 was it's lack of audio power...reducing the I.F. gain also reduced the resulting audio level but greatly perked up the radio's sensitivity. I have thought about finding out how low results in a point of diminishing gains and just using an external amp on the line out....I'll have to try that one day.

Best I remember from the old days (a year or so ago) many of the guys were running their R-390A's through one channel of their stereos by interfacing to the diode load connections anyway....Sounds much much better...

This IF gain decrease also resulted in a lower internal noise level with the RF gain full up.

I don't know about most of you guys but I run my RF gain full up most all the time...of course with the AGC ON....

Hope that helps a little.

Date: Wed, 28 Jan 2004 18:22:14 -0800
From: Dan Merz <djmerz@3-cities.com>
Subject: Re: [R-390] HSR-2 vs 390a

Hi Cecil, thanks for input, and I'm wondering when you run it at full gain, what is the sound like, do you hear some background "hiss" or noise, particularly with the antenna disconnected,

thanks, Dan.

Date: Thu, 29 Jan 2004 08:36:58 +0200
From: "Bryce Ringwood" <BRingwoo@csir.co.za>
Subject: Re: [R-390] HSR-2 vs 390a

Also run with RF Gain full and AGC on. IF Gain set way way way lower than when I purchased the set. Noise I get is almost all aerial noise - a combination of power lines, electric fences ,TVs , hair dryers, ... :(

Date: Thu, 29 Jan 2004 09:50:56 -0800
From: Dan Merz <djmerz@3-cities.com>
Subject: Re: [R-390] HSR-2 vs 390a

Bryce, if you use the Chuck Rippel check on i.f. gain what does your line meter read? For info, the check:

disconnect antenna

set recvr to 15.2 Mhz
function switch to MGC
4 kc bandwidth
rf gain at maximum
peak ant. trimmer for max on line level meter
line meter switch to -10 db scale
line gain control full clockwise

What is the reading on the line level meter? Rippel recommends -4 to -7 db by adjusting the i.f. gain control, assuming the rest of the radio is operating right.

I did this check on my receiver and it was reading lower than this so I'm guessing that my rf stage may need attention since if I adjust the i.f to bring it up to his recommended level, I think the noise is just going to get higher without really helping the radio receive better. As best I can recall, I used a 150 microvolt 455 khz signal to adjust the i.f. per the handbook, which according to Rippel is already too high. I also noticed that the antenna trim doesn't really peak the internal noise with the antenna disconnected so this would indicate that the rf section isn't doing its job (I think, according to Rippel). It does work in peaking a signal or band background noise.

I think this excursion into the archives answered one question that I had regarding "hiss" or noise that is there when the rf gain is turned all the way up. I think the line level meter indication is a direct measure of this level, so the -4 to -7 db is at least an indicator of what that level would be in one guy's opinion of a well-adjusted set.

Date: Fri, 4 Jun 2004 10:27:06 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: [R-390] R-390 Visual Alignment

Is the visual alignment procedure for the R-390 as described in US AS ATC&S ST 32-152 a worthwhile procedure to carry out?

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Date: Fri, 04 Jun 2004 09:57:40 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] R-390 Visual Alignment

I don't know about using in with the R-390-A, but I know from experience, it is really the only way to ACCURATELY adjust the IF tuning in multi-transformer IF stages in most superhets. I have used it with a number of receivers and it always produces amazingly better results.

Date: Fri, 04 Jun 2004 21:00:36 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] R-390 Visual Alignment

> Ken, I have never heard of a visual alignment ....

For those who are not familiar with this method, it consists of using a sweep generator covering the IF frequency, and an oscilloscope, preferably with a triggered sweep and blanking on re-trace. It would also help if the o'scope had a long persistence phosphor on the screen. For a single-conversion receiver with a 455 Khz IF, you connect the sweep generator through a DC blocking capacitor at the plate of the 1st mixer tube. Set the sweep genny frequency so that it sweeps from 440 to 460 Khz, and set the sweep rate as slow as it will go. Connect the output of the sweep generator also to the scope so that it controls the horizontal sweep and in synchronized with it. Connect the vertical input of the scope to the plate of the detector tube. You may find that connection to the grid of the detector tube makes a slight difference so try it both ways. I prefer the plate. Again, I use a large value capacitor. With the lights dimmed so you can see the trace, start your sweep generator. When you have everything set right, you will see, on the scope screen, a visual representation of your receiver's IF passband. If your scope doesn't blank on re-trace, you will see two images. By proper manipulation of the controls, you can separate the two traces.Now, when you make any adjustment to any transformer in the IF strip, you will instantaneously see the effect. You may have to adjust the sweep generator amplitude until you get a large enough trace. Once you figure out how to use this method, it is REALLY NEAT and makes perfect adjustment of IF strips really easy.

From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] R-390 Visual Alignment

The reference US AS ATC&S ST 32-152 in my note is the manual reference. I think it is commonly referred to as the Fort Devon or maybe Fort Monmouth procedure. I have a very old copy of this procedure. It was made on a hectograph and purple ink. I don't know if it would copy or scan.

Date: Sat, 5 Jun 2004 09:23:24 EDT
From: Commtekman@aol.com
Subject: [R-390] Visual Alignment

That is probably the procedure from the Army Security Agency in Fort Deven's Mass, of which I attended 44 years ago-

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Date: Sat, 05 Jun 2004 10:28:57 -0400

From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Visual Alignment

You can also do this with a modern network analyzer. I suspect Dave Medley was the first to take a shot at it on a 390 and report the results here on the reflector. Several others here have tried it as well. The main problem is that the delay time / ringing through the mechanical filters is pretty long. If you think about it they are audio gizmos and you have to wait for the sound to go from one end of them to the other. That doesn't sound like much but it can easily get up to a fraction of a millisecond. In some filters it can run tens of milliseconds. What happens on your sweeper is that the display shifts so center frequency is no longer at center screen. There is always a temptation to speed up the sweep so you can see what's going on faster. When you do so the results you see are not as accurate as they should be. An interesting replacement for the sweeper is a rig using a computer sound card in various configurations to generate and detect the signal. The main claimed advantage is that you can use the computer to store the results and don't have to try to figure out a couple of hertz rep rate on a P7 phosphor screen.

Date: Sat, 5 Jun 2004 12:40:27 -0500
From: Tom Norris <r390a@bellsouth.net>
Subject: Re: [R-390] Visual Alignment

What is the best method of doing this? Any software packages out there for "software scopes" that aren't an arm and a leg?

Date: Sat, 05 Jun 2004 11:37:39 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] Visual Alignment..computer and sound card...

Ah! Glad you reminded me...someone on the GB list mentioned this method a few months ago. I'll try to research the details and post them here. It makes the process MUCH easier and, as Bob mentioned, you can save the results. I'll look it up.

Date: Sat, 05 Jun 2004 14:19:47 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject:"Visual" alignment with a computer and a sound card...

OK. I talked with one of our GB guys about this. What you need is a spectrum analyzer program like Spectogram, which is written by a ham, BTW, and a fairly decent computer with a sound card. You then connect the sound-card's mic or line input to the output of the receiver's detector. Using the proper settings in Spectogram, you will see a perfect representation of your receiver's passband when the receiver is hearing just band-noise. If it were me, I would use one of those simple noise-generators we used to use to align VHF pre-amps.I will forward on to this list the message I got from Ron D'Eau Claire which talks about this in greater detail. There are other pieces of software available on the net which work almost as well.

Date: Sat, 05 Jun 2004 14:20:23 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: [R-390] (Fwd) RE: GB> "Visual" alignment of receiver IFs...

OK, gang, here is the message I got from the GB list. Ken W7EKB

------- Forwarded message follows -------
From: "Ron D'Eau Claire" <rondec@easystreet.com>
Subject: RE: GB> "Visual" alignment of receiver IFs...
Date sent: Sat, 5 Jun 2004 12:52:03 -0700

Ken, there's an excellent program called "Spectrogram" available on the internet that runs on most Windows PC's. Basically what you need is an PC running windows (95 or later), a sound card, and the ability to listen to "band noise" from your receiver I.F. strip that's been detected and presented as an audio signal to your computer sound card input. That's no problem, of course, if you are aligning a fully-functional receiver. It provides a great bandpass display showing frequency on the horizontal axis and amplitude on the vertical axis. You just align the filters for the desired bandpass characteristic you want, watching the display change in real-time. The most recent version of spectrogram is available at: http://tinyurl.com/3922r It's shareware with a free downloadable trial version. The current version has a timer that limits your use to 10 minutes a session (I believe it is) before you must restart the program until/unless you register it. A version of the program that is still shareware (so you are encouraged to register it and keep the developer at his keyboard <G>) but which has no timer is available at Tom, N0SS, web site at:

http://www.qsl.net/n0ss/
Scroll down the page to locate "Download Spectrogram V5.17".

Just below that link is another link: "Download Spectrogram v5.17-specific (K2) alignment docs"

That's a PDF file that was written for aligning the Elecraft K2 I.F. filters using Spectrogram. It's useful to you to see the menu setups in Spectrogram thatare recommended in this application, and it shows sample displays of what you'll see. Spectrogram is a really handy tool. I'm thoroughly spoiled after having used a signal generator and meter for so many years <G>

Date: Sun, 6 Jun 2004 14:03:08 -0400
From: "John KA1XC" <tetrode@comcast.net>
Subject: Re: [R-390] "Visual" alignment with a computer and a sound card...

> Using the proper settings in Spectogram, you will see a perfect.......

Perfect, well not quite. Not to quibble but the above statement would be true if you were using an RF spectrum analyzer and looking at the actual 455 KC IF; then the spectrum mask would be a representation of the IF passband. In the case of the audio soundcard analyzer you are looking at an audio spectrum which is the result of the detected IF signals, and this depends to some degree on the type of detector in use. To keep things simple what will be coming out of the sound card will be a composite of the LSB and USB power present in the IF response and there is no way to distinguish it at this point.

What this means is that if you see an unwanted dip in the audio spectrum you really can't be sure which side of the IF passband is causing it, so it's actually possible to over-compensate the wrong side of the passband response in an effort to make the detected audio response look flat on the audio analyzer. Of course if you happen to adjust the correct side of the passband to begin with then things would work out better. Perhaps by manually tuning the receiver across the calibrator signal and watching the carrier meter you could get a better idea of which side of the passband might be causing trouble and then proceed from there.

So the swept IF method of measurement is really the only accurate way to measure a passband response, as long as it is set up properly.----

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Date: Mon, 07 Jun 2004 12:38:39 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: RE: [R-390] R-390 Visual Alignment

>The reference US AS ATC&S ST 32-152 in my note is the manual reference.

I have a PDF version of the manual (file name ST-32-152.pdf), and it is available at: <http://www.r-390a.net/ST-32-152.pdf> Also, I will mail it to anyone who asks for it. The title is: ST 32 - 152 VISUAL ALIGNMENT OF RADIO RECEIVERS R 390/URR AND R-390A/URR
USASATC&S 32-152 March 1959

Notes:

1) The title uses the word "alignment" but the word "alinement" is used in the text.

2) Figure 5-4 is supposed to be a sine wave but actually shows an S- hook shape that is not possible as a diagram of a voltage over time (But you can get the idea.)

3) Some of the information relates to non-retrace-blanked situations where the RF sweep is derived from the line voltage and is a sine wave. More modern sweep generators will be more convenient to use.
4) The majority of the procedure is for the R-390/URR (the "non-A") and a brief description of the procedure for the R-390A/URR is given, with many statements that it is the same as for the "non-A".

Date: Sun, 27 Jun 2004 10:50:09 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: [R-390] aligning the balanced input

I align the balanced input by selecting two matched 68 ohm resistors. I solder them in series and push the wild ends into the balanced input connector. I attach a signal generator to the center of the two resistors, and apply a signal. There is a deep null at the balance point while adjusting the balancing trimmer. Inject only a small amount of signal.

Date: Sun, 27 Jun 2004 14:19:19 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] aligning the balanced input

There is nothing wrong with the procedure you use. Provided you shield the setup and are careful about lead lengths and stray capacitance it will work and you are doing it correctly. If you want to go a little more nuts on the circuit then put a 50 ohm resistor from the center tap of the two resistors to ground. That will give the signal generator something to run into. It won't have any effect on the outcome of the test but the signal generator police will not give you a ticket next time they cruse by.

The only problems with the process are that it uses yet another custom test rig and it only makes sense on a 125 ohm balanced input radio. Since you need a 125 ohm to 50 ohm adapter to set up the balanced radio in the first place that makes two odd setups to keep track of. I have enough trouble just finding my soldering iron from time to time .....

On a 50 ohm unbalanced radio you are going to short out the balance adjustment cap as soon as you hook up the coax. Once you short out the balance cap the tuning of the first RF circuit changes. That pretty much eliminates any benefit from doing the balance adjustment.

If you are running a true 125 ohm balanced setup then the balance cap adjustment is a very necessary part of the alignment. If you don't do it then the input simply isn't set up right.

If you use it as a 50 ohm radio tune it up as a 50 ohm radio. If it's a 125 ohm radio tune it up as a 125 ohm radio. If you are running 300 ohm balanced line into the radio then you should set it up for that. In each case the radio will run a whole lot better if you match things up.

Date: Tue, 6 Jul 2004 11:13:12 -0400 (EDT)
From: "Paul H. Anderson" <paul@pdq.com>
Subject: [R-390] URM-25 RF output measurement

I need to align a nice 67 EAC. To set the receiver gain pot, I have to set my URM-25 to 150 microvolts output (then adjust the gain until the diode load voltage is -7 volts).

How can I tell if my URM-25 is actually putting out 150 microvolts?

Do I need a calibrated RF meter with a known input impedance and make sure that is matched to the output of the URM-25? Thanks for any suggestions...

Date: Tue, 06 Jul 2004 12:24:30 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] URM-25 RF output measurement

This is actually two questions in one.

The first one deals with how to set up the IF gain adjustment. There has been quite a bit of work done showing that the procedure in the manual does not result in the most sensitive radio. It does result in a radio that can be rigged up in a diversity system. Since most of us are not running diversity setups there are better ways to set the gain. Chuck Rippel certainly has made the most posts about this so I think you might want to check his web site for the details.

The second question is how do I make sure I know what my URM-25 is actually doing? Needless to say this has been another of those things that long threads have gone on about. Here's one way to do it, there are *many* others some of which may be better:

- 1) Always run the generator into an attenuator. This way you are always
  sure of what the output impedance of the generator is. Different

people use anything from 6 db up to 20 db for the purpose.

- 2) Take a radio you reasonably trust (an R-390 is always a good candidate here ...) and run the attenuator in the generator from one end of it's range to the other while watching the radio's AGC voltage. The if the AGC jumps abruptly you may have an attenuator with a problem. Often simple cleaning is all that's required to fix it.

- 3) Grab a 20 db pad you trust and switch it in and out of the line from the generator to the radio. Since the external and internal attenuators add to each other a simple "get back to the same AGC voltage" approach will let you check the calibration on the generator's attenuator. Just like in the step above what you are really looking for are dead spots.

- 4) If you have a low level power meter you trust you may be able to get the URM-25 to drive it, if not then try step 5:

- 5) The output of a CMOS gate running with a light load goes almost from ground to the supply voltage. Feed it with a simple crystal oscillator and that's close enough to make a pretty good RF voltage standard provided you keep the frequency down to a few MHz. A couple of one percent resistors from the junk box should let you go from a K ohm or so down to around 50 ohms. Just for fun let's say it's 1K down to 50 and that gives you 250 mv peak to peak. Anything much less than this and the ground bounce on the CMOS gate may become a problem. 250 peak to peak has a 88 mv rms component in it at the fundamental frequency if I remember correctly. A pair of 20 db pads should get this down to the range that the radio and the URM-25 can reasonably deal with it.

Once you have one frequency on one band checked out then you can be pretty sure the attenuator is running fine. All that remains is to be sure you have level on all the bands. I do not see any need to try to check the attenuators range at any more than one point. It takes almost as long to describe all that as it does to do the tests. Once you are done, except for

leakage out of the generator
cabinet and the accuracy of the attenuators you used your URM-25 pretty much right on for level calibration.
You can get pretty exotic with the CMOS gate voltage standard.

The Boonton calibrators have something like a 12th order low pass filter between the gate and the output. That's overkill for what you are doing with the standard and it adds the tolerance of all the filter parts into the mix.

Padding the output part way, then putting it into a transformer to break up the grounds followed by another attenuator followed by another transformer also is said to help the ground bounce problems.

Shielded box inside a shielded box construction probably is a good idea. That way you do not have a leakage path around everything that messes it all up. Copper foil flashing material from Home Depot cuts easily and can be quickly soldered into all kinds of cute little shield boxes. Some people like brass stock from the hobby store.

If you have a good oscillator the output will be a 50/50 duty cycle square wave. The odd harmonics will fall off in a predictable fashion up through at least the first few. Since the radio will tune the harmonic just as well as the fundamental this gives you a way to check the setup.

Date: Tue, 06 Jul 2004 16:10:26 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] URM-25 RF output measurement
> ... How can I tell if my URM-25 is actually putting out 150 microvolts?

Actually, you can't. You can be more or less confindent after some testing. Bob Camp's advice on building a new rf generator or level setting device sounds like a find but challenging project.

> Do I need a calibrated RF meter with a known input impedance ....

I see two ways to do this, both depending on the assumption that your URM-25 attenuator is working as it should.

1) Follow the calibration procedure in the URM-25 manual. Basically, you set the oscillator output to two volts and then depend on the attenuator to do the rest. the URM-25 front panel meter measures that two-volt level during normal operation.

2) Get or borrow a millivoltmeter of some sort. A good oscilloscope may do in a pinch. Measure the URM-25 output level at some reasonable level

like 100 millivolts (being sure to terminate the thing correctly) and then assume the attenuator is working on other (lower) settings. If you then think clearly about what the signal generator is doing, what the termination or external attenutaor "pad" is doing, and what the load of the receiver is on that setup, you will come to some conclusions about what the actual rf voltage is at the receiver terminals. (note that the input impedance of the balanced antenna input can vary from 50 to 700 ohms.)

Date: Tue, 6 Jul 2004 13:46:17 -0700
From: "Jack Antonio" <scr287@sbcglobal.net>
Subject: Re: [R-390] URM-25 RF output measurement

I'd like to add a couple of things to the URM-25 thread: I've used a scope to check output levels, but, remember the scope input is high impedance, so make sure the sig gen output sees a 50 ohm load, and also the scope reads peak to peak, not RMS. I wouldn't use this method for absolute accuracy, but at least it will let you know you are in the ballpark. I've also used the Tektronix 2710 spectrum analyzer at work to look at the sig gen output levels. Playing with looking at really weak signals with an analyzer is an education in itself. <snip>

Date: Tue, 06 Jul 2004 17:29:32 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] URM-25 RF output measurement

So now I'm both in hot water for Lutefisk threads and in trouble for being to technical. I just can't win this week .....Every time I have gotten the "can I trust my signal generator" bug the attenuator has been the part that I trusted the least. Admittedly the waveguide beyond cutoff style used in the URM-25 and it's cousins is less prone to trouble than the switch based gizmos used in more modern equipment. The attenuator check is pretty simple and generally it gets me back to worrying about other things. The CMOS signal generator is fairly easy to build, but to your point if you don't get it quite right then it's more trouble than it's worth. There is one other way to do the whole thing. It's nice because it takes out all the errors at the low signal end of things. That's normally where you really care about it being accurate anyway. The stuff I came up with last time was all aimed at the high level end of the range. There are a number of ways to generate a fixed level of RF noise at R-390 type frequencies. One easy way is to pick up a used GR tube based noise source. You might also go looking for a tube for it as well. Since you have a R390 handy you have a radio with known IF bandwidths. Once you know the bandwidth *and* the noise level into the radio you can calibrate the radio in terms of micro volts. Poof! you have an accurate RF micro volt meter. Just the thing to check out your

URM-25 with. Since you have the full attenuator in on the URM all the tolerance build up from the accuracy of your substitution attenuator in the other procedure goes away. Note that no animals were harmed in any of the above proceedings ....

Date: Tue, 6 Jul 2004 19:40:18 -0400
From: "Michael Murphy" <mjmurphy45@comcast.net>
Subject: Re: [R-390] URM-25 RF output measurement

Bob and Roy, I agree, this is tough. Here are a few ideas. Calibrating the generator all the way down to the "knat level" that an R390A can handle may well be impossible in the shack. The leaking around problem (RF leaking around the attenuator) makes you think that the receiver is more sensitive than it actually is. (BELIEVING that the R390A really is that sensitive seems easier....) owever, finding, rolling and calibrating some decent attenuator pads may not be so difficult, at least at HF frequencies. If you can establish a reference that you can trust like 0 dBm or 1mW RMS into 50 Ohms or 0.224V into 50 Ohms or God forbid 0.775 V into 600 Ohms (something that you can easily measure with an AC meter), this makes a good starting point. You can also see how the generators attenuator works at a high level using the meter. This proves that the generators attenuator works fine and establishes that you can vary the generator by some trustworthy amount like 20 dB. Sometimes you see a pile of attenuators at hamfests. Usually these are microwave grade and are well shielded - grab them! They may be the best pieces of radio gear you will ever own. Measure (verify that they are not smoked) each attenuators loss with your generator and meter. Finally you put the attenuators in series until you get down to the signal level your need. If you can find a pair of those HP microwave attenuator banks, you havce hit gold! The attenuators will have to be a completely shielded type. Since the generator is always being used at high level, this will give you say 20 dB of range at the lower level set by the "calibrated" attenuators. If you put 100 dB of attenuators in line, you would end up with a range of -100 to -120 dBm, for example. Don't forget cable loss. This should be low at HF unless the cable or connectors are not correctly terminated. Double shielded cable like RG-223 is a must for accurate measurements. I have found that the problem (even with a lab calibrated generator) is that the signal easily sneaks around- over and through the generator chassis, cables, connector interfaces and thus around the attenuator or attenuators. I was having problems getting decent readings at work below -120 dBm at least at VHF. Having a 100 dB screen room at work, I used a feedthru connector with 20 dB attenuators on each side of the wall and got the extra isolation I needed. Fortunately HF should be easier to deal with.

Date: Tue, 6 Jul 2004 19:47:47 -0400
From: "Chuck Ochs" <jmerritt2@capecod.net>

Subject: Re: [R-390] URM-25 RF output measurement

> I need to align a nice 67 EAC. To set the receiver gain pot, I have to set my URM-25 to 150 microvolts output (then adjust the gain until the diode load voltage is -7 volts). How can I tell if my URM-25 is actually putting out 150 microvolts? Do I need a calibrated RF meter with a known input impedance and make sure that is matched to the output of the URM-25?

YES

Date: Wed, 07 Jul 2004 20:10:30 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] URM-25 RF output measurement

Well if you wanted to set up specifically for R-390's there is a magic table in the manual that spells out the frequencies to use for alignment. Roughly it works out to three frequencies per octave. It's not quite every MHz but it's close to that on the low end. It's probably more reasonable to do the top bottom and middle of each range of the URM-25. Maybe use something like 10% in from the ends and the middle. The levels you care about are generally the ones down around a microvolt. If you know you are on say at 0.1, 1 , and 10 uv then you have a pretty good idea of what your generator is feeding the radio. If the generator has to crank more than 10 uv in a sensitivity test then your R-390 is pretty sick ....If there's any interest I can probably make up some of the CMOS level standards. Somehow I seem to have most of the parts lying around here ..... they should be pretty cheap. Depends a lot on how nice a box we want to put them in.

Date: Thu, 08 Jul 2004 04:22:35 +0000
From: hdalexander@att.net
Subject: [R-390] Calibrator tone every 90 Khz

I have a Motorola R-390(non-A). The calibrator makes a tone approximately every 90 Khz., not every 100 Khz.. For example: 14000, 14090, 14180,14270, 14360. Do any of you have any words of wisdom for me? Thank you in advance for any help.

Date: Thu, 8 Jul 2004 00:50:14 -0500
From: Tom Norris <r390a@bellsouth.net>
Subject: [R-390] How To Adjust the Calibrator on a non-A

What is happening is that the crystal in your crystal calibrator is off freq. Find the calibrator chassis - It's on the bottom next to the PTO - it will have a crystal oven and 2 12AU7's on it (V901 and V902). Between the crystal oven and V901 there is a trimmer cap with a metal shaft. This is trimmer C901 (don't touch the small ceramic trimmer cap between the tubes.) With an antenna connected, tune to WWV and adjust the BFO to zero with WWV. Then put receiver in CAL mode, (make sure you have not touched the BFO knob in the mean time) zero beat the cal signal by adjusting C-901. Double check afterwards by making sure the cal marker is now every 100 kc. If not, skip a paragraph and read what to do in the unlikely event that it's still screwy.

Alternately can adjust the crystal for exactly 1.0000 MC using a frequency counter. Best way to couple your counter is to take the shield off V901 and wrap a few turns of wire around the tube for a pickoff. (Usually works for me) With the second method it is easier to see if the other non-touchable cap needs adjusting. If don't have a counter, the WWV method is what is outlined in the manual, and should be considered good enough. If the crystal will zero beat with no problem, and the points are still off, you will need to go to the cap I said earlier not to touch. Best way is to use a freq counter then adjust the ceramic trimmer C912 for exactly 100 kHz out. (several turns of wire around V902 will maybe give you enough to see the signal.) Most likely you won't need to adjust this trimmer if all else is normal. The 1 MC cal crystal does age over time and it is normal that it will need to be adjusted now and again as part of your regular PM.* It's really not as hard as it sounds, I just tend to ramble when I try to explain procedures.

Date: Thu, 08 Jul 2004 13:29:08 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Calibrator tone every 90 Khz

The crystal can't be off enough to create this situation. The 1 mc crystal drives a 100 kc multivibrator oscillator to synchronize it to the crystal. The multivibrator circit is not being synchronized and needs to be adjusted, or have some components replaced.

Date: Thu, 08 Jul 2004 18:12:29 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] VFO / BFO with no ballast.

Actually if you want to check it out here's how to do it: Fire up your GPS and take it's 10 MHz output or what ever frequency it comes out with into the front end of the radio. Tune it in with the BFO on and then feed the audio output into your PC. Run a spectrum analysis program on the PC. There are lots of free ones out there. If you get one with a waterfall display then you can watch it drift in real time.

Date: Thu, 08 Jul 2004 18:36:41 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Calibrator tone every 90 Khz

That's a little far for the crystal to have drifted. I suspect that the multi vibrator circuit has a carbon comp resistor in it that has shifted value.

Here's how to figure out if it's the crystal: Crystals are pretty tough to tune very far at all. Fortunately they rarely drift further than you can tune them. A very wide tune range circuit will pull a crystal 0.25 % of it's frequency. When you do this the stability of the oscillator is degraded quite a bit. For stable operation you rarely see them pulled more than about 0.0025%. Note that in your case the percentages refer to the 100 KHz frequency. A 10 KHz shift is 10%, way more than the crystal can move without being physically damaged. R-C circuits like the one in the mulitivibrator on the other hand can tune all over the place. That's why you see things like the HP 200 series audio oscillators using R-C circuits to set up their frequency. They trade off stability for a wide tune range. At audio you never notice the stability, but at RF you would be bothered by it quite a bit.

The manuals are generally pretty good at describing what is going on in the radio, but here's how the two gizmos work together:

The multi vibrator runs as a frequency that is close to 100 KHz, but not quite on. The crystal oscillator runs at a higher frequency. When a pulse comes along out of the crystal oscillator *and* the multivibrator is just about to go from one cycle to the next the crystal oscillator pulse makes the multivibrator cycle. The net result is that you can divide frequency this way. The technical term for all this is an injection locked divider. Back before digital IC's this was pretty common. I don't know if that helps or not but I have to post a certain number messages in threads that do not involve or mention certain words or I'm back in the penalty box .... hhmmm I wonder if penalty box is one of the words ....

Date: Thu, 8 Jul 2004 19:34:36 -0400
From: "Michael Murphy" <mjmurphy45@comcast.net>
Subject: Re: [R-390] Calibrator tone every 90 Khz

Perhaps a Motorola feature? Did you rock C310 the crystal frequency trimmer to try and zero her back in? Do you run out of adjustment? The crystal oven could have failed and cooked the crystal. Of course, it could just be a bad crystal.

Most likely, the crystal has aged badly and drifted down in frequency. Do you have a counter with a 10X probe that you can put on the crystal pins (octal pins 2 or 8 after removing the oven cover) to check for 100 kc? Do you have an old 100 kc crystal that you can plug in to the octal socket between pins 2 and 8? Next try swapping out the tubes in the calibrator.

It also could be a cap or resistor failure in the circuit. This means pulling the RF Deck - much fun! My R390A calibrator had poor output - you could barely make it out on most cal points. I pulled my RF deck a couple of months ago when I was doing my general re-cap exercisce and replaced quite a few capacitors. I can report that several of the resistors in the calibrator, especially the plate resistors on the multivibrator were cooked and way off in value.

I replaced R221, R224 and R226 with 1Watt flameproofs. Wishes for a much happier calibrator

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Date: Thu, 08 Jul 2004 17:40:15 -0600
From: Jordan Arndt <jordana@nucleus.com>
Subject: Re: [R-390] Calibrator tone every 90 Khz

This is simply due to the calibrator being out of adjustment...setting it for zero beat with WWV will solve the problem... 73 de Jordan....

Date: Thu, 8 Jul 2004 19:44:56 -0400
From: "Michael Murphy" <mjmurphy45@comcast.net>
Subject: Re: [R-390] Calibrator tone every 90 Khz

I screwed up: the crystal is actually a 200 kc job, not 100 kc.

The multivibrator is a divide by two afair much like a flip flop circuit, and thus it produces the square wave and dirty little 100 kc harmonics. If you stick a 100 kc crystal in you may get 50 kc markers!

Date: Thu, 08 Jul 2004 20:38:20 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Calibrator tone every 90 Khz

Oddly enough since the divider is also an oscillator a 100 KHz crystal will give you 100 KHz markers. The multivibrator is still timed by it's R-C circuit and it will lock lock directly to a 100 KHz input if that's what you give it. It will also probably do strange things like lock up at 100 KHz with a 333.3333 KHz input. Truly and almost unbelievable is the ability to be driven in KHz and put out in KC. It is also rumored that the circuit can be driven with KC and it will put out KHz ....

Date: Thu, 8 Jul 2004 20:22:19 -0500
From: Tom Norris <r390a@bellsouth.net>

Subject: [R-390] 390 non A calibrator is not 200 kc

Far be it from me to start a fight or anything, but... In my previous post, I said the 390 non A uses a 1 mc crystal I'm sitting here looking at the manual, and I quote - "Calibration oscillator V901A, a Pierce Crystal oscillator supplies a 1 mc signal for synchronizing multivibrator V902" Not 100 kc, not 200 kc, but 1 mc.

I've got two versions of the manual here. Both say the same thing. Latest is TM 11-5820-357-35 dated 9 March 1962. The other is the "Air Force" printing which is the same manual same date. Also have the Navy Manual. Also says the Y2K CD.

The 390A does indeed have a 200 kc crystal oscillator in the cal circuit. So does the 392. Got both those radios right in front of me. Only have the manual for the 390NON A right now. Mind you the manual and schematics may be wrong....

Date: Thu, 08 Jul 2004 22:21:23 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] 390 non A calibrator is not 200 kc

Locking up a multi vibrator over a decade frequency ratio is quite a bit more tricky than over an octave. I suspect that's one of the reasons why they went to 200 KHz in the later radios.

Date: Thu, 08 Jul 2004 22:35:51 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] 390 non A calibrator is not 200 kc

The problem I am having with this is that I had *exactly* this same thing happen on one of my radios. The answer was something simple and stupid, like a wrong tube or a mashed over part shorting out to the one under it.

Wish I could remember what it was. Once I found it the fix was simple ...

Date: Sun, 18 Jul 2004 12:39:27 +0200
From: "Francesco Sartorello" <francesco.sartorello@virgilio.it>
Subject: [R-390] R390A GAIN ADJ and final testing

In accordance with TM 11-856A, para 148 (adjustment of GAIN ADJ potentiometer R519) signal generator should be connected to J513 via an MX-1487 Impedance Adapter: is this a simple 50 ohm termination for the Signal Generator as the CU-406/URM-25F or else?

About overall sensitivity, I have the impression that approximately the same results can be achieved with both antenna inputs (Balanced and Unbalanced), with proper setting of the Antenna Trimmer and alignment of the first set of RF coils is not so dependent from the antenna input used: will someone comment on this? What about Electrcal Dummy Load DA-121/U mentioned in Section 5- Final Testing? Is it, maybe, something like a DA-109/URM-25F with a resistive partitor to obtain balanced output?

Date: Sun, 18 Jul 2004 13:39:41 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R390A GAIN ADJ and final testing

Since the manuals were written there have been some changes in how we do things in these areas. The input to the radio at the antenna jack should be the same impedance as the antenna you will use. If you use a 50 ohm antenna then use a 50 ohm generator.

The dummy load mentioned in the manual is only required to convert a 50 ohm generator into a 120 ohm generator. Since we do not have very many 120 ohm antennas we rarely use the dummy load. The IF gain setting in the manual was intended for running multiple radios in a diversity system. Some of these systems used the AGC voltage as part of the "voting" between the receivers. Today thanks to members of this list we think that there is a better way to adjust the IF gain.

We set it to optimize the sensitivity of the radio. This is a lower gain setting than the military recommended in the manual. Because it is a lower gain setting it also improves the overload performance of the radio. The web site www.r390a.com has some good information on both of these points if you are looking for more information.

Date: Thu, 19 Aug 2004 10:04:37 +0100
From: Charles B <ka4prf@us-it.net>
Subject: [R-390] Preselector

What happens if you install a small preselector or preamplifier in front of an R-390A? Does it help or hinder?

Date: Thu, 19 Aug 2004 09:25:58 -0400
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] Preselector

The entire front end of a 390 is in essence one very high performance tuned preselector, and probably does the preselection function very well by itself. So unless you have a particularly strong interfering signal in an adjacent band needing additional attenuation, I couldn't see another preselector as helping. If you have a less than optimum antenna, the preamplification (or maybe an active antenna) could help overcome antenna loss, but you also run the risk of overloading the 390 front end, although this is unlikely. Sensitivity at the high bands might be improved with a pre-amp. I have also heard that 390a's have a slight droop in sensitivity in the 7 Mc range, so there might be some improvement there. But in general I would think it would be like hitching a self-propelled mower in front of a Mac truck to improve its pulling torque.

Date: Thu, 19 Aug 2004 12:20:57 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Preselector

To support J's message, it would be an unusual situation where an R-390A needed extra front end selectivity or RFI rejection. I can think of a few, however:

1) As J mentions,
> So unless you have a particularly strong interfering signal in an adjacent band needing additional attenuation, I couldn't see another preselector as helping.

The R-390's were perhaps not meant primarily for broadcast band use, and some of us live near transmitters in that part of the frequency range. For example, here at my QTH, there is a moderate power AM transmitter less than 4 miles away, and a clear channel 50 kilowatter some 10 miles away. If this is your situation, a filter or preselector of the sort used by MWL folks or beacon hunters may be all you need. If there is just one station causing trouble, try a simple series tuned trap at the frequency of the offending station from the antenna connector to ground. Here are some links to start a search for filters and the like:

Long Wave Radio (UK)
<http://www.wireless.org.uk/index.htm>

the Beaconworld Website (UK)
<http://beaconworld.org.uk/>

the Longwave Club of America
http://lwca.org/

Altair's Lowfer Page
<http://www.altair.org/lowfer.htm>

Kiwa Broadcast Band Rejection Filter ($60)
http://www.kiwa.com/bcb.html

Bandpass and I.F. Filter Information
<http://www.qrp.pops.net/bandpass.htm>
(not suggested for BCI problems from the high end of the band)

2) If you are getting cross modulation of any sort:

A) Check front end and mixer tubes for weakness or incorrect tube types. Many of our receivers suffered at the hands of folks who wanted to "make it a lot hotter" by putting in wrong tubes of higher gain, or cranking up the IF gain setting.

B) Check the IF GAIN SETTING. Do the check from Chuck's website, and set the IF gain at a reasonable level. See:
<http://www.r390a.com/html/gain.html>

3) Preamplifiers and active antennas lead to trouble if not carefully selected and used. As J says:
> If you have a less than optimum antenna, the preamplification (or maybe
> an active antenna) could help overcome antenna loss, but you also run the
> risk of overloading the 390 front end, although this is unlikely.

It's easy for BCI or other interference to exceed the ability of an active antenna amplifier to stay linear. Even a properly working preamp can cause mixing of normal strength signals if it's not a really good one. Look for product reviews and performance reports from the SWL and ham literature before you buy any pre amplified device.

The preamps built by Millen, RME and others, were intended to improve the performance of pre-war and budget receivers in use at the time. The SX-28, for instance, is terrible at higher frequencies when compared to the R-390 radios. Using one of those preamps with a well tuned-up R-390 would be quite instructive.

4) The LF "mod": One trick published some years ago to get the R-390 to operate below 500 kc
is to feed the antenna to the set past the first RF stage. This opens up the receiver to all sorts of distortion and overload. At least one article mentions the use of a preselector if you are looking for signals below the BC band. The 55G-1 RF Preamplifier made by Colllins for use with the 51S-1
receiver might be good for this, but unfortunately the only one I know of sold in quite some time apparently went for over $2,000. (On my to do list is a functional equivalent with a toobe instead of a FET.)

5) Antenna thoughts: Sensitivity at the high bands might be improved with a pre-amp.

I can't quote correctly, but the very first ARRL Antenna Book mentioned that the most and least costly improvement in any station can be made by improving the antenna. In most situations that advice still holds even though many decades have passed.

Date: Thu, 19 Aug 2004 17:02:23 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Preselector

Probably would just add weight....can't imagine improving the front end on a 390A...kinda got one built in.

Date: Thu, 19 Aug 2004 19:28:24 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Preselector

One place that a pre-amp might help an R-390 is up on 10 meters. The radio is plenty sensitive enough on the lower bands but as frequency goes up the noise level off a typical antenna goes down. The antenna it's self gets smaller and both the man made and natural noise drop off some as frequency goes up. You can come up with a sub one db noise figure pre amp for just about any band from 1 GHz on down. That has to be significantly better than the front end of most HF radios.A simple way to check if it will help: Listen to the noise out of the radio as you attach the antenna. If it goes up you don't need a pre-amp. Since you have an antenna trimmer involved it's a little more complicated than with a rice box, but the net result is the same.

Date: Thu, 19 Aug 2004 20:03:20 -0700
From: "Dan Merz" <djmerz@3-cities.com>
Subject: Re: [R-390] Preselector

Bob, I've heard this said before - and I always delight when my receiver shows noise when the antenna is connected - a good sign. But what if the preselector that I add has narrower bandwidth than the front end of the receiver I'm using but is still wide enough for what I want to hear? Won't I see a benefit by adding this preselector? another misinformed listener ready to be informed,

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Date: Fri, 20 Aug 2004 10:35:04 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Preselector

The balanced input to the R-390 has some fairly good filters on it already. In order to do better you would have to go to a fairly complex filter. The exception to this would be a notch filter for something like broadcast band overload. So far pretty straightforward ..... now off the deep end ..... Passive LC filters are not quite as simple as they look. As you add sections of a filter together they interact with each other. A simple example is to whip up two identical three element pi section 1 MHz low pass filters. Check them out to make sure they 3 db right at 1 MHz. Next put them in series and check out the result. For most filters you now have something that peaks significantly and may or may not cut of anywhere near 1 MHz. If you do the math for a proper five element filter you will find that the parts values are not the same as for the two three sections put together. The two filters interacted in a fashion that is predictable (the math works) but not intuitive (1 + 1 does not = 2). Filters can be cascaded but you can't design them to run into and out of a resistive load and then go and run them into something way different ....

Now back to reality .... sorry for the drop off into theory land. If you have a passive filter on the front end of the R-390 *and* its narrower than the filter that's already in the R-390 front end then they probably are going to interact. The result may be a filter with more loss or a wider pass band than you expected. A solution to the problem is to isolate the two filters. That way they won't interact. The good old way to do this was to slap a tube in between the two filter sections. That keeps each filter so it runs like it should. Another equally good solution is to slap a 10 db attenuator in between the two filters. Either way the filters each see a proper resistive load and they work right.

If you go with gain to isolate the two filters then you have a real possibility of overload and distortion. If you put in a pad then you have cut your sensitivity. Either way you are trading off one thing for another. I'm not suggesting that you can't do a better job than was done on the radio originally. All I'm saying is that it's a fairly complex thing to do.

Date: Fri, 20 Aug 2004 11:05:26 -0400
From: Bob Camp <ham@cq.nu>
Subject: [R-390] Antenna Noise

We (I) keep talking about the noise of the radio going up as the antenna is attached. That's all well and good and it's an excellent way to check a receiving system. Like everything there are a few things you need to be careful of on any radio and a few things specific to the R-390's.

The first thing to watch out for is a front end that is going in and out of oscillation. This is not a problem on a well designed radio, but not all radios are well designed. It can be an issue on a radio that's broken.

Generally the effect is dramatic, the noise goes from "lots" to "none" when fairly small changes are made. The front end gain goes pretty much to zero db when it starts to oscillate....

If you have a radio with a very hot front end then it may have a significantly different noise output with 25 ohms on the antenna terminals than with 100 ohms. To be absolutely accurate you should first measure the noise with the correct resistor on the antenna terminals and then check it with the antenna. If you are working on a moon bounce 0.4 db noise figure pre-amp for your R-390 then this is something to watch for.

An R-390 and most of the radios of it's era have a tuning adjustment on the front end of the radio. Modern radios seem to have forgotten just how neat a thing this is. Unfortunately this makes the antenna test a little more difficult on the older radios. To be totally accurate you need to first peak up the radio with the resistor on the antenna input and then peak it up with the antenna. The proper comparison is between the two peaked conditions. On a radio with a good AGC you can have a case where the AGC comes in and makes this all a bit hard to check. Most noise measurements are made with the AGC turned off for this reason. As an alternative you can monitor the AGC voltage and see what's going on. Of course to do this you need a radio that was nicely designed to have the AGC voltage show up on a easy to get to terminal strip on the back, or better yet a nice Navy installed jack on the front panel. IF filters do not all have the same insertion loss. If you have a radio with significant differences between filters this can be an issue. One example would be a 4 KHz filter that has the foam inside turning to sludge. In that case you need to check with the filter you will be using. On a normal radio with well matched filters the measurement will be lots easier with the widest bandwidth filter you can switch to. That way the noise through the filter will swamp any audio chain hum and noise as much as possible. So now we have a really complicated way to do something that was nice and simple. What you used to be able to do in about 10 seconds now takes the better part of an hour and requires a spread sheet to interpret the results. Well maybe not. The human ear is a marvelous thing. You can pretty quickly tell the difference between antenna noise (static pops and crashes) and thermal noise (no pops). Once you get used to the difference it's easy to spot a problem. So much for all the theory junk above and back to a quick and easy check.

Date: Fri, 20 Aug 2004 10:24:14 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Preselector

I agree with Lester and others that have commented. I think the first question that needs to be asked is what problem are we trying to fix? Are we trying to increase sensitivity, reduce noise floor, eliminate adjacent channel interference..etc...?? (probably others that could be added to this list) Then determine two things....is the radio fully up to specification and not the source of, or contributing to, the problem. (try other radio's on the same antenna system and determine if the problem still exists...even a high quality modern rig.) Then when all those questions are answered and the radio is eliminated as part of the problem...what would be the most appropriate fix for the problem. Could be as simple as some grounding improvements. Could be a local interference source that needs to be located...might be contributing to the creation of an intermod problem which can present itself as adjacent channel problems or overloading. (not a front end filter in the world going to fix an on frequency intermod problem)

As you can see we are shooting in the dark here....

I would say in general, the addition of a preselector to the front end of a properly working R-390A would probably not be an improvement....even with a preamp because unless the preamp is a late vintage, well designed preamp it would probably contribute more to the raising of the noise floor than to the improving of weak signal responsiveness of the radio. A well designed radio has the gain well distributed along the signal path to detection...adding significant additional gain to the front end brings along with it a truck load of new problems....even when combined with tunable selectivity.

I've heard stories of guys bringing in an R-390A to replace any number of receivers used in amateur rigs of the last 20 years at annual Field Day events practiced by the Amateur Community because a complete operating position was rendered useless due to overloading from a co-located transmitter and antenna system but on another amateur band. The R-390A didn't even know the co-located radio systems were there. (as the story goes) Makes sense since the same type conditions existed many times in ship board installations.

Hard to improve on that!

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Date: Fri, 20 Aug 2004 11:29:13 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Preselector

>I see a benefit by adding this preselector?

The preselector is operating at the received frequency, and will almost certainly have a bandwidth wider than the IF if the receiver. The IF bandwidth is set by the mechanical or crystal filters (and by the whole IF strip for those with "the MAN's R-390".) The Preselector is a tuned circuit (or maybe two) at the normally much higher received frequency, and the Q needed for, say, 4 Kc bandwidth is not practical to build. The situation is different at LF and VLF, and in particular with TRF and regenerative detector receivers (such as the RAK/RAL at lower frequencies.)

Date: Fri, 20 Aug 2004 11:32:34 -0400
From: "WF2U" <wf2u@starband.net>
Subject: RE: [R-390] Antenna Noise

Re.: low noise front ends - it is good to keep in mind, that the ambient atmospheric noise in the HF band (up to 30 MHz) averages 8 dB. Going out of the way on HF with attaching sub - dB noise figure preamps is a complete waste of effort, as it's not going to reduce the 8 dB noise you're going input to your receiver even under the most idealized conditions. Antenna mismatch from the lowest noise input complex impedance at a particular frequency and individual receiver is going to contribute additional noise. As we all know, the best noise figure is not at the best impedance match anyway... Fractional dB preamps are only valuable and necessary in the higher frequency bands - VHF, UHF and microwave - where the ambient noise is under a dB or less.

Date: Fri, 20 Aug 2004 11:54:14 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Preselector

I agree that it's better to have a destination in mind before you pull out of the driveway ... One of the things that we all are putting up with a lot more of these days is man made crud. Seemingly simple stuff like toasters all of a sudden are full of strange RFI inducing gizmos. This not the world that the R-390 was designed for. There are several paths that RF can take to get into an R-390. The antenna connectors are the obvious ones, but the power cord is an equally good path under some conditions. Almost any wire that attaches to the radio *can* act as an antenna. For those of us who live on multi hundred acre estates with several rhombics to choose between for any particular direction and band this is a particularly significant issue. It also impacts those of us who live in the real world. The line filter on the R-390 is there for a purpose. On a lot of radios this filter has not survived very well. Replacing it with an outboard filter is a reasonable solution to the problem. Isolation of any lines you have off of the radio may be as simple as a couple of resistors and maybe a coil or two. It may be a lot more complicated depending on how much crud you have in the same room as the radio. How does this all relate to preselectors? If the crud is coming from your VGA through the audio cable to the speaker no amount of preselection on the antenna lead is going to help you. You first need to be sure that the radio is quiet *without* the antenna. This is a bit easier on something like an R1051 with it's monster shield of a case than it is on a R-390. One nasty thing can be an RF loop that runs from a local crud source out to the antenna ground. The radio sounds fine with no antenna so the assumption is that the curd is not local in origin. A balanced antenna connection can help this out. Also an RF isolation transformer may be of help. Until you are sure that the problem is definitely coming from the antenna any work on preselection will be a very frustrating exercise.

Date: Fri, 20 Aug 2004 12:09:43 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Antenna Noise

Absolutely true. The only case that can be made for a super pre amp on a good efficient antenna is up in the UHF / moon bounce area. Even a good antenna will have a significant amount of thermal noise if it's pointed at ground level targets. Not all antennas are good efficient antennas. Sixty feet of coax buried three feet down in the back yard terminated in 50 ohms will act as an antenna. It's not an efficient antenna, but it is an antenna. It will pick up signals and they can be heard on the receiver. Since the efficiency of this kind of antenna is quite low it will not have as much atmospheric noise out of it as a matched dipole. It's source impedance may be similar to the source impedance of the dipole, but it's noise will be lower. Of course the signal is also lower so who knows which antenna is better.

There are a number of these sorts of antennas out there. Most of them are quite small compared to a dipole and are resistively loaded in some way to improve directivity. The impedance match on these antennas does not imply that they have the same power capture as a properly matched short dipole. In the case of a low efficiency antenna like this you might need a lower noise front end even down at some fairly low frequencies. I'm not suggesting that we all go use our coax feed lines as antennas, only that it has been done. It is a special case but it does come up from time to time.

Date: Fri, 20 Aug 2004 12:20:46 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: RE: [R-390] Antenna Noise

>... the ambient atmospheric noise in the HF band (up to 30 MHz) averages 8 dB.

Can someone give a relatively simple explanation of what this means? I seem to remember that the "8dB" indicates that a certain (standard?)

antenna will deliver 8 dB more noise to the receiver than a resistor (at room temperature?) equal to the antenna's impedance. Do I have that right? Maybe we could watch the RF Level meter and see such a change. Related musing: I wonder if anyone has measured the response of the RF Level meter and receiver system to see if the indications are anywhere near right.

Date: Fri, 20 Aug 2004 09:46:02 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] Antenna Noise

Concerning noise levels below 30 Mhz: while I agree that noise in this range averages 8db, as implied by the word "average", there are times when it is both significantly lower, and significantly higher than 8db. Although, hanging a pre-amp on an R-390(A) is completely unnecessary, IMHO, there ARE times when, with OTHER receivers, a lower receiver noise level would be very useful. In my experience, some of these times were when I was doing 'phone patching into SEA during the Vietnam troubles. I was operating for AFMARS and working above the 20 meter band. I purposely modified the driver I was using, an SB-101.5 (!), for lowest receiver noise possible, and could often run phone patches long after the SEA stations could not be heard at all on a KWM-2A sitting along side the SB-101.5, because of the higher noise level in the KWM-2A. Admittedly, this did not often occur, but it did often enough that I thought the effort well worth while. Hopefully, the guys in SEA thought so too.

Date: Fri, 20 Aug 2004 13:21:49 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Antenna Noise

Simply put it's how much "extra" noise the antenna has. A resistor at room temperature generates a certain amount of noise all by it's self. In a 50 ohm system this is about -174 dbm in a 1 hertz bandwidth.Any antenna the size of a dipole or smaller *if* properly matched to it's load (and that's a big if in the case of antennas well below a 1/2 wavelength) will pull a certain amount of power out of the air.
To keep things simple let's just say that we compare a normal 50 ohm resistor to a normal dipole and that the dipole is up high enough that it is working well. The common way to look at it is "how much more noise did I get from the antenna than from a normal resistor?". It's a lot easier to understand 1.9 db that way than in terms something like -172.1 dbm in a 1 hertz bandwidth. The definition also fits into the noise figure concept fairly well. You can also look at it as the noise figure of your antenna. People sometimes carry it one step further and talk about the noise temperature of the antenna. People have spend a lot of time looking at

how much background noise you get at various frequencies, times of year, angles of polarization, and for all I know as a function of the phase of the moon. You also see data up at radar type frequencies that is correlated to how far above the horizon the antenna is pointed. If anything there is more data on this stuff than you can keep up with. The measuring systems I am familiar with sit there on the antenna and average the output of a receiver over a period of several minutes and then record the result. When you do this there are a bunch of variables like antenna gain and the sensitivity of the radio. One of the most common ways to do this was with an R390 hooked to a chart recorder. An awful lot of universities have an R-390 or ten sitting around from these 1950's and 1960's projects. I suspect that does not qualify for the winner in the "simple explanation" category .....

Date: Fri, 20 Aug 2004 14:05:55 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Antenna Noise

Here's a link
www.ofcom.org.uk/static/archive/ra/topics/interference/documents/rsgb.pdf to a little four page thing on noise. One of the things it shows is that the picture changes fairly dramatically at about 15 MHz. Below 10 MHz the 8 db number is probably optimistic most all of the time. The chart they give shows numbers in the 15 to 20 db range for most of the 500 KHz to 10 MHz region. The other thing they plot is man made noise. In that case you are talking about 50 db of noise by the time you get to 1 MHz. A lot is going to depend on how much noise you get from your neighbors.

Date: Sat, 21 Aug 2004 11:58:52 +1000
From: "Bernie Nicholson" <vk2abn@batemansbay.com>
Subject: [R-390] preselectors

The only case I could see for the use of a preselector with a 390A RX is if you wanted to hear in duplex mode close to your transmit frequency . Both Racal and Collins have produced boxes for this purpose, I had a pair of URC32 trancievers from one of our Oberon class Submarines that were fitted with Tracking Preselectors and I was able to have Full Duplex QSO s with in the 80 meter band with with 200Khz separation and running 1Kw input .I have also seen similar boxes for the 618T system to permit full duplex telephone calls on 747 aeroplanes, I still own a Racal box called a preselector and protection unit that I use in conjunction with my Ra17L, it was designed so that you could opperate the receiver in a transmitter hall and not burn out the rf coils when you tuned across the transmit freq. and so you dont hear birdies associated with mixer overload

This box also has the facility to instataniously switch it out of circuit so you can see what it is doing and I have never experienced a change in signal to noise ratio and all these boxes do is Increase the dynamic range of the system, further the dynamic range is increased much more on the lower frequencies than the higher frequencies due to the attainable Q of the tuned circuits dropping off as the frequency goes up there are diminishing returns.

But in a contest on 80 or 40 meters and someone running a kilowatt just down the road one can operate with impunity , or if you lived next door to a 50 Kw broadcast station you would probablly gain from having one of these boxes, the dynamic Range of the 390A is in the order of 80Db which is pretty amazing for a general coverage reciever of this age.

HOW GOOD is it well looking on the TENTEC site the published figures on the Kenwood TF2000 is 69Db the FT1000Mp is 73Db and so on, so even after all this time the 390A is still a FORCE to be reckoned with amongst recievers, I hope I have explained the use of PRESELECTORS , regards to

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Date: Fri, 20 Aug 2004 22:17:52 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] preselectors

Sherwood Engineering has a pretty good page on comparing various radios http://www.sherweng.com/table.html . The amazing thing about the R-390 is that it combines good sensitivity with good overload performance. It is not tops in either category. It's the combination of the two that makes the R-390 one heck of a radio.

Date: Fri, 20 Aug 2004 19:01:01 -0700
From: "Dan Merz" <djmerz@3-cities.com>
Subject: Re: [R-390] Preselector

Bob, ok, I am listening and becoming informed. My idea probably has no bearing on making a 390a work better. I do remember an article by D.Langford where he put a 6 khz filter in a 390a in front of all the other filters to improve the set, closer to the front end. My thinking started extending to the idea that if you didn't want to tune the radio and were happy with a fixed channel, how close to the antenna could you put a crystal or mechanical filter, and derive much improved performance.

Have such receivers been built? It would seem that whispering is one of the earliest forms of hiding your conversation from another listener. Has this principle been extended to radio transmission by making the receiver capable of hearing such weak signals that no one else, except someone with the same type of receiver, can hear the deliberately weak signal.

Or is this wishful thinking that such a concept would work? I suppose it's simpler to just encode the information by other means. Dan

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Date: Sat, 21 Aug 2004 17:26:33 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Preselector

That's a couple of different questions on a couple of different topics. Yell if I miss one of them.

Back when I worked for Motorola one of the standard products we made was a crystal filter that you stuck in the antenna line of your two way FM radio. Since the filter was in front of the entire receiver I suppose that's about as far forward in the process as you can possibly push the filter. I have seen the same thing done at HF both by Ham's and in military settings. NASA uses the same idea on their command destruct receivers. One problem with putting a poor little filter way up by the antenna is that filters have overload problems and produce intermodulation products. You can have a situation where the little narrow crystal filter actually produces a worse result than a big helical LC filter with a wider pass band. It all depends on how far away the overloading signals are from your channel.

Another problem with any kind of narrow front end filtering is that they generally have measurable insertion loss. If you have a 6 db loss in the front end filter you drop the noise figure of the radio by at least six db. If you are trying to pick a weak signal this is probably not a real good idea. To use your analogy of whispering, it only works in a quiet room. Making the room more noisy isn't going to help things much .... Cascading filters to get better selectivity is a workable idea. You have to be careful about pass band ripple. Depending on just where each filter peaks and dips you can wind up with some odd results. One solution is to use filters that have been designed from scratch to be cascaded. Another solution is to make one filter much wider than the other and pick a wide filter with very little ripple in the middle of it's pass band.

Using the minimum amount of power to get a message through is one way to reduce the probability of intercept. One issue is the relative location of the intercept station If my R-390 has a better path to the transmitter than the intended receiver then my R-390 is going to get more power than the guy the message is intended for. Since propagation can be very strange stuff a better path may or may not be related to being closer to the transmitter. There are a number of stories about HF and even VHF intercept taking place at significant distances from the transmitter. Of course they may just be stories .... Like it or not there is natural noise out there. It's a fact of life. As long as you are operating on a terrestrial path it's going to be a very significant limiting factor on what you can or can not do. Even with space communication they get to a noise limited situation, they just have to work harder to get there. Different modulation techniques result in different relationships between channel noise and noise after demodulation. They all run out of steam at some point though.

A guy named Shannon came up with a relationship about all this back in the 1940's. Still seems to hold true today ..... You can go real slow and real narrow and use low transmit power. You can go nice and fast and wide and use lots of transmit power. One interesting experiment with your R-390. Next time there's a lightning storm running a couple of towns over try to listen to a distant station through a narrow filter and through a wide one. Narrower is not *always* better .....

You can design a system to perform optimally under a stated set of conditions. That often means it will be non-optimum under a much wider set of conditions. No free lunch .....

The R-390 is an amazing compromise design that works awfully well under a wide range of conditions. It's a few db shy of being optimum on a number of measures. It is a good example of covering a lot of bases well rather then just one base and throwing the rest of it away. Even so it's only a few db away from perfect ....

Date: Sat, 21 Aug 2004 17:36:16 -0700
From: "Dan Merz" <djmerz@3-cities.com>
Subject: Re: [R-390] Preselector

Bob, thanks for the examples of real attempts at doing this sort of thing. I'll chew on it awhile. I've never read any of the initial defining theory for all this stuff - but the slow/narrow vs fast/wide makes sense and relates to what I've mostly heard and read about information theory. It may be analagous to picking any two of - price, schedule, quality- and I'll tell you what the third will be. Pick any two of bandwidth, speed (information rate), power and I'll tell you what the third has to be. Now this is getting far afield. thanks for relating your memories of some real gadgets - I'd love to know more about those filters at the front end - a crystal or mechanical filter only has so much off-frequency suppression which just isn't always good enough to keep out the strong signal relative to the one that we desire going down the pike unless we put it where the relative level of the two is more favorable, and you have to worry about noise figure degradation as well, best regards, Dan.

Date: Sun, 10 Oct 2004 17:50:35 +0800
From: face@netunltd.com.au

Subject: [R-390] R390 Posts: Excess line input voltage Noise Figures

<snip> I end with a question.

Does any of you know if Collins specified a noise figure test on the R390 series ?
Ie: a recommended test circuit.

I was going to use a carbon resistor across the co ax input (known noise voltage). to determine overall receiver noise floor. (when I get my hands on a replacement set of good bottles). But I have seen 'dummy antenna' used to evaluate more realistic noise figures when connected to a 'real' antenna. Example: LCR network used to evelaute noise performance of LF receivers... such as seen in Termans and Langsfords Smiths books) We used such LCR networks across antenna terminals years ago for lw/shop evaluating probable S/N floor under actual operations in remote, desert areas when using a resonant long wire.(2 harmonically related 'ops' frequencies)

I dont own an active, calibrated noise source and wondered whether the LCR dummy load would give a more realistic figure than just the resistor (The LCR circuit can be tuned to the resonace of the 'real' antenna, or to its receiver entry impedance at a working frequency and thus give a more realistic result than the broad banded carbon resistor approach.)

Date: Sun, 10 Oct 2004 11:44:03 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R390 Posts: Excess line input voltage Noise Figures

Rather than specifying the noise figure of the radio Collins (or more correctly the military) specified the sensitivity of the radio with specific IF bandwidths. For what ever reason this was the more common approach in that era.

The "correct" approach to making the measurement uses a resistive pad between the generator output and the radio input. You measure a signal to noise ratio on the output of the radio. The net result can be loosely translated into noise figure since you know the impedance of the pad and the bandwidth of the filter.
<snipped>

Date: Tue, 12 Oct 2004 17:59:12 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: [R-390] R-390 alignment questions

I'm doing an alignment on an R-390\URR and I didn't follow the instructions in the manual as to inputting a signal for doing the RF alignment. The IF alignment went slick...no problems. (followed the book..HA!) For the RF alignment I put a signal into the unbalanced BNC cable that attaches to the antenna relay directly to my 50 ohm input HP-8640B. Seemed the logical thing to do. The alignment went well and the radio turned out to be quite sensitive on all bands...around 0.2-0.3 uv for 10db over noise. Performs excellently on the air as well. I am aware of all the cable leakage problems and what not...but the final product turned out ok... I thought I would go back and input a signal on the balanced input through two 68 ohm resistors and set the balance trimmer for each band only to find the radio pretty much deaf. Thought maybe the antenna switch was bad....and I still have to check that tonight but I believe now that it's more the way I aligned the RF deck.

My questions are this....what input do most of you use when operating the radio? I know that going into the unbalanced input bypasses part of the tracking preselector....but it sure is easier to get a signal into the unbalanced input...especially since most of our antennas are unbalanced. If I realign as per the manual am I going to be compromising performance on the unbalanced input to bring up the balanced input....or should I expect better performance by including the additional preselector stage.

Or maybe I have stumbled upon something....the radio seems to work really good the way it was aligned? Just can't use the balanced input.(no loss here)

I assume at this point the issues are the same...390/390A. This is the first time I have aligned the RF section of one of these radio's...(bet you couldn't guess) I plan to go back and realign one band tonight and see what difference it makes. I know using the 50 ohm generator is already a variance from the manual since it specifies using the URM/25 and it terminates differently. Any suggestions are appreciated....R-1051's don't give me these kinda problems....

Date: Wed, 13 Oct 2004 20:50:38 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 alignment questions

The unbalanced input bypasses part of the front end selectivity on the radio. The balanced input is the preferred input. Some of the coils are not aligned when you only do an alignment with an unbalanced input. That's probably what happened with your radio.

Most people run the radio with one side of the balanced input grounded. The antenna hooks to the other side of the balanced input.

No matter how you run the radio you need to align the radio the same way you use the radio. If you run a 50 ohm antenna then align the radio with a 50 ohm source. If you align with one impedance and then run with another the difference should not be dramatic, but it will be noticeable. Best guess is that you would see maybe a 30% change in sensitivity.

-

Date: Tue, 12 Oct 2004 22:40:42 -0400
From: "John KA1XC" <tetrode@comcast.net>
Subject: Re: [R-390] R-390 alignment questions

Cecil, for doing the balance adjustment that's perfectly normal. I've found that to get a hearable signal for nulling I need to set the generator output several orders of magnitude greater. (Think about it, if the input balance was perfect you'd never hear ANY common mode signal).

RF alignment is best done using the low-z balanced input with one side grounded (thus making it unbalanced) and connected directly to the signal generator output. Connecting a 50 ohm sig gen output to the hi-z unbalanced input will work of course but you're *really* loading down the front end tuned circuit and probably getting a much broader peak during its alignment.

Date: Tue, 12 Oct 2004 22:18:02 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R-390 alignment questions

I feel kinda silly....after coming back in from the shop a few minutes ago and finding out exactly what John has described while out there. I didn't read the book close enough and use my brain. I knew I was doing a balance adjustment and by inputting an in phase signal on both inputs it's going to take a lot more signal....I also didn't notice I was tuning for a "NULL".... That's what happens when you stay in the shop till all hours of the night....hate to give it up knowing you have to go back to the real world in the morning... Anyway...after inputting a signal into the balanced input with one side referenced to ground only minor alignment to the first set of coils and caps was required then the balancing was performed... All is well now....sensitivity is still in the 0.3-0.4 uv range overall... slightly down from before but there is another set of coils in the signal path...so selectivity should be better.

I spot checked the other stages but found everything on peak...so I am calling it done. Antenna trimmer now peaks at the center for the input impedance being used so it looks like it's right... Thanks again for the help.... Gonna have to start giving it up a little earlier....

Date: Wed, 13 Oct 2004 08:50:28 EDT
From: K2CBY@aol.com
Subject: [R-390] R-390 alignment questions

You may be deceiving yourself with respect to the sensitivity measurement. You make no mention of terminating the 8640B signal generator. To get an accurate reading, the output attenuator of the 8640B (and any other signal generator) has to be terminated with a specific load resistance -- in this case, 50 ohms. If it is terminated with a high impedance -- i.e., the unbalanced input of the R-390A -- less current is going to be pulled through the series element of the attenuator, and the "multiply by" marked on the skirt of the output attenuator dial isn't going to be correct. What appears to be 0.2 or 0.3 uV is actually going to be higher. The BALANCED input is nominally rated at 125 ohms (though this is probably far from constant either from one band to another or across a signle band). A 50-ohm signal generator connected to the balanced input should therefore terminated by an 82 ohm resistor (with short leads) connected across the antenna input terminals.
The impedance of the UNBALANCED input is not indicated in any of the documentation I have, but it is supposed to be "high." I would therefore terminate the signal generator with a 51 ohm resistor so that it sees a proper load. Only when the signal generator is properly terminated do the output signal readings shown by the panel meter and the switch attenuator correspond with reality.

Date: Wed, 13 Oct 2004 09:07:34 -0400
From: "Veenstra, Lester" <lester.veenstra@lmco.com>
Subject: RE: [R-390] R-390 alignment questions

Of course doing the balance nul adjustment assumes you are goung to feed your rhombics with long runns of latter line in a noisy environment,

> I thought I would go back and input a signal on the balanced input
> through two 68 ohm resistors and set the balance trimmer for each
band
> only to find the radio pretty much deaf.

For doing the balance adjustment that's perfectly normal. I've found that to get a hearable signal for nulling I need to set the generator output several orders of magnitude greater. (Think about it, if the input balance was perfect you'd never hear ANY common mode signal). RF alignment is best done using the low-z balanced input with one side grounded (thus making it unbalanced) and connected directly to the signal generator output. Connecting a 50 ohm sig gen output to the hi-z unbalanced input will work of course but you're *really* loading down the front end tuned circuit and probably getting a much broader peak during its alignment.

Date: Wed, 13 Oct 2004 08:35:24 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R-390 alignment questions

Rhombic I wish.....no ladder line either. Just a little Carolina Windom from Radio Works...fed unbalanced up about 50'.

Date: Wed, 13 Oct 2004 11:48:25 -0400
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: [R-390] R-390 alignment

One thing to note with the balanced input is that one side has a variable alignment cap to ground and the other a fixed cap. You need to make sure that if you ground one side and feed the other, you feed the side with the variable cap.

The ground shorts the fixed cap. I did the balance adjustment to set these, but I wonder if running with an unbalanced input I should just peak the response with the variable cap to match the input better. What do you think?

On a similar topic, I get some crackle when I adjust the antenna trim. I think the rotor contact is a bit dirty but getting into the box will be a major pain. I plan to try some deoxit on the shaft when I next open the case, but is there any other accumulated lore on this subject.

Date: Wed, 13 Oct 2004 12:32:18 EDT
From: K2CBY@aol.com
Subject: [R-390] R-390 alignment

Accumulated lore says to check the fibre insulated shaft of the antenna trim capacitor for oil-borne contamination.

Date: Wed, 13 Oct 2004 14:28:27 -0400
From: "John KA1XC" <tetrode@comcast.net>
Subject: Re: [R-390] R-390 alignment questions

Technically you are correct, and this is one of the several ways of measuring sensitivity that have been cussed and discussed here and on the different R390A web pages around.

-Some folks want to terminate the sig gen for 50 ohms
-others want to terminate the sig gen AND match the RX antenna input for 120 ohms so they make a minimum loss matching pad, do the measurement, and then add in the loss factor for the pad.

-others connect the 50 ohm sig gen directly to the RX.

I used to worry a lot about what is the proper "correct" method, but in reality a 390x balanced input is anything but 120 ohms; I believe it actually rises to a few hundred ohms on some bands. So now I just use the simplest method with a direct connection to the sig gen and be done with it, and BTW also use the sig gen Modulation on/off method when measuring the AM 10 db SN ratio. Both these are described in Para.166 of the TM-856A 1956 Army manual (my fave) and give me R-390A AM sensitivity values in the 0.4 to 0.5 uV range after a refurb and alignment. My feeling it this technique gives the most "honest" sensitivity measurement (or at least in the ballpark) and also aligns the receiver to a 50 ohm impedance which is a standard ham shack value. I suppose it would be cool if everybody could get on the same page with these sensitivity measurements but I doubt that'll ever happen :^)

Date: Thu, 14 Oct 2004 18:16:05 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 alignment questions

In just about every other measurement I know of what you say is exactly true. For a variety of reasons receiver sensitivity is not measured that way. In the case of a receiver you do not know the impedance the receiver presents to the antenna. It may be high and it may be low, who knows. It is rarely 50 ohms. One solution would be to measure the actual impedance that the radio presents to the antenna. With a reasonable amount of gear you could do that. Once you know the radio's impedance you could come up with a combination of coils, capacitors, and resistors that converted that impedance to 50 ohms. In doing that you would have to make some decisions about the impedance transform you applied in the process. Different individuals could make different assumptions and their data would be significantly different as a result.

Since that's more than anybody wants to go through they came up with a different approach to this particular measurement:

1) Make sure the *source* impedance of the generator is correct. The old Measurements generators came with an attenuator to do this. Most modern generators have a number of fancy attenuators in them that do this quite nicely.

2) Calibrate the generator into a 50 ohm load or into what ever impedance you are running.

3) Hook the generator straight into the receiver. Use the "calibrated" numbers on the generator to report the data.

Obviously this means that a radio *could* have twice the calibrated voltage at it's input. In fact this is exactly what most radios do. You could look at this as cheating but that's how it's done.

Date: Wed, 13 Oct 2004 18:39:54 -0700
From: "Craig McCartney" <craigmc@pacbell.net>
Subject: RE: [R-390] R-390 alignment questions

In some situations, like a large receive site, matching the impedance presented by the receiver to the antenna is not so important. The antennas all terminate in a set of distribution amplifiers. The output of these amps is what drives the receiver. The amps are nominally rated at "50 ohms" which typically means a low impedance cathode follower (or emitter follower depending on vintage) output with several 50 ohm resistors, one in series with each output connector. This is the setup at all the Globe Wireless and AIRINC HF sites (and also in my shack). In this case I think it is best to align (and measure) the receivers on the bench with the 50 ohm termination or matching pad. Then they will be optimized for a 50 ohm system. By the way, most antennas are not 50 ohms resistive over much of a frequency range (if any). Just some rambling thoughts.

Date: Thu, 14 Oct 2004 13:41:54 +0800
From: face@netunltd.com.au
Subject: [R-390] r390 Alignement: Tuning r390 to the antenna via sig gen.

Just a thought Try this systems aproach With all the unknown variables we seem to have, perhaps quickest way to actually tune (unknown) antenna to Rx (unknown) impedance without use of fancy Z bridges, etc:

1.   Make up a frame (lor simple loop aerial) to match your sig gen Zout n' frequencies of interest

2.   Stck sig gen and loop outside at fixed point as far back from antenna as you can

3.   Tune sig gen to centre of band of interest (or at where its quiet around there...   like choose a daytime / nightime freq   thats poor propagation wise)

4.   Tune in rx to gen sig, then adjust its front end bits for best signal strength.

5. Check on band edges without touching anything for relative reading to band centre.

Now your rx is best matched to the antennna charecteristics and the rx Zin, no matter what it might happen to be, for that frequency. Try out on differing frequencies, or the centres of the bands you want, to see how antenna characteristics and Rx Zin influence received signals. (The frame (loop) antenna output will change with frequency this way, as may the sig/gen, swr etc, but we are taking relative readings here for reference so doesnt matter so much.) Make the frame on a marked baseboard so you can repeat future tests at same angle to antenna (same location in backyard), of course)

Record all readings for future reference. It's cheap and dirty, and needs a sunny day / dry night, but more certain this way as it considers most everything in the signal path without affecting results by tying stuff onto the front end.

Notes:
The magnetic field from the loop is more predictable and calculable than the electric field. (It is in fact, quite accurately calculable for emitted uV/m for a given, accurately made up loop) The antenna responds to both transmitted vectors anyhoo, so you are reading a fairly realistic result This signal is more predictable than using standard freq xmission and you have your choice of frrequencies, It gives you some exercise lugging sig gens around.(turns pears into mars bars)

Date: Fri, 15 Oct 2004 19:33:09 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 alignment questions

If you have a receiver with a 50 ohm input impedance *and* a generator with a 50 ohm output impedance *and* a 50 ohm termination resistor then the impedance is equal to three 50 ohm resistors in parallel. That gives you about a 16 ohm impedance at the junction.

I totally agree that the alignment needs to be done out of a well defined source impedance. If you don't do that then the resulting measurement has no meaning.

Depending on the antenna and on the transmission line between the antenna and the receiver you can have just about anything as a source impedance in the real world.

The more advanced radio designs have an antenna trim knob to help take

care of this problem ....

Date: Sun, 24 Oct 2004 18:48:23 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] SP-600 - NRC Type 159 - Radio R-450/FRR-28

I have no doubt that the radios were deliberately designed for 100 or 120 ohm feed. I also have ample evidence that they work perfectly well when re-aligned for 50 ohm use. There is a ton of gear out there that hooks to these radios when run with 50 ohm feed. There is also a lot of evidence of these radios being used in 50 ohm setups. Back to the original question - why go to all the trouble of designing them for 100 or 120 ohms and then use them at 50 ohms?

Most of the theory work on coax cables was done in the 1930's. The relative merits of 50 and 75 ohm lines had been figured out before the start of WW 2. The 50 ohm coax thing was not an invention that came up some time in the mid 1950's after the radios were designed. The basic impedance data on antennas dates back at least into the 1920's and in some cases long before that. Again it's not something people discovered in the mid 1950's.

Obviously there are antennas like rhombics that you can match with a 4:1 balun to 100 or 150 ohms and get a fairly good match. There are also things like a full wave loop that are a better match to a 100 or 150 ohm line. Obviously a number of radios were used with rombics. I have not seen a lot of data on full wave loops.

Was the whole balanced input, high impedance input driven by some kind of direction finding set? If so there must be data out there on them. Was there a standard wire antenna that worked into a 100 or 120 ohm impedance? Again there should be data on it.

If 100 or 120 ohms was important enough to design all the radios for that impedance there *should* be data to support the decision ....

Date: Mon, 25 Oct 2004 10:32:58 -0400
From: Rbethman <rbethman@comcast.net>
Subject: Re: [R-390] SP-600 - NRC Type 159 - Radio R-450/FRR-28

Perhaps the documentation makes more sense then. The diversity antenna system recommends the use of rhombics BEFORE talking about others. With what you've just written, that MAY be the reason.

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Date: Mon, 3 Jan 2005 21:04:41 -0500

From: <fraserb@quasc.com>
Subject: [R-390] AGC/MGC

Is this normal: RF gain at 10, AGC at FAST, on a local AM station, audio is absolutely excellent. I switch to MGC and audio becomes very badly distorted. If I back off RF gain to about 5 or 6, audio gets nice again. Normal?

Date: Mon, 3 Jan 2005 21:06:29 EST
From: Llgpt@aol.com
Subject: Re: [R-390] AGC/MGC

Yes, the way it is supposed to work, however, you might want to use "slow" for listening. YMMV.

Date: Tue, 4 Jan 2005 13:43:53 -0800
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] AGC/MGC
>
> RF gain at 10, AGC at FAST, on a local AM station, audio is absolutely excellent.
> I switch to MGC and audio becomes very badly distorted. If I
> back off RF gain to about 5 or 6, audio gets nice again. Normal?

<Laugh> I should hope so! Note the reading on the Carrier meter when you're in AGC mode. It should be up the dial a ways, indicating that the Automatic Gain Control system is lowering the radio's gain. When you switch to Manual Gain Control, this is no longer done for you, and that strong local signal overloads the IF amplifier with attendant distortion, unless you back if off by hand. By the way, the Carrier meter circuit is designed to go upscale on overload as well as on AGC action, so in your scenario it should be off 0 in both modes. Related topic: I'm an SWL and most of my radio time is spent listening to international broadcasts. I have found that the SLOW position gives the most uniform and listenable audio across fades, and I have gradually become convinced that the receiver's slow-attack AGC design contributes to this. This strikes me as counterintuitive, but I believe what I hear. Can anyone who's applied the Lankford or any other fast-attack AGC mod compare notes? Remember, I'm talking about AM voice/music, not SSB or CW. Does fast attack have a downside? Why? Discuss.

On the other hand, FAST is better when I'm cruising looking for signals; then when I find a good one I go to SLOW. Because of this habit, I repeatedly experience the blast when entering SLOW and the Moment Of Silence when exiting. If you have replaced C551, it can be avoided to some extent by turning the knob as fast as possible, minimizing the time spent in MEDIUM, but this kind of clumsy workaround annoys me no end. Now and then I wonder if it would be possible to eliminate or reduce it without too much hacking. A quick glance at the Y2K suggests an interesting possibility, to wit: Disconnect S107 (AGC) pin 9 (MEDIUM) from ground, and instead connect a new capacitor between pin 9 and pin 8 (SLOW), sized to make a series combination with C551 that gives the same time constant operating in the V608A feedback loop, as was afforded with C551 in its original connection to ground and not using V608A. I haven't done the math, but it's probably between .1uF and .5uF . Also, connect a 22 meg resistor between pins 7 (rotor) and 8 (SLOW) to charge C551 to the average V608A plate voltage. The IF deck does not need to be modified, only the front panel. This would be very easy to test out with jumper leads clipped onto the switch (using the FAST position), no soldering or cutting.

Date: Sun, 16 Jan 2005 22:46:05 EST
From: DJED1@aol.com
Subject: [R-390] R-390 sensitivity measurements

Here's another bit of trivia which I hope will entertain. In looking at Dallas' other postings, he discusses a method of measuring receiver sensitivity. From my view, I'm not sure there is an absolute correct way, but just for fun I looked up the MIL spec for the R-390 (MIL-R-13947B) to see what the test requirement was. It's pretty close, but not exactly what Dallas discussed. The spec has two tests: AM and CW. The AM is performed by turning the generator modulation on and off, with 30% at 400 cycles modulation. The signal level is set for 10 mw audio out with modulation, and 1 mw with no modulation. The only difference from his test is that it is done at 8 Kc bandwidth, and a 125 ohm matching resistor is in series between the generator and the receiver. You still need to do the correction for the generator reading to get the voltage at the receiver. For the CW case, the setup is the same, except the generator is unmodulated, where signal is carrier on and no signal is carrier off (still in the 8 Kc bandwidth). The AM spec is 3.3 uv except in the 16-32 bnd, where it is 4.4 uv. The CW spec is 1 uv. This, I believe, was the final spec for the R-390 and was used for acceptance testing. I never did much like the concept of turning the modulation on and off, but this gives that approach significant legitimacy.

Date: Mon, 17 Jan 2005 10:37:05 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 sensitivity measurements

As with many things, what matters the most in sensitivity measurements is that you define how you got your numbers. There are a number of ways

to change the setup that will impact the result that you get. That's neither good or bad in it's self. What is a problem is a undefined method. If I use method A and you use method B we really can't be sure that the results are comparable to each other. If we each have fully characterized and defined (no small task) our methods then we may be able to guess at a comparison. A lot of restoring these radios comes down to "I got 0.001 uv on all bands, time to tell the world". I think that has lead to a number of conversations about measurement technique .... A far more interesting question - does *any* single sensitivity number actually tell what's going on in the real world? I would claim that the answer is no and that is the root of the problem. At that point (no one number) we more or less divide into those who give up on numbers and those who measure a whole bunch of numbers. That makes for interesting conversations.

Date: Mon, 17 Jan 2005 10:54:41 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390 sensitivity measurements

I think the test serves two functions- first, you can tell if a particular repair to the radio has improved the performance in a relative sense, and you can compare two radios in a relative sense. The test is probably useful in an absolute sense only if you define all of the test conditions- then a knowledgable person can calculate the differences in measured performance based on the setup. For example, testing at 8 Kc bandwidth versus 4 Kc gives a degradation in sensitivity of 3 dB. I think tweaking the radio for the best sensitivity has lead to its reputation as one of the best weak signal receivers ever made. I've found it to be as good as my R4C and distictly better than my SP-600. But I won't try and argue that its got 0.0XX microvolt sensitivity. Maybe the uncertainties in measurement is why the spec numbers are so loose.

Date: Mon, 17 Jan 2005 10:58:57 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390 sensitivity measurements

Good point. Maybe the company QA people took advantage of that feature, although the spec was so loose that it should have been easy to get the radio through that test. I would expext the vibration test would have been tougher. Incidentally, the spec in on the R-390 FAQ web site if anyone is interested.

Date: Mon, 17 Jan 2005 11:46:38 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 sensitivity measurements

The nice thing about a relative measurement as you align the radio is that your setup stays more or less the same. For instance the output impedance of your generator doesn't change. The point of an absolute measurement is to know when to stop.

There's nothing wrong with working on radios but at some point you probably should haul it of the bench and *use* it. You can spend a couple of weeks going over all the possible variables in an absolute sensitivity test. At some point you either need a fairly fancy lab or you need to accept that the number may be off by 3 or even 6 db in either direction.

Unfortunately 0.7 uV is a lot harder to brag about than 0.35 uV. They both may be a reading on a radio that is really 0.5 uV ...... The real point is how does *your* antenna work into *your* radio. That's a tough one to characterize except by actually using the radio.

Date: Mon, 17 Jan 2005 10:45:06 -0500
From: "Lester.veenstra K1YCM" <Lester.veenstra@intelsat.com>
Subject: Re: [R-390] R-390 sensitivity measurements

One unexplored problem with all the signal generator based sensitivity measurements is that they are dependent on a flat bandpass response for the results to be meaningful. For example. take a 4 kHz filter with 2 dB od pass band ripple. In terms of uV, a two dB difference in measured performance, what would appear to be a significant difference, as possible on the same receiver, as a function of where in the pass band the signal generator is placed. The solution, although not the most practical in most shops, is to go to a noise generator based system, which will be independent of both IF bandwidth in which the measurement is made and independent of any pass band ripple.

Date: Wed, 19 Jan 2005 20:19:08 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390 sensitivity measurements

I have run into this problem when measuring commercial gear. Some of the FM IF filters have a "dip" in the middle of their pass band. Since you measure with a carrier at channel center that's the *worst* sensitivity number you can get. The thing that always has bothered me is that the sensitivity measure assumes a 50 or 125 ohm system. In general both the receiver input and the antenna output will be significantly different than the assumed characteristic impedance.
To many numbers .....

Date: Wed, 19 Jan 2005 20:23:35 -0500
From: "Dave Maples" <dsmaples@comcast.net>

Subject: RE: [R-390] R-390 sensitivity measurements

All: While we are talking about sensitivity, I have wondered for a bit if doing a SINAD measurement on an R-390A in the 16 kHz or so setting would be of value in setting the sensitivity pot. The idea here is that we would be looking at a known modulation (1000 Hz) against composite noise. Any thoughts before I drag the service monitor home to take a look?

Date: Thu, 20 Jan 2005 13:00:28 -0500 (EST)
From: "William A Kulze" <wak9@cornell.edu>
Subject: Re: [R-390] First they chased off Nolan...

I knew I should have waited a bit longer before posting that one. I must be high... (Subtle binary humor purely intentional) I like to go through the postings and save the ones with good technical advice and info.

Someday I'm probably gonna have to put it to use. I might even try to do the pto alignment. But for now, my old Motorola keeps chugging along, in spite of having solid state rectifiers, resistors instead of a ballast tube and some old meter that I cut the shunt resistor out of for carrier strength (I can hear the shrieks out there now). Not to mention a mixture of black and silver tube shields. For anyone new out there with one of these, in my humble opinion it does not take much more than a good alignment as long as everything else is in good working order. I used to fiddle with it every so often, but it seems to hold alignment for a VERY long time, so I haven't messed with it for a while.

I've never had too much money to sink into this thing so I've always had to make do with what was handy. But I am in no means of a mind to hack it up with too many mods. I've just done what I needed to do to be able to keep enjoying this fine, fine radio. It seems to have very good sensitivity and stability. I most definitely respect all you guys out there, don't get me wrong. But this has been my experience with the receiver. Maybe my needs are not too demanding. I consider myself lucky to have one. It even has all Motorola sub assy's.

Date: Thu, 20 Jan 2005 10:21:21 -0800
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] R-390 sensitivity measurements

It's well-known that the strong points of the manual's procedure for setting IF gain are ease and uniformity, not optimal S/N. The preferred gain is somewhat lower, and several people have discussed this. I think there's a technical report on Chuck Rippel's web page, for example, but there's no standard that I know of. The goal is weak-signal copy, but I

don't know what kind of test signal serves that best.

From: MURPH <rickmurphy1001@earthlink.net>
Subject: [R-390] Red Dot - Second try a charm (Maybe)

It's getting time to for cleaning, lube and alignment of my R390a. Need to know the physical position of the ant cap plates in relation to the red dot, i.e. open, closed, 90 degrees etc., for mine is missing the dot and there is no punch mark or other marks to allude to its correct position.

Date: Fri, 11 Feb 2005 15:42:51 -0800
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Red Dot - Second try a charm (Maybe)

Find a band and antenna length where ANT TRIM peaks in two places. Set it midway between them, and reset the knob on the shaft to be horizontal. That's it. It's a plain old semicircular straight-line-capacitance unit. Doesn't matter whether +4 is closed or open, you'll get all possible capacitances either way. By the way, has anybody noticed that the Y2K front-page line drawing got it wrong? It says 0 to 8 instead of -4 to +4. Worse, it goes more than 180 degrees. I can't believe I didn't see this before.

Date: Fri, 11 Feb 2005 18:51:50 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Red Dot - Second try a charm (Maybe)

I have always looked at it this way, it may not be right but it seems to work. The whole idea of the antenna trimmer is to compensate for an antenna that may be either capacitive or inductive. When you do an alignment the trimmer capacitor should be half way meshed. That corresponds to the knob being straight up. I generaly lift the lid to see what the state of the cap is ....

Date: Fri, 11 Feb 2005 20:16:13 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Red Dot - Second try a charm (Maybe)

Best I remember the marking was to denote 90 degrees. Half meshed...

Date: Sat, 12 Feb 2005 08:27:05 -0500
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: Re: [R-390] Red Dot - Second try a charm (Maybe)

This is the way I find half-mesh if the red dots are missing and the knob mounting is questionable. There shoudl be two peaks in signal on the antenna trimmer. Find the mid position between the two peaks. This will be either full mesh or zero mesh. Move the knob 90 degrees from this position.

Date: Sat, 12 Feb 2005 10:12:47 -0500
From: Bill Abate <wabate@dandy.net>
Subject: Re: [R-390] Red Dot - Second try a charm (Maybe)

I was faced with the same problem on my 390A. No marks. A friend told me that it is something that hardly anyone messes with. There just is no reason to. So the knob set screw detent on the shaft is all I needed to align the knob.

I felt I needed to check this so I used my capacitance meter to find the minimum. He was right. The detent indicated the correct alignment. I won't doubt him next time!

Date: Sun, 20 Feb 2005 13:14:20 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Source for URM-25 MX-1487/U impedance adaptors?

There are schematics out there for the adapter. Basically it is a 50 ohm to 125 ohm resistive matching pad if I remember correctly. I suspect that for an enormous sum of money they are available on the auction sites ...One question to ask before investing thousands of dollars in one of these - If you had one would you want to use it? The pad is useful for setting the radio up to run out of a 125 ohm source. Most of us seem to be running antennas that are anything but 125 ohm impedance devices. To be totally correct you would have to be running both a 125 ohm antenna *and* 125 ohm balanced coax into the radio. I suppose that if you have the antennas you probably are running the coax as well ....

If you are running a 50 ohm (nominal) antenna and 50 ohm coax then you should align the radio from a 50 ohm source impedance. The same would be true of a 75 ohm setup (75 ohm coax, 75 ohm antenna, 75 ohm generator). There have been numerous posts on this list that verify the value of using the same source impedance for alignment as for operation.

From personal experience the biggest benefit of using the correct impedance is that the antenna trimmer centers up better in actual operation. If you want the maximum correction range from the trimmer then using the correct impedance is a must. If you want to get hyper about all this then you can look at the input impedance of the radio. Unfortunately that only makes the problem more complicated since it's a complex impedance (versus pure resistive) even when correctly set up.

Then you find that most antennas aren't 50 ohms over a very wide range. Ever *measure* the impedance of cheap coax (don't they won't take it back ...). Heck of a lot simpler to just look at the source impedance ....

Date: Fri, 25 Feb 2005 23:04:12 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] URM-25 replacement

There is one problem that you may run into and a fairly easy way to get around it. Almost any signal generator depends on the integrity of it's shielding to keep radiated RF from messing up the measurement you are doing. A URM-25 is a fairly simple beast in this respect. A 8660 is pretty darn complex by comparison. Our beloved R-390's are fine receivers, but they are not right at the top of the class when it comes to shielding. If you have enough RF running around the test bench it will get into the radio without going through the antenna connector. If you are going for that 0.03 uV alignment this may be an issue.... The easy way to check what's going on is to simply unplug the coax from the antenna connector on the radio and see if the signal goes away. To be complete you probably should ground the shield of the coax to the radio case just to be sure you don't have a ground loop. Of course if you fail the test then you have to do a little work. Often it's as simple as dressing the power cords on the bench with a little more care. Other times you need to clean the finger stock on the plug in compartment of the generator. Not a lot of rocket science, but there can be some work involved. If you want to go totally nuts then here's something else you can do. Make up a "sniffer coil" on the end of a scrap piece of coax. Four or five turns about 3/4 inch in diameter seem to work well. Crank up the generator into a shielded 50 ohm load. Hook the coil to a good radio (R390 recommended ...). Tune the radio and generator to the same frequency. Run the coil all around the generator looking for a signal. Meter openings, attenuator knob's and power cords are all good things to check. If the generator passes this test at 30 MHz and at 500 KHz you should be fine.

Date: Sat, 26 Feb 2005 10:04:16 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] URM-25 replacement

Another suggestion someone mentioned at some time in the past to determine if your setup is causing you to THINK you have that ultimately sensitive receiver is to add 10 or 20db inline pad to the output of the generator at the front panel of the generator and see if your measurements move down the appropriate amount or stay the same. Could be a leakage problem. If there is little change it's probable that the generator is leaking more signal into the air than your attenuator setting indicates and the radio is detecting that instead. I guess it's the same principal as what Bob is describing it just keeps the generator and radio terminated into a controlled load.

Part of the problem with getting a signal into the R-390 series is the darned balanced input and some of the silly things we may do to get a signal into the radio at that port. That is where it needs to be inputted but it should be shielded from connector to connector, radio to generator. That's not always easy to do.

Just my 2 cents worth added on to the good info Bob has posted...

Date: Sat, 26 Feb 2005 11:28:40 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] URM-25 replacement

One other odd point. Back when I was at Motorola generator leakage was a big issue when testing pagers. A standard part of the acceptance procedure on *any* new generator was to run around the entire generator with a pager and see if you could "hear" anything. It was amazing just how many generators failed this test.

If you are going the pad route I have always liked a 20 db pad. That way you just have to divide the generator output by 10. It's a lot less work for the poor tired old brain cells. Most pads I have seen work just fine at R-390 type frequencies. You don't have to be terribly careful about them they way you do at UHF or microwave frequencies. If you have a generator that uses a "stacked attenuator" rather than the old sliding coax attenuator it's a good idea to check the attenuator. They switch in a variety of fixed attenuators to make up your final attenuation value. At any given setting you may have a fairly small number of pads in the circuit. With an external attenuator and a receiver (R390 recommended) you can step through the entire range of the generator. Since the attenuator is the part most likely to fail in a non-obvious way it's worth doing on a "new to you" generator. Checking the pads you use is probably a good idea. It turns out you can do a quick and dirty check on *any* pad with the same technique. Terminate one end of the pad with 50 ohms. Use your DVM to measure the resistance on the other end. It should be 50 ohms. Reverse the pad and repeat the procedure. Pads tend to die a lot more often from RF or DC overload. The thing that usually goes is the part would be a resistor to ground in a PI pad.

If you want to go whole hog on your new pad you can put a *small* DC voltage on the input and check the DC on the output. The key issue here is keeping the DC low enough that you don't blow up the pad. Depending on your voltmeter you can check pads up into the 30 db range this way. Past that an AC signal and an AC voltmeter probably are a better idea.

Both of these techniques depend on the fact that the DC and RF performance of the pads are nearly identical. This is normally a good bet at R390 frequencies. It may not be as good a bet at microwaves. I have certainly seen a number of dummy loads that are AC coupled. I have not seen any wide band attenuators that are AC blocked though.

Date: Tue, 1 Mar 2005 21:31:00 EST
From: DJED1@aol.com
Subject: [R-390] R-390A sensitivity measurements

I tried making some sensitivity measurements on my receiver, in which the IF gain was reduced per Chuck Rippel's suggestion.   I tried several different scenarios: First, per the MIL spec, sensitivity is measured with an 8 Kc bandwidth and adjusted for a 10 dB change in output by switching the modulation on and off (30%, 400 cycles).   They also call for a resistor in series with the radio input.   I couldn't see how this made sense, so I followed the directions in the URM-25 manual. It calls for a series or parallel resistor such that the load the generator see is 50 ohms.

I know both the URM-25 and the new HP need to be terminated in 50 ohms to provide the voltage indicated on their meter, so I put an 82 ohm resistor in parallel with the nominal 125 ohm receiver input, resulting in a 50-ohm load.   The results were interesting:

Using the method of modulation on and off gave a sensitivity of 1.9 microvolts.   Not the result you often hear discussed with these radios, but credible for a radio where the specification is 3.3 yo 4.4 microvolts.   I then tried the method I used in the past, of turning the modulated carrier on and off, and using a 4 Kc bandwidth.   Big difference-   0.23 microvolts. I tend to like this method because it seems more representative of an actual signal. Finally, considering that we listen to CW and SSB as well as AM, I measured the sensitivity with the BFO on and a 2 Kc bandwidth. Got about the same result- 0.22 microvolts.   I then reduced the signal level until the signal was just detectable in a 1 Kc bandwidth and got down around 0.01 microvolts.   That's in the ballpark of the -143dBm noise floor that is quoted by some for the radio. All in all it was an interesting exercise.   The measurements made with the specified method explain the specification of 3.3 microvolts, while I believe the method of switching the carrier on and off is more realistic.

Definitely, the CW measurement is more representative of real world conditions.   And I think 1/4 microvolt is adequate for almost all application in which I would use the receiver. I'd be interested in hearing from anyone who has duplicated the test setup and gotten results better than mine. (Incidentally, I did check the generator for leakage prior to making the measurements. Detected a very low level with the receiver connected to a wire near the generator, but nothing when connected to the generator by a shielded cable.) Ed

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Date: Tue, 01 Mar 2005 21:53:22 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390A sensitivity measurements

The only odd thing being done here is to terminate the generator with an external 50 ohm load. Here's what's going on put in fairly simple terms to keep the math from overloading my brain ...

1) The generator is set up to deliver 2 volts into an open circuit load
2) You terminate the generator in 50 ohms.
3) There is 1 volt on the output of the generator (since it's a 50 ohm generator).
4) The impedance at the output is now 25 ohms (50 in parallel with 50 = 25)

Since the generator is calibrated in terms of a 50 ohm load the generator is "set to 1 volt" in all the examples above. A lot of this does not make a lot of sense, but that's the way it's all defined. A normal sensitivity test is done with the generator only terminated by the impedance of the radio you are testing. If you have a radio that looks like an open circuit then it gets 2 volts. If the radio looks like 50 ohms it gets 1 volt. This is also the way a 50 ohm antenna would drive the radio.

If you want to have a 125 ohm generator then you need to put a 75 ohm resistor in series with a 50 ohm generator. Because of the way levels are defined you don't have to change the voltage level when you do this. If you first load the generator in 50 ohms you cut the output voltage in half and must figure that into what you are doing. I know this all is a bit whacked, but that's the way RF is defined ....

Date: Tue, 1 Mar 2005 22:09:01 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements

Thanks for the note, Bob. I went with the instructions in the URM-25 manual, which clearly intend that there be a 50 ohm load on the generator for the output voltage to be equal to the meter reading. I was reminded of this when i put my scope on the HP generator to check the output- way off until I put a 50 ohm termination on the etup, then the generator output was right on.

So I'm convinced that the generator needs to be terminated properly. Of course this is not a problem for 50 ohm receivers. For the R-390, it troubles me that we don't have an impedance match between the generator and the radio, but we do know, I submit, the voltage across the receiver terminals. If you wanted to determine the power going into the receiver, I would use the 125 ohm value and the measured voltage. Probably the best way is to devise a lossless transformer to go from 50 ohms to 125 ohms. I haven't tried to do that yet, but I'm working on it.
Regards, Ed

Date: Tue, 01 Mar 2005 19:25:38 -0800
From: "James A. (Andy) Moorer" <jamminpower@earthlink.net>
Subject: Re: [R-390] R-390A sensitivity measurements

Given that a 50 ohm resistor has a thermal noise of .0142 microvolts (at room temp, BW of 1 KHz), it is hard to see how adding .01 microvolts can cause a 10 dB change in the reading. Even if the input is 25 ohms, the thermal voltage will still be .010 microvolts.

See my "noise and sensitivity page" at
http://www.jamminpower.com/main/noise.jsp

I think we are doing this measurement wrong, but I haven't managed to figure out what the right way of doing it is. I did publish (with permission) an article by Dallas Lankford on the measurement process where he obtains numbers that are more believable. I understand that we do see the meter change by 10 dB, but I think there are other explanations for that.

For instance, the R-390A is not very well shielded. Neither is the URM-25.

Is it possible there is some leakage via a route that is external to the antenna input? I dunno, but I know we can't get more sensitive than the thermal noise. It doesn't take many electrons rolling through the ether to show up as a 10 picovolt input.

Date: Tue, 01 Mar 2005 23:26:16 -0500
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: Re: [R-390] R-390A sensitivity measurements

I did the impedance match with one of National's really fast unity gain amplifiers, the LH0063. I run the sig gen into the high impedance fet input, with a 52 ohm terminator and drive the antenna input directly with the amp low impedance output with a 0.01 uF cap to kill any DC offset from the amp. The voltage at the amp input is the same as the voltage impressed on the radio antenna connector. I used 20 dB attenuators on the terminated amp input so I could check the actual sig gen output with a scope. The scope results look OK when I use a humongous signal and when I cut the gen output way back I get reasonable sensitivity values. Does this sound like a reasonable approach to the matching?

Date: Wed, 02 Mar 2005 07:16:21 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390A sensitivity measurements

A lot of this is not a matter of what is right and wrong from theoretical standpoint. It's an issue of how things are defined. In the case of a receiver measurement you do not supply an external load, regardless of what the input impedance of the radio actually is. Fifty ohm radios rarely if ever present 50 ohms back to the generator. Since we don't know the impedance of the radio the decision was made long ago to define this measurement not in terms of the *actual* voltage at the input of the radio but instead to define it in terms of what the voltage *would be* if the radio was presenting 50 ohms.

One way of looking at this is to consider what we are trying to do. When we use the radio we hook it up to an antenna. Antennas are weird just like receivers, but let's ignore that for right now. With a bunch of power the antenna would put out 2 volts into an open circuit and 1 volt into a fifty ohm load. By the way we define things we would call this a 1 volt signal from the antenna. If the receiver presents an open circuit then it gets to use 2 volts. If it presents a 50 ohm load it gets to use 1 volt. We test the radio the same way we use the radio.

If you are going to calibrate a scope then yes you need to remember to terminate the generator properly. Probably the biggest issue here is to check what the input capacitance of the scope looks like at the frequency you are using. A 15 pf scope capacitance can have a big effect at 400 MHz.

If you are going to use a 125 ohm antenna then by all means use a 125 ohm generator. In fact if you use a balanced antenna then a balanced generator is a good idea. The radio should be aligned with the same source impedance as your best guess for the antenna. Again test the radio the way you are going to use the radio.

Hard core electrical engineering for breakfast - gotta love it !!!

Date: Wed, 02 Mar 2005 07:36:08 -0500

From: "Mark Huss" <mhuss1@bellatlantic.net>
Subject: RE: [R-390] R-390A sensitivity measurements

First off, use the Balanced Adaptor that is normally used for the Balanced input. This shorts out one side of the input transformer, and presents the other pin with a '62 ohm' input. Since this input changes with tuning, you will have error unless you correct impedance match at each frequency of measurement. According to Lankford, the input impedance of an R-390A varies from 90 to 250 ohms over frequency range. For measurement purposes, a reading of 0.3uV could actually be 0.2 to 0.4uV. Without a lot of work you are never going to get much better than that. If you are interested in doing better than that, build an attenuator with a 50 ohm input, and a variable impedance output. Connect the generator to the receiver at the frequency of interest. Tune radio to same frequency, increase generator output until you can measure amplitude on oscilloscope or AN/URM-26 VTVM across receiver input. (you have to use unbalanced feed for this to work). Adjust output impedance of attenuator to maximum. Measure voltage. Divide this by half, then adjust attenuator impedance until voltage reading is half. Measure components in attenuator and calculate input impedance, output impedance, and attenuation. Reinsert attenuator into circuit and do sensitivity test at that frequency. Adjust result using the calculated attenuation. Repeat the whole thing at the next frequency.

Unless you want bragging rights, and can be sure they are doing it exactly the same, it doesn't seem to be worth the effort.

Date: Wed, 2 Mar 2005 09:59:48 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements

What we old microwave guys are used to is having an impedance match between components, so maximum power is transferred. For newer equipment, we almost always work in a 50 ohm system, and measure in dBm.

For older radios, where the impedance is not 50 ohms, measurments were not so clearly defined. This is true for the op-amp also, because its output impedance probably does not match that of the receiver.

That's why I'm troubled by using resistors to fudge the sensitivity measurement-it terminates the generator properly, by part of the signal power is lost in the resistor. I think we need a good low-loss transformer to properly feed the R-390. Anyone have such a thing? Ed
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Date: Wed, 2 Mar 2005 09:51:25 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements

I didn't mean to imply that 0.01 microvolts gave a 10 dB S+N/N ratio- it was more like 1 dB- just detectable in the noise.

Date: Wed, 2 Mar 2005 10:48:27 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R-390A sensitivity measurements

I've been contemplating a balun to go from the balanced input to the antenna/generator anyway. Question is do I do a 2:1 or a 1:1. Keep the radio at it's native 125 ohm nominal impedance or take it to around 50 ohms nominal which is what we are doing using current wisdom on the twinax connector to coax fabrication.

Date: Wed, 02 Mar 2005 13:30:35 -0500
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] R-390A sensitivity measurements

One thing I found with my HP8640B sig gen is that if you do not use the 50 ohm terminator, the output voltage meter would not measure correctly. If you depend on the output level meter as a reference point for sensitivity measurement, without the proper impedance match your calculaions could be off considerably due to meter inaccuracy.

Date: Wed, 02 Mar 2005 16:22:51 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] R-390A sensitivity measurements

>I've been contemplating a balun to go from the balanced input to the
>antenna/generator anyway. Question is do I do a 2:1 or a 1:1.

Try both. And let us know what happens. I plan to install a little toroid core inside a twinax connector with a BNC female connector mounted in the rear of the twinax. there's plenty of room for a small toroid. I'll be glad to hear how you make out. The TMC company in their GPR-90 receivers used a toroid input transformer inside at the antenna connector. I don't know it's turns ratio. The
input RF amplifier tube is a 6AB4 triode in grounded grid configuration. The transformer is tapped for both 300 and 75 ohms input, and the crystal calibrator signal is fed to the 300 ohm input point.

Date: Wed, 02 Mar 2005 20:05:59 -0500
From: Bob Camp <ham@cq.nu>

Subject: Re: [R-390] R-390A sensitivity measurements

Simply put you have two reasonable alternatives. A one to one turns ratio gives you 50 ohms to 50 ohms. A two to one turns ratio gives you 50 ohms to 200 ohms. Either way it's a mismatch. In general (though not always) you will do better with an input impedance that is higher than the characteristic impedance rather than lower. The whole issue is made a bit more complex by having a piece of coax between the antenna and the radio.

A high impedance at the radio may be transformed to a low impedance at the antenna. Each time this thread has come up before the net result of the tests run has been that the radio is slightly more sensitive when run from 50 ohms than it is when run from 125 ohms.

Date: Tue, 1 Mar 2005 20:16:15 -0500
From: "Michael Murphy" <mjmurphy45@comcast.net>
Subject: Re: [R-390] R-390A sensitivity measurements

A lot of these RF guys on the R390 net will attest that leakage can surely fool you. Some have probably solved the leakage isue by building something or using some clever technique. The basic symptom of RF leakage is that the receiver seems miraculously sensitive - "what a good tuneup job did I!" You keep reducing the RF input signal (throwing in more attenuation) and the
receiver just keeps hanging in. Wow is this baby hot!

I have been burned by measurements done much below half a microvolt on the bench. We have problems at work obtaining accurate measurements outside a screenroom or screenbox environment. One typical (difficult) test is to determine end to end system gain with a high power transmitter and a sensitive receiver. The RF just seems to be able to go around to the back door! This is a bad example since our test generator is not a 2 Watt transmitter, but the ideas still apply.

Let's look at an approach.. Good results are obtained by placing the RF generator on the outside of the screen room. This may not be ideal, but it keeps the receiver from picking up extraneous signals and keeps the higher level RF on the outside (the dirty side). Terminate the generator if that is
required. Connect the generator to the screenroom bulkhead via double shielded coax like RG-223. Adding an inline pad of say 10 dB on EACH SIDE of the bulkhead is another good trick. Just inside is also a good spot to put a precision variable attenuator inline. Next connect to the receiver with more RG-223 using one of the matching networks described. Of course one will have to know the total loss of the cable attenuator system.

Our three Screen Rooms at work are double shield Faraday types with a single point ground and they claim better than 100 dB of isolation. Solid construction screen rooms are actually far better than this.... but it gets so lonely.

I would say that a more practical home version of this approach might be to make a simple screen box to house the generator side. This could be made of copper screen and wood. Making the inside and outside of the box insulated from one another using square dowel or lumber should enable you to build a tight little Faraday screenbox. The bulkhead can serve as the single point ground. Ground the box. A clever door with RF gasketing fingers would allow access to the generator for setting adjustment. Think about it - the door must also be two metal doors without inside touching outside to maintain the cage integrity. Again, double shielded cable is a must.

Date: Wed, 2 Mar 2005 23:02:35 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements

A shield room is not a bad idea, but it may be too expensive for most of us. I played around with a couple of items tonite, and the issue of shielding came to the fore.   first, I made an autotransformer on a toroid which matched 125 ohms to 50 ohms (both unbalanced).   I soldered it to a piece of coax and a connector and put it on the back of the receiver... the external noise coming in on it was 10 dB higher than that of the receiver. Definitely not useful unless built in a well-shielded case.   So I've put that on the back burner. I thought about the very good comments from you guys, and did a few calculations which turned up some interesting results. First, I concluded that adding an 82 ohm resistor in parallel with the receiver, to give the generator a 50 ohm load, and adding a 75 ohm resistor in series, to give the receiver a 125 ohm load, both form 2 to 1 voltage dividers between the generator open circuit voltage and the voltage across the receiver terminals.   Thus either will allow us to use the generator meter to read the sensitivity.   I haven't tried a pad which matches both, but requires a correction to the meter reading.   That also awaits a shielded box. I also did some calculations on the noise floor assuming a 125 ohm resistor at room temperature, and the 9 dB noise figure I measured on my receiver.   It comes out to a voltage of 0.4 microvolt for 10 dB S/N in a 4 Kc bandwidth. I then reran some of my measurements using both the URM-25 and the 8660.
For measurement with the carrier turned on or off, either with the BFO on or with 30% modulation, I got measurements of 0.3 to 0.4 microvolt.   So everything seems to hang together, including agreement between the URM-25 and the 8660.   The only difference is that below 0.5 microvolt on the URM-25 the readings don't drop down much as I turn the attenuator.

The 8660, on the other
hand, just keeps going down into the noise. So shielding is definitely an issue for the old generator. However, I think I'll keep her. I was pleasantly surprised at the accuracy- the two generators agreed within 1 dB at levels of 1 and 5 microvolts.I got sensitivity of 1 microvolt in 4 KC bandwidth when I measured with the modulation turned on and off. This is the specified procedure for AM.
I'm now satisfied that I understand the methods and results. The only unexplored issue is whether a balun will make any significant difference.

Date: Thu, 03 Mar 2005 18:21:54 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390A sensitivity measurements

One or two minor items:

When you put an 82 ohm shunt resistor on the generator that gives you a 31 ohm source impedance for the combination (50 ohms from the generator in parallel with the 82 ohms you just put in).

When you sick a 75 ohm resistor in series with the receiver you get a 106 ohm source impedance.

The 75 ohms is in series with the assumed 125 ohm input impedance of the receiver. That gives you 200 ohms.

The 200 ohms in parallel with the 82 ohms gives you 58 ohms. That's pretty close to a 50 ohm match to the generator.

The net result is that you are almost matched to the generator, and sort of matched to the radio.

If you refigure the resistors you can hit both terminations at the same time. In this case you have put in a second termination on the generator. You need to subtract six db from the generator output to get the correct value for the driving voltage relative to the generator output.

The real question is whether any of this will make the radio work better. Any time you put a resistor on the input of a radio you degrade its sensitivity. This is true whether the resistor is is in series or in parallel with the antenna input of the radio. If sensitivity is your goal stay away from resistors. They can improve overload performance but you will always trade off sensitivity. When you use the radio you peak up the sensitivity with the antenna trimmer. As soon as you move it off of the "straight up" position you are changing the radio's input impedance to something other than the best setting for the impedance you aligned it with. Assuming the signal goes up when you do this then your antenna is not providing the same source impedance as your generator. Most all of the time I seem to run with the antenna trimmer set to one side or the other of straight up. The antenna is what we care about. If you could set up the generator to duplicate the antenna then you might be able to directly measure what is really going on. If you run a vector network analyzer into the antenna you can get a pretty good idea of what it looks like. That sounds like a lot of work though .... The easy test is to hook the antenna to the radio. See if the noise out of the radio goes up. If it does then the whole front end match thing is not an issue. With a reasonable R390 and even a fairly short antenna I pretty much always seem to pass this test. The only time it can be a problem is above about 16 MHz after the band dies.

Date: Thu, 3 Mar 2005 22:07:22 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements
Content-Type: text/plain; charset="US-ASCII"

No, the 82 ohms goes in parallel with the nominal 125 ohms of the radio, resulting in 50 ohms as seen by the generator (procedure from URM-25 manual) In this case, the generator is correctly terminated in 50 ohms, and connected directly to the receiver terminals.The 75 ohm resistor goes in series with the 50 ohms of the generator, giving a 125 ohm impedance for the radio (procedure from MIL-SPEC for R-390). In this case, the generator is not terminated in 50 ohms, but the voltage division between the 75 ohm resistor and the receiver impedance give the correct voltage at the receiver terminals. Either approach allows you to use the generator meter to correctly read the voltage across the receiver terminals. You can use both a series and shunt resistor to provide the correct impedance to both the generator and the radio, but then you have to correct the meter reading to get the voltage across the receiver terminals. I haven't tried this yet, but doubt that it will make much of a difference in the results.

Date: Fri, 4 Mar 2005 07:50:29 -0500
From: "Veenstra, Lester" <Lester.Veenstra@intelsatgeneral.com>
Subject: RE: [R-390] R-390A sensitivity measurements

"See if the noise out of the radio goes up. If it does then the whole front end match thing is not an issue"

Again Bob has come back to the key point. If the interest is in coming up with numbers to make a radio look good, then there needs to be a commonly used "interface" pad (or no pad at all). However if the interest is in getting the most sensitive receiver operationally, than it should be connected to the antenna it will be operated on, and with signal injected

via an independent antenna, the front end adjusted for optimum. In the absence of that, and in recognition of the fact that most of us use multiple antennas, an alignment with a 50 ohm source signal
generator into the standard configuration of one side the standard balanced to external input and the other side of the balanced line to ground is most practical. Then, in the few cases where the ambient noise from external sources is not significantly in excess of the radio's internal (input terminated) noise, and when the trimmer adjustment does not produce a peak within its range, you might want to consider an antenna specific front end only re-alignment.

Date: Fri, 4 Mar 2005 11:42:07 -0500
From: "John KA1XC" <tetrode@comcast.net>
Subject: Re: [R-390] R-390A sensitivity measurements

I have to disagree here, I think aligning this receiver front end to a (freq dependent) antenna load is falling off the deep end of the RF sensibility curve; for one thing you can kiss your RF deck coil tracking goodbye. Is anyone actually doing this? (the aligning part, not the kissing part!). The 390x antenna trimmer circuit is designed to tune out only *small* amounts of XC or XL present at the antenna input, and it can do nothing to compensate for a mismatch in the R component because the turns ratio in the RF transformer Primary to Secondary windings is fixed and so is the degree of coupling between them. If you really have a bad antenna mismatch and you really really want
that last dB of performance from your setup then put an antenna tuner/transmatch device inline and tune it up with a TX or MFJ-259B, they work as well in the receive direction as well as in the transmit direction ya know........

Date: Fri, 4 Mar 2005 12:39:29 EST
From: DJED1@aol.com
Subject: Re: [R-390] R-390A sensitivity measurements

I agree with John about not aligning the radio to the antenna- too much variation in impedance over the band. I use an antenna tuner on my wire antenna and logged the settings for each frequency of interest using an MFJ antenna analyzer. The tuner settings show a LOT of antenna impedance
variation, especially below 4 MHz. Of course, the radio is now looking into 50 ohms, but it's close enough for Guvm't work. Certainly, for those of us in noisy suburban locations, a tuned antenna provides a high enough noise level that I don't worry about that last 0.5 dB of sensitivity. That's what I did today- put the signal generators away and tuned up the radio to some interesting SWBC. Ed

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Date: Fri, 4 Mar 2005 12:31:46 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R-390A sensitivity measurements

I believe antenna tuners fool your radio by presenting a controlled impedance thus making solid state transmitters happy but they don't make your antenna system any more efficient. My guess is that received signal strengths with the antenna tuner in line and tuned are probably the same or maybe even lower as without the antenna tuner and antenna directly connected in an accepted manner and radio trimmer peaked. Just a guess....haven't tried it....yet!

Date: Fri, 04 Mar 2005 18:26:04 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390A sensitivity measurements

If when you *use* the radio the noise out goes up when the antenna is attached then you do not need to do anything at all. The front end of the radio is not limiting what is going on. If this is not the situation then the best thing to try is an antenna tuner. This will allow you to match things up better, add a little front end selectivity, and generally will not create distortion. There are a variety of outboard tuners out there that allow you to do this. Since you really need this kind of thing at the higher end of the radio's range you can also build one fairly easily. To the extent that the antenna tuner is "tuning the radio" then it's a perfectly reasonable thing to do. If you have an idea that your antenna looks like 300 ohms broad band, then by all means align your radio out of 300 ohms. The main effect will be to better center up the antenna trimmer for use with a near 300 ohm antenna. Since the range of the trimmer is limited it makes sense to center it up as best you can. The radio will not provide a 300 ohm "match" but then it doesn't supply a 50 ohm or 125 ohm match either. If you want to go really nuts:

1) Grab a "correct" coax connector for the balanced input and a chunk of "correct" coax.

2) Run it over to a nice little box and mount a properly designed 1:1 balun to drive the coax.

3) Put in a "bypass" switch and a simple T match tuner for 10 to 30 MHz

On receive the tuner is not so much providing a proper load to the antenna as taking what you get from the antenna and doing the best job of shoving it into the radio. I would guess that if this won't peak up the antenna to override the front end noise then you have a really rotten antenna (or the

band is *very* dead).

Date: Sat, 05 Mar 2005 19:21:34 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Searching: R-390A & Signal Generator

Depending on the local market and possibly the phase of the moon URM-25's and HP-606's move around relative to each other. Both are fine generators for setting up a R-390. About all you might need to go with them is a single pad in the 6 to 20 db range. A lot of people run them with no pad at all. A VTVM is about the only other "major" piece of test gear that you need for an R-390. Nothing fancy is required, the auction sites have a number of them pretty darn cheap these days.

Date: Thu, 7 Apr 2005 15:23:34 -0400
From: "Veenstra, Lester" <Lester.Veenstra@intelsatgeneral.com>
Subject: RE: [R-390] Ramblings on Calibration - was: HP 8640B

By the way, there is another similar process, that can give significant accuracy, that I have used, particularly for setting internal ref of a synth receiver. On a good day, on a good freq, at the right time, set up the R-390 (of course) in AM detection mode, on WWV with audio to scope. Set up SSB receiver under test to same WWV carrier freq, with audio also to scope. (Dual trace sync to one trace, or XY, what ever you prefer) When the 600 Hz tone is broadcast, adjust frequency standard for no drift or 1:1 ellipse.

Date: Sat, 9 Apr 2005 09:19:53 -0700
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: [R-390] Help getting unstuck!

Tried the usual fixes: Checked C327 & C286, they were both fine according to the TO-6A. Decided to read some of the older archives and found a post in April of 2000 with a solution worth an attempt. Seems another Motorola owner had the same low sensitivity symptoms below 8MHz and noticed an open connection on pin 7 of V207. He installed a jumper between pins 2 & 7, to fix his dilemma. Looking at a pin-out of that tube it has an internal connection between 2 and 7, I couldn't see where adding a jumper on the tube socket would make a difference. My Motorola was the same and had some flakey readings on pins 5 and 6 also. What the heck, it would only take a few minutes to try. Well it worked! Now have all bands working fine. Could of been a bad solder joint on pins 2 or 7??

By the way, while going through the RF coil alignment per Y2K R1, I thought the sensitivity of the lower bands were still below those above 8MHz. So I went back to section 4 and ran the sensitivity test as per 4.3.1. 750kHz and 3.25MHz were lower than the rest. Peaking T207 on the RF deck brought those two up to spec. So now, with a URM-25D with no sticker traceable to NIST, the sensitivity is 3uV or just below. Next step is to put up an antenna better than a test lead. Tnx for all the help, those who wrote the Y2K manual and post information on this reflector are a great asset!

From: Flowertime01@wmconnect.com
Subject: Re: [R-390] What is the difference between 390 and 390A

>I have heard of some WWII receivers that were specially built to minimize the osc leakage >through the antenna input for the reasons you mentioned, the National brand comes to mind but I >could be mistaken. John

Folks, The Army Security Agency was happy to couple bunches of R390 and R390/A receivers to the same antenna. The favorite antenna was a rhombic. The favorite antenna coupler to spread the signal around was a CU872.

Local oscillators radiating grief to other receivers was a real no-no. The R390 and R390/A will work and play well with any other thing that glows in the dark. Some solid stuff is a bit uppity but its the solid stuff not the warm and glowing items fault.

The Ops ran rooms full of the receivers and you would never know there was another oscillator any where except that single signal you were working. R390 and R390/A just do not leak.

Date: Mon, 11 Apr 2005 22:33:57 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] What is the difference between 390 and 390A

The mechanical filters in the R390A are not bad at all. The ringing is not a major issue. The main point is that if you have a good enough situation the R390 not an A will sound a little bit better. If you are fighting for the last couple of db with a strong signal just up band the 4 KC mechanical filter on the R390A will do a very nice job in AM mode. With an outboard gizmo like the Sherwood box you can do some odd stuff with the 2 KC filter as well.

Date: Mon, 11 Apr 2005 22:48:56 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] What is the difference between 390 and 390A

Most 05H guys liked the R390/A over the R390 when it was time to pick one out of the mud. The 2Hkz mechanical filter will let you get a bit more separation. On any day given any two adjacent signals one wanted one not, Its going to be a subjective opinion what one receiver works best. I watched 5 or 6 ops roll up on a ditty with two radios each and all the Opts said every R390/A of the 10 or 12 sounded different. They would send the worst receiver to the shop for PM. But their choice was still the R39/A over the R390 to pick crude from mud.

Date: Mon, 2 May 2005 21:35:35 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] R390 progress 6AK5/6AJ5

Sounds like you are making progress. Start hanging a DC volt meter on the diode load. You are looking for -7 volts. every place the procedure says tweak and measure some point, just tweak for maximum signal on the diode load.

Put the scope away.

Hang a DC meter on the diode load.

Hang a 600 ohm 1 watt resistor on the audio output and an AC volt meter with
a DB scale across the audio output and resistor.

When the BFO is on read the AC volt meter for 1/2 watt of power. The DC volt
meter will peg off the DC scale with over -30 volts.

When the BFO is off read around -7 volts on the DC load.

If you have more than -7 volts (with the BFO off) back the signal drive down of reduce the DC gain in the IF deck.

Just do all your adjustments for maximum signal on the DC load.
The goal is signal you can hear.
The DC load is where you can hear it.
Set the receiver to CAL and the BFO off.
Pick a 100 KC dial setting.

Start at 31 so you can adjust the transformer and the cap for maximum signal and a single peak.

On each band roll the KC knob around for a maximum cal signal and tweak the OCS trim cap for Max peak.

Just monitor the DC load and peak them out.

You need to get a signal generator on the antenna and start looking at your signal to noise.

Until you see how close to the minimum 10:1 you are.
How close you are to the 20:1 you should have.
And how close to the 30:1 you can get, you just have no idea if the problem is a real problem or not.

How old is the receiver?
How exact is your line voltage?
How exact was the TM reference?
How exact is your meter?
How does your meter load your circuit?
How does your scope load your circuit?

Just to many questions to mix in. Go to the bottom line. DC load voltage and Signal to noise ratio. Then any thing you try either makes an improvement, makes no difference, or makes the situation worse. Use the same test for every thing so you can at least compare the results. You will wonder for ever about voltages on grids and is the TM correct. At least your down to the 7Mhz band. And it sounds like your narrowing in the problem. Sounds as if their are some side benefits coming out of the effort as improved performance on other bands.

Date: Tue, 03 May 2005 10:45:41 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] R390 progress 6AK5/6AJ5

>Start hanging a DC volt meter on the diode load.................

Above is a very succinct "how-to" for quick and useful results. You can't go far wrong with that, and this point may be very important:

>or reduce the DC gain in the IF deck.....................

I suggest you set the IF gain with the procedure on Chuck's site, "Setting IF Gain for Optimum Performance"and specifically at:
http://www.r390a.com/html/gain.html
Two things may have been done to your radio by some dumbhead to "make it hotter":

- crank up the IF gain

- put high gain tubes in the thing instead of what should be there.

Undo them both. Notice again Roger's suggestions on how to know what's going on in side your radio: These two functions could be built into a small box: two panel meters, one for diode load voltage and one for audio output.

In a well stocked junque boxe you can unearth a couple of meters of just the right scale markings and a nice slope-fronted box to mount them in. Label the thing "R-390 Series Receiver Test Boxe" Add a nice long shielded cable with spade tips on it and you can wrestle the radio around all over the bench and not knock over your meters.

(Note to self: Follow own advice. Head for Junque Boxe asap.)

Date: Wed, 4 May 2005 12:31:16 -0400 (EDT)
From: "William A Kulze" <wak9@cornell.edu>
Subject: [R-390] R390a IF Alignment

What preference do some of you folks have on stagger-tuned IF vs all tuned for 455 kc? I've done it both ways, and my latest run through the unit was 455kc all the way. Seems like I get more interference from strong adjacent stations when tuned this way. I can still go to 2kc filter and tune one side or the other for better audio, depending on which side the interfering station is. I'm just wondering what other folks have found from their experience.

Date: Sat, 7 May 2005 18:08:52 -0500
From: "Barry" <N4BUQ@aol.com>
Subject: [R-390] Alignment questions

I've started aligning my "new" R390A. When I got to the point of being able to hear AM broadcast stations, I used my frequency counter, tuned the PTO to the desired frequency (3.455 - 0.770) for a strong local station on 770kc and set the BFO to 455kc. At this point, the heterodyne theoretically should have been zero; however, I was hearing a very high-pitched heterodyne. Investigating this, I found the 17mc oscillator is 16.997mc. This (along with any inacurracy in the second crystal oscillator frequency) is the cause of the non-zero beat. When I originally set the PTO, I tuned it to 3.455 (by frequency counter), set the counter to x.000 and clamped it together. If the other oscillators are dead-on, this would be valid; however that's not the case. My first question is this: Using one of the crystal deck frequencies that is the closest, should the PTO be set to accomodate the off-frequency of the 17mc oscillator? In other words, it won't always track between 3.455 and 2.455 exactly. To do this, I can loosen the clamp from the Oldham coupler to the front-panel shaft, dial in a known frequency (say my 770kc station), set the BFO to 455kc, and while holding the dial at 0.770kc, rotate the PTO shaft to zero-beat and retighten the clamp. Is this a good method?

One more question: For aligning the second IF, the manual states to set the signal generator to 18.750mc and the R390A to 7.250mc. I think this should either be 18.250 & 7.250 or 18.750 & 7.750. Is this a known issue with the documentation? If so, which frequency is correct?

Date: Sat, 07 May 2005 20:01:12 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Alignment questions

Since the crystals in the crystal deck can not be tuned you pretty much have to put up with what ever you have or swap them out. Back in the days when the radio was new getting crystals for them was fairly easy. Today it's not quite as simple. More or less:

1) Run through the range of the radio and figure out the highest and lowest band in terms of frequency error. Hopefully this will be a few hundred cycles and not a few KHz.

2) The PTO runs through a slip drive to correct for the error. The idea is to center up the PTO between the high and low band with extra room on each end.

3) You slip the drive on the counter to get everything to center up once you have range for the high and low bands. The net result is that the PTO is running at who knows what frequency most of the time. It will be within a few hundred cycles most of the time. The Y2K manual is probably the best thing to refer to when the manual you have does not make sense. On page 6-20 it talks about the alignment procedure for the first variable IF using the generator at 18.25 MHz and the radio at 7.200 and 7.250 MHz.

Date: Sat, 7 May 2005 21:46:10 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Alignment questions

You are thinking to hard. I hope the following diatribe is helpful. If something just does not make sense, post some more questions. I retired because my senior moments were becoming problematic. Retirement did not cure the problem. I just am not making statements in retirement that impact people's lives. I may be screwing your hobby up, but you will have time to recover.

>Should the PTO be set to accommodate the off-frequency of the 17mc oscillator?

Answer NO.

>PTO won't always track between 3.455 and 2.455 exactly, what do we do?

Answer Set Zero adjust to center Set dial to 500, Set PTO to 2,955,000. Lock the clamps.

>Is this a good method? To do this, I can loosen the clamp from the Oldham coupler >to the front-panel shaft, dial in a known frequency (say my 770kc station), set the >BFO to 455kc, and while holding the dial at 0.770kc, rotate the PTO shaft to zero->beat and retighten the clamp.

Answer NO. Set the PTO for 3.455 or 2.455 Smack in the middle of the zero adjust. Use the frequency counter. Remember you want it to work with some 20 crystals and their harmonics. You may never get the PTO to exactly 1 Mhz in ten turns. Just do the best you can. Then have it spread both ways from center by setting it up at 500Khz rather than at either end point. When using a broadcast signal (good idea because we know what the frequency is), during alignment process. Set the zero adjust to calibrate on the nearest 100 KC.

This operation dials in the crystal offsets:
Set the bandwidth to .1Khz (to get into the center of the filters)
Set the BFO to zero (in the center of the IF deck filters)
The 100Khz crystal has a 320 plus harmonic that is close at 31.000+
The PTO is then beat with all the mixers to get into the middle of the band pass. The act of doing a cal zero at the closest Khz marker dials all these offsets in for you.

Roll the receiver counter to the same frequency as the signal is on.
Now rock the Khz knob for the best peak output you can get.
This will get you around the offset of the fixed crystals on any Mhz.

Believe this is close, remember it has worked for Army techs for the last 40 plus years. Now tweak the thing to be peaked at the frequency you are on.

Skip trying to inject frequencies any where except the antenna input.

If you are aligning the first and second mixers second IF's, use 10 μv or less of RF at the receiver dial reading into the antenna input.

Use the frequency setting in the TM for the dial read outs.
Adjust the item you need to adjust.

For the Second variable IF Para 75 page 116. it says.
Set the receiver to 1.900
Set the signal gen to 2.1
Inject the signal at E210.
Adjust the 3 slugs in Z216 cans

Really do the following:
Set the receiver to 1.900
Do the receiver Cal at 1.900 (a calibration point)
Set the signal gen to 1.900
Inject the signal into the antenna input.
Rock the receiver to max signal or rock the signal generator.
Adjust the 3 slugs in Z216 cans

Remember symmetry. If you are doing an alignment 250 off one end, then you want to be 250 off the other end for the matching alignment. (off the other end is likely 750, because its below the end)

The TM says find the nearest 100KHZ and zero adjust.
Then it says rock the AN/URM25 to exact frequency.
You are not going to rock the AM station, so you need to rock the receiver dial to peak.

>Investigating this, I found the 17mc oscillator is 16.997mc.

Buy doing a calibration zero at 100Khz closest to the alignment frequency before injecting a signal and doing alignment, you factor this variation into the receiver's alignment.

Trying to peak all the RF deck over a 3,000 cycle crystal shift is not going to make a performance difference in the receiver. We know these crystals are not super exact, which is why you want to inject everything at the antenna. Do the calibration zero beat against the BFO into the middle of the 0.1Khz 455 Khz IF before each tweak. Then set the dial where it belongs and then peak the
innards to perform.

Then when a signal comes in the antenna and we peak it max, the dial should read the exact frequency we expect it to see.

I watches a lot of guys try a lot of thing over several years. Tried a bunch myself. The approach above works the best. You can get some frequency to Max out buy playing around. But it will cost some where else. We had 4 or 5 guys working 2 receivers per 8 hour shift. three shifts a day 365 days a year. We had time to try all kinds of stuff. Any and every variation was talked about. Some real tech wizards though about this stuff. I had techs with math degrees drafted to be receiver repair guys. We had some other guys who were detailed to clean dust out of fans, some more that were just allowed to push a pencil. Every one was not equal in creativity. But over the years some real sharp guys with lot of time on their hands considered what was going on. The TM procedure is pretty good. The mid point alignment procedures are really needed if you have a dead receiver or a marginal problem and you are trying to decide if you need to re replacing, cans, slugs, caps, or other nasty subtle problem. So the TM is the over-kill covers everything approach.

For a good receiver just needing a good alignment, there are ways that get better results with less work. You try to do a real PM on your receiver in 4 hours. You are humping it. This is why we did them two at a time. Once you were dusting you dusted 4 or six, while your buddy shoved a bunch of tubes through the tester. You would be cleaning away and some guy would walk up and pop your 3 6C4's out and walk away. Soon he would bring you back 3 tubes plug them in and pop out some other tubes. If you were doing tubes you would grab all the 6C4 and test them all. The best would go back and you tried to put all the new tubes into one receiver. That receiver was noted on it PM record. In the next monthly you knew it would need alignment. The other 3 or 5 receivers would be OK in the monthly with well broke in tubes. Coming out of cleaning, someone would do the Calibration zero, BFO and PTO with the frequency counter. The rest of the alignment was done against the BFO, PTO and cal or the receiver. You could do 2 receiver by your self in 8 hours, go to lunch and do a couple trouble calls.

>One more question: For aligning the second IF, the manual states to set the signal >generator to 18.750mc and the R390A to 7.250mc. I think this should be 18.250 & >7.250. Is this a known issue with the documentation?

Answer: NO.

Remember you are doing a difference in this mixer. you are 250 off the ends.
One way is 250 the other way is -250 = 750.

What you really want to do is:

Do the calibration zero adjust at 7.200 or 7.300
Then just insert 7.250 into the antenna input.
Let the mixers mix it with all the small offsets.
Tweak the proper item to get the best peak you can get.
Trying to rezero, insert things in the middle, compensate for some item

just drives you to distraction.

You want the receiver to perform the best it can on all frequencies.
All frequencies may not perform equally well.
But not because the receiver is not properly aligned.

Get each setting as good as you can. Repeating the whole process 3 or more times will bring improvement on each pass.

Realignment after changing a tube, may or may not bring an improvement. The old and replacement tube may be very equal in distributed capacitance and gain. The first 100 tubes you try may all peak exactly the same. Then boom the next time you stuff a tube in, it will need a different alignment.

Let the receiver run 24 x 7 and do a realignment of the RF deck. You likely will not need to do the BFO and PTO settings. Things seem to change with a little burn in time. We use to re align the receivers the first monthly TM after a semi annual PM and see some improvements. Enough to make it worth doing.

>I used my frequency counter, tuned the PTO to the desired frequency (3.455 - >0.770) for a strong local station on 770kc and set the BFO to 455kc. At this point, >the heterodyne theoretically should have been zero; however, I was hearing a >very high-pitched heterodyne. Investigating this, I found the 17mc oscillator is >16.997mc. This (along with any inaccuracy in the second crystal oscillator >frequency) is the cause of the non-zero beat.

Answer: This is why you do a calibration at the nearest 100Khz and move the zero adjust where ever it is needed to get a zero beat in the middle of the IF band pass. This is why you rock the AN/URM 25 to zero.

The TM suggests the problem is the signal generator. You are not rocking an AM station to zero, so rock the receiver dial to zero. The alignment points in the TM are not set in stone. They are some good points on the bandwidth slug rack position to give good performance.

Just get close to the frequency and peak every thing up. The TM says rock the generator. You can rock the receiver much easier and get just as good an alignment.

Good Luck with this Barry, Roger KC6TRU

Date: Sat, 7 May 2005 21:51:32 EDT
From: Flowertime01@wmconnect.com

Subject: Re: [R-390] Alignment questions

Bob, nailed it pretty good.

Date: Mon, 9 May 2005 15:24:13 -0500
From: "Barry" <n4buq@aol.com>
Subject: Re: [R-390] Alignment questions

Thanks so much for the details. I'm still mulling over it, but I think I understand what you are saying. Since the 17mc oscillator is running 3kc below where it should be, then the clutch will be running at some point other than midrange to account for it. Granted there will still be +/- from that point for inaccuracies in the other oscillators, but basically, it will not be centered, right?

This effect is most likely not noticeable since there is plenty of adjustment in the clutch, but theoretically, it isn't running "centered". The end effect, though, is that the PTO still won't be running from 3.455 to 2.455, but from 3.458 to 2.458 -- it's just the clutch is the mechanism that is letting me adjust it to accommodate the difference in the 17mc oscillator, right? Thanks again. I really love to hear from someone who has so much "been there, done that" experience!

Date: Fri, 20 May 2005 18:21:59 -0500
From: "Barry" <N4BUQ@aol.com>
Subject: [R-390] Stagger-tuned IF question

In the alignment instructions in my R390A manual, it states that some IF's should be stagger-tuned while others should be straight through at 455kc, but it doesn't explain what determines this. Is there a component difference that makes this distinction or is it simply the application for which the receiver is to be used?

I'm thinking a CW-only receiver might benefit from being tuned at 455kc while a receiver that was going to do a lot of voice work might sound better stagger-tuned. What's the skinny on this?

Date: Sat, 21 May 2005 09:34:44 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Stagger-tuned IF question

In the first run from Collins, all the I.F. cans were peaked at 455 kHz. Turned out, though, that the Q was a bit too sharp for the 16 kHz bandwidth, so all subsequent runs are stagger-tuned. This includes the first-run models as soon as they hit Maintenance.

If you tune it straght, you will get higher gain and a bit less noise at the detector, but the 16 kHz position will roll off about 10-12 kHz. Then you will have to turn the GAIN pot on the I.F. deck down a bit, which will reduce noise a bit more. Don't know what you would gain by doing this, though, except a slightly lower noise floor.

Date: Thu, 2 Jun 2005 11:18:01 -0500
From: "Barry" <n4buq@aol.com>
Subject: [R-390] Signal Generator Impedance Questions

The IF alignment procedures for the R390A state to connect the URM-25* to the input connector using an impedance matching adapter (either Test MX-1487 /URM-25D or CU-206/URM-25F depending on which generator you have). Assuming the URM-25* is 50-ohm output, what does this converter do? I find it odd that the adapter is mentioned for the IF GAIN ADJUSTMENT procedure, but not for the IF alignment procedures even though the generator is connected to the IF module the same way for both procedures.

I assume the input impedance of the IF module is something other than 50-ohms and the adapter is being used to match the two impedances, but I don't know what the input impedance of the IF module is.

I have a GR1001A signal generator which, for most attenuation settings, has an output impedance of 10 ohms. The reason I'm asking about the above adapters is I'd like to construct a proper matching network for my 10-ohm generator to work the same way as the 50-ohm generators do for the IF alignment procedures.

Another question: The instructions state to set the output at 150uV for the IF GAIN ADJUSTMENT procedure. If I'm using a different adapter for 10-ohms versus 50-ohms, will I need to change the output setting to something other than 150uV to account for the different adapter impedances?

Date: Thu, 02 Jun 2005 16:44:04 +0000
From: rbethman@comcast.net
Subject: Re: [R-390] Signal Generator Impedance Questions

The GR-1001A originally came with a 50 ohm adapter. It, however, was limited to certain outputs to "maintain" its 50 ohm output. I'll take a GOOD look at mine and see if I can look inside and get a schematic drawn of its insides. May take a week! I'm just starting a string of 12 hour shifts.

Date: Thu, 2 Jun 2005 11:48:14 -0500
From: "Barry" <n4buq@aol.com>

Subject: Re: [R-390] Signal Generator Impedance Questions

That'd be great. I've not been too handicapped with the 10-ohm output for the most part, but I'd like to get 50-ohm output just so I can eliminate that from the overall equations.

I'm guessing I'd still need details for the other test adapter as apparently it is matching the 50-ohm output from the URM-25 to whatever is the input impedance of the IF deck.

Date: Thu, 2 Jun 2005 13:33:23 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Signal Generator Impedance Questions

As it was done way back when (68-75) and taught at the ASA schoolhouse at Ft Devens Mass: **skip all those adapters**. **None were actually used**. We all read that same TM. Nice theory, good education, likely the real exact science way to do things. Just not what was practiced in the field world-wide for years.

>I find it odd that the adapter.....for the IF GAIN ADJUSTMENT procedure, but not <snip>

Just one of those errors in the TM. Do you know what it cost to get an errata page distributed for a TM? This was our excuse for never using any adapter. Just look at the preferred paragraph and get it done.

>I assume the input impedance of the IF module is something other than 50-ohms.. <snip>

No one at the school house or student of the school house knows either.

>I have a GR1001A signal generator which, for most attenuation settings, has an >output impedance of 10 ohms.... <snip>

Old 33's knew the input of the IF deck was not 50 ohm's. Its likely not 10 ohms either. Field practice was to skip all the adapter stuff. Just cable it up. We did use 150uv into the IF deck. BNC to adapter on the back panel and mini BNC jumper cable moved from the 50 ohm output to the IF deck input. Chuck Rippel had a good procedure to readjust the IF gain for over all receiver best signal to noise ratio. This procedure is not dependent on signal generator impedance matching and gives the real world best performance. Just cable up your generator for alignment and tube noise testing. Everything is relative. An adjustment either provides more output or less output. A tube change either provides a better signal to noise or a poorer signal to noise when the generator is adjust for the same signal plus noise level. This checks the noise of a tube compared to another tube in the same socket. Changing tubes into the same socket with the signal generator held constant, checks tube gain. More tube gain may or may not be more tube noise. This is a definite place where YMMV.

<snip> will I need to change the output setting to something other than 150uV to >account for the different adapter impedances?

For alignment and test, just cable it up and use 150uV. Run what you need to get a 1/2 watt of audio out. You are running a 10 ohm source into a higher impedance. The higher impedance will not load the source. The receiver is essentially a voltage circuit as opposed to a current circuit. You hang a 1 watt 600 ohm resistor on the local audio output and start measuring the output while reading the DB scale of the AC meter. You quickly find that when turning the audio modulation on and off, you either are getting a 30 DB change between modulated signal and un modulated signal. As you play with the IF gain to change the diode load DC voltage (-7 volts) and the signal generator output level to get the 1/2 watt output. you are either getting the 30 DB change. Changing the exact gain and drive will not change the signal to noise ratio. Making adjustments will make changes. Changing tubes will make changes. Work on it until you get the 30 DB change. Then just dial 150uV and set the IF gain for -7 volts. Go on to the RF deck alignment. When you get that done then set the IF deck gain as Chuck Rippel details it.

Barry, If this is all not as clear as mud or darker, ask some more questions.
Roger

Date: Thu, 2 Jun 2005 13:06:57 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Signal Generator Impedance Questions

It's true that if you measure the input in microvolts then the impedance doesn't matter. But the low impedance puts a load across the antenna coil that isn't there if you use a long wire antenna.

The purpose of the network was to simulate the antenna and not load down the antenna coil. As it is, most people aren't set up to do microvolt tests because their shielding isn't good enough.

Might just as well connect the generator direct to the antenna and do the alignment without worrying about impedances. You'll use the antenna trimmer with a real antenna.

You can't really test the receiver sensitivity that way, though. You can check your shielding by seeing if the jump in dB from 1 microvolt to 10 is the same as 10 to 100. If your generator has a microvoltmeter, it may be looking at the input to the attenuator, which has to be properly terminated to have the right voltage at the output.

Date: Thu, 2 Jun 2005 13:18:11 -0500
From: "Barry" <n4buq@aol.com>
Subject: Re: [R-390] Signal Generator Impedence Questions

It's pretty clear and makes sense. I have Chuck's method for setting the IF gain and will probably use it, but was wanting to try the method in the manual. One thing I did notice that was rather humorous. In the section for aligning Z503, the manual states that if Z503 is defective, replace it. I'm not sure why they felt the need to include that blurb. Kind of obvious, isn't it?

Date: Thu, 2 Jun 2005 13:23:05 -0500
From: "Barry" <n4buq@aol.com>
Subject: Re: [R-390] Signal Generator Impedance Questions

The GR1001A doesn't have a microvolt meter. In reality, I was guessing at 150uV by setting the output level to 100uV and setting the adjustable attenuation control to 150%. Kludgy, but probably not too far from accurate (if it is in calibration which I'm sure it isn't). I was just trying to get something close to the procedure that's in the manual. I was disappointed that with 150uV(?) at the input, I was not able to get -7V on the diode load. I'm guessing I have a gain problem (bad tube, drifted resistors, etc.) in the IF deck, but haven't checked all that yet (but plan to). I was thinking that the 10-ohm impedance mismatch might be affecting my ability to set the gain by the manual properly. Thanks for the input guys!

Date: Thu, 02 Jun 2005 14:59:51 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Signal Generator Impedance Questions

I have both information and experience with the GR 1001A. (I thought I had a manual in digital form, but I find I do not.) I'll provide more details later, but in short:

- The thing was meant to be operated with a 40 ohm series output resistor to create a generator of 50 ohms source resistance. For the RF Level Set meter, Output mulitplier, and Output Variable control to give you a correct indication, the end of any cable needs to be loaded with 50 ohms. With the end of the cable not terminated, you get twice the indicated output. - They provided one 50 ohm load that was also a voltage divider (I think it was 10:1). Use of that thing let you be quite confident of the actual voltage at the input of the receiver (or whatever) with little effect from the actual receiver (or whatever) input impedance.

> In reality, I was guessing at 150uV... <snip>.

You did just the right thing *IF* you loaded the end of your cable with 50 ohms, *and* used a 40 ohm series resistor at the generator. (And avoided the one attenuator setting that is not 10 ohms source impedance.)

> Kludgy, but probably not too far from accurate.. <snip>

It may be closer than you think. More later. Roy

Date: Thu, 2 Jun 2005 14:43:29 -0700
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Signal Generator Impedance Questions

Roy Morgan beat me to the punch in saying that the GR1001A "impedance matching adaptor" was nothing more than a 40 ohm resistor. The connector assembly it's embedded in costs about 100x what the resistor did.

But I want to take issue with your statement that the 1001A does not have a calibrated attenuator.

It most certainly does, unless early production omitted it.

To get 150uV (assuming it's terminated right), using the CARRIER control you set the meter to the SET CARRIER line, then set the step attenuator (MULTIPLIER) to 100uV, and set the vernier (OUTPUT) to 1.5 .

Simple.

Date: Thu, 2 Jun 2005 17:17:50 -0500
From: "Barry" <n4buq@aol.com>
Subject: Re: [R-390] Signal Generator Impedance Questions

Looks like I'll be finding a 40-ohm resistor post haste.

I didn't say the 1001A does not have a calibrated attenuator; I said it doesn't have a microvolt meter. Your instructions to get 150uV are exactly what I did. I am confused on one issue, though. If a 40-ohm resistor is in series with the output and then a 50-ohm resistor is in parallel with the output, the 10-ohm output sees 90-ohms, right? I don't quite understand this.

Date: Thu, 2 Jun 2005 15:27:31 -0700
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Signal Generator Impedance Questions

Point well taken, Barry. I skipped past your words and went straight to the task. The 1001A meter is not calibrated in uV. For what it's worth, it does have a "relative" scale. The SET CARRIER line is 1.0, and there are marks for 1.2, 0.8, and so on. It doesn't matter what the 10 ohms sees; since it and the 40-ohm series resistor are not separated by any cable, there's no "termination issue" between them.

The cable sees 50 ohms, and the generator+series R (which can be taken as one contiguous blob) sees 50 ohms, everybody happy. Note that you _will_ have to do some arithmetic to figure out what the output voltage is. This kind of "wart" was endemic to GR instruments. Good stuff, but quirky.

Date: Thu, 2 Jun 2005 18:51:48 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Signal Generator Impedance Questions

I have not used a GR1001A. Consider stepping the output up to the next output range and setting the adjustable attenuation control back under 100% to what would be 150uV. Just because the dial goes up to 150% the generator may not be able to put that out. Not that the generator will not do it, but the attenuation network and maybe current / voltage limiting of an output stage hits a ceiling before you 150% of output at the low ranges. Kludgy, !! Is there some other way?

>I was disappointed that with 150uV(?) at the input, I was not able to get -7V on the diode load.

Something is wrong, either low output or IF deck needs some work. The gain adjust should let you get about -15 volts with the pot cranked over full gain and 150 uV in. You are just not going to look at 150uv on a scope or measure it with a meter. How does the signal gen perform at 1 - 10 uv on another receiver? As the other mail pointed out, due to lack of shielding you cannot really run the 150uv output through an attenuator and see how it performs as a 1- 10uV drive for a receiver. You will know when you have it right, the R390 will definitely not be deaf.

>I was thinking that the 10-ohm impedance mismatch might be affecting my
>ability to set the gain by the manual properly.

Not likely. Either the generator output is low, or you do have IF, Audio

deck problems.
Pop the VFO on and you should get about -30 volts on the diode load.

>I was just trying to get something close to the procedure that's in the manual.

Understandable Barry, when every thing is not going well, Try reading the manual.

>....states that if Z503 is defective, replace it. <snip>

Lots of little bits of humor in those TM's dry reading but some error included.

Date: Thu, 2 Jun 2005 16:00:42 -0700
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Signal Generator Impedance Questions

It's not like that, Roger. The output from the oscillator goes to a meter. You goose the oscillator until it's on the SET mark, then you get a specific voltage by setting a downstream attenuator. It's a decade step atten plus a 0-to-2.0 vernier. So as I said to Barry, you'd set the step atten to 100uV and set the vernier to 1.5 . For the current task it's beside the point, as others have mentioned. Adjust for best S/N if you care; if you don't, well, you don't; set it midrange and forget it.

Date: Thu, 2 Jun 2005 19:17:28 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Signal Generator Impedance Questions

OK, what you fellows say about the generator is good. Barry must have a poor IF / audio chain as he is not getting a good -7 volts and generator cable set up is OK. Once Barry does a once over on the front panel to make sure he has the knobs set right. MGC, BFO OFF, 2KC, Audio and RF gain to max and limiter really set off, then he has to look at the cable. I would hate for him to have a bum mini-BNC adapter cable giving him trouble. You and Barry feel the generator is OK. So it should drive the IF deck to get -7 Volts. Did Barry rock the generator to get it into the middle of the IF deck output? Or is he just reading the front panel dial? Another one of those silly little bit of real world that did not make the TM and bites everyone once in a while. I understand Barry's original view, before this turns into rocket science, what is wrong with the picture.

Date: Fri, 3 Jun 2005 09:06:51 -0500
From: "Barry" <n4buq@aol.com>
Subject: [R-390] GR Adapter and Signal Generator findings

All this talk about the GR1001A reminds me that I need a GR 874 to BNC female adapter. Does anyone know where I can get one of these? Last night, I was playing around with the IF Gain control. I'm notconvinced I have it set right, but I think it's pretty close. It's about at 2/3 full CCW. After setting it and with the radio set to 15.2mc, I connected the signal generator through my impedance matching network and started listening to the signal. With the output level set to 1uV, I could hear the modulated signal. I began decreasing the output and could still hear the signal as low as 0.2uV. I realize this isn't exactly scientific, but I was kind of surprised to hear the signal at that low level.

Also, I didn't have the series 40-ohm or the parallel 50-ohm resistors in place yet so I'm not sure how this works into the overall equations, but I was pleased to be able to hear a signal that small. I also realize there is (can be) signal leakage from the generator, but if I turn the output down below 0.2uV, the signal is inaudible so I'm not sure I'm hearing leakage or not. I have the 2V output on the GR1001A plugged so I don't think there's much (if any) juice getting out from that point. What really surprised me was with the signal generator as my "antenna", signals on the 9mc band came blasting in.

I've heard some signals with the generator connected before, but not that loud. Does this indicate the generator could be really leaking more than I suspect? It was pretty cool nonetheless. Thanks for listening to my longwinded post.

Date: Fri, 03 Jun 2005 11:18:22 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] GR Adapter and Signal Generator findings

>I need a GR 874 to BNC female adapter.......

Watch Ebay and go to Hamfests. (Sorry, none of mine are for sale.) Email the seller of item 7519425441 to ask if they have what you need. Several small lots of adapters have sold in the last couple of weeks. Item 7519914142 includes one 874 to BNC female adapter and three other items..

>... With the output level set to 1uV.. <snip>

Here is how it affects it: the "source impedance" of the GR 1001A generator is (engineered to be) 10 ohms. With no series output resistor, and no 50 ohm load, the open circuit output voltage will be about twice what the meter-attenuator-controls indicate. If you just hook the 1001A output to the receiver input, you have in effect a voltage divider of 10 ohms and whatever the input impedance of the receiver is. Let's assume it's 120 ohms (it varies with band and frequency). Then the actual voltage at the input terminal will be 120/130 of twice the indicated 0.2 uV, or roughly 0.4 uV. The accessory I mentioned earlier is the GR Type 1001-P3 Voltage Divider. I seem to remember that it is a 10:1 divider with an input impedance of 50 ohms and an output impedance of 0.5 ohms. It this thing is used at the input to your receiver (along with the 40ohm series unit) you divide the indicated generator output by 10, and can rest assured that a receiver input impedance of 120 ohms or the like will not change that voltage value. Further, leakage is likely to cause less trouble. A further note on the 1001A: Another poster is right, the thing has a voltmeter (a "simple" diode peak rectifier) calibrated to indicate at the red line on the output meter when 2.0 volts RMS is present at the input to the attenuator. The attenuator, multiplier, and output variable control are arranged to indicate the correct voltage at the cable termination if:

- the 40 ohm series resistor is in place
- the cable has a characteristic impedance of 50 ohms
- the cable is terminated in 50 ohms.

(There are some circuit refinements that are switched in by the operator below 400 kc or some such to retain accuracy of the system.) If I remember correctly, the "high level" output connector is at the point in the circuit where the 2.0 volts is measured. The manual does say to cover that connector when making low level measurements.

>I also realize there is (can be) signal leakage... <snip>

What *may* be going on is that the control you are moving is a dual wire wound potentiometer whose "bottom ene" is grounded. You may be simply getting to the ground point and cutting off the signal to the attenuator system. Leakage can exit the generator via many paths: bypass routes around the attenuator, power line, meter holes, other connectors such as the high level output, shaft openings and so on. I would expect the 1001A to show moderately low leakage, but by no means superb by modern standards. I've never tested one. You can make a test though: terminate the cable with a good 50 ohm load (not a resistor twisted to the raw end of a coax cable). Set the generator output to some moderate or low level, and place the cable on the table near the receiver, and use a sniffer loop (a few turns of wire at the end of a coax cable) connected to the antenna input to see if you can find any signal at or around the generator or cable. Inversely, set the receiver up fed by the generator on some frequency, and use another generator with a sniffer loop on it's output to see if you can "inject" signals into the system from outside.

>   I have the 2V output on the GR1001A plugged... <snip>

Those connectors were provided with a snap-on cap that simply covered the opening. Later GR 874 connectors were made in "locking" style that reduced leakage quite a bit.. if your generator does not have the locking style connector, and you are using the snap-over cap, you are likely getting some leakage from that place. Use of a GR-874 "open" termination with a locking connector would likely reduce leakage quite a bit.

>.....generator as my "antenna", signals on the 9mc band came blasting in.<snip>

This is the best indication that you may have been getting leakage. If radio signals can get INTO the generator, it's signals can get OUT.

>Does this indicate the generator could be really leaking more than I suspect?
It could be. You can experiment quite well with those signals coming in. Wiggle things and unhook and short circuit points in the system till you find where those signals are getting into the receiver. Of course, loose coax braids in your R-390A are a possibility. You have not told us whether or not you are using a proper GR 874 connector at the output of the generator. If you are using banana plug-ended leads (as GR says you can) then that is a likely source of the signals.

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Date: Fri, 3 Jun 2005 11:45:16 -0400
From: "Bill Levy" <levyfiles@att.net>
Subject: Re: [R-390] GR Adapter and Signal Generator findings

Besides Surplus Sales of N try emailing rfc@therfc.com
http://users.erols.com/rfc/index1.htm
He has lots and lots of connectors of all kinds and a few R390a's of his own.

Date: Fri, 3 Jun 2005 14:19:08 -0400
From: "Joel Richey" <richey2@mindspring.com>
Subject: Re: [R-390] GR Adapter and Signal Generator findings

Hey there old buddy, sensitivity is all in the front end, IF gain is just that, if the front end isn't able to hear a 0.2uV signal they all the IF gain in the world won't have anything to amplify.

The ability of a receiver to hear weak sigs is a function of the RF amp and the mixer stages, and the only reason there is an RF amp is to overcome the noise generated by the mixer, that's why alot of high end receivers made today don't have an RF amp, the mixer is so quiet that one isn't needed. I doubt if anyone on this list has the abality or the equipment or the shielding to come anywhere close to measuring levels as low as 0.2uV with any degree of accuracy and furthermore, unless you live on the moon that amount of sensitivity would be useless on the freq covered by the R390 series.

Date: Fri, 3 Jun 2005 14:44:21 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] GR Adapter and Signal Generator findings

>I was pleased to be able to hear a signal that small. 0.2uV. What really surprised >me was with the signal generator as my "antenna", signals on the 9mc band
>came blasting in.

Two things: One is this idea of shielding.
The other is I think you have your receiver working.

Roger

Date: Fri, 3 Jun 2005 14:08:55 -0500
From: "Barry" <n4buq@aol.com>
Subject: Re: [R-390] GR Adapter and Signal Generator findings

Yeah, I'd guess the generator is leaking some, but it did seem odd that with the attenuator turned all the way down, I could not hear any signals from the generator. If it is leaking from somewhere besides through the cable going to the radio, it would seem that I would still hear the signal when the attenuator is fully "off". Don't know, though. I tend to agree. If it picks up that well with my cubical desktop"antenna", it seems the radio is working pretty well.

Date: Fri, 03 Jun 2005 20:11:53 -0700
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] Signal Generator findings - .02 microvolt

I disagree. Although IN GENERAL what you say is true, there are times when 0.02 microvolt sensitivity comes in very handy.

Date: Sat, 04 Jun 2005 13:19:35 -0400
From: "Drew Papanek" <drewmaster813@hotmail.com>
Subject: Re: [R-390] Signal Generator findings - .02 microvolt

Atmospheric noise at HF almost always exceeds those fractional microvolt levels, particularly when the antenna resembles anything superior to an isotropic wet noodle. Where the sensitivity comes in handy,

however, is for use with antennas having poor signal-gathering ability. Shielded loop antennas would fall into that category. The shielded loop can offer good interference-nulling capability and freedom from susceptibility to e-field hash and trash that is generated by computers, compact fluorescent lights, and virtually all other consumer electronics so prevalent and unavoidable in the vicinity of our listening environment.

Date: Sun, 31 Jul 2005 11:44:39 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: [R-390] First 390A Alignment prep and weak bands

I've reassembled my Motorola '390A after recapping the last deck (AF). I've had this radio for over 13 years, but this will be the first alignment I've ever done on it.

No major components were replaced as the IF deck is a very recent EAC unit. Equipment to be used is a Measurements Model 80 sig gen with assorted 50 attenuators, an HP-410C VTVM and an Optoelectronics frequency counter. My intent is to align the radio to the conditions I expect to use it in, i.e. a nominal 50 ohm load fed through a balun into the balanced antenna terminals. I've elected to use Walter Wilson's alignment procedure

(http://r-390a.us/R-390A%20Alignment%20v2.htm)

because it avoids injecting (and loading) intermediate stages during alignment and I'm much more comfortable with a procedure that doesn't call for injecting signals into stages. The one exception maybe to use the calibrator to stagger tune the IF stages as Dallas Lankford described in the Pearls of Wisdom.

When I put the last deck in I fired it up and did a quick check with the calibrator on all bands. The signal level was fairly consistent across all bands with the 2 and 3 mc/s bands being the notable exceptions. On these bands, the calibrator was barely audible..no carrier level meter movement at all while other bands would be between 20 and 30 db. When I removed the RF deck for cleaning and recapping, I did remove the slug racks, but did not remove the slugs from the racks. I only replaced the brown beauties in the deck as I was not experiencing any sensitivity problems below 8 mc/s. Any comments, suggestions or wisdom are more than welcome.

Date: Sun, 31 Jul 2005 17:00:14 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] First 390A Alignment prep and weak bands

> The signal level was fairly consistent across all bands with the
> 2 and 3 mc/s bands being the notable exceptions.

With regards to RF alignment, the bands are:

0.5-1 MC   1-2 MC   2-4 MC   4-8 MC   8-16 MC   16-32 MC

It looks like you need to check out the 2-4 MC RF section. Not just alignment but condition of the coils/caps, bandswitches, etc. Sometimes the variable caps go shorted, other times the inductors go open-circuit, etc. The latter especially when somebody pumps a few hundred watts of RF into the front end! Sounds like your variable IF sections are OK too. Not that they can't be topped off, but look where the problem is first.

Tuning up your IF's won't make 2 and 3 MC come back. The right time to do the alignment is after you've gotten all the bands working - if you have to change out some parts then you may subtly affect the alignment of other bands. It's vaguely possible that the crystal oscillator section for 2 and 3 MC's are both out of kilter but it seems unlikely.

And check mechanical cam alignment before suspecting any of the electronics I mention earlier! Sometimes it's as simple as the clamp for the cam in question being loose or the springs not working for that band.

Date: Sun, 31 Jul 2005 22:20:49 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] First 390A Alignment prep and weak bands

Thanks Tim for the reply. I completed the first pass on the alignment tonight with generally good results. A couple things of note for the list: Stagger tuned the fixed 455 if, and to my surprise, both top and bottom cores of T-503 were fairly far off peak. Didn't expect to see such big gains from a stage I didn't go anything to. Seems to operate normally though.

Crystal deck trimmers were generally right on peak, but couldn't hear the peaks on 2-3 and 3-4. Used the upper bands for that adjustment. Both variable IFs peaked nicely with some increase in gain. 2-3 and 3-4 mc/s are deaf as stumps. In particular, the core for L-217 is all the way at the bottom of its travel with no real peak. Mechanical alignment is fine. Haven't set the IF gain pot yet, that will be the last thing I do. I want to find the trouble with the 2-4 mc/s section first. Looks like I need to pull T-203 again and have a look at the innards. Any idea what I should be looking for?

Date: Mon, 01 Aug 2005 09:15:43 -0400

From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] First 390A Alignment prep and weak bands

> .... 2-3 and 3-4 mc/s are deaf as stumps..... <snip>

If you've got a grid dip meter, you ought to see a peak at 4 or 5 MC with the core removed, and you ought to see it somewhere between 2 and 4 MC with the core halfway in. Take off the cover and look to see any physical evidence of burnt out inductors. If you don't have a grid dip meter, undo the minimum number of wires to separate the L's from the C's, and check for conductivity in the L's and lack of conductivity in the C's. If you've got some sort of capacitance meter, check the capacitors, including the variable ones under rotation. Those postage-stamp micas have been known to do some bizarre things, and I'm 99% sure there's two of them in the 2-4MC cans. IIRC there's also a small (<1 pF) ceramic cap in there.

Date: Mon, 01 Aug 2005 09:46:31 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: [R-390] calibration osc

My calibration oscillator (1963 Imperial) puts out two carriers several hundred cycles apart. One is weaker than the other. It is almost as if the multivibrator is not phase locked to the main xtal oscillator.

Both carriers are stable, and I have zeroed the stronger carrier to wwv. It is not a serious problem, but I would like to fix it next time I have the rf deck out. Any ideas?

Date: Mon, 01 Aug 2005 10:35:15 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] calibration osc

My suspicion would be the crystal itself. Crystals with mechanical damage and/or poor mountings and/or high ESR's can show spurs like what you're seeing. I'm not so sure "phase lock" is the right term, I thought it was just a divide-by-two-flip-flop made out of a 12AU7 to get from 200kHz to
100kHz and make lotsa harmonics.

(Yep, digital electronics in our beloved R-390A's!) Is the spur always a few hundred Hz away? If so, I don't think it's the calibration oscillator. If it were the calibrator and it was 200 cps at 10MC, then it would be 20 cps at 1MC and 600 cps at 30MC.

One of my RF decks had several resistors in the calibrator section way out

of tolerance (like 50-100%) and discolored by heat. I think it was the flip-flop parts. Strangely enough they seemed to track each other exactly (i.e. if one 10K resistor was now 18K, the other was 18K too, and the 1M was now 1.8M! There's gotta be some deep meaning there...)

Date: Mon, 1 Aug 2005 10:16:19 -0600
From: "Kenneth" <crips01@msn.com>
Subject: [R-390] frequency counter

I have one of the long discontinued RadioShack frequency counters. It works quite well except it's a battery hog. I want to use it to work on the IF/RF module.

I need some information on building a test lead for this counter. It has a Hi-Z switch on it but the documentation for making up the cord is really lacking.

Date: Mon, 1 Aug 2005 20:08:19 -0400
From: "Michael Murphy" <mjmurphy45@comcast.net>
Subject: Re: [R-390] calibration osc

I had the same experience with the way out of tolerance resistors in the calibration oscillator section of my Stewart Warner receiver and changed out quite a few with a power size larger. I suspect that this "digital" circuit stresses the resistors.

This was also a common problem with early logic devices using vaccum tubes. They actually had to design the tubes to be tougher too.

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Date: Tue, 2 Aug 2005 12:53:39 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: [R-390] T203

I got into the shop last night and pulled T203 to try and discover why my 2 and 3 mc/s bands were deaf. In order to get it out, I had to pull the two in front just to be able to grip the thing. Once I had it out, I noticed that the slug was different in appearance than the other two. It has a glossy finish, almost like it was coated with a shellac, where the other two (and all the rest) have a very flat matte finish. Nothing was apparent on a visual inspection.

No sign of burning or other evidence of too much power. Just in case, I swabbed the pins and sockets with DeOxit. Used a cotton swab on the pins and a very small brush in the sockets. Re-installed. Powered up and now I have an *almost* normal level of Cal signal.

The T-203 core is now almost at the top of its range instead of almost at the bottom, but adjusting it shows no real definite peak..just a very broad increase. The caps all show a nice peak. I did notice that with an antenna connected, where the ANT TRIM control peaks varies alot from one end of the band to another...from the far right through zero to the far left. Next time I will go and swap cores and see if it acts differently. I'm still don't trust T203. Is that ANT TRIM behavior to be expected on the 2 and 3 mc/s bands?

The antenna is a 120ft long dipole.

Date: Sun, 7 Aug 2005 19:17:06 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] T203

Try to swap a core from the 4-8 rack into the 2-3 rack and see how that aligns. We know there are different cores of same size but different composite stuff. A lot of wrong cores have been dropped into receivers.

If a core swap brings the 2-3 band up to par, you can go looking for a correct core. They are available. Do not worry about the antenna trim. As you go from 2.000 to 3.999 you run across whole fractions of wave lengths and impedance matches. Also, until you feed the antenna input with a balanced input and get the first trim cap in each band octave adjusted, the antenna trim can vary a lot.

Feeding an adjusted receiver from a one sided input will still give you a lot of antenna trim adjustment. Roger KC6TRU

Date: Fri, 26 Aug 2005 12:15:29 -0400
From: "Fraser Bonnett" <FraserBonnett@adelphia.net>
Subject: Re: [R-390] Dead 6MHz and 10MHz

Upon further investigation I have no Calibration signals on 6, 10, 23 and 28MHhz bands. (This is some sort of electrical retribution for not using the radio for 6 months!)

Date: Fri, 26 Aug 2005 11:56:51 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Dead 6MHz and 10MHz

6, 10 and 23 mc all make sense....they share a common crystal in the crystal osc. Y407 13mc. 28 mc maybe needs to be confirmed. It uses a different crystal... Y415 15.5 mc. Maybe a combination of things. Dirty contacts on the crystal osc. switch and dirty contacts on the Y407 crystal..... I would switch the bandswitch around quite a few times onto and off of 28 Mhz....and pull the cover on the crystal deck and clean the pins on Y403. Maybe do all of them while in there. DeOxit works wonders... Hope that helps...

Date: Sun, 28 Aug 2005 09:35:35 -0400
From: "Fraser Bonnett" <FraserBonnett@adelphia.net>
Subject: Re: [R-390] Dead 6MHz and 10MHz

>..........I have no Calibration signals on 6, 10, 23MC.. OK, so these bands share the same crystal in the Crystal OSC module. Is it possible to get the cover off the crystal oven, without going through the steps outlined in the Tech manual involving removing the from panel, playing w/ the gears etc?

Date: Sun, 28 Aug 2005 11:45:42 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Dead 6MHz and 10MHz

Yes. The cover has three screws: one at the front visible from the top, and two at the rear, not so easy to see. These two at the rear are accessible from the back of the radio if you have a LONG phillips screw driver. They are able to fall down into the radio and be hard to retreive but with care you can capture them as they are loosened. Note: the cover of the crystal oven has a heater element in it (along with some fiberglass insulation). The heater is fed power by two pins that engage correstponding contacts in the base of the unit. SO...Pull straight up once the cover is loose. Get all three screws out before you remove the cover. All this is easy to see and manage once you've done it once. It's ok to run the radio with the crytal oven cover off. You MAY find that just removing and replacing the crystal will solve the problem. You should do this for all the crystals to make sure they all have nice connections. More likely, the crystal is bad, but let's hope it's just a bad connection.

Date: Sun, 28 Aug 2005 11:49:50 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Dead 6MHz and 10MHz

Your earlier post mentioned that this is an R-390A, right? There's no need for major disassembly. The crystals are right on top of the crystal oscillator module under the cover. I think it's one screw to remove on top of the rectangular box - which is the oven, -- and there may be one along the side -- facing the rear panel. I forget if there's an access hole through the rear panel to get at that screw which may just be into an open slot whereby it just needs to be loosened so the thing lifts off. Be careful as there are the leads to supply current to the oven which is built into the top that you will be removing. Some versions may have a plug disconnect, but if not there's about enough slack to lay it to one side. If there is no access hole for the side/back screw, you can get at it with an offset screwdriver or possibly one of those mini-ratchet handles with a phillips bit in it. It might already be loose. I'm going from memory. It's been a while. Have no idea what you mean about removing the front panel, gears etc. You don't have to remove the crystal oscillator module to work on the crystals -- or the trimmers -- everything is right on top.Sometimes it's just a bit of oxidation on the crystal pins or socket terminals. Some contracts have a rather poor style of terminals made of dimpled stampings and may be loose. (found this with the '67 EAC's) Remove the xtal and stake the loose terminals with a sharp, small blade screwdriver lightly, so as to reduce the pin opening a bit. Use some DeOxit on the pins and sockets. Make sure the pins are clean and not hazed over with oxide. The problem might also be the trimmers on the top of the xtal deck -- in front of the oven (rectangular box). The one crystal that's not operative may have oxidation in/on the associated trimmer. Just turn a bit and turn back. If one is frozen, use some DeOxit and let it sit. You can either refer to the manual or the labeling of the trimmer caps to ID the correct trimmer and xtal. You should have the slotted switch on the rear panel labeled "ovens" set on off. You can operate the receiver with the cover off and tap lightly on the crystals to localize any intermittents. It's not a bad idea to remove, De-Oxit and re-insert all of the crystals while you have it opened up. Actually, they're one of the easiest things to get at. Hope this helps

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Date: Sun, 28 Aug 2005 13:03:54 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Dead 6MHz and 10MHz

> Yes. The cover has three screws:...<snip>

In my description, I think I was confusing the oven/xtal cover with the cover for the mechanical filters. Yes, screws are on the side for the xtal cover only -- not the top .

><snip>...The heater is fed power by two pins that engage corresponding contacts in the base of the unit....<snip>

Not all of them are "plug 'n play" design -- that much I remember. Many are as Roy describes -- integral contact pins. Others are hard-wired with a pair of leads. This may be a modification to ensure good connection to the heater element in the cover. Just watch for that as you lift the cover.

><snip>....but let's hope it's just a bad connection.......<snip>

It's sometimes difficult to get a good connection if the sockets are of the "cost reduced" type I described. You might notice that the crystals are rather wobbly and there's hardly any tension on the pins when your remove or insert them.

If so, then try staking them if they are of the type I described. They look like dimpled plated stampings with pinholes and two or maybe 4 cuts in the metal radiating out from the holes for the pins. Staking them closes up the pin holes a bit - enough to dig into the pins and make a better connection. Don' t do it unless there's clearly a lot of slop.

They may be of a better design, more like a conventional crystal socket -- The above does not apply to that type.

Date: Sun, 28 Aug 2005 18:59:29 -0400
From: "Fraser Bonnett" <FraserBonnett@adelphia.net>
Subject: Re: [R-390] Dead 6MHz and 10MHz

Fortunately, some years ago, someone on this list sold a very long Philips screwdriver and a wrench that fits on the back panel. I was able to use the screwdriver through two access holes in the back panel, to remove the cover of the crystal oven. I removed each crystal, cleaned the pins, and put Deoxit on them.

I inserted each one back into it's slot, fired her up, and those previously dead bands are working again. Phew! Thanks everyone for the pointers!

Date: Thu, 1 Sep 2005 08:52:03 -0700 (GMT-07:00)
From: Tony Angerame <tangerame@earthlink.net>
Subject: [R-390] R-390a Stability Specifications

From a cold start how far should an R-390a drift? I have a cool basement shack (60F) so it takes a good houtr to warm up to operating temperature, maybe longer. In that time it drifts almost 1 kc. So that's a rise of about 60 degrees or more. After that well I can't notice much change. I seem to remember maintenance in USAF replacing a receiver but it took a while for it to stabilize. But that's becoming a fuzzy memory.

Date: Tue, 6 Sep 2005 21:30:46 +0100
From: "charles bolland" <KA4PRF@peoplepc.com>
Subject: [R-390] Little Fading

Hi again, During the day when there's nothing to do, I like to listen to the BBC. If the BBC is fading badly, I end up watching Judge Judy - ugh! spit, spit. Anyway, sometimes I listen with my NRD545 and others with my R-

390A.

I've noticed that with the same antenna, the R-390A holds the signal better. Since the signal I am listening to is on 17 MHz, it has deep fades on the NRD545, but the R-390A holds the signal almost at a steady level.

I guess it's the AGC, but you'd think the NRD545'S AGC would be just as good? Any comments why the difference would be appreciated. Both receivers seem to have equal sensitivity. I mean, I hear the weak ones on both equally.

Date: Tue, 6 Sep 2005 17:34:19 -0400
From: "Mark Richards" <mark.richards@massmicro.com>
Subject: RE: [R-390] Little Fading

Could also be simply bandwidth or a combination of this and AGC time constant, perhaps? However, being an R-390 enthusiast,

I'd have to suggest that comparing it with anything else is unfair. The R-390 is, in Clint Eastwood speak, "the most powerful radio receiver in the world".

Date: Sun, 11 Sep 2005 15:07:08 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: [R-390] Noise when warm ('390A)

I've noticed lately that after a few hours of operation, a "frying bacon" or "snap-crackle-pop" noise begins to occur, slowly increasing as time goes on. No real difference in band or mode. Any quick troubleshooting hints to isolate to a stage? What is the consensus...more likely a cap or a tube?

Date: Sun, 11 Sep 2005 21:02:21 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Noise when warm ('390A)

The tubes get up to operating temperature within a few minutes of power-on. I would begin to suspect arcing over in the chokes or transformers. See if turning the rf gain all the way back to low gain makes the problem go away or if it stays there. If it stays there, it's probably something on the AF deck (which has plenty of transformers, chokes, capacitors, etc.) One of my two R-390A's has this and I've traced it to the Limiter switch on the chassis. Snap-crackle-pop only when the limiter is off. I suppose it could be some part in the limiter stage though I suspect that stage is pretty much supposed to be bypassed when the limiter is off. Tim.

Date: Sun, 11 Sep 2005 22:04:13 -0400

From: llgpt@aol.com
Subject: Re: [R-390] Noise when warm ('390A)

The voltage regulator tube OA2 has been known to have those symptoms.

Date: Sun, 11 Sep 2005 20:50:26 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] Noise when warm ('390A)

Update. First thing I did was start unplugging modules to try and see when it went away. Guess what. It goes away when the antenna is unplugged (sigh). Sorry guys. Should have checked that first, although it still doesn't sound like it's from the antenna. Is there any failure mode anyone can think of that would only be apparent when the antenna is connected? Haven't changed the antenna configuration here by the way. Its a 120' dipole fed with open wire line to a balun. Coax to the balanced antenna jack fed according to Rippel's instructions. Thanks for all the suggestions from all.

Date: Mon, 12 Sep 2005 11:56:40 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

Here is what happened to my Stewart Warner 390a few years ago. I would get snap/crackle after warming up just like you said. And it tended to go away when no signals were present (such as antenna disconnected, hence no AGC). I discovered that as the AGC (NO, diode load) voltage increased when a signal was present, the noise would start up. No AGC voltage (no signals) and the noise went away. I tried everything, it drove me crazy. Then someone on the list (forgot who) said this could be caused by a breakdown of the center dielectric in the miniature coax cables that carry the diode load voltage from the IF strip to the AF deck and some of the front panel controls. Even with the low voltages there (7-10 volts) the little coax cables would start to break down causing the popping. Sure enough, I replaced the mini-ax cable from IF deck to the terminals on the back, to the front panel, etc. and cured it. You can verify this by temporarily running a good cable from the IF deck to the AF deck or an external audio amp, isolating all other cable runs. Replacing the cables can be a pain if you are a purist and want to pull the old cable from the wiring harnesses, or you can just run the new cables along side the harness.

Date: Mon, 12 Sep 2005 12:03:43 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Noise when warm ('390A)

YES. Static electricity building up on the antenna can make such noises. Put an RF choke or moderate value resistor (100 K or so) from the antenna to ground to see if it goes away. The R-390 antenna input transformer primary is isolated from ground for DC, so if you do not have one side grounded (which most of us do) then static electricity on the antenna can build up. (The neon lamp in the antenna relay is across the UNbalanced antenna input jack.)

Date: Mon, 12 Sep 2005 12:15:36 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

Correction to previous post, I meant to say "Diode Load Voltage", not AGC. The AGC is not carried on the mini-ax cable, but it is proportional to the diode load voltage on the mini-ax. As signal increases, so does diode load voltage up to the point of dielectric breakdown and the popping noise. It tended to go away on weak or no signals. You will have to open the large multi-pin connector on the IF deck to get to the end of the cable there. I forget the pin number, it's on the schematics. If you disconnect that end, and run a temporary cable from the connector to an AF amp, and if that cures it, then there you have it. Just one idea, however, that worked for me.

Date: Mon, 12 Sep 2005 11:58:49 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] Noise when warm ('390A)

Well they say great minds think alike...<grin>. I'm going down the same path. After my last post, I continued poking around looking at relevant voltages and resistances to ground. Remember that bad filter with a partial short to ground? Well, looks like something else is dragging the AGC line down again. I thought I heard the return of the strong signal distortion. I'm not looking forward to digging around in the IF deck again. Troubleshooting that thing requires some time and effort for me, and I'm not likely to get to it till the weekend unless I get really lucky. In the meantime...I have another "Poll" type question. How likely do you all think that one of my two remaining filters has developed a partial short to ground? How unexpected is that? I've already isolated the fault to the IF deck by the way. Would a leaky blocking cap contribute to a filter's slow demise, or would that take it out in milliseconds? Thanks to all...   Dennis, who wishes he could just send his IF deck to a depot for overhaul...

Date: Mon, 12 Sep 2005 16:01:56 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

I assume you have already replaced the "kiler cap" C-553 in the IF deck. If it leaks and shorts it will kill your mechanical filters.

http://www.r390a.com/html/C-553.htm

I have also seen a lot of loose hardware in IF and RF deck. The screws holding sockets and terminal lugs to ground tend to loosen over time resulting in degraded performance and intermittants. Check the tightness of these. While that would probably not cause a partial short to ground in the IF filters, it's worth a look otherwise.

Date: Mon, 12 Sep 2005 16:20:54 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

I read some of your past posts on your AGC problem,.. wow that's a good one. When I worked through my Stewart Warner I recall getting some questionable AGC behavior. The bypass caps on te AGC line would of course read fine with the VOM test. I finally just brute-force replaced ALL bypass caps in the darn thing. I suspect they could behave differently under power. Went through the whole radio, IF and RF decks, any bypass cap that touched the AGC line got replaced with a new one from Mouser. It wasn't elegant, but it cleared up a lot of problems. (I have used the brute force "replace 'em all, don't ask questions" approach on plate, screen and cathode resistors too.)

From: "Dennis Wade" <sacramento.cyclist@gmail.com>
Sent: Monday, September 12, 2005 4:58 PM
Subject: Re: [R-390] Noise when warm ('390A)

Thanks for the notes Jim. I may have said this in previous posts, but in case I didn't...the IF deck is a recent vintage EAC deck that was "factory" modded for SSB (Rippel on his site has a short description). It had no black/brown beauties, and all the "problem" caps were the West-something sealed variety. Therefore I took the "only replace if needed" approach with the radio. My primary concern was physical access to the caps in the IF deck, especially the ones near V501 and V503. The bypass caps in there now look like disk ceramic (in shape). Are they really paper? And yes, of course they test good. Do you remember having to go through any disassembly to get to those caps to replace them? That is my major reluctance...incurring damage in getting to them. I am beginning to think wholesale replacement (at least in the IF deck) is indeed warranted even in a late EAC deck. Anyway, thanks for your input..I appreciate it.

Date: Mon, 12 Sep 2005 17:29:45 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

If I were you I would replace the problem caps, C553 especially, regardless of how new they look. It's still a 40+ year old deck and they can still start leaking with time. The AGC bypass caps in my radio were disc types also, but even they developed leakage apparently as I was able to remove some problem behavior by replacing them as well.

I don't recall any disassembly required in the IF or RF deck to replace these, I used a small pencil type soldering iron with lots of solder wick to get the solder out first, then some dentist picks to loosen the wires and remove the capacitors.

A magnifying lamp helps also. Your past posts seemed to indicate that the AGC to ground resistance dropped when you plugged in the IF deck, so these are suspects.Look also at caps C547, C548 (0.1) around the AGC time constant tube V506A.

An earlier post mentined seeing 350-400K on the AGC line when the ID deck is plugged in. This is probably normal since R547 220K and R545 100K form a path to ground. And then there's also the story that the antenna trimmer shaft is actually at AGC potential in the RF deck. Too much oil and grease on it can create a path to ground there and mess up the AGC in the RF stage. A VOM/VTVM test will never detect that, only actual operation of the radio. Not sure I have helped, unfortunately I have found that part by part replacement may be the only way to finally isolate a problem, starting with the mosr likely culprits first. The best indicator of a bad part is how it misbehaves in the radio, not a VOM test.

Date: Mon, 12 Sep 2005 17:37:21 -0400
From: "Jim Miller" <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Noise when warm ('390A)

My story about oil on the antenna trim shaft reminds me,... any oil anywhere on tube sockets or rotary switch materials can cause problems, even deoxit and contact cleaner. If the oil soaks into the tube socket or switch phenolic, you have a nice high impedance path formed, and it doesnt take much to disrupt a high impedance circuit like the AGC line. I fought with a Collins KWM2 radio once thinking I was doing good to clean the tube sockets with contact cleaner... NOT... messed up performance and AGC big time. Have to use deoxit very sparingly, q-tips or tooth picks just where you want it. If you suspect oil intrusion into any sockets or switches, use Big Bath (http://www.newark.com/product-details/text/catalog/59473.html)
or similar to displace it. These are high impedance circuits, everything you learned in solid-state books doesn't matter here. It just gets funner and funner doesnt it?

Date: Mon, 12 Sep 2005 17:44:59 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Noise when warm ('390A)

> And then there's also the story that the antenna trimmer shaft is
> actually at AGC potential in the RF deck. Too much oil and grease on
> it can create a path to ground there and mess up the AGC in the RF stage.

On my blue striper, where the rubber spacer fell was decayed to such a point that it was a messy goo, I replaced it with some glass-epoxy washers. Worked like a charm, even if not quite original

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Date: Thu, 22 Sep 2005 06:39:41 -0400
From: "Thomas Guest" <Thomas.Guest@TRW.COM>
Subject: [R-390] Dead R390A Need HELP

I am new to the R-390A but do antique radios. I may have bitten off more than I can chew at the moment but I hope that will change. I picked up this set from Fair Radio (used repairable) and powered it up and get almost nothing.

I have replaced the killer cap in the IF, the 8 ufd audio section cap, and the electrolytic tests good at full rated voltages. Fuses are good. I have a short antenna 20' hooked up to the balanced input with the other half of the connector grounded to the chassis.

The ballast tube is good. The brown beauty caps in the set have NOT been replaced! I see B+ of 285Vdc at the back panel fuse.

I have a Hallicrafters R-42 speaker (600 ohm input) tied to the set and get only a faint scratching noise from turning the volume control. No signals across the board on this set. The carrier meter deflects about 1/2 way (my meters are not the factory ones) and I get no deflection on the line meter.

Problems that I did find was the VFO was not connected to the front panel knob, & the rear terminal strip was loose and could have been shorting the RF gain jumpers to the chassis. After fixing these issues still have the same results.

Any ideas on where to look next? Or is there a way I could inject signals into the set to prove out a section at a time?

Date: Thu, 22 Sep 2005 07:10:20 -0400
From: Walter Wilson <wewilsonjr@gmail.com>
Subject: Re: [R-390] Dead R390A Need HELP

You can inject 455 KHz (modulated) into either one of the IF deck inputs and check the IF deck alone. After that checks out OK, you can start moving back through the RF deck one stage at a time, using the RF deck test points to inject signals into to grid circuit of each mixer.

Details are in any of the R-390A field depot manuals, many available for free download. If the PTO was disconnected from the front panel, the first thing I would do is set it at 2455 KHz at 7+000 KC (that's 1 KC above 7 999 KC). While at this position, check that all the camshaft pointers line up with the black alignment marks on the front of the RF deck.

The deck is so selective it won't receive any signals if the RF tuned circuits are a little off. Good luck.

I have lots of alignment information on my website,
www.r-390a.us

Date: Thu, 22 Sep 2005 09:20:20 -0400
From: "Miles B. Anderson" <mbalaw@optonline.net>
Subject: RE: [R-390] Dead R390A Need HELP

The very first thing to do is to be certain that the jumpers (RF gain control to ground 1 to 2, AGC to normal 3 to 4, diode detector output to audio input 14 to 15) have been installed on the back panel terminal boards. Any one of these will kill the set dead.

The very second thing is to make sure that all of the interconnect plugs (both the mini-BNC RF cables and the power plugs) between the modules are properly connected and fully seated. A loose or disconnected plug from the VFO to the RF deck will produce no signal. Don't forget to check the cabling to the antenna relay.

One more quick fix -- be sure the Noise Limiter is set to OFF. When it works, the Noise Limiter pretty effective at killing the audio at anything above "2" or "3" on the dial. When the pot wears out it's even more effective. The OFF setting bypasses everything.

If you don't have test equipment, there are a couple of quick checks you can perform:

(1) Turn the radio on, let it warm up and leave it on for all of these tests.

(2) Det the FUNCTION switch to MGC and both the RF and Audio gain controls wide open:

(2) Crank the IF gain pot on top of the IF subchassis wide open.

(A) You can hear scratchiness when diddling the Audio Gain control.
That's the first test, and the radio passes.

(B) Pull V602 out of the socket on the IF chassis. You should hear a "pop" on audio. If not, the problem is somewhere between V602 and the Audio Gain control (2nd or 3rd IF amplifiers, detector or audio preamplifier). If OK, reinsert the tube.

(C) Pull V601. You should hear the same thing, only louder. If not, the problem is the 1st IF stage, the BANDWIDTH switch, or the mechanical filter. If OK, the IF subchassis and audio subchassis are probably good enough to hear something.

(D) Rotate the MEGACYCLE control to some setting above 7 MC -- say 8 MC. Then slowly rotate the control between any two adjacent stops (say 8 MC and 9 MC). You should hear a "pop" and a change in the noise level when the switch goes out of detent. If not, the problem is: the 1st or 2nd mixer or the crystal oscillator.

Last: Remember the doctor's adage; "When you hear hoofbeats, think horses, not zebras." That is, look for the most common faults: (1) a bad tube or the wrong tube; (2) a disconnected plug -- before looking for something exotic.

Date: Thu, 22 Sep 2005 10:01:13 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Dead R390A Need HELP

As my yellow striper arrived from Fair Radio, there were a couple of broken tubes and a few connectors undone. Also missing the appropriate jumpers on the back.

Date: Thu, 22 Sep 2005 07:43:57 -0700
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: RE: [R-390] Dead R390A Need HELP

You have come to the right place. Just about everyone on the list has played with these beast for some time. Going back through the archives and reading earlier posts will help with issues. I don't think there is anything new under the sun with R-390A's that hasn't been solved with this motley group. Do down-load (and print) the Y2K manual, it might be in a second revision and is 312 pages loooonnnng. It is a must read!! There are several sites where it can be found, a search on google is a step in the right direction. Most of your future issues can be solved with a VOM of sorts,(DMM, VTVM, Dual FET-VOM,etc.) sig-gen(URM-25D is referred to in the Y2K manual), and a tube tester is sort of nice to have.

The issue of capacitors will of course start quite a ruckus here, there are the replacers and keep everything original sides of the story. I let a Sprague TO-6A decide which caps get to stay and which have to go. All of the brown beauties in my R-390A were bad, poor, or no insulation resistance. Several of the electrolytic were shorted and or leaky.

You haven't bitten off more than you can chew. The R-390A was the first receiver I've ever worked on. The Y2K manual will take you through every step. I think the only thing missing in this document is a step by step (with pics) description assembly of the gears. It can be found elsewhere on the web, I can give a URL if needed. I'll take a guess the receiver from Fair might have been modules put together for a complete radio. It has to be in mechanical alignment before an electrical alignment will bring things together. Got mine running in less than two weeks.

Date: Mon, 26 Sep 2005 21:34:31 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Dead R390A Need HELP

Sorry to come in late on this one. I was up at Fair Radio in Lima getting myself another R390A. Spent $900.00 on travel to avoid $50.00 shipping charges. Its a Polish thing, don't ask. OK so I was going to visit Mom in Michigan and just stopped on the way up as on the way back was scheduled for a Saturday and Sunday.

Once you get to the point where you have a calibration tone every 100 KC you have a working R390/A. Between a working R390/A and a wonderful receiving R390/A is a range of work. A working R390/A and a wonderful receiving R390/A should not be confused with a good looking R390/A. Each of these are different. Good looking R390/A are selling for over $1000.00 on Epay and may not work at all. A good working tube and a real good tube is a range that a tube tester will not evaluate for you. Old used tubes can work better than some new tubes. I do not want to send you out shopping for bunches of new tubes, because what you buy may not in fact be any really better than what you have. All tubes are not equal. Swapping the 5749s around will change your signal to noise. Changing the 6C4s will also make a difference. Finding a good 6DC6 can be a treasure hunt. Swapping the 5814s around will make differences. The 6AK5s or 5654s also make differences. Start looking for tubes for your receiver. Accept what you can find when you find them. If you really need some tubes because some are just bad and you have nothing else to use, then buy some new ones. Hopefully not from Radio Shack. RCA and Sylvania are good. Other good brands are also around. Old JAN tubes are likely OK.

Then comes alignment. Do the mechanical alignment of the dial over run and set the zero adjust to center before doing the RF cams.Once through the mechanical alignment of the RF cams will get you OK. Once the PTO is set you are OK. You can set the PTO against WWV and zero the cal osc to WWV. The mechanical coil alignment of the RF deck will improve with as many as 4 passes. If you change any RF tubes, 6C4, 6DC6, a realignment is in order. The Y2K manual will get you through that OK. A signal generator and a volt meter will get you through any alignment you need. Truth is that the cal tones and a volt meter will get you into good alignment. A good frequency counter that lets you set the PTO and BFO is a blessing. Not required, but use it if you have it.

Real good reception comes from just swapping tubes into the same socket and evaluating the results. As my ear is not calibrated, I use a signal generator and a volt meter. I like my signal generator as I can turn the modulation on and off. This compares CW to Modulated, AM. Some (Military) like to call this signal to signal plus noise test.

I hang a 580 ohm (600 Ohm) 1 watt resistor across the local output on the terminal board with an AC volt meter. My AC voltmeter has a DB scale. A good receiver will put out 1/2 Watt so you need a 1 watt resistor or spares to burn.

Using any signal frequency you can and start swapping tubes for comparison. Run all the tubes through a tube tester some where just to get the shorted ones discarded. Watch them all to get out the ones that glow blue. In the receiver circuit thump them all a time or two to get out the microphonic ones. Get all your 5749's or 6BA6's and sub them one at a time into the first IF socket. Using the same level of signal generator input. inset a tube and compare the audio output level with the signal generator modulation turned on and turned off.

A good (acceptable) receiver will have 10 DB difference. A nice (up to military spec) receiver will have 20 DB difference. 25 is very doable in today's R390/A even with their age. 30 has been seen on many receivers and can still be achieved today. (You may spend more on tubes and caps than you paid for the receiver to get there.) So sticking several tubes into a socket and comparing them to each other you can judge them for noise. Put the better performing ones into some of the other tube sockets. Set the test up again and compare the tubes you pulled. Find the best of what you have and use those tubes. Doing the 5814's needs two test to get each side of the dual triodes. Run the 6AK6's in the last IF not the audio deck. Swap the 6C4 into the second mixer above 8MHZ. If you are not blessed with tubes, Just buy your self a new 6DC6. Compare it to the one or ones you have and write that down some where (on the tube box side) so you can judge it again at some later date.

The Army ran these receiver 24 x 7 for six months or 4380 hours. Tubes would go for a year or 8760 hours. We would check all the tubes every six months and swap out the poor ones to get the receiver back up to minimum of 20 DB signal to noise at 1/2 watt output. Also need 4uv sensitive to get the 1/2 watt. If you do not have a calibrated signal generator this means nothing. It also has no impact on your ability to get your R390/A working very good. You can compare tubes using the Cal tone and BFO on and off. It will let you compare the same tube type in same socket and judge them from best to not best. You can them insert the best to the front end and work down the line from there with what you have.

If you have a signal generator that puts out 150 uv at 455 you can get the IF deck into shape real fast. You need 150 uv in to the IF deck by moving the IF out jumper wire over to the IF input and feeding the BNC connector on the back panel. Set the RF gain adjust on the IF deck to -7 volts on the diode load. Set the RF gain to mid range and adjust the generator for -7 volts on the Diode load. Set the band switch to 0.1 setting and rock the signal generator frequency for maximum signal level through the 455Khz crystal. You can zero the BFO against the signal generator. This will get you amazingly close. If you think you generator is close, set it to 150 uv and then set the RF gain to -7 volts. Set your generator modulation to 30%.

Open the IF bandwidth back up to 2KC. Turn the BFO off. Start swapping between modulation on and modulation off, you need a 30 DB difference. If you do not have this 30 DB difference in the IF deck and Audio deck string, you will never get a 20 DB difference for the full receiver. You will get 30 DB in the IF deck and have the meter needle bumping around. This random noise will not get it. You may get 28 and have a rock solid flat meter needle. This may be OK and things are just not all that exactly calibrated. So accept this and get on with life. Better tubes will come in the future. A bouncing needle may be a leaky cap. More likely its a noisy tube. Over time and repeating these test, you will get a feel for what is passable. Just get your receiver as good as you can with what you have today. Enjoy it.

The IF front end 5749's will make the most difference. The 6AK6's are next in order. The 5814's will also make a difference. You can swap poor ones into the line audio path. Some 5814's are in the limiter, 455 cathode follower, and AGC circuit. You can get the better tubes into the critical path and put some of the others elsewhere until you can find some better tubes. Once you are getting 30 DB in the IF deck and audio string, you know that end of the receiver is good. You can move over to the RF deck. In the RF deck you run 4 uv into the antenna input and look for a 20 DB difference between modulated signal generator to unmodulated signal generator. You can set the IF band switch to the 0.1 position and rock the generator frequency into the band pass. Once you tweak over peak, you can roll the KC knob for maximum signal point. Doing the cap or core slug alignment in the RF deck within 50KC of the specified number in the procedure will not cause you any grief in the final alignment and signal to noise ratio. Get the generator close and use the KC knob to get max signal. Then do adjustments.

When you are done, go find the Chuck Ripple RF gain setting procedure and use that to get the best receiver sensitive setting. Swapping tubes in the RF deck will make improvements. When comparing tubes, do not try to align the RF deck for each tube. Just plug what you have of each tube type into the same socket for comparison. You will get real hot great gain tubes. Some will have lots of noise. Some lower gain tubes will give better noise ratios. Its just a plug and try process. Once you get the best of what you have sorted and the best moved to the front of the line the receiver will improve in sensitivity. Do the RF deck alignment more than once over with a set of tubes. It will make a difference.

If the R390/URR receiver TM there is a procedure to feed both sides of the balanced antenna input from one signal generator wire through 2 each 68 ohm resistors, one to each side of the balanced antenna input. This set up lets you adjust the first antenna cap in the octaves of the RF deck. Any resistor pair between 50 and 120 ohms has been shown to work for this test setup. Grab a pair of resistors and do this alignment on your receiver at least once. While any single ended input setup will show no difference in output or signal to noise having these caps balanced will improve the minimum signal you can hear. If you ever get to feed the receiver from a balanced antenna, you will want these caps adjusted. The R390/A URR manual has never covered this alignment procedure. I do use an antenna match box and band pass filter with my R390. It has a balanced output into the receiver. So I do this alignment.

Dave at Fair Radio provided you a working receiver. It works. What it needs now is within your ability to provide. The US Military taught thousands of guys and some gals to convert that receiver into an up to spec receiver with under 4 hours of hard work using only a screwdriver, spline wrench, volt meter, 600 ohm resistor, signal generator and one hand behind their back for safety. It took the instructors 50 weeks to teach the required theory and mechanical skills to each student. It took 40 hours to teach someone every thing the military mind knew about an R390/A and what was needed to service any problem that receiver may ever have. Two instructors taught me what I needed to know as part of a class of 10 guys. I used what I learned to fix receivers for 8 years back in 68 to 75. I have still not found a R390 problem I could not isolate and fix.

The credit goes to the receivers. The engineers at Collins did an awesome job. For as many parts as these receivers have they are still flat reliable and simple. Thomas, there is not any problem in that receiver you cannot fix. Ask hear on the R390 reflector and you will more help and humor than you will need to get er done. Roger KC6TRU

Date: Sat, 01 Oct 2005 18:47:58 -0700
From: James Cottle <jim_cott@earthlink.net>
Subject: [R-390] A little help on sensitivity - where to look

I finally had the distinct pleasure of turning on my R-390A today after building a roll-around rack for it. I have the diode load output connected to an old Altec Lansing computer speaker system. Here is my problem: The AM broadcast band sounds simply fabulous. BFO works, both meters work, Veeder-Root is very accurate. I can get NOTHING ELSE! There seems to be a distinct lack of sensitivity on most all other frequencies. On my ICOM 756 proII, I had WWVH coming in today at a solid S-9 with some fading. When I swapped the antenna over to the R-390A, I could hear nothing. On further digging, I could hear with the headphone output (through some Sony headphones), the WWV signal but barely discernible, way down in the mud of the noise and only with the AF gain turned all the way up. Obvious some work to do on the beast. Anyone have any ideas where to start? Thank you in advance for any advice.

Date: Sun, 02 Oct 2005 08:47:01 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: [R-390] RE: R-390 Digest, Vol 18, Issue 2

The diode load is a very sensitive hi-z circuit. Computer audio systems are at line-level impedance. Are you using a DC blocking capacitor and 10k to 250k ohm resistor in series between the diode load and audio input of the computer audio? How does the rig perform using the rcvr's own audio module? How does the rcvr hear its own 100 khz calibration signal? If the 756 Pro will hear 455 khz, put it on the rcvr's IF output and listen. You can use a ricebox receiver tuned to 455 khz, with a blocking cap on the ricebox coax, move the make-shift probe back through the if deck until you find the problem. Here is where it helps to have tube socket test adapters. Use the balanced line antenna input even if you are using a single line antenna. Just ground one side of the input. The single line coax input doesn't perform good with a long wire. It was made for a whip antenna fed by short coax.

Date: Sun, 2 Oct 2005 14:05:35 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] A little help on sensitivity - where to look

I put this mail up last week to a similar question. Do you have a copy of the Y2K manual? It is on line and a must have read. Run the cal tones and tell us what bands have tones. You either have a tone some where in a 1MHz band or you do not. If tones are missing on one or more bands, then a band problem is to be resolved.

If you are missing tones on whole octaves (.500 -.999) (1-1.999) (2-3.999)(4 - 7.999) (8 -15.999) (16-31.999) Then you are looking at a set of octave transformers, slugs and caps. If you are missing two or more octaves, then you should look at the band switch. Likely you have enough AM stations to get through some weak tubes. The rest of the receiver range just does not have enough antenna and signal to drive it to the output. From day one the most likely problem was just plain old tubes that have reached the end of their useful life. You may need to check your RF band switch if the receiver only works on the 0.5 - 1 and 1-2 octaves.

Pull the RF deck and do the band switch by eye ball. All the switch sections are not exact and you want to get the best possible adjustment on all the octaves. The switch contacts carry current. If you get one section just barely making contact, over time the contact will burn. You want a good alignment when the octaves are changed going both up and down in range.

Check your cam adjustments at 7 +000. The RF and IF slugs should all be about mid range. If any are at the upper or lower limits, some real good alignment is in order. You may need some tubes in the RF deck if the cam alignment is good and the slugs are at the ends or there range.Now you get to checking tubes and RF alignment. <snip>

Date: Sun, 02 Oct 2005 16:06:39 -0700
From: James Cottle <jim_cott@earthlink.net>
Subject: [Fwd: Re: [R-390] A little help on sensitivity

Roger, Thanks so much for your lengthy and helpful email. I did a little inspecting today and found two serious problems (one which is my original and probably one new one). The first was a single slug in one of the tuning racks that had broken free of its screw, meaning it was always stuck in the bottom of the coil form. The only place this was supposed to be the case was on the 1 MHz megacycle setting. I think this was my major problem, so a little glue got it back to where it will track with the other two. Secondly, today I could not get very much at all to work...then I noticed that the first 6BA6/5749 (V501) looked really cloudy. On pulling this tube, it had cracked diagonally across the base of the pins. I would bet that even before its catastrophic failure, it wasn't all that good. So NOW I am all set to proceed with a proper IF and RF alignment. I am sure that I will have a healthy beast when done. Your swapping tips are greatly appreciated, for these are not common knowledge, even in the technical manuals. Thank you for your tips. It is truly a wonderful beast to have in tip top shape.

Date: Mon, 07 Nov 2005 17:03:38 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Another 390A Carrier meter question

I did not get the impression that "the friend" claimed it was "Chuck's Method": here is what the friend apparently suggested: "Later a friend more familiar with R-390's told me the best method of setting the pot was using the line audio meter. First set the pot for full IF gain with no antenna input ..." Perhaps he really meant "set the RF GAIN full on with the antenna terminated by a resistor." Just for the record, here is the procedure from Chuck's site, with the comments in parentheses added by me.. http://www.r390a.com/html/gain.html

"Procedure to set R390A IF Gain:

Once the receiver has been fully mechanically and electrically aligned, the final procedure to perform before "buttoning it up" is to set the IF gain control. Many otherwise very sensitive R390A's are thought not to be due to weak signals being covered by noise generated by excess IF deck gain. Allow the receiver to warm up for at least 1 hour then:

1- Terminate the antenna input (with 50 Ohms to ground with one terminal of the balanced input grounded, or with 125 ohms across the balanced input.)
2- Set receiver for 15.2 mHz
3- Set the "FUNCTION" control to MGC
4- Select the 4kc filter with the "BANDWIDTH"
5- Set "RF GAIN" control to 10 or maximum
6- Peak the "ANTENNA TRIM" for maximum noise as indicated on the "LINE
LEVEL" meter (Adjust the LINE GAIN control upwards to get a reading.)
7- Set "Line Meter" switch to -10db scale
8- Set "Line Gain" control to full CW or "10."
9- Adjust IF gain control, R-519 to cause "Line Level" meter to indicate between -4 to -7 VU.
10- Re-zero the carrier meter control, R-523
11- Set controls above for normal operation and reconnect antenna.

Discussion:
This will yield the best compromise on all bands. I usually "poll" those

bands which I normally spec out. Then, using an HP signal generator set for internal modulation of 800 hz @ 30%, "massage" the gain setting and even specific signal path tube selections for the best overall performance." What this does is give you a modest amount of noise with the LINE GAIN and RF GAIN at full. Any signal at or above that level you probably will hear. But no stage in the radio is working harder than it needs to. The IF strip is contributing very little noise to the receiver output. The majority of the noise you hear is from the first RF stage, where it should come from. Adjusting the ANT TRIM for the noise peak assures that this is true. If you get no peak with the ANT TRIM control, you have other things to fix first.

>I believe what it does is to set the gain lower in order to improve the
>sensitivity by reducing the IF noise contribution.

What it does is set the gain of the IF strip to be in balance with the gain of the other stages, and makes sure that the overall gain of the receiver, at full gain, is producing a modest amount of noise, mostly from the front end.   Roy

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Date: Thu, 8 Dec 2005 01:34:13 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Christmas Wish List (part 2)

Part 2 and more to follow (tomorrow)
This about the RF signal to noise test.
Tomorrow will cover those tube swaps and IF deck test.

Thank you Barry Al, and Pete for the Y2K manual. It is still the best book an R390 owner or an A owner can have next to his receiver. Just my 2 cents. OK its Christmas. I owe Craig. Hopefully someone will put this in the frequent question file. You all copy this into you personal files. Healthy comment is welcome but when, Barry, Barry, Barry or Barry start to complain the horse is
beginning to smell we drop this thread.

A short dissertation of what happens when a sig-gen, such as an URM-25() is used without consideration of impedance matching, RF leakage, etc. Now this is a very dead horse in the archives. Mostly no one has an isolated shielded environment where impedance matching makes a "measurable difference". Les and other fellows provided some very real detail on this the last time we flogged this poor horse to death. Craig, from your point of view, do a Force mind trick here and just ignore it. Hey it worked for every one in service for years. It was just the way it was done. You start getting scientific here and the fun just falls right out of it. But you are right it is a relevant subject. Just saying ignore it is a flippant response. But the truth is not provided in the TM. Some Fellows have thought about it and there are real answers in the archives. From a practical point of view in any ham shack you just ignore it because the leakage exceeds any gain from cable matching and or impedance matching. At the real levels in use, the open bench work area, and the leakage, the effort to shield hings and do matching exceeds return on investment. Accept that thousands of technicians working on thousands of receivers for half a century did not even venture down this path and produced good results every day. There is an explanation for why this has worked. It is scientific. It stands up to good logical investigation. I do not have the exact data here to pass on in this mail. Hopefully someone will dig it out of the past mail and post it again. Its Christmas and we can put it on the wish list.

Addition three: Same thing in the above paragraph to the RF section all the while hoping for the 20dB difference between modulated signal to un-modulated signal. Of course ignoring impedance matching between the sig-gen/receiver, RF leakage, plus the antenna to be used with the receiver will vary your results in real life.

Exact calibration level and signal generator level is not required for this test. Exact output level is not required for this test. If you hang a 600 ohm 1/2 watt resistor (1 watt preferred, 560 ohm is OK) on the line output of the receiver you can use the line level meter for your output measuring device. The meter of military choice was exactly a TS585 test set. This is a mW/dB meter with range switch and internal load resistors. One load resistor is 600 ohms and about 10-watt (de-rated because its in the case to 5 watts). Any AC voltmeter with a dB scale will work. Better meters and finer granularity of dB values just aid in getting the job done. Beyond the scope of this Christmas gift is the fact that with some math, just a plain AC volt meter can be used to meter the local or line output of the receiver for this test. So the signal generator does not matter, the output meter does not matter; the cabling does not mater. What counts is a relative difference in output meter reading when the signal generator modulation is switched on and off. All this gets you is a relative merit value of your receiver on any given day. It is not calibrated and it will not travel across the internet in mail as my receiver is better than your receiver because we have no clue as to the wholesomeness of any of the receivers, equipment or people involved in the comparison of the two events reported to have been conducted on planet earth in one or more of its current dimensions or incarnations. This silly little test does work to determine if the last, tweak, tube swap, change, adjustment, fiddle, nudge or whatever was an improvement.

Why does this test need the un-modulated signal? Because with no input to the receiver, the front-end stages do not produce an output of the first stage's noise into the next stage and thus yield a noise level at the output.

So one test-state is with a continuous signal activating all the stages and providing an output that reflects all of the receiver noise.

Why does this test need the modulated signal? This provides the test with a second different state that can be compared to the first state. Someone please jump in here with some good real explanation of the signal to noise test. We were asked quite politely as a Christmas wish. I'm begging here not beginning here. (See past post). Actually the modulated signal is richer in content and more of the receiver noise mixes with the modulated signal to produce a greater output level. Greater output level is not by its self, good. Observe that as we make changes to the receiver and inject the same modulated and un-modulated signal the difference between the two test states increases (good) or decreases (bad) and the relative output power may go up or down (indifferent). You may change one tube then measure; less noise less power (OK), less noise, more power (good), more noise less power (very bad) or more noise more power (bad). More or less power is not the true grail. As long as there is the required half watt (OK 0.4-watt). The exact input level is not critical the exact output level is not critical. Notice that the absolute noise of the signal generator is not an aspect of this test. As long as the modulated signal from the generator is not so microphonic that every thump on the bench pegs the output meter. Some is OK as long as you let the setup rest while you are trying to evaluate the output meter reading. Again moving targets should be avoided.

Accept that any change you make to the receiver that lets you reduce the signal generator output is good. Accept that any change you make to the receiver that produces a larger output meter reading between modulated and unmodulated signal is good. The method of coupling the signal generator into the antenna input is not critical because the leakage of the equipment on the bench often exceeds shielding provided by the test setup. Here impedance match can be ignored for much the same reason. On the output you do want to provide a 600-ohm load. 600 Is the "manufactures recommendation" 550 - 800 is likely OK. A wattage rating large enough to not smoke and change the resistance value during the conduct of the test is sort of nice. I hate working with moving
targets. The output meter scale is not critical. It need not even be a dB scale. The right scales and easy to read numbers just makes the project more fun. More difference in range between the two test states is good. Having the value in dB across a 600-ohm load just takes the math out of the problem. Hang a 600-ohm resistor across the line output and use the line meter to find the dB ranges on
your AC voltmeter. The better resolution of the AC meter will help you judge if small differences are better or not.

The military required 10:1 ratio in these two test states. The military required 0.4 watt output for 4 microvolts of input. Collins engineers did a very good job on the design. We find that with good lab grade calibrated test equipment in very controlled test setups, the receivers will do 20:1 any day of the week even after half a century. Back when (68 -75) I saw receivers do 30:1. Using just military calibrated test equipment, miss matched cabling, no extra shielding, just setting on the bench, one side of the balanced antenna input grounded, long ground straps from receiver to a bench ground that when forever to the station ground, and a TS585 for a load resistor and output meter. That sorry test setup was used every day by every one in service. The test got good receivers up to the best we could get out of them. We shoot for a 20:1 ratio. If you were not getting it easy, you went looking for a few good tubes to install. Tweaking will bring the whole power level up and it will help the ratio. But you cannot tweak a receiver up to 20:1 if the tubes are not up to it. Tweak 20:1 on some poor tubes and you can have 25:1 just by swapping in some better tubes.

Exactly what were we getting? Who knows. But it was every thing those receivers were capable of. We could determine if every change we did was making the receiver better or worse. You just had to know your limitations. How dead could you beat that receiver before the horse-meat began to smell so bad you got banded from the mess hall at mid meal time. There is just no exact absolute benchmark in this test. But getting a 30:1 ratio was an all day job with a supply room that had all the tubes I wanted at no cost to me and no restocking charges. At what RPM does your Mustang idle? Who knows. But you know when you get it down low and smooth enough so it fells right and does not stall at the stoplight. Where does your Mustang red line? Who knows. At what ever you need to dust that thing in the other lane.

So for the RF test, This is the full receiver from end to end.

Specification is 10:1 signal to noise at 4 μV in and a 0.4-watt out across a 600-ohm load.

Wonderful life is a 20:1 ratio and about 4 μV in and 400-MW (0.4-watt) output. Never mind the impedance match or shielding. The exact audio modulation frequency is not critical. The URM-25 had 1000 and 400 Hz. We used 400 HZ just to save our ears.

Run the signal generator into one side of the balanced antenna input.
Ground the other side of the input
IF bandwidth switch set to 2KC.
Antenna trim to max.
KC and MC to peak the signal pass.
AF gain to Max
RF gain to Max.

Function to Manual
AGC not being used.
Limiter off.
BFO off.

What did I miss? Like it says in the TM. Someone quote the Y2K paragraph just to drag this horse a few more yards. Paragraph 93 Sensitive Test in the TM details this test. (Almost no one has a copy) The procedure calls for a ratio of 10:1 in mW on the TS585. We would get a 20:1 ratio with this test set up. You can fudge a 30:1 dB ratio if you work at it.

To do a by the book at 10:1: we would set the AN/URM-25 for 4.0 microvolts. Set AF and RF gain to max. Adjust the IF gain for 0.4 watts with the 30 % 400 hertz signal. This is also 26dB on the TS585 meter (16+ 10). Back the local gain off some. Switch the meter down one step. Back the local gain off unit the TS585 reads 10 mW (10 dB). Turn the modulation off and switch the meter range down until you get a meter reading. To pass the test you needed to switch the meter down one step. This was down 10 dB and from the 10-mW range to the 1-mW range. The meter had to read less than 1-mW (1dB) to pass this test.

For the 20:1 20 dB test we would set the AN/URM-25 for 4.0 microvolts. Set AF and RF gain to max. Adjust the IF gain for 0.4 watts with the 30 % 400 hertz signal. This is also 26DB on the TS585 meter (16+ 10). Back the local gain off some unit the TS585 reads 100 mW (20DB). Turn the modulation off and switch the meter range down until you get a meter reading. To pass the test you needed to switch the meter down two steps. This was down 10 dB and from the 100-mW range to the 10-mW range. Plus down 10dB from the 10-mW range to the 1-mW range. The meter had to read less than
1-mW 1(dB) to pass this test.

For the 30 dB test we would set the AN/URM-25 for 4.0 microvolts. Set AF and RF gain to max. Adjust the IF gain for 0.5 watts with the 30 % 400 hertz signal. This is also 27DB on the TS585 meter (17+ 10). Turn the modulation off and switch the meter range down until you get a meter reading. To pass the test you needed to switch the meter down two steps and watch the meter very close.
This was down 10 dB and from the 100-mW range to the 10-mW range. Plus down 10dB from the 10-mW range to the 1-mW range. The meter had to read less than 1-mW (1dB) to pass this test. If you had a good clean reading at 1-mW 1 dB you were at a 27:1 ratio. If the meter would peak on noise at less than the number 9 mark on the meter you were down 30:1. This was of course a judgment call and you had to work at getting a receiver to do it.

I have read this a couple times and I think I have this all correct. We can rewrite it and re-post it until someone doth protest to much.
Roger KC6TRU

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Date: Thu, 8 Dec 2005 23:58:31 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Christmas Wish List (part 3)

Warning this diatribe will induce drowsiness. Warning most satire was left out and this is no fun to read. But it was ask for and I offer it in the spirit of the Season. May you all enjoy. If any one wants any thing more, just ask. I'll give it another shot. I can fix them my self faster than I can write about it. Roger KC6TRU

Ok so you have run all the subassemblies through the dishwasher. Pulled the RF deck, cleaned the gear train and lubed it with the magic synthetic Mobile oil. Everyone that went this far was sure to visually check the RF band switch alignment. Some have even taken the whole frame out in the summer sun light and given it a bath. A few more have removed the front panel, sanded it clean,
scraped out the engravings an applied non military paint like things to the panel. Then all the parts were heaped back inside, the green screws (bolts) were snuggled up (yep snuggled), the connectors connected and the RF deck cover replaced, many more than the recommended tube shields inserted, all the knobs checked and twiddled, some (like me) mounted the micro dial on the BFO shaft, a few more installed the "@RARE@ dial bezel with @SPOOK@ cover to arrive at one specific incarnation of a good looking receiver. All this effort has been duly noted and good credit standing with Santa applied for.

Then the shocking receiver was placed on the "bench" and properly grounded so that it could be checked to be a working receiver. After much tube testing, tweaking and other maintenance procedures as described in the manuals were completed the receiver was found to have a calibration tone on every 100 KC. The signal generator was attached to the antenna input, the voltmeter and
load resistor attached to the output, the calculator dusted off and the End to End sensitive test was performed. After some button smashing on the calculator, review of math and magic thumping of test equipment, the receiver is found to clearly pass the military 10:1 signal to noise ratio any where on the dial. Some spots almost made 20:1 but the receiver clearly passes the 10:1 with less than 4 microvolts in and .4 watts out. All this effort has provided a working R390 receiver in much better condition than some things we have seen sell on E-bay. At least you know what state

your state is in and that's a step ahead of some things we have seen sold. You have solid stated the rectifiers. Inspected the caps and replaced the brown and black critters. You have looked under all the subassembly decks and fixed any charred resistors, leaky caps and other real problems. You have the RF band switch properly adjusted by visual inspection. You have the crystal oscillator switch adjusted by visual inspection. You have the dial over run set. You have the Zero adjust set. You have the detent load set. You have the mechanical alignment set. You checked the slug racks for nice operation. You have resolved your ballast tube problem to your satisfaction. You have the power supply caps on the Audio deck under control. You have the PTO end points set to your satisfaction. You have been through the RF alignment more than once. You have watched the receiver glow in the dark both the top side and the bottom side and none of the tubes have that that unhealthy blue glow in them. The 5654's tend to get it first. Then the 6C4's. Just using what you have you are doing the best you can. But maybe you can get a bit more with what you have if you just had some inspiration. You have a good working R390 and you have done the real right stuff to get it up to snuff. You have done all the right stuff, But you been watching Emeril Live and you want to kick it up a notch. Its Christmas and you deserve some additional sensitivity. Besides the sun-spots are not all that good this year and you need some additional sensitivity.

You have been reading the E-bay pages and other things where you have seen allusions to receivers that do better than just pass requirements and work. You have explored this subject and understand that if you just replaced every tube in the receiver it could be better. A quick look at some tube prices and your pocket book tells you that that approach is not practical. Asking for a tube tester is not a solution to the problem. A more selective scientific selection of tubes to place on the Christmas Wish List is in order. You could get every tube you ask for no matter what the cost if you approach the request with rational. The I want it may fly with the children but these kinds of glow tube procurements need a bit more presentation to get through the procurement approval process.

So you put out an E-mail request for some help to the R390 reflector Fellows and start asking for the inside real spook tips on how to get this done. All right enough ducking and dodging. Enough introduction. Enough procrastination. Its time to fish as I am not cutting no stinking bait. I did the RF end to end sensitivity test in DB milliwatt and too much detail. So I will do this tube time in AC volts across a 600-ohm resistor. All in plain text as tables do not go through my mail tools. That's My choice and I'm sticking to it. Beat the 600-ohm problem with a pair of 1.2K 1⁄2 watt resistors. A pair of 1.2K 1⁄4 watt resistors will work. Pick you AC meter with the most readable scale. Go digital if you must. Warm up the signal generator.

OK so you have this receiver on the bench. Its semi time. You did a good face wash, mechanical check and electrical alignment. You do the RF end to end sensitivity test described in part 2 of Christmas wish list and the receiver fails to get the 20:1 you need to have the trick chief hack off on the paper work so you get down the hall and on to important things. Where and how do you start trouble shooting this receiver problem. The receiver is aligned. Its OK. It works (sort of). It has no specific problem. It just does not pass the shops 20:1 signal to noise test setup. I seen this twice a day six days in a row took a trick shift (2 days more or less) off and did it again for years. You need to know how to deal with this problem. It is not in the manuals. It was taught in school.

You need a minimum tube test set of each type tube in the receiver. (More is good but not required) For every tube type you need N-1 tubes. There is one 6DC6. N-1 is zero 6DC6 in the tube test set. There are 3 6C4's one is in the first mixer. Above 8 MHz the receiver uses only two of the 6C4's So N-1 is 1 6C4 ,in the test set. The 26Z5 are sand state and need zero. The 0A2 either lights or got replaced. N-1 is zero 0A2. The pair of 5654 AKA 6AK5 needs one. The three 6AK6's need 1 because the line and local are in parallel and you only meter one branch. You need 4 each 5749 AKA 6BA6. You can grab the 5814's out of the calibration area and V509 for the theses test, but 3 each 5814's help.

So you need
1 signal generator (and wire to antenna input)
1 AC volt meter (and test leads)
1 600 ohm resistor
1 6AK5
1 6C4
2 6AK6
2 6BA6 /5749

That's the ingredients..............A blow by blow account of what to connect, where to connect, the values are we looking for, and the correct order of tubes to swap while measuring for the 30db goal. Is that clear?? For the '60's Vets

EXACT

On the back of the receiver is J116. On the outside this is a BNC connector. On the inside this is a mini BNC connector. If your receiver is missing this item ask Santa for one this Christmas.

On the inside of your receiver is a coax with two mini BNC numbered P116 and P114. The P114 connector should be attached to J514 on the IF subassembly. The R390 did this sanely in BNC cable and all this mini stuff is avoided. If your receiver is missing this small assembly or it does not have continuity ask Santa for one this Christmas.

Set the signal generator up for 455 kHz, 150 microvolts un-modulated. For those with a copy of the TM. this is paragraph 73 Adjustment of GAIN ADJ Potentiometer. Right out of the TM and to follow here in detail. But for reference and history just so every one knows where this stuff is being drug in from. So people with keyboard say I miss the truth some days. Its close to Christmas, My wish list is in and I'm not about to jinx my chances with any fibshere.Understand.

If you were doing the electrical alignment of the receiver and got to paragraph 73 to set the IF gain R519, and knowing that proper prior planning prevents poor performance, you would make a could switch flips while in the conduct of this test and ensure the IF and audio deck was going to make the grade when you get to the end to end sensitivity test. Paragraph 73 has no clues on how to
do a signal to noise test on the IF and Audio decks. This is where the inside information comes from. Believe you need a 30:1 ratio here. Exact reference to a voltage or power level is not needed. Exact calibration is not needed. The signal generator should be in the 2KC-band pass as best you can rock the generator into the band pass. The mechanical filter is not tunable, so you have to rock the generator into the filter. The 150 microvolts is not exact. The 150 number is what got published in the book. Crank your generators output to 150-microvolts and accept it.

If I have no frequency counter how do you get my signal generator set to exactly 455? And the follow on question is how do I get the BFO set to exactly 455 and the knob pointing at zero? Glad you ask and it offers a nice transition into the next paragraph.

Unhook P218 from J518 and P213 from J513. Tube pullers worked good for this.
Unhook P114 from J514.
Hang a 600-ohm resistor across terminals 6 and 7 of TB 102.
Hang the AC voltmeter across this load resistor.
Set the local gain to max
Set the RF gain to max
Set the BFO off
Set the limiter OFF
Set the function switch to MGC

To set the signal generator on frequency do the following :
Back the signal generator output down very low.
Turn the BFO off.

Set the band width switch to 1KC.
Hook P114 to J513.
Turn the signal generator modulation on.
Set modulation to 30% and 400 Hertz as published in TM paragraph cited above.

Hook the signal generator to J116 using a suitable length of coax and connectors as require too make the setup.

Hook P114 to J513

Rock the signal generator into the 1KC band pass while watching for a AC volt meter peak.

Set the band width switch to 0.1KC.
Rock the signal generator into the 0.1KC band pass while watching for a AC volt meter peak.

This get the signal generator peaked into the 455 crystal filter of the 0.1KC band pass.

To set the BFO to zero do the following;
Turn the modulation off on the generator.
Turn the BFO on.

Tweak the BFO Pitch knob to zero beat with the signal generator, until AC voltmeter nulls

If null is not with the knob pointed to zero, perform a shaft clamp adjustment to null
Do not adjust knob to shaft.

Shaft at knob is burred and will not adjust easy.
Spline bolt in knob is inaccessible at BFO zero.
Set clamp inside front panel so spline bolt is easily accessible while making this adjustment.

(Just some inside info not in the TM).

Turn the BFO off.
Set the generator output to 150 microvolts turn the modulation back on and peak it into the 455 crystal as best you can.

Un hook P114 from J513
Hook P114 to J518
Set the band switch to 2KC

You likely pop the top off the mechanical filters here and trim each cap up to the best you can.
This is a subject for another mail.
You may neutralize the BFO at this point
This is a subject for another mail.

Set the gain adjust as follows. (I can name five ways to do this "properly")
For this test do the following and readjust later if necessary.
Hang a DC voltmeter on the diode load to ground.
Set the signal generator modulation off.
Set the signal generator output to 150 microvolts.
Set the BFO off
Set the bandwidth to 2KC
Set the function switch to MGC
Adjust the IF gin R519 for -7 volts on the DC load.
Remove the DC meter.

As long as you are here, you may as well check to see if this receiver IF and audio decks are going to make the signal to noise test.

You can do it now as part of the alignment of come back as part of your trouble shooting.
As long as you are here. 400-mW across a 600-ohm load is Volts = square root (P * R) = 15.4919 Volts = square root (0.4 * 600)
Verify the local gain as follows
Set the signal generator modulation on.
Set the signal generator output to 150 microvolts.
Set the RF gain to max
Set the local gain to max
Set the BFO off

The AC volt meter on the local gain must exceed 15.50 volts. (It could even be twice this voltage)

Verify the line gain as follows
Set the signal generator modulation on.
Set the signal generator output to 150 microvolts.
Set the RF gain to max
Set the line gain to max
Set the BFO off
Move the AC volt meter on the line gain with the load resistor
Output must exceed 15.50 volts. (It could even be twice this voltage)
The line level meter will flat peg out on the +10 meter setting.

100-mW across a 600-ohm load is Volts = square root (P * R)
= 7.745 Volts = square root (0.1 * 600)

Reduce the line gain from max until the AC voltmeter reads 7.745 volts. The line meter should read 20 DB +10 on the switch and 10 on the meter scale.
I know this is tricky math but follow along.

OK,   150 µV modulated 30 % with 400-hertz tone should produce 0.4-watts of output into a 600-ohm load on both the local and line outputs. The power gain is there. Both channels work. The line meter works. The BFO is set. Run through all the 2, 4, 8, and 16 bandwidth switch settings and check that the power is up. All the mechanical filters are at least passing signal. You checked the 0.1 and 1 when you rocked the generator to 455. Depending on what modifications you have made to the caps in the audio section, the power output may be over 1 watt. At least a 1⁄2 watt in a stock deck.

If you have -7 volts on the diode load and less than 1⁄2 watt out of either audio channel you know you are looking for poor tubes between the diode load and the output. Grab your schematic and see which tubes are in the line.

If you have trouble getting -7 volts on the diode load, look at the 5749's and 6AK6 in the IF deck. The diode load should crank to -10 or 15 on the end of the resistor range.

OK, 150 µV modulated 30 % with 400-hertz tone should produce 0.4-watts of output into a 600-ohm load on both the local and line outputs. You can do the signal to noise test on either the line or local. You can do them both at the same time. If they are not equal you now the 5814 and 6AK6 in the audio deck is the difference between the two outputs. OK a 150 µV modulated 30 % with 400-hertz tone should produce .4-watts of output into a 600-ohm load on both the local and line outputs.

To get the receiver to pass a 20:1 one signal to noise test this much of the receiver must be able to demonstrate a noise level that is 30 DB down from this output. 30 DB in AC volts across a 600 ohm resistor is 16.67 volts.

Verify the IF and audio noise range as follows.
Set the signal generator modulation on.
Set the signal generator output to 150 microvolts.
Set the RF gain to max
Set the local gain to max
Set the BFO off
Set the band width to 2KC
Set the limiter off
Set the function switch to MGC.

Set the audio gain for the channel under test so the AC voltmeter reads 17.32 V
This is 0.5 watts into a 600 ohm load and equivalent to 27 DB.
Set the signal generator modulation off.
The AC voltmeter must read less than 0.65 volts.

This test is not exact. Set the Audio as high as it will go.
Turn the modulation on.
Read the AC volts.
Turn the modulation off
Read the AC volts
Is the difference more than 16.5 volts?
Yes = you are OK
No = you have work to do.

Seeing all these silly AC voltages you understand why a nice analog AC voltmeter with a DB scale and range switch you understand how to use is nice here. With a DB scale on the meter you just read the max DB level with the modulation on. Switch the modulation off and read the meter in DB again if the difference is greater than 30 you pass go and collect $200.00 if not you have work to do.

What do you do when you do not have the 16-volt or 30DB difference?

Round up those tubes. We know from life that front to back makes the most difference. In this test setup V501 is first and that 6AK6 in the audio channel is last. Some AGC tubes are out of the circuit. The exact order is as follows V501, V502, V503, V504, V506, V801, V602 and V603 or V604. That is all there is in the test string, eight tubes.

Pull the BFO and PTO 5749's for test critters. Pull V508 for a test critter. V502 and V503 are under control for this test. V501 is the test socket. 5749/6BA6 is the test subject. If you have two extra 5759's install them into V502 and V503. If you have been here and done this before you have the two poorest 5749 you own marked and ready for this test.

Run the test.

Verify the IF and audio noise range as follows.
Set the signal generator modulation on.
Set the signal generator output to 150 microvolts.
Set the RF gain to max
Set the local gain to max
Set the BFO off
Set the band width to 2KC
Set the limiter off

Set the function switch to MGC.
Set the audio gain for the channel under test so the AC voltmeter reads.
17.32 v
This is 0.5 watts into a 600 ohm load and equivalent to 27 DB.
Set the signal generator modulation off.
The AC voltmeter must read less than 0.65 volts.

Swap the 5749 out of V501 and repeat the test.
Did this tube provide a higher maximum voltage?

Did this tube provide a wider range between modulation on and modulation off than the first tube?

Check all the 5749 you can round up and rank them more range is best.

If you do not have spares, swap the poor ones into V502 and V503 and run them all again.

If you do not have spares put the poor one in the BFO
Put the second poorest one in V508 AGC IF AMP.
Run the receiver in MGC do not listen to SSB or CW and wish for 5749 for Xmas

First put the very best 5749 into the PTO.
Second put the next best one into V501.
If this set up will not pass the 30:1 ratio test here, then put the best one in V501
Third put the next best into V502,
Fourth is V503.
Fifth is V505 (BFO)
Sixth is V508 AGC.

Save at least two off the 5749's for test.
Any tube that will not get you the 30 after 2 spares is a discard.
Save the rest if you have them.

The next time you run this test put your two weakest but (hopefully) passing
5749's into V502 and V503 and grade all the other 5749 you can round up.

Install the best of the 5749 and re grade all the spares so you know which will at
least pass and which bottom end ones to save to start the test with the next time.

You next test the 6AK6's in V504. You need to leave one in the audio channel you have the meter on. You can swap the other audio channel with V504 and pick the best one to go into the audio channel under test. Then check that one against the third one again for comparison. Put the best one in V504 and the second best in the local channel V603. If you have one spare 6AK6 to start with you can rank all three and place them in V504, V603 and V604.

You next test the 5814's in V602 because this socket tests both side of the tube at once in series. You can pull almost all the 5814's in the receiver and rank them. You need to have a tube in V506 the detector and V602. When you do this in the R390 you have to watch the series filaments to keep the tubes you need lit up. Rank them all and put the best as follows.

First one in V506 the detector
Second one in V601 audio.
Third one in V602 audio
Fourth one in V507 limiter
Fifth one in V509 AGC
Sixth one in V205 Calibration
Seventh one in V206 Cal buffer

Save at least two for the next test event.

Once you do this one time you start to see how tubes are making a difference. You swap the order of V501 and V502 a couple of your best 5749's and see a 6 or more DB change in the span of the modulated to un modulated signals and you become a believer. Once you get enough good tubes in the receiver to get the range in the IF and audio sections you can hear the difference in the receiver when you put it back on the antenna.

V501, V502, V504 are the first three to receive new tubes if you can not get the 30:1 range. This is 2 5749's and a 6AK6. Three 5749's and two 6AK6 will get you there as V501, V502, V503, V504 and V603 or V604. You almost can always find a few good 5814's to fill the string. Trade a 6AK6 or 5759 for the 6DC6 on your Christmas list and have a 5 pack shipped in time for the Holidays.

Once you get the IF and Audio deck aligned and tested you put the receiver back together and start on the end to end sensitive test as detailed in part 2. You go into the RF deck alignment knowing the IF and Audio are good those tubes are good and the signal to noise ratio is good. What ever you need to do to the receiver now is in the RF deck.

If you went through this mess of testing for the um-tenth time it takes about a half an hour to just do it. First time can take a week of you hobby time. If you go through all of this and you have a meter needle that just wants to bounce big time, and none of the tube juggle seams to help, you may need to be rethinking caps. But you should still be able to rank your tubes and know the better from the poor. You can look into the IF deck and judge the cap problem. An assembly full of brown or black things is a cause to heat a solder iron. Been there done that is cause to consider some new tubes.

Once upon a time a brought 5 new Raytheon 6BA6's. They were the hottest tubes I have ever had. Power out over 1 watt. I can not get any of them to pass the noise test. I'm burning them in the BFO and AGC rectifier. I know its BFO noise but I can live with it. Moral new tubes may be worse than what you have. There are lots of good brands.So all this work may not cure all ills. In service we just knew if you did not get past this test you were not going to make end to end test. It was a place we learned to divide and conquer. We had to set this test up and do the BFO and IF gain here anyway. It was just a few switch steps to do the test. If you had to go for tube jockey status, this test at the half way point sorted the tube types. Only the 6C4, 6AK5 and 6DC6 were left for the RF section.

These tubes were done the same way with the receiver set up for the end to end sensitivity test. You set up the RF alignment and could get the 20:1 ratio when you did an adjustment or you swapped some tubes. If the receiver was looking poor after getting the IF to pass, you just started with a new 6DC6. If it did not make a lot of difference you put the old one back in and went through the adjustments. You swap the 6AK5 into the crystal deck above 8 meg and rank the 6AK5's. You swap all the 6C4's you have into V603 and rank them. Put the best one forward. Do you put the best 6C4 into V202 or V203? Depends on what you are going to do under 8 meg.

You keep at this long enough, buying tubes and grading them you get over 20 end to end and have a wonderful receiver. You stay at it and you find you have 25 or more end to end. Then you find the meter is just not laying real still. So now you can go at it back to front one stage at a time with signal injection and see where that meter bounce is coming from. Then you can consider noisy caps. But until you get a real good set of tubes in the less noisy caps are not your major problem. I have found just getting good low noise tubes to be a problem or buy and try. This cap subject has driven most of us to just acquire a complement of good quality caps and re work the whole subassembly one-week
end. Again the IF deck gets it first, then the Audio deck gets it, and last we do the RF deck.

So I hope this covers the subject clearly and allows everyone to test their R390 so as to generate a concise wish list of parts that will make a difference in what they hear with out exceeding the allowance. Merry Christmas to All,   Roger KC6TRU

Date: Wed, 4 Jan 2006 18:09:29 +0100
From: "paolo gramigna" <paolo.gramigna@controllo.it>
Subject: [R-390] Tuning the IF question

I'm trying to tune up my first R-390A. I have the manuals. When I came to the IF tuning, the manual says that each trsnsformer has two lugs; the primary in the bottom, the secondary in the top. The problem is, how can i reach the bottom one? There is no hole in the IF module chassis; to reach the bottom lug, i have to remove the top one; and so the transformer goes so much out of tune that no reading is possible on the VTVM. Where am I wrong?

Date: Wed, 4 Jan 2006 11:23:18 -0600
From: mikea <mikea@mikea.ath.cx>
Subject: Re: [R-390] Tuning the IF question

I think that the way to do this is to reach through the top slug to tune the bottom slug. This, of course, assumes that the slugs are hollow. I seem to remember that they are in fact hollow. Any other R-390A tweakers care to comment?

Date: Wed, 04 Jan 2006 12:26:13 -0500
From: Roy Morgan <roy.morgan@Nist.gov>
Subject: Re: [R-390] Tuning the IF question

Use a tuning tool that is very thin in the middle and has a short hex section on the end. General Cement makes them. You put the tool down through the top slug to reach the bottom one. All from above.

Date: Wed, 04 Jan 2006 12:30:02 -0500
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] Tuning the IF question

There is a hole in the top slug that a tuning tool will pass through to get to the bottom slug, but the tool needs to be small enough in diameter to pass through and still mate with the bottom slug. Most IF tuning tools have two sizes at each end. The smaller diameter end will pass through the hole. You do not need to remove the top slug!

Date: Wed, 04 Jan 2006 12:41:11 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Tuning the IF question

Go to Radio Shack and buy the Alignment Tool Set. You will find one of them has a hex head that fits the hex holes in the I.F. Cans. You will also note that the shaft on the tool is narrower than the hex head. To align the top core, insert the tool a little into the core and turn. you will see that the top core turns. Insert the tool farther, and the hex head will go past the top core and into the bottom core. turn the tool and you will note that the top core does not turn, even though you can feel resistance to turning. That is why the shaft is so narrow.

Date: Wed, 04 Jan 2006 17:21:50 -0500
From: Miles Anderson <k2cby@optonline.net>
Subject: Re: [R-390] Resistors, noise, etc.

"Rural area" doesn't help very much. While there is relatively little equine QRM, the power companies in rural areas tend to "let things go." A few cracked insulators, untrimmed trees and the occasional electric fence can be just as noisy as an urban industrial neighborhood.

Date: Wed, 4 Jan 2006 22:15:36 EST
From: Bonddaleena@aol.com
Subject: Re: [R-390] Resistors, noise, etc.

Miles, I have to agree with that! I recently moved fron a 'high dollar' neighborhood with underground utilities. Never mind the a--holes in the neighborhood that sued me because my towers 'did not match my house'. (they lost the suit, but the death threats cost me my marriage), I moved about 5 miles into a much more rural (poor) area. Although I am the last house on the power distribution line, I have 2 poles, that at times make any communication impossible. Even trying to assist those that needed help during the recent hurricanes. I have called the Utility 5 times and have been told basically 'too bad'. If this isn't resolved soon, I will persue it through the FCC like I have done quite sucessfully in the past in another state. The area I live in is a 'depressed non-caucasion' area, and the Utility (FPL) could not care less. I have told them that there are power lines in the middle (!!) of large trees but they continue to groom the power lines in more affluent areas.....

Date: Fri, 6 Jan 2006 08:23:53 -0800
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Tuning the IF question

All the information supplied so far is correct, but I don't think anyone answered Paolo's implied question. The answer is, a metal tool will change the coil inductance. Always use a plastic alignment tool.

Date: Fri, 6 Jan 2006 11:37:58 -0500

From: "Patrick" <brookbank@triad.rr.com>
Subject: Re: [R-390] Tuning the IF question

A bamboo skewer (bought at any supermarket) and a sharp pocket knife will make a great tunning tool (very cheap) for both the upper and lower coils. Been using them for many a time.

Date: Fri, 6 Jan 2006 18:26:34 +0100
From: "paolo gramigna" <paolo.gramigna@controllo.it>
Subject: [R-390] Tuning the IF Second Question...

First, let me express my thanks to everybody who contributed, both personally and on the list. Now, to the second question: the IF lugs are sometimes stuck in place, and I am afraid to breack them. What is the best de-stucker and lubricant for them?

Date: Fri, 6 Jan 2006 20:03:03 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Tuning the IF Second Question Stuck Slugs

>Now, to the second question: the IF lugs are sometimes stuck in place<snip>

This question comes up often. Watch the other mail and see what other advice you get.Do not jump right into this problem. Do you really need to get the skug unstuck? How do you get the slug unsuck? What do you lubricate the slug with once it free to keep it from seizing up again? Then we throw in a whole bunch of stuff not to do.

Go through the alignement and just leave the stuck slugs alone. These receivers are over 50 years old and receivered lots of regular service in their day. No reason at all to belive the stuck slug is not set at almost its best position. Align the receiver and see what the signal to noise ratio is. Then try some tube swapping to get the ratio up a little better. If and only if the reciver will not get you better than 15:1 signal to noise ratio and you can isolate the loss down to the stage with the stuck slug, then worry about getting it to adjust. Worry not if you break the slug. A broken slug can be replaced. A real concern is twisting the core inside the can and breaking a wire between the winding and the terminals inside the can. Pull the cover off the transformer so you can see your core and coil winding before twisting very much on the slug.

Never, never, never use WD40. The long term effects are more trouble than you want. There is no magic solvent that we just "know it works". Apply some rubbing achole and take the next day off while it all soaks in. Good lights and a neddle may help you dislodge some gunk. large amounts of air may help blow some crud out of the tube and help free the slug. Use a metal hex key in the slug to turn it. You may have to move the top slug a bit so the key will drop through the top and bottom slug to turn the bottom slug. Heat the metal key with a solder iron to "melt or soffen" some of the gunk. Hair dryers have been used to good effect for this. Gently warm the whole slug tube with the transformer cover off and watch the resin melt. Let the heat soak through the tube a bit before trying to turn the slug.

Date: Sat, 7 Jan 2006 10:21:41 -0500 (EST)
From: <w9ya@arrl.net>
Subject: Re: [R-390] Tuning the IF Second Question Stuck Slugs

A comment about the "magic powder" mentioned in the posting below: Um, there are many kinds of powders that magicians use to rub into decks. Be sure to get the stuff called "fanning powder". Why ? - Because some of the stuff is designed to make the cards stick to one another, and that would make life worse for keeping slugs loose.

Date: Wed, 01 Feb 2006 10:06:48 -0500
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: [R-390] Source for good ceramic alignment/tuning tools

I've got a set of thiry-year old alignment tools made out of nylon that I probably bought at Radio Shack. (In any event they come in a now decaying plastic pouch that say "Color TV alignment set"). They're getting pretty worn and ratty now, and since I'm getting deep into aligning RF decks and eventually IF transformers I want something better. Radio Shack doesn't seem to have any tools like this anymore. AES has some nylon tools but I'd like something better than what I have. (Well, at least the nylon ones are a little bendy and don't break). At one point you could buy from the electronics parts places some really nice ceramic and/or carbon graphite alignment tools. If I poke around Digikey etc. I see a couple of nice insulating screwdrivers but nothing with the hex tips (including the narrow-shaft one for doing the bottom of two slugs in a trasformer). If anyone knows of a good source for buying these ceramic hex thingys, I think that I'd now like to invest a little bit of money (maybe $20-$40) for a set that'll be useful in my R-390A and other radios. If anyone knows the exact designation for the hex core sizes that'd be handy someday too.

Date: Wed, 01 Feb 2006 11:12:59 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Source for good ceramic alignment/tuning tools

I have been collecting alignment tools for a *long* time. The wide array of forms and shapes tells me I have only a few of the ones that likely were made. Among my favorites are phenolic ones that have metal ends. Some are flat blades, some are internal hex like nut drivers. I just got a 51J-4 that has it's phenolic alignment tools in place, and one has a small round pin through the end of the tool.. None of the old tools are the hex shaped ones needed for more modern slugs.

>They're getting pretty worn and ratty now, and since I'm getting deep into
>aligning RF decks and eventually IF transformers I want something better.

The flat-ended ones will shape up on a grinding wheel or with a file. But the small hex ones are likely at the end of their life.

>Radio Shack doesn't seem to have any tools like this anymore.

Look here: http://www.action-electronics.com/toolidx.htm#Align
The PDF file describing lots of tools is: http://www.action-electronics.com/pdf/gcalign.pdf

>At one point you could buy from the electronics parts places some really
>nice ceramic and/or carbon graphite alignment tools.

I never saw them. If you find them, please tell us all.

Date: Wed, 1 Feb 2006 09:35:14 -0700
From: "SAM LETZRING" <sletz@msn.com>
Subject: Re: [R-390] Source for good ceramic alignment/tuning tools

I have a lot of ceramic screwdriver tip alignment tools (both straight and phillips) that I have used for adjusting surface mount inductors/var. caps.- but I have never seen ceramic hex tips- don't know why they wouldn't be out there though. A quick Google search didn't turn anything up-however.

Date: Wed, 1 Feb 2006 15:40:34 -0500
From: "Leanne" <leanne@islc.net>
Subject: Re: [R-390] Source for good ceramic alignment/tuning tools

I've got a set of thiry-year old alignment tools made out of nylon that I probably bought at Radio Shack. (In any event they come in a now decaying plastic pouch that say "Color TV alignment set"). They're getting pretty worn and ratty now, and since I'm getting deep into aligning RF decks and eventually IF transformers I want something better.

Date: Thu, 02 Feb 2006 20:13:12 -0500
From: "Steve Hobensack" <stevehobensack@hotmail.com>

Subject: [R-390] Radio Shack tools

Be carefull with those Radioshack alignment tools as pictured in the link. The metal goes straight through the plastic to the other end. I found out the nasty way when the palm of my hand took a hit of B plus!

Date: Sun, 5 Feb 2006 08:53:58 -0800 (PST)
From: Bruce Hagen <bhagen44141@yahoo.com>
Subject: [R-390] Alignment tools

The current Stanley, was Jensen, catalog (www.StanleySupplyServices.com) has complete sets or individual tools. See pages 132 and 279.

Date: Sun, 5 Feb 2006 10:56:05 -0800 (PST)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: Re: [R-390] Source for good ceramic alignment/tuning tools

Radio Daze, Digikey and E-bay all have GC alignment tools.

Date: Sun, 05 Feb 2006 16:28:56 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Source for good ceramic alignment/tuning tools

Thanks, guys. What I ended up buying was a 9-piece Aven set from Digi-Key, 243-1016-ND. They are "just" plastic, not the ceramic ones I was desiring, but they were pretty cheap and they seem to be more durable than my old chewed up Radio Shack set. My next Digi-Key order I might get a ceramic screwdriver or two (but they aren't very cheap!)

Date: Sun, 19 Mar 2006 13:12:26 -0500
From: "Jon" <jonklinkhamer@comcast.net>
Subject: [R-390] Calibration issue

I'm in the process of going thru electrical calibration on my R390A. I noticed a couple of things when I turned on the calibration signal.

After I zero adjusted it to achieve zero beat frequency I can basically do two things in which I would have to zero beat it again. First by just going +/- say 50khz (or maybe even less) around the calibration point, in this case 09.000 I would have to re zero and there would be a good tone not just a little off beat.

The other observation is by just sitting on the calibration mark and returning after about 15 minutes it again would be off. However not as bad. BTW the receiver has been warmed up for at least 2 hours in advance.

I guess I'm trying to pin down whether the BFO or PTO is drifting or maybe the 100Khz signal is off.

Date: Sun, 19 Mar 2006 18:04:44 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Calibration issue

>........ in which I would have to zero beat it again...<snip>

This sounds like the dial clutch is slipping. Lots of geartrains out there have so much grease and grunge on the clutch that I could see this happening. Also the anti-backlash spring on the Oldham coupler. And...also see my thread on PTO squirreliness.

>....after about 15 minutes it again would be off.....<snip>

You have to quantify "not as bad". A few hundred Hz of drift from power on isn't so bad. But as a data point: My R-390A's are stable to +/- 50 cycles after warmup (measured with a GPS-locked counter - if it says it's off by 0.1 or 0.001 cycles, then I believe it!)

> trying to pin down whether the BFO or PTO is drifting or.... <snip>

If the 100kc signal is drifting then you will see a much bigger effect at 31Mc than at 1Mc (a factor of 31 in fact.) Also keep in mind that the band crystals and the 17Mc crystal (which is on) could be drifting too. But again, you'll have to quantify the drift and find out on which bands it is there/worse.

Date: Sun, 19 Mar 2006 18:17:37 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Calibration issue

Oh, a couple more comments about frequency stability/calibration/etc.:

1. 50 years ago a frequency counter was unobtanium. (Well, they sort of existed but filled up an entire rack). But today they're cheap and everywhere. Do not neglect this as a tool to narrow down the problem! I know, the purists will insist that using any tool not mentioned in the official Army/Navy docs is a violation of the sacred rules. But it's easy and really does work. A simple coil put around the oscillator tubes will be enough to get amplitude sufficient to run most any counter. Sometimes the waveforms you will see at V401 will be a bit funky. The 100kc calibration is really a 200kc oscillator and a 5814A multivibrator (divide by two) and of course it has lots of harmonics. The 17kc osc on the RF deck only runs below 8Mc. And it's easy enough to pull the coax cable running from the

PTO to check what it's putting out.

2. Check the 0A2. Purple glow is good. But even if you've got a purple glow check out the +150V test point. I have been thoroughly unimpressed with the quality of lots of "consumer" 0A2's over the years.

Date: Sun, 26 Mar 2006 13:09:25 -0500
From: Rbethman <rbethman@comcast.net>
Subject: [R-390] Working on R-390A IF Deck

I've been working on an R-390 Collins IF deck. It is an early one with no trimmers on the filters. (Just reference info!) I had to replace Z-501 due to a broken slug and broken off adjustment "head". What would be the most reliable way to set this oscillator system "on the money" for 455kHz? Scope, Sig Gen., and Freq counter are available on bench.

Date: Mon, 27 Mar 2006 10:16:42 EST
From: DJED1@aol.com
Subject: Re: [R-390] Working on R-390A IF Deck

I'd vote for the frequency counter to start. I use a scope probe to connect using a high impedance input on the counter. Once the radio is all toghther and working, you can check the BFO setting by peaking the calibrator signal in the narrowest filter bandwidth, then zero beating the BFO. This will account for any variation of the crystal filter frequency.

Date: Mon, 27 Mar 2006 11:37:12 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Working on R-390A IF Deck

The thing that determines the value of the IF frequency is the crystal filter at the narrowest bandwidth. You should center the IF in the crystal passband. In some cases that might be 455.00, but not always. Crystals move a bit with frequency, as well. You really don't need a counter to align the set. Certainly the military didn't have many of them in the 50s. The HP 522B would work all the way up to 100 KC. If the IF is peaked near 455, set the bandwidth to 100 Hz and tune the generator for maximum output from the IF. Do this after the set and the generator have warmed up. You would need a counter if the generator drifts, but just to keep the frequency at the crystal filter center. Once the IF is aligned, go back and realign the RF and variable IF sections - unless you didn't move the IF more than a few hundred cycles. The bandwidth of the RF deck is about 16 KHz, right?   At least, that's what I'd do ...

Date: Mon, 27 Mar 2006 13:03:45 EST

From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Working on R-390A IF Deck

Bill Hawkins, is right on this stuff. If you do not have a counter on the signal generator. First run the 455 into the test point on the last stage of the RF deck. point E211. Use what ever signal level you need to get a good meter reading on the diode load with the BFO off and signal generator modulation off.

Trim up the Z501 cap C510 and coil L503 using the manual for setup of the bandswitch and when to adjust each item.

Also trim up T208 and leave it alone after this. Unless you change the 6C4 in the mixer stage. Then retune T208

You have pushed this coupling stage to best pass through your receivers 455 crystal and that's the best you can do. It may not be exact 455 but it sure is the peak band pass of your receiver.

Work the signal gen frequency into the 455 crystal and peak every thing for maximum output on the diode load.

This gets the "IF" aligned into the center of that crystal and does it with the balanced input from the RF deck to the IF deck in place. Some times you can get a little more out of the receiver this way. If you are doing CW and narrow band stuff TTY and computer stuff this is worth the effort.

Once you find the peak 455 for your receiver and signal generator then go to the single end input to J518 and adjust the rest of the IF deck.

Leave Z501 alone.

The mechanical filters will lay over the crystal center. We have seen from testing earlier this year that peaking the mechanical filters does not change their center frequency but will change the signal level.

The mechanical filter trim caps act more like gain adjust than frequency shift adjust.

Trim up the IF slugs.

To stagger or not to stagger. If you are a wide band AM listener try the stagger tune in 16KC band width. If you have a sweep generator adjust for nice band pass in 16KC bandwidth

Else, just center-adjust for 455KC and 2KC band width.

Roger AI4NI

Date: Wed, 29 Mar 2006 10:11:36 -0800 (PST)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Noise Floor question

In ads for the R390A the term of "noise floor close the theoretical limit" yada yada yada. is often mentioned. A search on google didn't yield anything comprehensible. If we follow Roger Ruszkowski's method for achieving a 30db ratio, then by logical definition we are lowering the noise floor by a ratio-metric method. I know the receiver has a very low "noise floor" but how would us mere mortals measure it? Short the antenna input, terminate the audio out put with a 600 ohm resistor turn up the RF gain and audio controls and then measure the AC voltage on the termination resistor with a micro-voltmeter?

If one did Chuck Ripple's audio improvements are we lowering the noise floor or just making a better sounding audio output or both? Inquiring minds ever seek knowledge for improving our radios.

Date: Wed, 29 Mar 2006 14:06:56 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Noise Floor question

Others will have more modern and authoritative answers, but here is mine, briefly:

Basic ideas:

1) The front end of the radio, that is the "antenna", the rf coils, and first RF amplifier tube contribute most of the noise to the radio.

2) The stuff in the front end, without any external signals, makes noise just because it has warmth compared to absolute zero. Thus, there is an equation that tells the theoretical noise floor contributed to these parts. And thus, folks in radio astronomy at least used to put liquid nitrogen onto their first amplifier tubes to reduce the noise they generated.

3) If we assume no or little noise is contributed by the later stages in the radio, and the amplifier is perfectly noise free, then this calculated amount of noise would show up at the speaker terminals and we can measure it. This would be the theoretical minimum noise or noise floor. In addition, in normal real radios, the first RF amplifier contributes some noise, thus we get the real minimum noise or noise floor.

NOW: If we add a carefully controlled amount of additional noise at the antenna terminals, by magic or by careful engineering, and the noise measured at the audio output DOUBLES, then we have added noise equal to the actual noise generated by the front end. There you have it. This is not impossible for us average folks to make an approximation of. Just make an input network (attenuator at the antenna input) that presents the needed impedance to the radio, and have a way of injecting a calculate-able amount of noise extra. A noise generator or maybe a URM-25 and a 100:1 attenuator would let you at least get started on this.

If you use a switched noise generator (pulsed on and off) and look at the receiver output noise with a scope, you can see a sort of square wave and easily get an approximate setting for the added noise to guess the self noise of the radio. Make adjustments to reduce this self noise, and you have made an improvement in the radio. This is more or less what Roger's method does, though with different noise levels being compared. And this is exactly what is done with converters, either with a manual knob-controlled noise generator, or with a pulsed one and a scope to see the effect of adjustments.

> Short the antenna input, terminate the audio out put with a 600 ohm
> resistor turn up the RF gain and audio controls and then measure the AC
> voltage on the termination resistor with a micro-voltmeter?

Yes. but you won't need a MICRO voltmeter - it will be plenty loud enough to measure with more normal voltmeters. Don't short the antenna terminals, use the expected antenna impedance.

>If one did Chuck Ripple's audio improvements are we lowering the noise
>floor or just making a better sounding audio output or both?

If the plain noise of the audio section adds a LOT to the receiver's noise, the audio section needs fixing (such as replacement of leaky caps, bad tubes, and bad resistors.) If the audio section makes *distortion* on normal sounds at normal levels (which it most certainly does) then this distortion is noise to you listening, but is not from the front end of the receiver. Most audio section modifications are likely to reduce the distortion you get from the radio. This is why the diode load audio pick-off method sounds so good.

Chuck's method of setting the IF gain has the basic effect of making sure the IF gain is not set so high that the IF section contributes (lots of) noise itself. Most of the noise in a normal radio should be coming from the RF front end amplifier. Some modern and very expensive radios have no RF front end amplifier, partly in order to eliminate the noise from the active part (tube, transistor, traveling wave tube, or whatever).

>Inquiring minds ever seek knowledge for improving our radios.

Improving our understanding of what's going on is a very good start. I hope this helps, and expect that other comments/posts will help, too.
Roy

Date: Wed, 29 Mar 2006 11:53:02 -0800
From: "Bill Feldmann" <n6py@qnet.com>
Subject: Re: [R-390] Noise Floor question

You may want to take a look at the noise floor measurements I did as a comparison of the R-390 and R-390A and the description of my method of measuring noise floor in the March Electric Radio. The article is really on a method for better audio on the non-A R-390 but had to be broken in half for a two part article where the first part is mostly just on the R-390. The April half will get down to business and talk about audio performance. Be very careful when someone gives a noise floor for a receiver and no information on how the testing was done. Noise floor numbers are often give as the minimum signal level in -dbm, db below a MW in power, that a receiver can successfully copy. The results are highly dependent on the test method, the receiver's IF bandwidth and the type of signal you want to copy. All my tests are done to measure the noise the minimum strength CW signal that could be copied over through a receiver's internally generated noise even though most of the receiver I've lately tested, like my R-390's and SX-28's, I use for mostly AM reception. But for comparing receiver noise floor and intermod performance I've found those that perform better using my CW method also perform better for AM when compared to other receivers. So when comparing noise floor numbers make sure the tests were all done under the same conditions using the same method, or better yet the same test fixture or equipment. I test a receiver, like the R-390's in my ER article, using a narrow CW IF bandwidth like one kc or less and for a carrier 3db above the noise. I didn't use 0.1kc because I don't like that bandwidth for CW, it rings too much for my ears. This was the method suggested in some Ham Radio and QST articles back in the 1970's for testing high performance CW receivers I used to build my fixture. I use this method because when I built my fixture over 20 years ago I was mostly using CW and want to compare the date on noise floor and intermod for the receivers I've tested in the past. But to properly measure the AM performance of a receiver the tests should be run with a 5kc or wider bandwidth and a carrier of 10db over the receiver's internal noise. This is the method used for most of the data you will see on the R-390's. So the numbers in my article for noise floor will appear to be much lower than those quoted for most R-390 testing. If I was starting over again I would run my tests using both the CW and AM methods.

The equipment to measure noise floor isn't hard to obtain or build. You just need a well calibrated signal generator and attenuators. But it all has to be very well shielded and carefully constructed. You don't want any signal leaking around the attenuators due to a poor set up or cabling. I was once testing a 75A4 I was working on and getting unbelievable low noise floor results. That darn noise flood was below 160dbm which was impossible. I had the bottom cover off the receiver and was using a digital frequency counter on my older HP signal generator. I then put the bottom back on the receiver and the noise floor came up around 10db. Then I unplugged the frequency counter form the raw output of the generator and retested the receiver. Then the numbers were reasonable and match those of other tests using my home brew fixture. The moral is a sloppy setup and an unshielded receiver's RF section can ruin your test results. Also be especially careful of noise floor data in rice box adds with no explanation of their test method. In all my testing because, I'm using a home brew fixture whose calibration could be questioned, I like to only compare my radios using this same fixture to be sure I'm doing performance comparison tests under the same conditions.

Incidentally, I've found good performing R-390's or R-390A's have a noise floor that is far below what is required on any HF band, 160M through 10M. They are also very good candidates for use with converts for VHF and UHF reception. They also have outstanding intermod performance numbers along with frequency stability and selectivity. The R-390 just completely amazes me for a 1949 design, just imagine what it's introduction must have done to the moral at the competing old line military receiver manufacturers. No wonder a lot of them sure faded away fast. I guess that's why we all collect, use and love these receivers.

Date: Wed, 29 Mar 2006 15:08:53 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Noise Floor question

What you're looking for is thermal or Johnson noise. Try this:

http://www.dataforth.com/catalog/doc_1065.html

The first RF tube contributes noise because it is hot. Wonder what you could do to the noise figure of a 390 class set just by FETing the first RF? Don't even think of it if you're a purist or concerned about overload capability. But if noise is your first concern ...

Date: Thu, 30 Mar 2006 10:57:01 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Noise Floor question

My understanding is that the 6DC6 in the R-390A was a compromise between low noise and overload performance. Since the highest sensitivity applications at the time for R-390A were in conjunction with high-noise antennas, such as Rhombics, it was a good match. A common MARS mod for R-390/R-390A/Sp-600's in the sixties were replacing the First RF Amplifier with a Cascode VHF dual triode. This supposedly reduced the first RF noise (esp. in the SP-600), but dropped the overload performance. As for me, after some research in this mod, I decided that unless you live more than five miles from the nearest house, the atmospheric QRM and QRN really does not drop below a level that would show any practical performance improvement. Also, don't forget that in tubes, shot noise from the electrons hitting the plate also generate a lot of noise (why triodes are quieter than pentodes).

-

Date: Sat, 8 Apr 2006 11:55:22 EDT
From: DJED1@aol.com
Subject: Re: [R-390] Noise Floor question

>.........In ads for the R390A the term of "noise floor close the theoretical limit". A search on google didn't yield anything comprehensible. If we follow Roger Ruszkowski's method for achieving a 30db ratio, then by logical definition we are lowering the noise floor by a ratio-metric method. I know the receiver has a very low "noise floor" but how would us mere mortals measure it? Short the antenna input, terminate the audio out put with a 600 ohm resistor turn up the RF gain and audio controls and then measure the AC voltage on the termination resistor with a micro-voltmeter? If one did Chuck Ripple's audio improvements are we lowering the noise floor or just making a better sounding audio output or both?<

I took a while to do some research on Perrier's questions. Here's my answers, although I'm willing to be corrected-First, people have thrown around "a noise floor of -143 dBm, close to the galactic limit". It sounded pretty ambitious to me, and I calculate that the noise of a resistor in a 0.1 Kc bandwidth is about -154 dBm. So that's the ultimate limitation on sensitivity, although the R-390A doesn't nearly reach that. I'll use my radio for further discussions, although it has not
been tweaked for optimum sensitivity per Roger's procedure. One measurement on my radio indicated that the noise figure was about 10 dB, thus putting the radio's noise floor at -144 dBm. So that may be where the claims come from, although most of us measure AM sensitivity at a 4 Kc bandwidth. But the radio was originally used extensively for CW intercept work, and so sensitivity on a 0.1 Kc bandwidth is relevent.

Measurement of sensitivity can be done in one of two ways- using a calibrated noise source and adjusting it for a 3 dB rise compared to receiver noise (this measurement is independent of bandwidth), or using a calibrated signal generator and adjusting the output for a given rise, usually 10 dB, in receiver output. This can be measured using the VU meter on the receiver or a separate AC voltmeter on the line output. Techniques are well covered in W Li's Pearls of Wisdom. The consensus is that the measurement should be using AM in a 4 Kc bandwidth, and turning the modulation on and off to measure the 10 dB difference. A CW measurement using the BFO will give significantly better sensitivity. My radio measures 0.6 microvolt AM sensitivity, and 0.16 microvolt CW sensitivity. Finally, Chuck's audio improvements will not change the sensitivity of the radio. However, his recommendation on setting the IF gain will help the sensitivity. Hope this helps- and the Pearls of Wisdom will tell you plenty about this topic Ed

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Date: Sun, 09 Apr 2006 14:41:04 -0700
From: "Kenneth G. Gordon" <kgordon2006@verizon.net>
Subject: [R-390] Book on alignment method needed.

I have seen a military book entitiled something like, "Using the Visual Alignment Method with the R-390/URR Receiver." Does anyone here have that book, or know where I might be able to buy one? I ***thought*** I had one, but now cannot find it...of course...

Date: Sun, 9 Apr 2006 18:08:22 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] Book on alignment method needed.

The manual is called Visual Alignment of Radio Receivers R-390/URR and R-390A/URR USASTC&S ST 32-152 (about 23 pages long). I have a copy but it was made by the old fashion hectograph process and I don't think it would reproduce very well.

Date: Sun, 9 Apr 2006 18:49:24 -0500
From: "Dave Merrill" <r390a.urr@gmail.com>
Subject: Re: [R-390] Book on alignment method needed.

http://www.r-390a.net It's under References-> "U.S. Army"

Date: Sun, 16 Apr 2006 10:01:01 +0200
From: "Massimo Penna" <massimo.penna3@tin.it>
Subject: [R-390] Low sensitivity on 7-8 Mhz band

Hello everybody, I have a Stewart-Warner R-390A receiver. I aligned it but

a low
sensitivity remain only on 7-8 Mhz band. What is the problem? Thank you and regards. Massimo

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Date: Sun, 16 Apr 2006 06:44:06 -0400
From: "Walter Wilson" <wewilsonjr@gmail.com>
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

A bad crystal would affect more than just the one band. I'm thinking you may have a bad trimmer cap in one of the RF cans for the 4-8 MC range. A bad trimmer cap would make it difficult to peak the upper end of the 4-8 MC range, so the greatest loss in sensitivity would be in the 7-8 MC range. Did you have any difficulty getting a good peak during alignment at the 7600 KC point?

Date: Sun, 16 Apr 2006 08:13:09 -0700
From: "Leigh Sedgwick" <bipi@comcast.net>
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

I have the same problem with my 62 Amelco that I rebuilt. Chuck Ripple told me that some R-390's exhibit that problem on the 7 mhz and he had no definitive explanation. Next time I pull the radio out on the work bench I plan to try and improve the situation. If you learn anything, please pass it along.

Date: Sun, 16 Apr 2006 13:42:13 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

Odd. I ws noticing the same thing on my Amelco. It's almost as if the bandswitch isn't clocking perfectly and I'm getting just a capacitance feedthrough signal. I'm going to do some side-by-side comparison with my Motorola.

Date: Sun, 16 Apr 2006 14:07:38 -0500
From: "Conard Murray" <ws4s@charter.net>
Subject: RE: [R-390] Low sensitivity on 7-8 Mhz band

Me too! My '62 Amelco is noticeably less sensitive at 7.999+ than 8.000. I haven't done the measurements or the math, but in practice I have had enough gain available on 40 that the difference isn't a problem. I thought it was just a feature of the set switching from triple to dual conversion or possibly a hint that the first conversion stage needs some attention in my radio.

Date: Mon, 17 Apr 2006 07:59:49 -0400

From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

> I checked my Amelco and saw a difference of about 3 dB in calibrator
> signal between 8.000 and 7.999+.

Well, that is the switchpoint where the radio goes from being triple conversion to double conversion. You switch out a mixer stage, switch out the 17.5-27.5 Mc tunable IF. And the crystal oscillator frequency jumps a lot (27Mc output on the 7Mc band to 11Mc output on the 8Mc band). With all those changes, I'd say a change in 3dB of the meter reading is entirely normal (and it's in the range of what I see with my EAC RF decks.)

So, not only check the RF stage peaking, also check the 17.5-27.5Mc IF peaking if you really think you have a problem. That said, S-meter reading is not the same as "sensitivity" (which is usually quoted as uV at a given S/N). If the local oscillator output for the 7Mc band were weak, it would also be weak on the 24Mc band. Not much to listen to on 24Mc right now. (Guys, check me if I'm right, I'm not sitting at the radio with my frequency counter right now...) The base crystal is 9Mc, and harmonics are picked off to make 18 and 27 Mc. 18Mc is used on the 15Mc band and there's stuff to listen to there in the daytime. 27 Mc is used for 7 Mc (triple conversion) and 24 Mc (double conversion). If I look at the crystal oscillator output on my scope, I see roughly a factor of two in output voltage between different bands. To over-generalize the higher osc frequencies are lower in amplitude than the lower frequencies, there is also some clear change between different crystals, although I think it has more to do with strength of harmonic. If the peaker capacitor for the crystal oscillator is out of whack (say you only get one peak instead of two) that's not a good thing (although the radio will work). According to my reading about mixer design, having the oscillator input to a mixer down by a factor of two can really cut conversion efficiency by a lot more than a factor of two.
Tim.

Date: Mon, 17 Apr 2006 10:25:08 -0700
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] Low sensitivity on 7-8 Mhz band

I would like to reinforce Tim's point about the S-meter. When you switch from triple to dual-conversion, the first mixer, which *has AGC on it* is removed from the signal path. This will change the receiver's AGC response curve. Don't expect your S-meter to read the same, and don't expect the same audio level. To really get the picture, you'll have to measure input for a given S/N. As he alludes, if .5-6 are okay and it's just 7 that's weak, that's a different story; either switching troubles, bad RF or

1st VIF top-end alignment, weak 2nd crystal, or misaligned 2nd crystal oscillator.

Date: Mon, 17 Apr 2006 12:30:48 -0700
From: "Bill Feldmann" <n6py@qnet.com>
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

I'm also having a problem with low sensitivity on my Stewart Warner R-390A. Mine was really dead on some bands, especially below 8mc even after checking all the tube, replacing a few weak ones, and aligning it per my year 2K manual copy. I found a lot of the trimmer caps in the RF transformers at maximum setting and the receiver not aligning good on those bands. After pulling the RF cans, check caps with my GR bridge and replacing about 12 mica ones reading low or with high loss the receiver came to life and aligned perfectly. However I'm now beginning to notice after the receiver has run a few hours and fully warmed up, the sensitivity drops 15 to 20db on the carrier meter for a 100µv signal on all or most of the bands below 8mc where it is triple conversion. So there is most likely some bad caps or other components under the RF deck, most likely in the first mixer and oscillator circuit. I'm not looking forward to pulling the RF deck but after reading my 2K manual copy doesn't look too bad. I wonder if there is a list of bad caps or components on the RF deck published anywhere to help me be sure the RF module is in good shape after I work on it? Don't want to have to pull it a second time. I'm new to the R-390A, had more experience with my earlier Collins non-A which had all good caps in it from the factory. Surprised I found so many bad ones in the later Stewart Warner and no sign of any bad ones in the non-A Collins which tracks perfect on all bands and it's carrier meter reading is very close between all bands.

Date: Mon, 17 Apr 2006 17:25:54 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

>.......... after the receiver has run a few hours and fully warmed up.. <snip>

My suspicion: leaky ceramic cap shifting the DC operating point of some tube in the first mixer/oscillator and drastically reducing your gain. Or... carbon resistor opening up after running warm for a while (also shifting the DC point of a mixer). If you can measure the voltages around the tubes a few minutes after turn-on and compare this with readings after the sensitivity has dropped, this will really reduce your need to "shotgun" all the RF deck caps/resistors. Ceramic caps do not OFTEN go leaky but there's a lot of them (mostly cathode and screen bypasses, 0.005mf) in the RF deck. Resistors can be flaky when warm too. There are some brown beauties in the RF deck: two for bypassing the crystal oven heater (these are entirely non-critical unless they're arcing over or something) and one that bypasses the RF-IF B+ line. It's unlikely that your specific problem is one of the brown beauties. Lots of other parts can go leaky when warm: tube sockets, standoffs, coil forms, etc. But find the voltage that's shifting first, before you tear off the RF deck. It could also be that nothing is leaky but you just have a bad trimmer or low-value ceramic tuning capacitor opening up when warm and giving you heartache.

> I.....earlier Collins non-A which had all good caps.....<snip>

While in the RF deck, look for carbon resistors that have drifted up in value too.

Date: Mon, 17 Apr 2006 18:10:05 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: Re-[R-390] Low sensitivity on 7-8 Mhz band

There is a shaft that runs from the clockwork into the RF deck. The shaft turns and switches in the correct coils in the rf amplifier (6DC6) circuit. Look to see that the shaft turns with the drive gear as you turn the band switch. If you see the drive gear turn and the shaft not turn, you have a loose gear clamp and the wrong rf coils will be selected.

Date: Tue, 18 Apr 2006 23:07:51 EDT
From: DCrespy@aol.com
Subject: Re: [R-390] Low sensitivity on 7-8 Mhz band

I am not sure anyone has mentioned this yet (although I may have missed the post). Years ago, someone on the list gave me a tip to check out C 327, a 100pF cap on the primary of T 207. Replacing it on 3 different radios so far has solved 90% of the poor performance up to 8mHz. Admittedly on one of the radios I had to replace some other components related to the 1st crystal oscillator (V207), to finally fix it. The problem was clearly, in each case, related to poor output of this oscillator. I used a high voltage NPO cap for the replacement each time. Hope this helps, and good listening!

Date: 20 Apr 2006 15:45:21 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] C327, T207, and 2nd Oscillator

Per the recent discussions, I checked the testpoint E209 last night and it checked very close to the proper voltage. Also, T207 peaks very nicely, so C327 is good. Checked testpoint E210, however, and it was low. Swapping

V202 and V203 didn't help (thinking since E209 was strong, there could be a problem with V203, but no luck). I think the problem is low output from 2nd oscillator. T401 peaks nicely, but that peak changes from band to band. Is there a recommended 'set-and-forget' band for T407?

Date: Thu, 20 Apr 2006 16:54:56 EDT
From: Flowertime01@wmconnect.com
Subject: Re: Re-[R-390] Low sensitivity on 7-8 Mhz band

Once you get past the bad crystals, oxide in crystal sockets, alignment of oscillator deck, and just old tubes there are a couple more things to look at.

A bad slug will get you on the top end of an octave. The top of 0.5 - 0.999, Top of 1.00 - 2.999 ---- 4.0 - 7.999

Look for a chipped slug.
You may not see anything with an eye ball inspection.
Swap a pair of RF octave slug racks and then realign both octaves.
If the problem moves over or goes away you can think is a slug.
Some times moving a slug over to a lower frequency will let it work there when if
will not work in the higher frequency band.
Try to align the octave band high frequency first and low frequency last.

If the slug has lost some of its permeability it will not track the full frequency range. On the low end with the slug in the coil, you gan get enough slug centered in the coil to peak up the low end frequency.

On the high end, too much of the poor slug is out of the coil and there is not enough cap to track the alignment. Then the whole octave is out of tracking alignment.

Every cap in the RF deck should have two peaks, at the alignment point. A clue that there is more than enough cap to reach a good alignment. On both sides of max cap value is a peak alignment value. If you have a cap that only has one peak you may be at the edge of OK or you may not have enough trim cap to reach best alignment point. It is a tinker and find experience with your receiver to get a good feel for where the slugs and caps should be.

Start on the top frequency of the octave and play with both the slugs and caps to find a place where the cap has two peaks. Adjust the slug a little and dial the cap around one turn and watch the meter.

You can likely swap some of the slugs racks around and get a better

adjustment to bring a weak octave back up to good performance. Just watch what you are doing. Find and fix the other real problems before you try and cure every thing with a spline wrench and a slug adjustment.
Roger AI4NI

Date: Sun, 4 Jun 2006 17:40:28 +1000
From: "Bernard nicholson " <vk2abn@bigpond.net.au>
Subject: Re: [R-390] Re: 390a II
To: "R. J Deeter" <k6fsb@juno.com>

Ron He may have been using a short antenna BUT you cant get blood out of a stone , even today you wont find any advertised Hf radios that have pretensions to sensitivities that are much better than what can achieved with the 390A in stock standard form it is possible to achieve a sensitivity of around 0.4 uv, in a narrow bandwidth he quotes 0.02uv , the noise voltage alone in a 50 ohm termination is around 0.026uv , and if the input impedance is higher the voltage is higher, I'm sorry Ron but his sensitivity figures VIOLATE the fundamental laws of physics
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Date: Sun, 4 Jun 2006 11:33:37 -0400
From: roy.morgan@nist.gov
Subject: Re: [R-390] Re: 390a II

This all reminds me of the very small odd-looking antennas that are I think still advertized in ham magazines. They have two bands of aluminum sheeting, a coil or two I think, and some sort of capacitor to make it all take power, all the size of a common trash can. I'm reminded of one fellow who worked out of his state on a light bulb dummy load hooked up with clip leads.

> sensitivity figures VIOLATE the fundamental laws of physics

My ER magazines are all packed (we are moving.. to a small farm in rural Virgina where the QRM is apt to be very low, hooray!). Are the Osterwald articles in ER? Maybe it was HSN. I may have missed the messages that tell where they appeared. Bernie, if you have them in digits, I'd appreciate a copy. My new location will be quite well set up for me to at least attempt to make careful measurements on my receivers. I look forward to that.

Date: Sun, 4 Jun 2006 09:19:14 -0700
From: "R. J Deeter" <k6fsb@juno.com>
Subject: Re: [R-390] Re: 390a II

I never said i agreed with his numbers, I found them questionable (actually impossible). I was only trying to giving insight to his reasons for making the mods. However, I do believe that some of the noise generated by the front end and mixers may be reducible. by how much, to what advantage depending on the environment and at what cost, hmmmmm didn't mean to stir up a hornets nest especially when the original info could have been a misprint? As Mark Twain mentioned one could possible die from a misprint.I'll crawl back in the woodwork......

Date: Mon, 5 Jun 2006 20:00:46 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Ray's Receiver Article

Thanks to the generosity of several members I've received the Osterwald and Felton articles. Thanks to all who helped. After reading Ray's article carefully I think there is an obvious but overlooked explanation for his numbers. Let's look at this logically. (AKA "the duck" test). Mounting soapbox.

First let me step back and make a couple of observations. Roy is no newcomer to this. He has been "around the block" more than once. Second, he'd have nothing to gain and everything to lose by purposely creating "vaporware" numbers. For several years I worked at Hallicrafters in Chicago at the plant that you see part of in their old ads. Being in quality control my job took me everywhere in their facilities. I also have been to one of the others where the SR series were being aligned. They had some of the neatest copper double-screened rooms in existence. Major envy. Hallicrafters, like other name manufactures (HP equipment was on Gary Powers U2) produced a bunch of one off or a low production volume of 5 to 10 units. One such that I saw was a frequency synthesizer that used miniature solid copper co-ax with SMA connectors going to metal encased modules. These inner workings were inside IIRC another shielded exterior case. What it was used for I have no idea but it cost Uncle a bundle. So what does this have to do with Ray? Glad you asked. To get accurate measurements down in the sub-micro-volt range one needs test equipment, shielded cables, and shielded test rooms that are way beyond any amateurs budget. Although Ray probably used fine test equipment with great care, I firmly believe that somehow, someway there was some blowby or circuitous leakage that proved again that Murphy sides with the hidden flaw. It's the only answer that makes since to me.

OK, so what if the numbers don't math up to Bloatmans constant comment tea or whatever? Remember all those long math posts in the past about peak to peak, RMS and diode rectification during the "discussions" involving ballast tube work arounds? Correct in theory ONLY. Total Baloney in the real world. I refer doubters to "Malvinos Transistor Approximations" which deals with real life semi-conductor design. Also the rectified voltage will vary some in relation to the current passing versus the diodes rating. For example: you need 5 amps DC at say, 12 volts. A 35 amp bridge rectifier will give you more output than if you used a 5 amp rated bridge at the same rated voltage.

Let's graciously challenge numbers that don't make sense to us but we should refrain from skewering individuals who are attempting to make good contributions and improvements to our hobby.

Off Soapbox Quack Quack. Regards, Perrier

Date: Tue, 6 Jun 2006 23:07:43 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Ray's Receiver Article

<snip> For some strange reason I never saw the original post that inspired all these posts. <snip> The article was never posted on the reflector. It was one I requested from members on the list. The title is "The R390A Receiver: A Milestone in HF Communications" by Ray W. Osterwald. It was published in Electric Radio magazine. The published date isn't on the copy I have.

The sensitivity numbers question came up in: Part Three: "The Competition-Grade" R390a. After extensive tube, component substitutions and circuitry modifications. Ray believes he has measured: A) A MDS value of <-150 DBM which he qualifies as reaching his test equipment leakage values. B) 10 dB S/N ratio: .022 uV (parameters not stated). C) AM sensitivity: 0.1uV at 4 Kc I.F. bandwidth. D) Single-tone blocking dynamic range: 123.5 dB. E) Two-tone spurious-free dynamic range: 101 dB at 20 Kc. Signal spacing and 85 dB at 10 Kc spacing. "Dynamic range measurements are also limited by equipment leakage, so the numbers are probably conservative". Some have posted that according to laws of physics that the 10 dB S/N ratio of .022 uV is not possible. I sure don't know. What I do know after re-reading the article several times is that Ray spent an enormous amount of time, effort and expense to create a better radio AND was kind enough to write it and share it with us. After editing the list chronologically for five years I've found that very few make contributions at Ray's level. Even if some of his numbers are off, why should he be crucified? Which of us made a perfect receiver? Belly up to the bar fellows. I'll loan a stock R390a to be modified by anyone who can prove on paper that he can do better than Ray. We also must concede that his modified radio is miles ahead in performance than the stock R390a. Whether one wants to do that with their radio(s) is a personal choice. Regards, Perrier

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Date: Wed, 26 Jul 2006 20:56:25 -0400

From: "Bob Young" <youngbob53@msn.com>
Subject: [R-390] R390-A questions

I just acquired an 390-A, which was done over by an expert, On the third time going through the bands I felt something happen to the feel of the the megacycle change knob, like something came loose. To make a long story short (after a few days) I found that one of the little springs that hold the two large gears together immediately inside the radio had come loose and had fallen out. I found it and reinstalled it but now the first two bands do not work correctly unless the megacycle change knob is tuned lower than the click stop (or whatever you call it).

The feel of the knob is definitely not right especially when I go from 1 to 2 megacycles, there are two distinct clicks. A few of the other bands also sometimes need to be fooled with (megacycle change knob rocked back and forth etc.) to come in right. It seems to me that the space where the springs are in between the two gears comes too close together at a certain point and this is when the spring falls out. Does this indicate worn parts? Also is this a major undertaking like it seems it would be? A few other questions, is it normal to have rezero the dial between bands with a newly aligned radio? And also is it normal to hear sideband artifacts on strong locals as far away as 10 khz on either side of the station with a 400' antenna no matter which selectivity position is used or was this thing knocked back out of alignment? Thanks,

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Date: Wed, 26 Jul 2006 22:32:35 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] R390-A questions

If you are able to move the two halves of the split gear with everything assembled, then something has definitely moved where it shouldn't have. The split gears are supposed to be loaded with spring tension and then both halves are supposed to mesh with a gear that is thick enough for both halves to engage with it. Sounds like you may have a loose gear clamp and the gear has slipped axially on its shaft far enough such that both halves of the split gear are not engaged properly.

Or I could be missing the description altogether...

Date: Wed, 26 Jul 2006 23:02:55 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R390-A questions

Well it sounds like one of the split gears was not tightened properly and has slipped far enough to allow it to unmesh loosing it's tension and dropping the springs out. (there should be two). Now it is out of sync. As far as having to rezero between bands yes that is fairly normal because of the aging of the crystals in the crystal deck. There is no padder to correct the frequency of the crystals just to peak the output. The important thing is that each band falls within the adjustment range of the zero adjust...if one or more does not the crystal should have been replaced...

Sounds like the Pro should get the radio back to get the gear train back in sync on the Mhz tuning. For what you were probably charged you should not be having that problem... Just my 2 cents worth...

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Date: Thu, 27 Jul 2006 11:20:26 -0400
From: "Bob Young" <youngbob53@msn.com>
Subject: Re: [R-390] R390-A questions

I think you and Barry hit the nail on the head. Is this as simple as aligning the two gears with each other and then tightening the proper clamp, or maybe trial and error, or is this a skilled procedure in which you really have to know what you are doing? I am a neophyte when it comes to these radios, there are two springs incidently and one does not seem to be in the best of shape, are these readily available? thanks
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Date: Thu, 27 Jul 2006 15:43:58 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] R390-A questions

The problem you describe here reads like a RF band switch alignment problem. You also describe a split gear slip problem. I though Barry did a nice job responding to that problem for you.

The spring in the split gears need not be maxed out to get the job done. A wimpy spring or a missing spring in a split gear is not a show stopper. Get enough tension on the springs by rotating one of the gears against the springs in the gears to get some tension on the springs. then go a bit more or less until the teeth on both gears line up. Then you need to slide the gear on or off the shaft until the split gear runs against the wide gear and both sides of the split gear stay engaged in wide gear and the tension remains on the split gears from the split gear springs. The idea of the split gears is to remove some of the gear lash when you change directions when tuning up and down in frequency. Too much tension and the whole gear train give you R390 wrist. Too little tension and the springs start to fall out. The minimum tension is longer gear life and you can live with a little lash in the gear train when tuning. Nothing sacred in the gear train set. Play with the clamps, alignment and adjustments until you get a feel for working with them and getting them to run in line and smooth. If you brake a clamp ask here on the reflector for a part. someone will make you

a reasonable offer to cover postage and aggravation of getting it in the mail.

But now the first two bands do not work correctly unless the megacycle change knob is tuned lower than the click stop (or whatever you call it).

This stop would be the detent.

The Rf band switch changes from 999. to 1.000
at 1.000 to 1.999
at 2.000 to 3.999
at 4.000 to 7.999
at 8.000 to 15.999
at 16.00 to 31.999

We would call these the RF band octaves. There is one set of RF transformers and a slug rack for each of these band octives in the Rf deck.. You can set the Rf band switch with a meter as described in the manual. I do not recommend this operation. As you tune up and down the band and change octaves the RF band switch changes. Some gears take care of this. You can read about it in the manuals.

Do you have a copy of the Y2K manual from the Net?

The RF band switch changes as needed. It should seat the switch wafers in their centers when the detent on the MC knob hits the center seat. You can adjust the detent spring in or out for more or less tension. Again less tension is good. But enough so the MC knob set still when the KC knob is spun.

If you have to go past the MC change point and then back up to get the RF band switch to set up and enable an octave for you, the switch is out of alignment.

The RF band switch alignment is independent of the cam alignment, Zero adjust and KC band over run alignments. You can do the RF band switch alignment and then do the other alignments without going back to the RF band switch.

A real little bit. Just enough to be a pain.

The best way to set the RF band switch is to pull the RF deck and adjust the band switch shaft by eye ball. Worry not about pulling the RF deck. Read the manual a bit. Find a long #1 Philips screw driver to reach the green screws behind the RF deck. Find a couple 2x4 blocks to rest the frame on. These leave the front panel hanging in free air. Thus you can drop the front panel on to the bench and pull the RF deck.

Some Fellows like to stand the stand the receiver on the RF deck end and remove the front panel. It then swings like a door at the bottom of the receiver. You can get at the Dial lock, Oldham coupler spring on the KC shaft, BFO pitch and bandwidth switch shafts.

The RF band switch is a 6 position 6 section switch. Some of the switch sections carry B+. Not all sections line up real good. Look at the schematic and find the switch sections that have B+ on them. You want this switch wafer to align the best.

Do not try to change the wafer contacts or rotate the wafer sections.

Remember, yesterday this receiver worked today it does not work. Something simple fell apart and some simple action will put it back together. The effort to get to that simple loose part has nothing to do with the total problem. The effort to get the receiver back together after fixing the simple problem has nothing to do with the problem. All that extra exercise is just a slow screw job and real work takes real time.

After years the switch sections do not all fully mesh and align real good on each wafer and each contact. If you just do an alignment by meter without looking at the switch you can get a working receiver. But you risk having a wafer section where the contacts just bearly make contact. Over time this just bearly there contact will burn. If you look at your receiver you may see a contact that has been burnt from a prior alignment that was just barely making it.

Its a judgment call for best looks. Tune the receiver up through the bands and down through the bands. Look and see how all the wafer sections look at each change point. Loosen the clamp on the band switch and adjust it a little. Run up and down the bands until the switch looks to get the best alignment you can get. You want the Rf band switch to fully make at each change point tuning
both up the band and down the band.

The feel of the knob is definitely not right especially when I go from 1 to 2 megacycles, there are two distinct clicks.

Bob, you are right on here. One click is the RF band switch moving. The other is the detent hitting center. They should both occur at the same location of the MC knob. OK like closer than your receiver does so the RF band switches clean without cranking the knob both directions.

A few of the other bands also sometimes need to be fooled with (megacycle

change knob rocked back and forth etc.) to come in right. It seems to me that the space where the springs are in between the two gears comes too close together at a certain point and this is when the spring falls out. Does this indicate worn parts? Also is this a major undertaking like it seems it would be?

Bob, Getting a split gear "loaded" so its springs do not fall out is separate from your RF band switch problem. Do fix the split gear loading problem first.

Is it normal to have rezero the dial between bands with a newly aligned radio?

I think Barry explained this one for you. But every band has its own crystal in a conversion stage. Unless two crystals happen to have the same error then you have to zero adjust for every KC band. Part of normal operation.

And also is it normal to hear sideband artifacts on strong locals as far away as 10 khz on either side of the station with a 400' antenna no matter which selectivity position is used or was this thing knocked back out of alignment? Thanks,Bob. Millbury, Ma

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Bob, One hears many thing with an R390 not heard with other receivers. Some of it can be alignment. Some can be mechanical filter ring. 400 foot antenna is a lot of signal grabber and some broadcast band filtering may be in order for you or out right attention. You may want to go to a balanced feed antenna input so you can get the antenna balance and first stage of the RF transformers to tune and thus filter some of the strong near frequency signals for you. Good Luck with this. If you have any questions to my cryptic response here, please send some more mail back on the R390 reflector and I will do some more details.
Roger AI4NI

Date: 27 Jul 2006 20:28:58 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] R390-A questions

If you are lucky enough to get the "driven" gear back onto the wide gear in the same tooth as it was when the radio was last aligned, then you should be okay; if not, you will probably have to do an alignment (or keep trying to get the original teeth meshed). If things have slipped enough, you may have to do a mechanical alignment as well to ensure the cams are where they are supposed to be in relationship with each other. It depends on which gear slipped as to whether this might be necessary. I'm not trying to scare you, but want you to know what all might have to be done to get

the radio back to operating as it should. You can do all of this, but you might have to ask some more questions and feel free to do so.

Date: Thu, 27 Jul 2006 16:19:55 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R390-A questions

I agree with all you guys are saying but if I had just dropped (guessing) $1200 to $1500 buck for a pro rebuild I would box it back up and have the rebuilder deal with the problems and pay the shipping back. I know that puts the radio at risk again because of the shipping issue but that's what I would do....unless of course the owner is capable and equipped to get into the gear train etc.... It may require dropping of the front panel and who knows what.....why go through all of that when you just paid good money to have the radio gone through and it develops a problem like this right after delivery. It may turn out to be a broken gear clamp which will require replacement....it just gets deeper and deeper. Bob have you talked with the restorer about the problem? I've been on both sides of these type issues having done restorations for payment on R-1051's and a few R-390 series radio's. It's no fun but I would expect to have to make it right if I were the guy that just got paid good money....

Date: Thu, 27 Jul 2006 18:01:25 -0400
From: "Bob Young" <youngbob53@msn.com>
Subject: Re: [R-390] R390-A questions

Your estimate was pretty close, was a little over a thousand not including shipping. I've e-mailed him several times since I think Monday and haven't received an answer yet. I think this guy is famous for taking his time answering e-mails though so I'm going to wait until at least the end of this week to see if I hear something from him. One other thing I forgot was that the knob on the megacycle change starting slipping from I thought oil on the shaft that had maybe seeped out of the joint where it goes into the radio so it definitely did not turn easily. I had to wipe it down and change knobs with the main tuning knob. I'll take the bottom off tomorrow after work and see if I can at least figure out which gear slipped.

I'm not going to get into it though unless I have to as I wanted one pro set up 390-A with which to compare others to and this thing was a mess when I first got it, wrong tubes and everything, had had little or no maintenance for probably twenty years. The reason I use the long antenna is because I'm mainly a BCB DXer although I want my ham license soon. I usually have two LW's with a Quantum Phaser which cuts down on big signals very well but I just moved and haven't had time to set up proper antennas   Bob
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Date: Thu, 27 Jul 2006 19:32:04 -0500
From: "tfrobase" <tfrobase@kitparts.com>
Subject: [R-390] R390-A questions

In my day's of repairing lots of 390's back in Lima, Ohio I can't tell you haw many times I would get one put back together and find a broken coupler. When you take a look in there tomorrow make sure none of the couplers are broken, sometimes it is hard to see the crack, I usually take the end of my Xcellite Bristol tool and push the couple to see if it is loose.
Lot's of luck, tom N3LLL

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Date: Wed, 16 Aug 2006 06:28:04 -0400
From: "dmartin" <dmartin@visuallink.com>
Subject: [R-390] 0.5-8.0 Low Sensitivity (Long)

Have a 390A here with the low sensitivity problem below 8 megs. It isn't the first 390A I've dealt with having this problem. Problem on this one is characterized by a 1st variable IF alignment that won't "hold", sensitivity that is good at first but can go numb after several hours of operation, and generally odd alignment results. Threads for slugs on Z213-2 and -3 cans may be all the way out during one alignment effort and then have to be screwed all the way in flush with the rack during a subsequent alignment hours later. With my IF gain set for -7.0 VDC with 150 uv of 455 kHz into J-513, "good" sensitivity on lower bands is defined as a carrier level of 40-60 db with the calibrator signal and -7.0 VDC at the diode load requiring but 1-2 uv out of my HP sig gen. Hours later this may be only ~20 db for the calibrator signal and 30-40 uv for -7.0 VDC! When the rig drops to the "low" sensitivity values, realigning the 1st IF, with vastly different final placement of slug positions and accompanying changes in the trimmer caps usually brings it back.

The 1st oscillator, V207, is sound and puts out a robust peak-to-peak 17 meg signal on my scope. Resistances and voltages on V207 and V202, the first IF 6C4 mixer, are typical. I've subbed NOS tubes for both the 1st mixer and oscillator without change. Problem seems to be lots of loss, but intermittently so, in the Z213 network and I suspect caps at fault, either the trimmers and/or the ceramic caps associated with Z213 under the rf deck.

If I keep the power off, pull the 1st mixer and oscillator tubes and all three Z213 cans, that leaves me with but the passive, discrete Z213 components underneath the rf deck to test. If I next pump in a sig gen signal of 24.3 megs (7.3 received) on pin 1 (plate) of the mixer of 4.5 volts peak-to-peak on my scope I can only recover ~0.5 volts peak-to-peak on jack 3 of Z213-2 and Z213-3. This suggests very little signal is getting through C281 and C282, the low value 1.5 pf coupling caps between Z213-2 and -3.

Is such a loss typical? Short of a shotgun approach that replaces all three trimmer caps and all five mica caps associated with Z213 under the rf deck (ugh!), anyone have ideas?   Dan   WB4GRA

Date: Wed, 16 Aug 2006 06:38:25 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Assuming it is not mechanical... I have had several failures of the resonating capacitors *inside* variable IF and RF cans that caused sensitivity drops after warmup and other odd behaviors. These are mica caps inside the cans, usually the ones that are across the side of the coils that feed a plate circuit (HV breakdowns with age). It's fairly easy to remove the can cover and replace the cap with a new modern mica cap (must be mica/RF caps, original specs., no ceramics, glass or others). Alternately, you may be able to buy replacement cans from Fair radio or someone on the list. The best diagnosis is to replace the suspect caps or can and see what happens. Shotgun approaches wok well too!

Date: Wed, 16 Aug 2006 06:56:15 -0400
From: "dmartin" <dmartin@visuallink.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

The 1st IF cans are unique in that they do not have any caps >inside< the can except the trimmers, which means you have to go for a deep dive under the rf deck. C281 and C282 are two >very low value< coupling caps that join Z213-1 to -2 and Z213-2 to -3.

C281 does see B+ and Z213-1 is the only 1st IF can with B+ on its trimmer cap. Yeah, if you are going to have to pull the RF deck, carefuly replacing all five caps with proper subs may be the way to go.

(Where to find a 1.5 pf with the needed tolerance, though, and do these funny little "tubular" caps really often go bad?) Let's see how others weigh in on this!

Date: Wed, 16 Aug 2006 09:02:34 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

THIS is your clue that a capacitor (or possibly the inductor) in that circuit is changing values. Get that can out of there and replace all silver mica caps inside.

Date: Wed, 16 Aug 2006 08:07:14 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

I don't think you have trimmer problems but I do think you have mica caps drifting all over the place with temp changes. There is a great article in this months Electric Radio covering just this subject... It's a must read....

Date: 16 Aug 2006 13:34:03 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Surplus Sales of Nebraska has hard-to-find capacitors like this. They're on the web and they're pretty expensive, but it may be one of the very few sources for them.

Date: Wed, 16 Aug 2006 10:46:09 EDT
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

>Yeah, if you are going to have to pull the rf deck,..........

Good advice! On replacing the 1.5pf coupling caps - that value seems to be impossible to find nowadays. I would imagine the more common value of 2pf would work fine in this application but if someone wanted to be super accurate they could use two 3pf caps in series for 1.5pf total. I see Mouser has both 2pf and 3pf 300V rated micas and 3pf 500V micas in their catalog. As you mentioned there is B+ across C281 so best to use at least a 300V rated mica cap here. I have never seen the coupling caps go bad before but there is always a first time and if the radio is acting funny and you have the RF Deck off probably best to replace them just to be sure. 73 Todd WD4NGG.

Date: Wed, 16 Aug 2006 13:08:55 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: [R-390] R-390 (Non A) Problems

My R-390 has developed a problem. I wonder if anyone has experienced a similar condition and what they did to correct it. The receiver suddenly seemingly lost sensitivity and the carrier level meter was not responding. I checked the tubes in the carrier level circuit, both with my tube tester and by substitution, and found no bad tubes.

Testing the stage gain as outlined in paragraph 53 of the manual, I used my signal generator to supply a 14.2 MHz signal to test point E206 (grid of V201 1st RF amplifier.) A signal of 12 uV gave me a reading of -7 V on the diode load terminal.

Spec for this test is 4-16 uV to obtain -7 V. I still have to do an additional test with input at the antenna input where the spec is 1-4 uV in case the problem is in the input transformers. However, as I read the result of the first test, the receiver is probably working OK.There is still no movement of the carrier level meter, or at least only a very slight movement off of zero.

Date: Wed, 16 Aug 2006 11:20:28 -0700
From: "William G Feldmann" <n6py@qnet.com>
Subject: Re: [R-390] R-390 (Non A) Problems

I would also check on some other bands using different front end coils like below 8mc and above 16mc just to eliminate any possible problem in the front end coils or transformers. If a front end transformer is bad it's most likely a bad SM cap but I've only worked on the A model's transformers that are a snap to remove and fix. Hopefully the non-A ones can be removed by just pulling the slug racks and removing a small screw in the center of the coil like on the A. But don't know, never had any problems with them in my non-A.

Also check the AGC is working by looking at the AGC line voltage and being sure the receiver seems to not be overloading on strong signals. If the AGC is working OK and the RF stages are OK, then you most likely have a problem in the carrier meter circuit.

Try and see if there is a difference between meter reading on the same signal when switching between MED and SLOW AGC. If there is a meter level difference the 2uf oil filled cap on the plate of the meter amp in SLOW is most likely leaking. It's C551 in a A model but will be a different reference number on the non-A model.

If the AGC is working it's most likely a cap or resistor that's failed in that meter amp circuit. Also be sure the carrier meter just isn't pinned below zero. That meter zeroing pot trouble some and is very hard to adjust. I usually replace it with a ten turn one. I'll mention that in my part 2 article in the Sep. issue of ER. Hopefully nothing has damaged the meter because stock ones are very hard to fine thanks to the demil process most have gone through.

Anyway the problem is most likely in the IF module that's easy to pull and run out of the radio. On my A model I could lay it on its side on a piece of wood on top of the radio and still connect the cables for testing as I mentioned in my article in the Aug issue of ER. I think you should be able to do that on a non-A.

I have a Collins non-A R-390 that hasn't had any problems besides a few weak tubes. But I sure went through hell with bad SM caps in the front end of my Stewart Warner R-390A that I talked about in my part 1 ER article. I'm at my second house in Mammoth Lakes but when I get back to Palmdale I'll look some more at the manual for my non-A for some ideas if your still having trouble. Let us know how you are doing. Good hunting David,

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Date: Mon, 21 Aug 2006 19:00:13 -0500
From: Barry Williams <ba.williams@charter.net>
Subject: [R-390] HP 3589A and HP 140T

Has anyone used either of these units as a spectrum analyzer for HF or MW? I recall someone using these and am hoping that someone can let me know how to use them, if they are worth using, etc.

Date: Mon, 21 Aug 2006 17:22:13 -0700
From: "David Wise" <David_Wise@Phoenix.com>
Subject: RE: [R-390] HP 3589A and HP 140T

I know the 141T, not the 140T. If the latter is not a storage mainframe, it's much less desirable for spectrum analyzer service than the 141T. You wouldn't be able to use the narrow resolution bandwidths, because they require a slow sweep.

That's just the scope frame. You plug into it an 8552A or -B IF module and an 8553L, -A, or -B RF module. I'm familiar with the 8553B and both 8552's. The 8552B adds tighter resolution bandwidths, better stability (required to utilize said bandwidths), a "manual scan" mode, and a 2dB log mode to supplement the standard 10dB log mode. None of this is necessary for aligning our favorite radio, but it's sure fun, and stuff of this vintage is not expensive. Beware that they're old enough to have developed their own problems. Unless you buy one that's known-good (and maybe not even then!) don't expect it to work without some sleuthing.

For measuring filter bandpass, you'll want a tracking generator to go with the SA. It'll be an 8443A or -B. (Or an 8601A with Option <mumble> if the RF is an 8553L.) In this case the -B is not an improvement; it's an -A with the frequency counter section removed. Early 8443A's have nixie displays, which are cool in their own right.

Late ones have LED displays and interact more smoothly with the SA, provided it's using an 8552B or a high-S/N 8552A. The cable that interconnects these two is rare. You can buy a made-up one from glkinst.com for 100-some bucks or make your own ugly but functional one for 1/4 to 1/2 that. You will probably have difficulty finding a parts guy who recognizes the connectors.

Date: Tue, 22 Aug 2006 09:11:51 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] HP 3589A and HP 140T

I've used the HP 8601A sweeper for aligning the Central Electronics wideband transmitters (as helper to W0YVA, who has the sweeper and is good at overhauling these things). The 8601A covers from 100 kc up to 110mc. It's small, pretty easy to use compared to other larger HP units, but fairly hard to find because it's so useful and easy to use. Of course a sweep generator plus a scope (and detector if needed) comprise a rudimentary spectrum analyzer system without some of the things a real spectrum analyzer does well.

I have a fancier, bigger sweep generator, the HP-8690B, that normally is found with microwave sweep heads plugged into it. Luckily, the hard to find low frequency plug-in is the one I have. This thing has a slide rule readout the width of the unit, which is rack wide and 10-1/2 inches tall. It's moderately complicated to use and somewhat confusing. It's also a bear to fix if something is wrong with it.

The HP 3300A is a function generator, but with the right plug-in it will sweep 50/80 kc IF's just fine. Actually, it goes from 0.01 Hz to 100 kHz. This is an older thing that may be available for not much money. The needed sweep plug in is the 3305A. If you find a frame with a blank panel or another plug-in, it may be possible to get your scope sweep output to sweep the thing in a remote control mode. If you can buy one at moderate price, don't pass it up. It will do all you need to align IF strips under 100 kc.

Date: Tue, 22 Aug 2006 19:53:15 -0500
From: Barry Williams <ba.williams@charter.net>
Subject: Re: [R-390] HP 3589A and HP 140T

The 3589 was a typo and should have said 3580. I was thinking of the 140A with 8555 and 5520 for frequency band analyzing, as like a panadapter. At one time, some of these units were somewhat cheap. It's been a couple of years since I was interested in this and I found the pics of these units yesterday on an old computer. The pic of the 3580 is from the *bay place where it was shown being used for that function. I'm not sure at this moment whether I would want to use either of these units with a R-390A or a HP 3586B....or with both. I don't remember the comments that seller had regarding IF inputs, etc on the 3580A. I corresponded with him until the auction price went too high for me. I'll probably want to use one some of the time for MW/LF on the 3586A as that area is crowded. Sorry to not have mentioned this earlier. BTW, how are you doing up there Roy?

Date: Thu, 24 Aug 2006 16:42:55 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: [R-390] Continuing R-390 Problems

Opps, I hit the send button accidentally!

As I dig more into the innards of my R-390 in an effort to uncover the source of my low sensitivity problems, things become more confusing. To show the degree of low sensitivity, this afternoon WWV on 15 MHz was 20 over S9 on my 75S-3. With the R-390 on the same antenna, I could hear WWV but it was so weak that the carrier level meter did not move off of 0. Following the alignment procedure in the manual, I find that when I adjust the cores in T502, 2nd IF transformer, something breaks into oscillation. Anyone have any ideas about that?

Date: Sat, 9 Sep 2006 23:26:54 -0500
From: "Barry" <n4buq@knology.net>
Subject: [R-390] IF Alignment Question

I put the latest project back together today and have begun aligning it. Aside from doing something really dumb where I had the PTO tracking from 2.55 to 3.55 instead of 2.45 to 3.45, it is going fairly well. I followed the instructions on pages 115 and 116 of TM 11-8586A to align the two IF assemblies. Then I started on the RF coils. I noticed that when I switched slowly from band 0 to band 1, the diode load would increase a bit before clicking to the next band and I noticed the rack that was moving the most at that point was the second IF. Leaving the radio set to a BC station, I started playing with the slugs in the IF and noticed a dramatic improvement in signal strength. I peaked all six coils that way and the radio seems to be a lot more sensitive.

Am I doing the alignment a disservice to peak the IF coils this way? Does this set them at an optimal position for one part of the band and reception will suffer at other portions of the band? That didn't seem to be the case but I didn't test it all that much.

When I said I followed the instructions, I don't have the "Test Lead CX-2919/U" the instructions call for. I was just connecting the output of the generator directly to the test points and using a minimum signal, did the adjustments. Is this possibly causing the circuit(s) to be loaded improperly and detuned? Does anyone know what's in that Test Lead?

By the way, I'm using a GR-1001A generator with the 50-ohm impedence adapter and an HP-410B meter. Thanks in advance for any advice.

Date: Sun, 10 Sep 2006 10:53:08 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] IF Alignment Question

The test lead has a .047uF 600V or so capacitor in series to block DC from getting into the SG attenuator. Other than that I can't supply much advice. I am trying, so far unsuccessfully, to find the source of an oscillation in my R-390 IF.

Date: Sun, 10 Sep 2006 11:17:04 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] IF Alignment Question

You are OK. PANIC NOT

>I noticed that when I switched slowly from band 0 to band 1, the diode
load
>would increase a bit before clicking to the next band.

??? This is your first clue that you need to pull the RF deck someday and do a visual alignment of the RF band switch.

>Am I doing the alignment a disservice to peak the IF coils this way?

??? It was common shop practice to align the variable IF slugs and caps by running a signal into the antenna inputs and catching the slugs and caps as you
were doing the RF octaves.

1.000 use 1.1001.250 use 1.100
1.900 use 1.9007.250 use 7.600

Or as you are doing the RF octaves readjust the setup to the frequencies as given in the TM and do the variable RF alignment. Use the same signal generator output as you use for the RF octaves (< 10 uv) You're right this gives much better tracking, gain and signal to noise performance. By doing the alignment this way you are dialing in the same PTO and crystal mixer offsets as the receiver really has.

>,,,,,,,,loaded improperly and detuned?

??? no and no

>Does anyone know what's in that Test Lead?

??? Yes, a 0.01 cap In case you poke the lead into a point with B+. The "adapter "
was used in a lot of places. We used a length of coax with a cap soldered on the center conductor. We depended on the receiver ground strap for a return path. We used the cap with a bare lead so we could bend a hook on it and hang it. Or we used the lead wire straight. Once the lead broke off to short from many bending we just soldered a new cap on the coax.

>By the way, I'm using a GR-1001A generator with .... an HP-410B meter.

???Nice bench.   Roger AI4NI

Date: Sun, 10 Sep 2006 11:20:50 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] IF Alignment Question

I stand corrected. David says the coupling cap is 0.047. I had suggested 0.01.
Thanks for the good input David.

Date: Sun, 10 Sep 2006 13:31:58 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] IF Alignment Question

I did a complete gear-train rebuild and mechanical/switch alignment. I just had the deck off again for some other work and put it back in place yesterday just before beginning this alignment. It doesn't seem to be the bandswitch make/break as much as the slight differences in the positions of the IF slug racks. That's when I noticed that if I tweaked them while listening on a signal from the antenna jack rather than the test point methods.

Can you expand a bit on the "octave" tuning method you described?

Date: Mon, 11 Sep 2006 06:16:38 -0400
From: "dmartin" <dmartin@visuallink.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Some of you may recall my post of a few weeks back, from which I got a number of helpful replies. The good news is that replacing the three under-deck caps across the 1st IF coils (C318, C329, and C334) and replacing all three trimmers seems to have solved the issue. I get a good and unvarying alignment of the 1st IF now, that holds over time, and I've experienced no 0.5 to 8 meg loss in sensitivity over time. The puzzling thing is why one of the three trimmer caps, the one for Z-213-1, still has only one peak and it is at max capacitance? By replacing all three under-deck mica caps and all three trimmers with NOS 5-25 pF I would have thought to have double peaks on all three trimmers. Additionally, I have one single peak at max capacitance trimmer in my 2nd IF, Z216-2. I replaced C292-2 with a 100 pF silver mica and also put in a NOS trimmer but still get only one peak, at maximum capacitance. In both cases, this suggests to me that the factory OEM values of the caps I replaced are no longer quite enough since the trimmers cannot quite trim up enough? All else works fine now and I'm tempted to just leave well enough alone. However, I'm puzzled why fresh trimmers and new micas at spec values cannot get two peaks during alignment. Got any ideas?

Date: Mon, 11 Sep 2006 10:59:30 EDT
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

>why fresh trimmers and new micas at spec values cannot...............

Have you tried screwing in the slugs a few more turns? What happens when you screw in the slugs a few more turns? Does the signal continue to peak or does it start to fall off? If it starts to fall off then the single peak would appear to be near correct even though you only get one peak when the slug is maxxed out. I wouldn't worry too much about a single peak if the sensitivity is back to normal. 73 Todd

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Date: Mon, 11 Sep 2006 10:12:44 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Well that's another tip off that there is a resonance problem in that particular tuned circuit. The slug tuning should never be at it's threaded limit to achieve the peak....(it's actually not the peak because you are at a physical limit prior to reaching the peak)

I've had to add and sometimes even remove fixed capacitance to get within the range of the trimmer. It's seems to me the inductance value has changed from when the can was manufactured. Maybe there is fine particles of slug material worn into the coil form.

Maybe the slug has a chunk missing off the bottom of it...who knows. The factory value of the fixed mica cap is no longer correct and requires custom matching to the current circuit conditions.

I've had to do it several times and sometimes the effect on performance is dramatic because you don't know how far off of the real peak you are until you can achieve two distinct peaks with the trimmer capacitor at different positions in their rotational range. It's worth the effort....

Date: Mon, 11 Sep 2006 11:37:13 -0400
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

The sllugs have different permeability depending on what circuit they are used in, i.e. it is possible a slug from an RF coil will not perform the same as a slug in the IF.

If you interchanged slugs accidentally this might cause mistracking.

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Date: Mon, 11 Sep 2006 12:19:51 -0400
From: "Patrick" <brookbank@triad.rr.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Tod, are you sure that you have the right slug?.....Pat

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Date: Mon, 11 Sep 2006 12:43:23 -0400
From: "Bruce Hagen" <b_hagen@sbcglobal.net>
Subject: RE: [R-390] 0.5-8.0 Low Sensitivity (Long)

There is something called, I think, the curie (SP) factor.

I ran into this in a TV IF strip many years ago and was told by the chief engineer of the company that the slug can change its characteristics from heat. Maybe one of our engineer types can through some light on this.

Date: Mon, 11 Sep 2006 13:25:52 -0400
From: "dmartin" <dmartin@visuallink.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

I do a pretty "classic" 1st IF alignment - peaking the slugs back-to-front at 1.2mHz and then peak the trimmers back-to-front at 7.6 megs, with signal input at the balanced antenna connector, one pin grounded. No, I've never tried to screw the slugs back in (or out!) to see if doing so would enable a two-peak trim cap. I'm sure the diode load VDC would drop off if I moved the slugs from wherever their "natural" 1.2 meg peak is, though. However, Todd and a couple of other private replies have suggested this so maybe I'll play around with it tonight.

To Cecil's point, it >does< seem to me that if I wanted to go nuts over not getting two peaks on every trimmer the only recourse might be to start empirically adding a little fixed capacitance, above what is factory original. The 1st IF uses 51 (I replaced with a 50 pF)and 68 pF and the can in question is the one with 50 pF. CDE makes a 56 pF. I could try that, or parallel other combinations. Experimenting like this wouldn't be too bad in the 2nd IF and RF, where the fixed caps are all pretty much in the easily accessible cans. Bit of a drag to do that in the 1st IF though, where the fixed caps are under the deck. Be good to hit that one right the first time! I've had rf decks out a bunch of times over the years. It's kind of like mowing your yard in August - not hard, just takes awhile and you don't look forward to it!Let's see what other posts come in. It is taking well under 4 uV for -7.0 VDC diode load voltage on 0.5-8.0 frequencies right now, which is TM-spec for field checking sensitivity. That's from my not necessarily calibrated HP-606 with no effort at impedance matching. Point is, sensitivity seems fine, but I do wonder what else might be available ???

I haven't decided whether to get paranoid about going for two peaks on all the trimmers (could be fun!) or just move it from the bench to my radio desk and enjoy it!

Date: 11 Sep 2006 18:13:16 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

All this talk makes me more interested in my R390As than it has in some time. The current project didn't look like I'd ever get it back together and working very well at all, but this last weekend saw me getting very good results after working on the crystal/RF decks. Signals were really coming in strong last night even in the part of the year where the bands are usually full of static. Fun. I was thinking of selling these when I'm finished with the current one, but now I'm not so sure. It's always a lot more fun when you get a little reward for your efforts. If I can get this IF deck working properly, this should be a very nice radio.

Date: 11 Sep 2006 18:19:34 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Forgot to mention that I finished the new RF-to-IF cables on Saturday. They sure look purty in there. If you are considering doing this, it does

look nice when you're finished.

Date: Mon, 11 Sep 2006 20:56:40 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] RF deck alignment

>Can you expand a bit on the "octave" tuning method you described?

The RF deck has six bands of tuning. There is band width in the IF and there
are first and second mixers in the RF deck.

0.500 - 0.999 First octave
1.000 - 1.999 Second octave
2.000 - 3.999
4.000 - 7.999
8.000 - 15.999
16.000 - 31.999 sixth octave

To give us fellows a way of talking about a rack of RF as opposed to a single megahertz of RF from an oscillator set up and MC change knob we talk about one of these six slug racks being an "Octave". Look at the harmonic arrangement of the RF slug racks and you see where this reference come from. The octaves change with the RF band switch. The crystals change with the MC change knob on every detent MC.

So when we talk about tuning an octave we are working on one of these RF slug racks, its three transformers and its four trimmer caps. Of course you need to drive the antenna input with a balanced source to get observe any change with the first trim cap in the first can of each octave. The R390 TM says use two 68 ohm resistors (this works) to drive a balanced input into the receiver from a single coax signal generator. The R390/A TM missed the whole section. One signal into two resistors and one resistor each into each antenna input.

The first and second IF cams also move with the KC change knob. And yes the 1.000 to 1.999 and the second IF tracks with this octave.

The second IF tracks one megahertz: 2.0 - 2.9 gets mixed with 2.455-3.455 and puts out 455KC.

The receiver kicks 1.000 - 1.999 up to 17.000 - 17.999 megs and back down to 2.0 - 2.999. The slug tuned VFO mixes the 2.0 - 2.9 out to 455.

So when you need to do two of these receivers every shift, have some screw off time, handle the pop up trouble calls and get a mid shift meal in, you learn to get'erdone. A real semi (once every six months) can be done in 4 hours. If you ain't getting it on hard for a good four hours you did not do a full semi. So you learn from them that been there done that just how best to geterdone.

Park that signal generator into the IF input and get the IF deck up to specification.

Park that signal generator into the RF balanced antenna input and get that deck up to specification.

A bath to wash the face. A blow job and oil in the gear train. Check the mechanical dial over run and cam adjustments. Check all the tubes in the TV7. Set up the IF deck and trim the BFO and Gain Adjust. Check the IF signal to noise. Set up the RF deck. Neutralize the BF. Check the VLF end points Do a alignment on the RF deck. Put the RF deck cover back on and return the receiver to the rack where you removed it from at the start of the shift. The time you spent walking the floor to find the receiver does not count. Sounds easy. Geterdone and go to mid shift meal. and do it again before you get relived at the end of trick. We would take two receivers on a cart and go find the tow
that were due for PM. At the end of shift you took them both back out on the cart and returned them to the rack. Macho man was to boost one on your shoulder and walk the floor with it until you found the one you were looking for.

Think about a big room like 1500 square feet. A double wide rack with two receivers side by side and 15 of these double wide racks in a room. Think 32 receivers in a room. Think 10 or more rooms. Think about 4 receivers in two side by side racks with 2 prints in half high racks beside that and a 1/2 rack as a desk with a typewriter. Lots of floor space to walk around on. There was lots of other
equipment like the RTTY demodulators and tape recorders and antenna couplers and rack fans.

Once you couple the signal generator to the RF deck you spin the knobs, tweak the caps, adjust the slugs and read the meters. One audio power meter and one DC volt meter on the diode load.

The thing to do was drive all the signals through the 455 KHz 0.1 filter. On any given band the crystal could be off one-way or the other. the VFO may not be spot on or linear. Remember to open the IF back up to 2K when you look at the meters.

Run the receiver over to the alignment point. Run the generator over to get an output. Start adjusting the signal level and rocking it into the band pass. Switch over to 0.1 on the IF and rock the generator into the best peak point you could get. Open the IF up to 2K and set the generator for a mid meter reading. Adjust what ever you were supposed to adjust at that point for best peak. Set the generator level and take a meter reading. Modulation off and modulation on. You had 20 and moved on or you went to work swapping tubes. If you swapped a whole set of tubes in that you knew were good and you were not close you had to stop and think.

So to make life easy the 1.100 and 1.900 adjustments were just made inline as you did the 1.000 - 1.999 octave you are set up for this. you get the slugs in Z216 at 1.900 and the caps in Z216 at 1.100

The second IF 1.250 and 7.250 We some days worked over to 1.250 if 1.100 was close to not passing and we needed a better answer. We did Z213 caps at 7.600.Again if that was not peaking and passing real good we would dial over and set up for 7.250.

We always run the signal generator into the antenna input at the receiver dial frequency and peaked into the 455 crystal as best as we could hit it. This got us as good as a result as injecting into the test points. Some times we got better results than injecting into the test points.

There have been some good comments the last few days on the slugs and trimmers peaking. I can believe that some decks are in need of some small cap adjustments.

Slugs have aged. coils have aged. We are not going to get need stock so we have to change or add some small caps to bring some old circuits back to peak on frequency. Briefly (do not ponder this next idea to ill health) think about all those decks I dumped into the TTY degreaser as a cleaning method. I was expecting to get new transistor Racal receivers any day to replace those old R390/A's. I was trained on the new Racal receivers in school in 1969 and still waiting for them to show up at the field station when I left service in 1975. There was a new building built at Torii Station Okinawa before I arrived there in 1973. Every one though the new building was going to get new equipment. As a results no maintenance had really been done on a lot of equipment for two years. Then we moved all the equipment over to the new building and spent a year getting it up to par. We were so far in the hole on bad tubes we overran the maintenance budget and from the top command down every one wanted to know why it had cost nothing for maintenance for prior years and now we were spending money on parts like no tomorrow. Messengers were shot while approaching headquarters. They did not even want to hear it. So Fellows, some where in this did I answer the question?

Roger AI4NI

Date: Tue, 12 Sep 2006 00:15:18 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] BFO 455 Crystal and Z501 C520 C525 L501

I felt a need to break this mail down. I hate when it bounces against the size limit and need dispensation to get it forwarded.

Remember the first lamp read out counters hit the Army Field stations in the late 50's In 70 we had one nixie readout counter in Phu Bia. In 75 we had two counters in Okinawa. We did receiver after receiver every day around the world pushing a AN/URM 25 into those R390 crystals and called it good. The TM procedure was all we had. As bad as it reads, we read it until we understood what had to be done.

If you have a counter use it.

When you was doing two receivers a day every day you learn a lot quicker than when you only own one and do this once a year.

After you get the IF deck aligned at 455 and before you jump over to the RF deck you need to finish up on the IF deck.

When you inject 455 into the IF deck through one of the RF to IF bnc connectors (J513) you are psetting Z501 in the R390/A and its mate in the R390. You also need to set the BFO at 455Khz. If you are blessed with a frequency counter you do it that way. For every one else you push 455 through the crystal filter as a filter and zero beat against it. You cannot get 455 through the filter without some work. As you finish the IF deck and have it all cabled back to gather, reach into the RF deck and remove the third mixer. This will quite down the RF out put into the IF deck.

There were comments last week about an adapter that had a 0.047 600 volt cap in it of use to the R390 community. And this is where it be used.

Use the cap to stuff 455 into the plate pin of the third mixer (pin 1 of a 6C4).

Again set the IF band width to 0.1 and peak the generator through the 455 crystal in side Z501. If you have a frequency counter use it.

You can zero the BFO against the generator at this point.

Z501 is properly cabled and you can tweak the slug L501 for 1.0 band width.

You can adjust C520 to go with the crystal and you can adjust T208 in the RF
deck.

If you do not know if your 0.1 crystal filter is centered and you do not have a counter, then you have to do the TM procedure to find the skirt points on the crystal. Then knowing the skirts (marks on the can) you set the crystal C520 center on the marks. This then becomes your reference for 455.

The TM says inject a small signal into the test point on the grid of the third mixer. This has all the RF deck noise mixing in with the generator and you are hard put to get good reading on the diode load and audio meter for doing signal to noise ratios. You cannot determine the noisy tube in this TM setup. Pull the tube. Get the RF deck noise out of the mix. The TM setup also makes it hard to find the peaks on the caps and crystals. The RF deck is working along just fine. It may have a noisy tube or tubes that you have not yet gotten to. So you do not know it is putting crud into the mix. You can go crazy because you have no idea what the RF deck is adding to your signal mix. The generator and the RF output are close about 455 you have no idea if you are peaking a RF deck noise or a signal generator frequency. You are adding two low level (RF deck and signal generator) signals and mixing them through a non linear mixing tube circuit. You wonder why you can make no sense of what is going on at the other end of the circuit in the IF deck.

The TM says over drive the crystal by 60 DB. On a URM25 we just went up one switch setting. As long as you did both sides (above and below 455) with the same generator output level you find the marks for C520 (the 455 crystal trim cap)

So you find the best 455 pass through the crystal as you can get by rocking the generator. You bring the signal down for a readable meter (-5 volts on the diode load). Then you kick the generator up 60 DB. (what ever works on your equipment) one switch range or some meter level. Then you move the frequency up on the signal generator until it falls out of the crystal bandpass and the level through the bandpass is again at -7 volts. Trim C520 to dip the meter. mark the slot on the can.

Adjust the signal generator frequency under 455 until the meter reads -7 volts. trim C520 to dip the meter. Mark the slot of C520 on the can.

Set C520 to between the two marks.

If you have a frequency counter skip all the above. Set the generator to

455. set the bandwidth to 0.1 Trim C520 to minimum. Never move C520 again in your life.

Setting C520 up to dip at 455 is a one time event. As you change band width over to 1, 2, 4, 8, and 16 you do not adjust C520. You do adjust L501 at the 1Khz band width for peak like you adjust the mechanical filter or the IF cans in a R390 for their respective bandwidths. The peak of any bandwidth is not relative to other bandwidths.

You want the generator set to 455. How you get your test equipment set is dependent on your bench population. Back when R390's were new, the best reference to 455 was that crystal in the IF deck. The best way to get that test equipment item (the crystal) calibrated was to follow the TM setup procedure to find the skirts and set C520 to center. Later in Life we learned to not worry about
the shock hazard (we was being shot at, a shock was just a wakeup call) and pulled the third mixer tube and inserted the signal into the plate pin of the RF deck. One can unplug the RF deck connector and then the third mixer plate pin does not have B+ on it. This works very well but it took time to undo and redo that connector. Works on any day you do not happen to have a cap to go on the end of your signal injector coax.

The TM then says to adjust L501 at 1. bandwidth for maximum at 455.

If you have a counter set the signal generator for 455. Set the band width to 1 set the generator output for about -7 volts and adjust L501 for maximum DC load.

If you do not have a counter set the generator to peak through the crystal filter at 0.1 bandwidth. move the switch over to 1.0 bandwidth and adjust L501 for peak. This is a one time pass. The C sets 0.1 while L sets 1.0 These two different bandwidths act very different. You tune them up separately.

The messy TM process about finding the crystal skirts is just for "calibrating" the crystal to the best center on 455. Once you set that crystal it is good until you open the Z501 can and pet the crystal container. Once you get to where you believe the signal generator is set to 455 you just go forward with alignment. The 0.1 crystal was just the best way to get a signal generator set to 455 until the arrival of frequency counters. The messy TM procedure was just the best way to "calibrate" the crystal for use as a frequency reference. Still works good today once you understand what the outcome is supposed to be. Getting the RF deck noise out of the mix also helps thing go cleanly.

You can get some higher peaks some where else than at exactly 455. That is not the objective. The objective is to get the 0.1 crystal balanced at 455. and 1.0 inductor into the centered on 455.

Get the signal generator as close to 455 as you can get. If you have a counter use it. If not you peak the generator into the bandpass of the 455 crystal and know your within a 100 hertz of 455. If you do the procedure above you have a 455 crystal filter that is within a 100 hertz. You likely only diddle the signal generator into the counter down to within 20 or 30 hertz just because you can.

Pull the third mixer tube and inject into the plate pin of the socket. Then you can set the bandpass filters at peak without changing frequency. Most days the R390/A get their mechanical filters peaked up while we are doing the signal to noise testing of the IF deck.

The book says 150 UV at 455 into J513. We skip the matching stuff because 50 years has shown it does not change the outcome. A lot of work goes into getting a good 30:1 signal to noise ratio out of the IF and audio deck. The R390 IF deck gets its transformers peaked and the R390/A gets its mechanical filters peaked.

Once we move over to putting 455 into the plate of the third mixer to set the crystal filter, L 501 peak and the last 455 output transformer of the RF deck we do not go back and reset the mechanical filter caps. We done been there and done that. We are trying to get out of here on time today. We are not going back to trim that stuff up once more. There is a long ways to go in the RF deck
before we are done.

But if you have been working without a frequency counter, You are now pushing the best 455 frequency you can set up on your bench at this point. A peak is a peak. You could see enough improvement to make it worth your while to go back and trim every thing in the IF deck up again with this test setup. Just leave the IF Gain Adjust alone. Besides you likely will use Chuck Ripple's
procedure to set the IF Gain Adjust as you place the receiver back in service (hook it to an antenna).

If I did not spell Chuck's name correctly, please let me know. At least put his web page address up for everyone. Thank You.

But while you are here and have every thing peaked. See how much signal it takes to get-7 volts on the diode load and write it down. Then nexttime you need to do your receiver you can just run the generator into the plate pin of the third mixer and do everything in the IF with this setup.

We could not do this for show and tell in the shop because we had no way to validate that what we were driving the receiver with was equal. The show and tell signal to noise process had to be repeatable and by the book. The book does not say 150 UV into the IF and 30:1 signal to noise if you want to get the whole receiver to pass muster. But you start fixing receivers that do not muster and you find some things at some points that clue you in as to which way to go next.

The book does not say pull the third mixer and inject a signal into the plate pin. But you learn it removes the RF deck noise from the mix and makes it easier to set up the 0.1 and 1.0 bandwidth adjustments as well as that last RF deck transformer. You also learn to use a counter if you have one. The TM never got updated to doing things with a counter on the bench.

Pulling the tube and injecting on the plate pin of the socket, gives you a point to get 455 into the IF and set your BFO against if you do not have a counter to count the BFO directly.

Also at this point you can neutralize the BFO. Instead of using a cal tone we used the signal input. You disconnect P213 (the crystal side of the balanced coupling between the RF and IF deck) and stick the long spline or Philips screwdriver into J513 and short the center pin to the chassis while you trim C525 for minimum meter reading on the Audio power meter You have to kick the diode load meter up a range or two when you turn the BFO on. You can find a null on the diode load meter here as well.

The TM says hang a RF meter on the 455 output so you cannot use your little jumper from the IF deck to the back panel to short P213. In life we metered the audio out with a power meter (TS585) [and AC volt meter with a DB scale and a 600 ohm resistor] (try two 1,200 ohm in parallel a couple 1/4 watts or better a couple 1/2 watts will handle the 1/2 watt output of the receiver.

On the RF meter you are reading total signal and noise out of the BFO and receiver at 455Khz. You are adjusting the BFO for minimum noise.

Looking at the Audio output of the Diode load reading -30 volts with the BFO on you will not see a large dip when you hit minimum noise. As you need to do this with the BFO and a signal you are hard put to see the dip on the over 1/2 watt audio output.

Plug in your head set and listen to the audio. You can hear the change in noise. Adjust for least noise.

Try no input to the IF deck. Turn the BFO on. With no signal to mix with the diode load and audio noise should be low. Trim C525 for a dip in the audio noise.

Make a BNC short with connector and come coax. Use this on your R390. Use the mini BNC cable from J513 to the back panel and place the shorting plug there.

Do this setup and trim C525 to minimum output. Draw a line on the chassis side in line with the slot on C525. Now put J513 and P213 back together. Readjust C525 and see if its goes to minimum at the same point.

A good BFO is a quiet BFO and it just gets adjusted for minimum output against a signal.

For the SSB guys, remember a quiet BFO and a strong BFO are not the same thing. C525 changes the noise of the oscillator circuit not the output level of the oscillator. Max output from adjusting C525 is not a better SSB signal catcher.

Remember all this is done with 455 going into the plate pin of the third mixer.

Remember to use a cap between that B+ plate pin and you signal generator.

Exact generator output level is not specified. If you have a counter use it.

Roger L. Ruszkowski

Date: Fri, 22 Sep 2006 13:27:02 -0400
From: "WD4INP" <WD9INP@isp.com>
Subject: [R-390] Setting I-F GAIN ADJ pot and tuning R-F stages on noise

Over the years, I developed a simple set of procedures for adjusting the sets used by hobbyists, as opposed to sets in use by the Navy (which must be done according to the standards):

1. Adjust the RF and IF stages for a peak on front -end noise with no signal input. Use the LINE LEVEL meter. The 0.5 - 1.0 MC band needs termination of the antenna input with a 50-ohm resistor, and then realignment with the ANT TRIM control set to zero and on the antenna to be used. This most closely mimics weak-signal reception. Use the most sensitive combination of LINE LEVEL meter and LINE LEVEL pot possible. Note: as long as R-F input levels don't exceed about 10 μV (as with front-end noise), the set can be aligned with the FUNCTION control set for "MGC."

2. Set the I-F GAIN ADJ pot for deflection of the LINE LEVEL meter to "100," with the LINE METER set to "+10," and the LINE GAIN pot set fully clockwise. This also provides a rough check of the deterioration of tubes over time.

Charles A Taylor, WD4INP   Grifton, North Carolina

Date: Sun, 17 Sep 2006 15:02:25 -0500
From: "Barry" <n4buq@knology.net>
Subject: [R-390] Yet another question... sigh...

Started checking the R390A from the audio deck "up". Referring to the Y2K Rev 2 manual, table 5-5, step 6 (on page 5-27), it gives voltages to set the AN/URM-127 to look for 0dB on the Line Level meter. I have an HP-200CD whose output isn't calibrated in volts. Are the voltages shown P-P, RMS, or what? Should I be loading the HP-200 into a 600-ohm resistor for these measurements? I have a TS-585 but it's calibrated in mW and dB so not sure how to correlate that to the table's values because I don't know if they're RMS or P-P. Any help is appreciated.

Date: Sun, 17 Sep 2006 17:11:09 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Yet another question... sigh...

(Trying to answer my own question) The HP-200CD is supposed to put out 11.5V at full scale when across 600-ohms. 11.5V across 600-ohms yields 220mW. This checks out on my TS-585. Based on that, 5V RMS (which I found out the AN/URM-127's output is measured in) should yield about 42mW. Should I leave the TS-585 in the circuit such that the 600-ohms load is present and set the HP-200CD to get 42mW on the TS-585 to get the 5V specified in the test?

Date: Sun, 17 Sep 2006 21:09:23 EDT
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] Yet another question... sigh...

That sounds correct. It shouldn't hurt anything to monitor the HP-200CD output with the TS-185 to be sure you are getting the correct 5V RMS audio sinewave into the test point. It would be nice if you had something like a Boonton 92B or similar millivoltmeter to measure the HP-200CD output directly in volts or millivolts but as long as you correctly convert mW at 600 ohms into voltage RMS you should be fine. 73 Todd WD4NGG

Date: Sun, 17 Sep 2006 21:09:23 EDT
From: ToddRoberts2001@aol.com

Subject: Re: [R-390] Yet another question... sigh...

That sounds correct. It shouldn't hurt anything to monitor the HP-200CD output with the TS-185 to be sure you are getting the correct 5V RMS audio sinewave into the test point. It would be nice if you had something like a Boonton 92B or similar millivoltmeter to measure the HP-200CD output directly in volts or millivolts but as long as you correctly convert mW at 600 ohms into voltage
RMS you should be fine. 73 Todd WD4NGG

Date: Sun, 17 Sep 2006 22:00:02 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Yet another question... sigh...

Well, some of my test equipment actually agreed for a change. 42mW measures 5V on my DVM. Cool. The audio tests were spot on. Following the table, when I inject 0.1V of modulated 455kc on pin 7 of the detector (V506), I don't get the expected results. The only difference in my test is my internal modulated signal is 800cps whereas I think the test states something like 400cps but I don't think that would really matter. I suppose I can hook the audio signal generator to the RF signal generator and use the external modulator position, but, again, I doubt that would change anything very much. According to the table, I have problems in the detector circuit. I'll start looking there for problems.

Date: 18 Sep 2006 13:51:19 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Yet another question... sigh...

Still mulling this over. Injecting a 0.1V modulated 455kc signal at the plate of the detector (V506) isn't giving any output. If I inject 0.15V audio at the grid of V507, I get the expected results so the table says the problem is in the detector circuit. What I can't figure out is the radio does play -- perhaps not to specification, but it does play so I'm curious how the problem could be in the detector. Not sure where to go from here. There's very little componentry around the detector (and I'm running a NOS tube there just in case) so it should be easy to spot if anything's amiss there.

Date: Mon, 18 Sep 2006 10:38:08 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Yet another question... sigh...

Which tube pin on V507 2 or 7 is resulting in normal results....? (hopefully pin 7) How much signal on pins 6 and 7 of V506B gives you some output? (crank it up and see) The IF may be driving much more than the .1V that you are injecting resulting in the radio working somewhat. Should be able to put a scope on it and see what the level is there with a strong signal on the antenna port and the radio tuned to it. Are you using something like a .01uf DC blocking cap in series with your generator probe? (should be) Try injecting your 455 at pin 1 of T503 then at the diode load point....any change?

I see opportunities at C531 the .1 coupling cap, R 527, some of the limiter circuit components, L502, C562 in T503. Possibly C530 leaky.... Looks like shielded cables out to the diode load terminals on the rear panel and back. Pinched or damaged cable?

If you can inject and get normal results at the grid (pin 7 of 507B) I would back up and open the diode load jumper on the rear panel and see if I could do the same from terminal 15. That would eliminate the cable from the back panel, the influence of the limiter circuitry, R527, C531 etc.....

Unless you have been injecting on pin 2 of V507A which then adds several other possibilities. If you can inject your signal at the diode load with just a reasonable decrease in signal level due to R527, R527 and C531 then I would look at what's going on between pins 6 & 7 of V506B and the diode load terminal 14.

Have you tried using the NOS tube somewhere else in the radio to be sure it's good. NOS tubes are sometimes bad.....

Are you sure your signal generator is outputting 0.1uv and that it's on frequency? An HP 3400A RMS voltmeter pays for itself here...(for the level part anyway)

Put a scope on the same point you put the RF generator and see what you measure while injection your 455 Kc RF signal....

Just some thoughts after looking at the schematic....and considering other opportunities you might be facing....:-) The modulation frequency of your RF generator won't matter at this point...

Date: 18 Sep 2006 16:19:51 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Yet another question... sigh...

The attenuated output will only do 0.2V (100mV with 200% override on the attenuator). There is a 2V output that I use to drive the frequency counter. Maybe I'll try that.

> Should be able to put a scope on it and see what the level is..<snip>

Lots of good things to try. The radio "works" with the NOS tube in place so I assume it's at least functioning to some degree. I replaced a few of the tubes in the IF with NOS and got the AGC a lot closer to the MGC reading on the Carrier Level meter (less than 10dB now). I'm thinking bad tubes was partly responsible for the 20dB difference between AGC and MGC. The radio "works" with all these new tubes in place but still trying to get it working "right" (lower distortion, better gain through the IF deck, more response with BFO off, etc.).

Date: Mon, 18 Sep 2006 16:59:36 EDT
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] Yet another question... sigh...

What exactly is the problem with the radio? Is it weak or distorted audio? I have seen the 0.1uF coupling cap C531 between V506 and V507 go bad. That could be why you get output when you inject an audio signal into the grid of V507 but no output when you inject an RF signal into the plate of V506. Two other troublemakers around V507 are the small mica bypass caps C532 100pf and C537
180pf. Those seem to be more prone than others to short or get leaky. But first I would try replacing C531 and see what happens. Also you might check resistors R526 and R527. 73 Todd WD4NGG

Date: Mon, 18 Sep 2006 17:08:31 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Yet another question... sigh...

If the radio is not sounding good you have a problem. AGC should always give less output than the MGC. As you are loosing signal at the detector, and have AGC problems You need to work through that nice list from Cecil. The AGC starts there at the detector. Keep working. Good Luck and keep us posted.

Date: Tue, 19 Sep 2006 07:40:58 -0400
From: "dmartin" <dmartin@visuallink.com>
Subject: Re: [R-390] 0.5-8.0 Low Sensitivity (Long)

Regarding an inability to get two peaks on some of my 1st and 2nd IF can trimmers, in some cases even after replacing the trimmers and fixed caps bridging the coils, advice from the list was again right on!

In almost every case I've tried so far, the "fix" was to turn the coil slug in or out a turn or two and attempt to re-peak the trimmer. Doing this very often yielded a "two-peak" trimmer. I would then go back to the low end of the alignment process, i.e., 1.200 for the 1st IF, and then re-peak all the coil slugs. Doing this would invariably cause me to back out the slug just a little, back slightly in the direction of where it was, but when next redoing the caps at the higher frequency, i.e., 7.600 for the 1st IF, I found I >still< had two peaks on the trimmer.

Point is, there >is< a lot of interaction between the L and the C in LC circuits. Such a fact is Electronics 101, to be sure, but I did not grasp the significance of it and found I was tending to strictly align the slugs and trimmers individually, in isolation. Thought I'd share it with the group in case others, too, and trying to align their slugs at one frequency and caps at another without consideration for how each drives the other. Seemingly perfect peaks on the slugs may or may not yield two peaks on the corresponding trimmer. Often, there is a very narrow, mutual "sweet spot" of slug and trimmer position and I've learned to align both together. Thanks again for all the on and off list replies!

Date: 19 Sep 2006 13:50:55 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] Detector tests followup

I tried some of Cecil's procedures last night. I injected a 4V peak-to-peak 455kc 30% modulated signal at the grid/plate of the detector and the results on the dB meter were where they should be with a 0.5V RMS signal. Too much voltage required to see the proper results.

I then disconnected the diode load jumper and injected the audio signal on pin 15 of the back panel. The output wasn't up to spec, but then I realized there's a resistor in the path from pin 15 to the grid of V507 causing a voltage drop from pin 15 to V507's pin 7. Measuring the voltage at pin 7 of V507, I increased the signal level at pin 15 to see 0.15V RMS at pin 7. The output level was on spec at that point. Looks like there's still something wrong at the detector and assuming that eliminating the limiter as a problem by the above tests, there's not too much else at the detector to work on. The choke has the right resistance so the 150pF cap to ground is my next suspect. If replacing that doesn't help, does anyone else see anything else that might be a problem?

On another subject, I started looking at the capacitors in the various IF transformers. As I mentioned before, these have a mixture of rectangular micas and what appear to be silver-micas. In an effort to get better peaking in these cans, I'm considering replacing these capacitors. The slugs are very near their limits and are very hard to turn at their peaks so I'd like to move the resonant point somewhere closer to mid-range of the threads. I can read the rectangular micas, but I'm not familiar with the coding on the other caps. They appear to have a large round purple(?) dot on one end with color code stripes along one side. Can some tell me how to read these? Provided I can stay away from the Litz wire connections (I

don't want to resolder Litz wire if I can help it), it doesn't look like too bad of a job to replace these caps and if it will help the resonant point, I'm willing to do it.

-
Date: Tue, 19 Sep 2006 12:56:11 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Detector tests followup

Did you record the signal level required at terminal 15 to get the .15v at pin 7 of V507? Just curious whether it took just a bit more level or something closer to 4v p-p. Simple test for C530....cut one end of it loose but where you can solder it back. See if that brings the signal level up. C530 and L502 are used to remove the 455kc signal from the audio...

It could also be a bad T503 secondary or C562. Pull the cover off T503 and inject your AUDIO signal into pin 1 of T503 with the diode load jumper back in place and see what you get.

I would also do a continuity test of the cable from terminal 14 back to pin 1 of T503 and center to ground etc.... One thing that don't add up is that you were originally injecting 0.1V at Pins 6,7 of V506B and expecting to see the equivalent of 0.15v of audio at Pin 7 of V507 where you just had to crank the level going in at the diode load point to achieve 0.15 volts of signal at Pin 7 of V507. Those numbers don't add up. Where did you get the 0.1V of 455kc at the plate of V506B from...out of the manual somewhere? My manual is showing a level of 0.3 to 0.4 V at pin 1 (grid) of the 4th IF amp V504. I don't see anything showing the expected output on of that IF amp is but I would expect it to be fairly high to drive a decent signal through T503. I haven't found any expected level at the input of the detector so far....but something approaching 1 volt p-p might not be unreasonable..... 100mv sounds low but I haven't measured a working radio that I remember. The signal substitution process in my manual speaks only in general terms as to the levels to inject in this area...things like sufficient signal level to achieve an output etc....

Date: 19 Sep 2006 18:11:55 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

> Did you record the signal level required at terminal 15 ......

I don't recall the value at terminal 15 to get 0.15V at pin 7, but I'm pretty sure it wasn't anywhere near 4V - perhaps something nearer 0.3V - 0.4V. It seemed about right to compensate for the series grid resistor.

> Simple test for C530....cut one end of it loose .... I can certainly try that.

> It could also be a bad T503 secondary or C562..........................

Okay. Something I just noticed about the schematic versus my IF deck: the schematic shows RCL on each side of the IF transformers whereas (and my memory might be playing tricks on me here) my transformers have two capacitors on both the primary and secondary of the transformer (in addition to the resistor). I wonder if this was a "tuning" thing. It appears to be factory but maybe not...

> ....Where did you get the .1V of 455kc at the plate of V506B..............

That value came from the Y2K manual in one of the trouble-shooting tables (chapter 5 I believe it is). It is a step-by-step trouble-isolating procedure that starts at the audio deck and works its way back up the chain. It shows what you should see for various signals injected at various points in the various decks.

Date: Tue, 19 Sep 2006 21:17:42 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

I did another test tonight. I coupled the audio generator to terminal 15 and measured the voltage it required to get 0.15V at pin 7 of V506. It was approximately 0.33V. I assume that would be about right given the voltage drop across the grid resistor going to the limiter circuit. Next, I shorted the diode-load terminals and watched the voltage on pin 7 of V507. It only dropped about 0.01V. Given the fact that it takes 4V p-p on the plate of the detector to see 0.15V on pin 7 of V507, I sort of expected to see a good drop in voltage when I included the diode-load connection.

I suppose I'll try subbing the 150pF to see what effect it has, but I'm beginning to think this isn't the problem. I have some 180pF so until I get the right value, this should at least give me an indication if this is the problem point. Thanks guys. I do hope to get to the bottom of this...

Date: Wed, 20 Sep 2006 07:59:39 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Detector tests followup

Need to try that same test and back up to pin 1 on T503. If .33V at that point gives you proper level at Pin 7 of V507 then the problem is either in T503 or a bad V506 the 5814/12AU7. (swap it with V206 out of the calibrator for a test)

Check for a 6 ohm reading across pins 1 and 2 of T503 and an open circuit between pins 1 and/or 2 and the remaining pins of T503. It's possible L513 in T503 could be open...or shorted to a turn of L512. As a long shot you could lift one end of C535 and see if isolating the BFO circuitry has any effect. Getting close...

Date: 20 Sep 2006 18:12:41 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

Checked 6 ohms for both windings; however, I don't get infinity between coils when the deck is connected to the main harness. If I disconnect the diode load, the windings show infinity between them so something downstream of the diode load is providing a high-resistance between the windings (about 50k). I notice this varies a bit when turning on/off the limiter. Perhaps the circuit ties back from the centertap of the primary back to the limiter. I briefly looked into that but was on my lunch break and didn't look at all the places where this could provide a high-resistance shunt between the primary and secondary windings.

Date: 20 Sep 2006 19:12:10 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

Okay, did a little schematic reading and see where there are paths from both the primary and secondary to ground through a series of resistors so with the main plug and the diode-load connected, there should be some resistance reading between the primary and secondary of T503. Perhaps I do need to do some tube-swapping. I thought I had a good one in there but maybe not.

Date: Wed, 20 Sep 2006 22:18:33 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

Tried swapping another NOS 5814A for V506. Didn't notice any real differences; however, something happened tonight as I was tinkering with the radio. It was as if a switch suddenly turned on and the noise level with the BFO in the off position came up rather noticeably.

Not sure what's going on. I did poke around the innards of the various IF transformers just flecking off any loose varnish, etc., making sure things were connected well, etc. Not sure if that might have had an effect or not. At any rate, I started tuning around. Radio Tiawan International

(5850(?)) was coming in extreeeeeemely loud.

If I switched to MGC, the carrier-level pegs and I have to back off the RF gain just a bit to get normal audio.Switching to AGC works great with signals around 80dB.

Is this normal? While I can't seem to get that elusive 0 VU or better with 150mV on the detector, the radio seems to be playing quite well and I'm beginning to wonder if I'm chasing ghosts. I'm just about ready to do the final alignment, put the covers on it, and enjoy it for a change.

Date: Thu, 21 Sep 2006 08:10:18 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Detector tests followup

Sounds like you have some sort of intermittent issue. I typically pull every transformer on the RF deck and clean each pin and socket with Deoxit prior to the alignment work.

The action you noted with the AGC/MGC is completely normal. Strong signals require a reduction in RF gain to prevent overload. AGC just does it automatically for you...in MGC you have to be the gain control thus reducing the front panel mounted RF gain.

I would go through the Carrier meter zero adjust procedure and the IF gain level setting procedure but I recommend the one on Chuck Ripple's page as opposed to the one in the manual. A version of his may be documented in the Y2K manual...not sure....

Now that the magic switch has been thrown what do the levels look like around the detector stage....is it taking less than 4 v p-p to get proper level going into the noise limiter tube? Just curious...

I don't think you are chasing a ghost because things should not change that drastically from day to day.... One test to keep in mind....the background noise level on any band should always change (increase) when you connect an antenna to the radio...that's a good indication that the radio has sufficient sensitivity to overcome it's internal noise level which is a good sign that it's working fairly well. If you can't tell much difference between antenna connected or disconnected when tuned to a quiet place on the band there is more work to be done.

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Date: 21 Sep 2006 13:35:26 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

I cleaned the RF transformers about a year ago. The low noise issue was evident on all bands so I don't think it was RF transformer issues. Could be, though. When I tried Chuck's method before, I could not get enough noise with the BFO off to get full-scale on the Line Level meter. That's when I was sure something was up. Last night, I could get plenty of noise with the BFO off and antenna disconnected to set the IF Gain per Chuck's method.

Something I have noticed in the last week of testing. At times, I noticed the noise level would just rise a bit on its own and then fade again. Not a really high rise in noise, but I could tell it was there. Last night, it was as if this "noise rise" suddenly got a lot louder and stayed there. Must be an intermittent but maybe it went to ON and will stay there...

I'll have to check that voltage level on a good signal to see if it has changed very much. It still bothers me that I don't get the desired output for 0.1V on the detector, but I might just have to live with it.

I did notice that the area around V506 got a lot more sensitive to the presence of my hand near it. Not sure if it was because I had the signal generator on and it was picking up something from me as an "antenna" or what, but it did seem to change there too. Weird.

I do have an issue with the 0.1 trimmer on the input of the IF deck. I get very little in the way of a peak on that trimmer and the signal level drops off quite a bit in 0.1 and 1.0 vs the rest of the bandwith settings. The coil does peak just a bit, but the cap does virtually nothing. Maybe a bad cap or crystal in that can. I plan to try swapping crystal with my other radio to see if that changes anything. If not, perhaps the fixed cap may be bad. More to do...Thanks again, Barry

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Date: Thu, 21 Sep 2006 10:19:55 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Detector tests followup

I suggest you get a nice capacitor hooked up to a probe and when the noise appears, short out the test points in the radio one at a time to find what stage the noise is coming from. If it's in the IF deck, then pull tubes one at a time till it goes away. Roy

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Date: Thu, 21 Sep 2006 10:28:54 EDT
From: DJED1@aol.com
Subject: Re: [R-390] Detector tests followup

If I remember correctly, the meter will only indicate in the MGC setting when the signal is very strong. Backing off on the gain will eliminate the overload and return the meter to zero. You should get good audio with AVC action at or above 80 dB. Good luck in your troubleshooting.

Date: Thu, 21 Sep 2006 20:11:12 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Detector tests followup

So first off most of the receiver is disconnected so we expect a low noise level. When the receiver is working well we still think we have good tubes and expect a low noise level. We do not hear a lot of the noise from the from the IF deck because it is not at audio frequencies. We detect the modulation on any signal in the IF deck. Most of the noise is of constant amplitude and has little if any modulation to detect.

Once the BFO is turned on then we hear more audio output. The noise is of amplitude but of different frequencies. as the "random" noise mixes with the BFO it produces more "snap crackle pop" at audio frequencies.

Pretty much a normal response.

Look what happens when you inject 455 into the IF. You expect -7 volts on the diode load. You add modulation and you get -7 volts on the diode load but 1/2 watt of audio output.

You turn on the BFO and you peg the -7 volts off the meter scale.

The BFO mixes with the noise and you get a lot more out of the audio.

BFO levels vary with every tube. So no one has tried to characterize how much change is possible or meaningful. Some is there and that good.

Have you got the distortion out?
Is the receiver sounding good?
Is MGC giving stronger audio signal than AGC?
Are you getting a good 1/2 watt output with the TS585?
Both line and local audio channels?

When you get a 1/2 watt out on the line with the TS585 and back the line gain down to read 100 Milliwatt Zero DB on the TS585 does the VU line meter read 0 VU?

Date: Thu, 21 Sep 2006 22:55:48 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Detector tests followup

I need to test the above scenarios. I did do something tonight, though. Attempting to follow the mil manual, I ran the sensitivity test. With modulation off, I set the TS585 to 1mW. Then with modulation on, set signal generator to get 10mW. After going back and forth a couple of times to get things levelled out, I ended up with 4uV sensitivity. This is somewhat uncalibrated as the signal generator is putting out 50 ohms into the balanced input and my IF gain wasn't set exactly right (I had fiddled with earlier and had not reset it properly). This isn't too bad a performance indicator, though, is it? I'd be worried if it took 10uV or 20uV to get the 10dB increase and I realize 3uV is the spec, but I'm not completely unhappy with 4uV at this point. Also, I tried the test of injecting modulated100mV @ 455kc at pin 7 of V507 on my other R390A (all '56 Motorola). It does the same thing. There's enough noise to get nearly full-scale VU readings with the Line Meter at -10 and Line Gain at 10. When I inject the signal (using a 0.1uF cap between the signal generator and pin 7), the audio goes nearly dead and the VU meter goes to full left scale. I'm beginning to wonder about the validity of this test. Anyone else try this? Enough for tonite. Thanks again for all the advice!

Date: Fri, 22 Sep 2006 19:32:59 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Detector tests followup

After going back and forth a couple of times to get things levelled out, I ended up with 4uV sensitivity. This is somewhat uncalibrated as the signal generator is putting out 50 ohms into the balanced input and my IF gain wasn't set exactly right (I had fiddled with earlier and had not reset it properly).

This isn't too bad a performance indicator, though, is it? I'd be worried if it took 10uV or 20uV to get the 10dB increase and I realize 3uV is the spec, but I'm not completely unhappy with 4uV at this point.

I think you have your receiver operating within specification.
Now it sounds like lots of alignment and some better tubes.
I think you may be on about the test not being exact numbers.
My Y2K manual is some where with my R390 TM. Still packed from the move.
So I have not been able to check what you are reading there.

Date: Fri, 22 Sep 2006 19:53:04 EDT
From: Flowertime01@wmconnect.com
Subject: Re: Setting I-F GAIN ADJ pot and tuning R-F stages on noise

Lets get this one over in the PEARLS OF WISDOM.

I like the idea of setting the meters against the receiver noise so that we can watch the receiver noise change with time on the tubes. I expect noise to go up and sensitivity go down over time. Roger AI4NI

Date: Sat, 23 Sep 2006 14:54:14 -0400
From: "WD4INP" <WD9INP@isp.com>
Subject: [R-390] Some practicalities on alignment of the R-390A/URR

<snip> To save you some trouble, when you align R-F subassemblies that are energized with plate voltage, be careful. Use an insulated screwdriver lest thou meet thy creator prematurely. It is not of great consequence if you briefly short an energized trimmer to the slug rack. Unless a resistor has already been burnt to about 95% of opening up, it will take the abuse BRIEFLY. So don't call 9-1-1 and have a heart attack (in either order) if you do so inadvertently.

Keeping in mind that the RF subassembly is troublesome to remove and replace.

Date: Sat, 23 Sep 2006 14:56:04 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Some practicalities on alignment of the R-390A/URR

<snip> Now what were we voting on....oh yea....that most LOUTS know to use an insulated tuning tool for alignment work.

Date: Sun, 24 Sep 2006 11:14:28 -0400
From: roy.morgan@nist.gov
Subject: Re: [R-390] Some practicalities on alignment of the R-390A/URR

>..when you align R-F subassemblies that are energized
> with plate voltage, be careful. Use an insulated screwdriver

I suggest we make up little stickers in red with "<-- B+ !!" on them. Putting one next to each dangerous adjustment would help us or others in the future.

Date: Sun, 24 Sep 2006 11:23:22 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] Some practicalities on alignment of the R-390A/URR

What is a good insulated screwdriver to adjust the RF transformers and BFO neutralizing trimmer? I've tried the plastic and the fiberglass ones. The tips just break off. I wrapped electrical tape around a long

screwdriver to where all but a little of the tip was exposed, but I haven't found a good way to insulated a screwdriver for the RF trimmers. I've gotten bitten several times.

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Date: Sun, 24 Sep 2006 11:12:35 -0500
From: "Mike" <mike46@cwjamaica.com>
Subject: [R-390] Cosmos PTO End Point Adjustment Tool

Does anyone have a design to make one of these? Or know how to mod an existing screw driver?

Date: Sun, 24 Sep 2006 13:07:59 -0400
From: "WD4INP" <WD9INP@isp.com>
Subject: [R-390] All Hands Stand By While Arcing and Sparking Slug Rack

(That's Navy talk) David and Roy and the rest, as I see it, putting heat shrink on a small, plastic handle screws driver will do plumb fine. Too much trouble for me. I use a small insulated screw driver and be purty careful not to short to rug slack, er slug rack. If I get a spark, I got a spark. Then I know sparks work. Charles A Taylor, WD4INP

Date: Sun, 24 Sep 2006 14:08:10 -0500
From: "Barry" <n4buq@knology.net>
Subject: [R-390] Still wondering about the 100mV detector test

Yesterday, I tried something a bit different.

I disconnected the input of the IF deck and fed it with the output of the signal generator.

I set the line meter to -10 and the line gain to 10.

With the scope on pin 7 of V506, increased the input signal until the the line meter read -10. At this point, I was seeing 0.8V p-p (approximately 0.28V RMS). Apparently, this is nearly 3 times the signal on the detector it takes to get the output level where it should be.

I'm still wondering if this radio has a problem. Anyone else try anything like this (or the original 100mV test on pin 7 of the detector)?

Date: Mon, 25 Sep 2006 19:05:46 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Still wondering about the 100mV detector test

The real old test from the TM is as follows.

Line gain to max
Local gain to max
RF gain to max
Mode to MGC
Bandwidth to 2KC
BFO off
Line meter to +10

Hang a DC voltmeter on the diode load.
Hang a TS585 on the line output.
(AC volt meter with DB scale and 600 ohm resistor)
Inject about 150 micro volts of 455 with 30% modulation into the IF deck.
Set the gain adjust or the signal generator for - 7volts on the Diode load.
Read at least 400 milliwatt or +26 DB on the audio output.
This should be +2 VU on the line meter scale.

A good receiver will get you 500 milliwatt. This is a go-no-go test.

You either got -7 volts and at least 0.4 watt out or you have an audio deck problem between the diode load and the point you are measuring (line out or local out on the terminal board). 150 µV at 455KC should get you an easy -10 volts on the diode load or you have an IF deck problem before the diode load. IF deck problems manifest more as not making signal to noise ratio than not having enough gain.

If both line and local fail it's the common stuff. If only one audio channel fails it's in that channel.

All the other tests are just to help narrow problems down. Anything you read anywhere between the original TM and an e-mail today is subject to the same disclaimer. Errors in print do happen. Do the test and put you anxiety to rest.

Your off looking at these points that change with every tube. Pick a point near a tube. Swap at least three tubes into the circuit and measure the same point with no change except to swap the tube.

Wait for the tube to warm up and settle down. Take a reading. If you get two tubes that give you the same meter reading you are lucky.

Date: Mon, 25 Sep 2006 22:21:06 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Still wondering about the 100mV detector test

> <snip>.....Set the gain adjust or the signal generator for - 7volts on the Diode load....<snip>

Okay, did this. I got about 40mW max on the line gain; however, was able to get +2VU with -7V on the diode load. If I increase the IF gain to maximum, I can get -10V on the diode load. I switched the TS585 to the local gain and there I got over 500mW out with -7V on the diode load.

Hmmm. Looks like I have some issues with the line out somewhere past the output transformer. Probably resistors/wiring around the back terminals.

I also have an open between the headphone jack and the rear terminal board (haven't checked this before so something else to fix).

Looks like maybe the IF deck is performing to specs? I'm still concerned about the IF transformers. It's all I can do to get T501 and T502 to peak unless I'm really forcing the slug down to its limit. I'm still thinking I have some bad mica caps on those that need addressing. I really do appreciate all this advice. You are a wealth of knowledge on these old radios.

I'm somewhat amazed all that is still at your "fingertips" as I assume it has been some years since you did this fulltime, right?

Date: 26 Sep 2006 15:29:08 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Still wondering about the 100mV detector test

I'm not looking at the radio right now so can't check things, but I'm wondering about something. With the line meter switch set to +10, the 2µV reading translates to 12µV. Does 12µV correspond to 26dB (400mW)? I've looked for a way to convert these and haven't found exactly what I'm looking for. A 1000cps signal into 600 ohms at 1mW should show 0µV, but I don't know how to translate 12µV into dB.

As I say, with 150uV modulated into the IF deck and -7V at the diode load, I get 2µV with the switch set to +10; however, I only see about 15mW on the TS585.

Since the line meter and it's associated hardware are all wired in the main harness, the problem would most likely not be in the AF deck.

I assume I probably have something going on with the resistor network on the terminal board where the line out is located but not sure about that. Any input on this?

Date: Tue, 26 Sep 2006 12:23:42 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Still wondering about the 100mV detector test

<snip> First the DC voltage on the Diode Load is a function of the RF Carrier Strength (Signal Strength).

What is shown on the Line Output meter, and a meter on the Line Out or Speaker Out is a function of the Modulation. To prove this, inject the 150uV, 455 kHz, 30% mod at 1000 or 400 Hz into the IF deck. Monitor Diode Load Voltage and adjust Line Level Gain for a reading on the Line Level Meter. Turn off the Modulation. Diode Load voltage will change little, if at all. The Line Level Meter will drop to zero.

In other words, the Line Level Meter is handy for peaking a signal, it being more sensitive than the Carrier Level Meter. But it does not relate well to the actual uV of the signal entering the RF Deck, as it varies with modulation. The Line meter reads dbV at the Line Output of the receiver. The standard is 0dBV = 0.707 VRMS into a 600 ohm load. This would come out to 0.833mW. (.707*.707 / 600). <snip>

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Date: 26 Sep 2006 16:54:52 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Still wondering about the 100mV detector test

Okay, I looked in the Y2K manual. Line output is "at least 10mW", whereas local output is "at least 500mW". Looks like the audio chain may be okay. The headphone is only supposed to supply 1mW; however, I get an open to the jack so I still think there's a problem there. Oh, and I meant VU, not μV. Sorry.

Date: Sat, 07 Oct 2006 16:38:06 -0500
From: Rick Brashear <rickbras@airmail.net>
Subject: [R-390] Calibration

Well... I have what will probably turn out to be a very novice R-390 owner question, but since I am a novice R-390 owner I guess that's okay. I have very low calibration signal on the lower bands and not a real good showing on the upper bands. I am sure just the other day this was not the case. I am sure I was getting as much as 3/4 meter indication on the carrier level meter, but it barely moves now. I have done little to the receiver other than clean it up a bit and repair a bent meter case. I did lay the front panel over to remove the carrier level meter to straighten it, however, I "think" I put everything back as it was. I carefully marked the meter leads ad they are back correctly. I just replaced the calibration

oscillator tubes (2 - 12AU7's) and that seemed to help a very little bit, so I doubt they really needed replacing since they did check good on the old Hickok tester. I have run through the procedure a hundred times and I can't see anything I'm doing differently, so I am assuming something has gone south or I have gone totally insane.

Date: Sun, 07 Jan 2007 07:26:12 -0500
From: Murph <Murph2006@copper.net>
Subject: [R-390] Broadcast radio at 2 meg

Why is it that I can hear broadcast stations on the 2 meg band. I.E. 1.250 can be heard at 2.50 etc. Twice the freq!

-
Date: Sun, 07 Jan 2007 07:30:54 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Broadcast radio at 2 meg

How far away is the station. If it is within 1-2 miles...

1) If you have modified V201, you could be overloading it if the station is close.

2) If you have an external preamp. Many solid state units use a diode for static protection, and this can cause it.

3) If the station is High-powered, and you are within a mile or two, you could be hearing a transmitted harmonic.

Date: Sun, 7 Jan 2007 10:08:17 -0500
From: <b_hagen@sbcglobal.net>
Subject: RE: [R-390] Broadcast radio at 2 meg

Perfectly normal I'd guess. I am within 3 air miles of a 50K watt at 1100KC and it is present, reduced of course, at 2200 on my 390.

Date: Sun, 07 Jan 2007 11:41:11 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Broadcast radio at 2 meg

Harmonics, either in the transmitter or something between you and the transmitter or in your receiver. I have a fairly powerful transmitter (630 kc) just a mile from my house and a weaker but still somewhat local station that I like to listen to on 1260kc. The 390A does better than all the other radios I have. Just sticking a scope probe in the air in my basement shows several volts of the 630kc signal. My 40M dipole in the backyard, oriented on purpose against the 630kc signal, shows 10 volts or so. Just hooking a diode and a small speaker up to the dipole I can clearly hear the broadcasts! Bonding the rain gutters around my house helped eliminate constant QRM from harmonics but the harmonics are still there. Most modern el-cheapo shortwave receivers get nothing except for the 630kc broadcaster, all and everywhere all over the dial on all bands (including FM!)

Date: Sun, 07 Jan 2007 17:57:25 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Broadcast radio at 2 meg

Rain Gutters! Never say the words "Rain Gutter" to me! I start screaming uncontrollably and Shoot the nearest TV with a Shotgun! Now that I have settled down a bit, I first ran into them as an 18 year old kid working my second job as a Cable TV Repairman down in Austin Tx back in 71. Customers had really bad herringbone patterns on one channel. Up the Pole, Down the Pole for
six days straight! Finally disconnected a house, and the herringbones went away. Turned out to be a poor connector up against the downspout of a rusty Rain Gutter. Replaced connector and jumpered the gutter with tinned braid and sheet metal screws. Told my Boss what it was. He told me I was full of it.

Date: Mon, 08 Jan 2007 02:59:46 -0500
From: Murph <Murph2006@copper.net>
Subject: [R-390] Broadcast radio at 2 meg {Thanks}

I want to thank all those that took the time to reply. It is time to do the five year disassembly and clean up .And was going to repair this problem at the same time. Whilst I run most covers and all tube shields, I will reinstall the Utah plate this time and see if it helps.

Date: Mon, 08 Jan 2007 08:27:57 -0500
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: Re: [R-390] Broadcast radio at 2 meg

We always have a similar problem on 160 for field day from a station at 570 kHz. To fix it we built a can (yes, a can at 570 kHz). Its a helical resonator, 160 turns of number 12 wire on a 12 inch sonotube (concrete form tube) in a 45 gal drum. Believe it or not its 18 dB deep at 5780 with a 10 kHz bandwidth. I do love titanic ngineering.

Date: Mon, 8 Jan 2007 12:07:01 EST
From: Flowertime01@wmconnect.com

Subject: Re: [R-390] Broadcast radio at 2 meg
To: r-390@mailman.qth.net

Not just close AM will get you. WBZ Boston was all over the HF bands at Ft Devens Ayer Mass some real miles from the Towers near Boston. Every thing in LA County was all over my R390 in west end of LA County in California. Every thing in San Diego was all over my R390 in Spring Valley San Diego County. So many local stations with real power to mix it up. On a real second AM broad cast harmonic we would expect the voice modulation to be spread twice as wide as on the fundamental. So its distorted. If the signal is nice and clean you think a mixer formed the move. If you have only a couple AM stations mixing over its likely over load. If you have the whole broadcast band mixing over its likely a problem. Think about what you are getting.

One station on it second harmonic is the station doubling. We have lots of cases where stations have harmonics. Every loose joint in the AM station antenna tower wants to mix the carrier and signal with modulation to a second harmonic at the station tower. Several stations spaced some frequency above their original are mixing with a fixed signal from some where else. Do the math to find that frequency. It could be external like a 1 MHz time base on the bench. Not your bench, but any one down the street.

Crystals will have spurs that will mix for you. Get the signal generator out and plugged into the antenna input. Get the level down low. turn every thing but the generator and receiver off and start listening. Run the generator over to the frequencies of the offending stations. Listen to the band where you have the second signal. See how much signal generator output is needed to get you a signal on that second dial location. If the fundimental frequency shows up on the second dial location with no chage in generator output you likely have a crystal with a spurous output. It will be one of the crystals that is active in the mix for the dial setting you are on.

You need to decide if the problem is internal to the receiver or external. You may need to run some attenuation or band pass filters on your receiver. I had to put my R390/A into a full metal jacket (small cabinet) and ground that jacket with a real braid and real ground rod to keep AM 600 out of the receiver in LA. I have real twin AX between the antenna input and a feed through coming out of the jacket. Then a length of twin Ax into another metal box (antenna tuner) where the antenna goes single ended to my wire. Roger.

Date: Mon, 8 Jan 2007 20:11:07 +0200
From: "Paul Galpin" <galpinp@absamail.co.za>

Subject: [R-390] Re: Broadcast radio at 2 meg

Picking up harmonics? Here's my entry for the competition (?) About 20 years ago, I was tuning round the 30M band, when I found BBC World transmissions. Interesting, I didn't know they were on that band! But they're not in the World Radio & TV Handbook. It turned out that I was hearing the second harmonics of the 15060, 15400 TX. Local, powerful station - no, I was in South Africa, and the transmitters were in UK. Of course there were a lot more sunspots then!

Date: Tue, 09 Jan 2007 22:47:02 -0800
From: "Kenneth G. Gordon" <kgordon2006@verizon.net>
Subject: Re: [R-390] Broadcast radio at 2 meg

> herringbones went away. Turned out to be a poor connector up against
> the downspout of a rusty Rain Gutter. Replaced connector and jumpered
> the gutter with tinned braid and sheet metal screws. Told my Boss what
> it was. He told me I was full of it.

Well, you WERE NOT full of it. I had much the same kind of problem with rain gutters on a house next to a ham in Missoula, Montana about 30 years ago. The ham was running a 100 watt rig to a vertical mostly on 20 meters in his back yard and was getting into his neighbor's stereo something fierce. Neighbor's rain gutters were perfectly resonant at 20 meters. Grounding and bonding them dropped the interference to the stereo very noticeably. Then bypassing the LOOOOOONG speaker leads at both ends with .01 mfd disk ceramics took care of the rest of it. The stereo amp was one of those new-fangled solid-state jobbers and was particulary susceptible to diode rectification in some of the transistors' junctions.

Date: Tue, 9 Jan 2007 12:01:55 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: [R-390] OT: ARRL 600M experimental work

This is off topic for this group but I know the depth of this group and felt this would be the best place to field this request. A local ham is a part of the 600 meter experimental license that has been issued for 18 months to explore the possibility of spectrum there having some viability for Amateur use. All the equipment is homebrew in the same spirit of what many of us knew back in the 40's, 50's and 60's. I find the work fascinating. I have offered to Pat what little I have that will help him out but he is in need of parts to build a PA that will work down in that part of the spectrum. Pat has requested a desire to limit the weight they have to work with due to his age so large steel 19" racks are a bit of a problem. Pat is looking for the following in any condition or whatever can be made available to support this effort:

*   A cabinet similar to what an old DX-100 would have been in. A whole transmitter of that sort with parts missing would be even a bigger help for parts. As I understand it coils and such at that frequency are large and efficiency quite low so a spacious cabinet is needed.

*   Used but working transmitting tubes...triodes like a 811's or what have you that will work GG....(I have offered a pair of 3-500 pulls)

*   Sockets to fit the above...(I didn't have those)

*   Maybe any old Commercial broadcast tank circuit parts etc?

*   HV/filament transformers that would be suitable for PA tubes offered or
listed above.

*   Large filter capacitors.... (I might be able to fill that one)

This work is a labor of love and is on a shoestring budget and no telling what it might mean for the Amateur community in the future not to mention you guys that would like a group of weak signal targets to hunt for down on 600 Meters. Pat's beacon transmitter can be listened for on 505.6 KC (less than .05 watts ERP at the moment and that's with 80W into the coax) and if interested in finding out more about the project go to www.500kc.com. This would be a great chance to help this group out with some of the old stuff you might have laying around that you know you will never get too. (we all do it!) I would be happy to be the collection point and delivery guy for anything you might want to send to help Pat Hamel out (W5THT and WD2XSH/6) I haven't spoken to him about it but I expect he would be willing to pay for shipping if needed. Please contact me off list about my address and any potential items etc...don't want to seem ungrateful but I also don't want a divorce due to my garage looking like Fair Radio's warehouse. Thanks in advance for your help!

Date: Tue, 09 Jan 2007 12:54:38 -0800 (PST)
From: Ed Zeranski <ezeran@ezeran.cnc.net>
Subject: Re: [R-390] OT: ARRL 600M experimental work

> *   A cabinet similar to what an old DX-100 would have been in.

I have a desk top cabinet of that size he can have, needs a little paint. If the tubes are chosen let me know the type and I probably have the fil/plate xfmrs too. Contact me directly with shipping info, I'll send cabinet measurements. The RAK, RBA and their friends are looking for sigs!!!!

Date: Wed, 10 Jan 2007 02:13:27 -0600
From: Don Reaves <don@reatek.com>
Subject: Re: [R-390] OT: ARRL 600M experimental work

Cecil wrote about the 500kc experimental group. That's where my receivers have been trained lately, and I'm having a lot of fun with it. Cecil is quite right to characterize this effort as what we knew about radio tinkering back in our heydays. Let me encourage you all to listen for our beacons, and QSOs, remembering that these are not 24x7 stations. Some of us go off air during storms, or out of town trips or when we fall asleep at the switch. Many crank up the beacons just before sundown and run them until sunrise. These are slow speed CW beacons; I run mine at the slowest speed I can get out of my controller which is around 9 wpm. A typical message might be VVV DE WD2XSH/15 15 15. And that repeats every five minutes. The reason I bring this up is the group is actively seeking reception reports so we can collect as much propagation data about this segment of the spectrum to make the case to the FCC we can operate without causing interference to any navigation aids or other nearby government services. If you are so inclined, log your reception reports into the database at 500kc.com - its quick and only asks the basics like time/sig report/freq. The full list of participating stations, and the band plan is posted at the site, but here is the latest active CW list, compiled by Ralph Wallio, W0RPK, and posted on the 600MRG mailing list. That mailing list, like this one is an open list, as far as I know. Again, details and more at the 500kc site. So this is a target rich environment for your R-390 series receivers. These are all weak signals, stations being limited to 20W ERP with mostly very lossy antennas so its going to offer you a good test for the sensitivity and stability of your 390. And at least two of the R-390 list members are active participants in the 500kc group. (Hi, Conard). I have QSL cards for reception reports for WD2XSH/15. Give a listen. I'd love to get a hundred reception reports Wednesday evening! (if this table's format is screwy, sorry. better copies available directly from me)-----

WD2XSH 600m Activity - 07Jan07 Update
I] WD2XSH 505-510KHz stations reported on-the-air:

LAST LAST FREQ
CALLSIGNS QTH REPORT REPORTED
------------------ ------- ---------
WD2XSH/1 W1NZR RI 10Oct06 --
WD2XSH/2 W5TVW LA 06Jan07 508 CW test
WD2XSH/5 KW1I NH 07Jan07 507.00 CW QSO
WD2XSH/6 W5THT MS 07Jan07 507.00 CW QSO
WD2XSH/9 W2ILA RI 05Dec06 --

WD2XSH/10 W4DEX NC 07Jan07 507.00 CW Beacon
http://www.w4dex.com/wd2xsh_10.htm
WD2XSH/11 WS4S TN 31Dec06 --
WD2XSH/12 AI8Z CO 06Jan07 505.4 CW beacon
WD2XSH/13 K0JO MN 23Nov06 --
WD2XSH/14 W1FR VT 29Dec06 --
WD2XSH/15 W5OR AR 07Jan07 505.700 CW beacon at :05 :10 :15 :20
... :55
WD2XSH/17 AA1A MA 06Jan07 505.750 CW beacon
WD2XSH/19 K9EUI IL 07Jan07 505.55~ CW beacon at :05 :10 :15 :20
... :55
WD2XSH/20 N6LF OR 07Jan07 505.65 CW beacon
http://www.antennasbyn6lf.com/
WD2XSH/21 W0RW CO 03Dec06 -- WA2XRM 3min 480KHz beacons at
:00 & :30 0000-0700UT daily
WD2XSH/23 K2ORS MA 07Jan07 507.00 CW QSO

Additional station status info at http://w5jgv.com/cgi-bin/lwlread-online.pl. See http://www.500kc.com/downloads/technical_data_about_station_locations.pdf for station operators and locations. A map is available at http://www.500kc.com/. Also see the ARRL story at http://www.arrl.org/news/stories/2006/11/10/101/?nc=1.

II] Reported QSOs in http://w5jgv.com/cgi-bin/csvread.pl and/or discussed in 600MRG and 500KC nets:

CALLSIGNS	DATE	MILES	REMARKS
WD2XSH/5 <> WD2XSH/11	29Nov06	884mi	
WD2XSH/2 <> WD2XSH/19	04Dec06	775mi	
WD2XSH/10 <> WD2XSH/14	03Nov06	747mi	
WD2XSH/5 <> WD2XSH/10	04Nov06	721mi	
WD2XSH/5 <> WD2XSH/10	17Nov06	721mi	
WD2XSH/5 <> WD2XSH/10	07Jan07	721mi	
WD2XSH/10 <> WD2XSH/23	07Jan07	690mi	
WD2XSH/10 <> WD2XSH/17	28Nov06	636mi	
WD2XSH/10 <> WD2XSH/17	30Nov06	636mi	
WD2XSH/6 <> WD2XSH/10	04Nov06	617mi	
WD2XSH/6 <> WD2XSH/10	07Jan07	617mi	
WD2XSH/2 <> WD2XSH/11	03Dec06	491mi	3-way /2 /6 /11

WD2XSH/6 <> WD2XSH/11 31Oct06 463mi
WD2XSH/6 <> WD2XSH/11 04Nov06 463mi
WD2XSH/6 <> WD2XSH/11 14Nov06 463mi
WD2XSH/6 <> WD2XSH/11 23Nov06 463mi
WD2XSH/6 <> WD2XSH/11 03Dec06 463mi 3-way /2 /6 /11
WD2XSH/10 <> WD2XSH/11 21Sep06 308mi
WD2XSH/10 <> WD2XSH/11 04Nov06 308mi
WD2XSH/10 <> WD2XSH/11 29Nov06 308mi
WD2XSH/14 <> WD2XSH/17 05Oct06 173mi
WD2XSH/5 <> WD2XSH/9 05Dec06 127mi
WD2XSH/5 <> WD2XSH/14 03Oct06 125mi
WD2XSH/5 <> WD2XSH/17 03Oct06 87mi
WD2XSH/5 <> WD2XSH/17 11Nov06 87mi
WD2XSH/5 <> WD2XSH/17 24Nov06 87mi
WD2XSH/5 <> WD2XSH/17 28Nov06 87mi
WD2XSH/2 <> WD2XSH/6 28Nov06 87mi
WD2XSH/2 <> WD2XSH/6 02Dec06 87mi
WD2XSH/2 <> WD2XSH/6 03Dec06 87mi 3-way /2 /6 /11
WD2XSH/5 <> WD2XSH/17 19Dec06 87mi
WD2XSH/1 <> WD2XSH/17 10Oct06 81mi
WD2XSH/9 <> WD2XSH/17 01Dec06 81mi
WD2XSH/9 <> WD2XSH/17 05Dec06 81mi
WD2XSH/17 <> WD2XSH/23 13Dec06 59mi
WD2XSH/5 <> WD2XSH/23 13Dec06 53mi

All known QSOs between stations but only one/pair/date.

Date: Thu, 22 Feb 2007 23:15:53 -0500
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] New Project (Progress)

Some random thoughts: If the mechanical alignment is not sync-ed to the PTO, your sensitivity will suffer some. The preselector circuits are very selective and if not synced to the PTO, it will suffer. Just for comparison I usually get between 30 dB and 50 dB carrier level on the calibrate signal on the mid bands, even higher on the broadcast band. So get the mechanical side lined up with the PTO before trying to fix anything else.

On SW bands the big stations (7 Mhz range at night) should be booming in with midscale to 3/4 scale carrier levels on a good antenna.

Be sure all the slugs are moving up and down without sticking too. Sometimes the slugs stick in the coil and a rack will not move as it should. The slug racks should each have two springs to keep them seated. Press down on the racks gently as you tune to see if they seat better - if so then a slug is probably sticking - there's a way to fix that too - later. The plug in crystal oven does heat up on my radio even with the switch turned off. That is normal. The oven switch only turns on the PTO and Xtal Osc chassis oven.

I have aligned a 390a pretty well with just the built in calibrator and the carrier level meter to work with. It's not perfect but it works. The Y2K manual has an alignment procedure using an external signal source but it can be done with just the calibrator signal. But first be sure the mechanical parts are working together with the PTO. And since you had one loose coupler, check the other couplers that you can get to - if a coupler somewhere in the other gear trains has loosened, then the problem may become more difficult - lets hope not.

An interesting experiment is to tune to a strong signal, then watch the carrier level meter as you slightly rock the MC change knob back and forth. If the meter wants to start peaking either side of the detent, you are out of mechanical alignment. You can also pull up gently on the slug racks and watch the carrier level. If it wants to peak anywhere other than at rest, then the mechanicals are off. Get them synced with the PTO - an easy way as I said before is to loosen the PTO clamp, tune it to a known station or calibrate signal, hold it there and then turn the KC knob for maximum meter reading - with the PTO held still, what that does is peak the mechanics to the signal. This will be a start only, from there a realignment may be needed (as described in the Y2K manual). Other things could be happening - such as bad oscillator crystals, but that comes later. Good luck.

Date: Tue, 27 Feb 2007 11:39:31 -0500
From: Carole White-Connor <carolew@bellatlantic.net>
Subject: [R-390] RF Alignment Questions

My R-390A is coming along nicely. I sounds great and is performing nicely on most bands. Now, I want to tweak the RF alignment on the 2 mhz and 3 mhz bands. Here are my questions:

1. According to the manual, I should set the bandwidth to 8 khz. Is that correct? I would think it should be adjusted more narrowly.

2. The output meter is adjusted to the diode load. The signal generator is adjusted to give an output of -3 to -7 V. Is that on the -DC range?

3. Do I set the signal generator for modulated or unmodulated output?

4. Would there be any great problem if I adjusted the slugs and trimmers to WWV on the 2 mhz band and CHU on the 3 mhz band without a signal generator?

Date: 27 Feb 2007 17:58:01 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] RF Alignment Questions

> 1. According to the manual, I should set the bandwidth to 8 khz.<snip>

• The manual should be correct here. I don't think it really matters all that much as you are looking for peak readings on the diode load. If you go a lot narrower, the signal is just harder to get in the passband of the filter.

> 2. ...signal generator is adjusted to give an output of -3 to -7 V. Is that on the -DC range?

• That is; -3 to -7 VDC.

> 3. Do I set the signal generator for modulated or unmodulated output?
Modulated.

> 4. Would there be any great problem if I adjusted the slugs and trimmers to WWV on the 2 mhz band and CHU on the 3 mhz band without a signal generator?

• You would be tweaking them at a single frequency. The caps are supposed to be tuned at one end and the slugs at the other. I think the slugs are adjusted at the lower frequency and the trimmers are adjusted at the higher frequency. As always, thanks, Joe Conner
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Date: Tue, 27 Feb 2007 12:56:44 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] RF Alignment Questions

The narrowness of the *IF* bandwidth doesn't make too much difference as you adjust the *RF* circuits. Just follow the manual. The meter should be measuring negative DC voltage at the diode load. Don't confuse an *audio output meter* with a DC measuring meter. The Audio Output Meter is used in other measurements on the radio (specifically signal plus noise to noise measurements. You can use a VTVM or DMM set to measure AC, however, when you measure the audio output of the receiver.)

>3. Do I set the signal generator for modulated or unmodulated output?

Either, I would say. The diode load terminal will have a DC voltage proportional to the carrier of the signal. It may be less confusing to have the modulation off.

>4. Would there be any great problem if I adjusted the slugs and trimmers to WWV on the 2 mhz band and CHU on the 3 mhz band without a signal generator?

There may be a problem. WWV is at 2.5 mc. CHU is at 3.335 (or close to that) mc. The alignment frequencies given in the manual are intended to allow you to adjust an inductor at the LOW end of a band and a capacitor at the upper end of the band (If I remember correctly.) The WWV and CHU frequencies are likely not close enough to the top and bottom edges of the respective bands to be best.
You CAN use the calibrator signal to do the alignment of the RF stages. Just pick a calibrator frequency close to the frequency called for in the manual for the alignment points. Don't forget to set the IF Gain to something reasonable. If that is set too high, you are apt to get misleading results. The procedure is publicized well, but to be very quick about it: set audio and RF gain full up, short or load the antenna with a 50 or 100 ohm resistors, and set the IF gain pot to get a low but audible noise level. Then later do it right. One other note: make sure the correct tubes are in your radio, especially the 6DC6 in the first RF stage and the right tubes in the IF strip. I have a 75A-4 in which some earlier owner substituted a 6VZ6 for the 6DC6 first RF stage. I certainly will back out any under-chassis changes he made and put the right tube in there. Anyone who has done tube changes to "make the receiver hotter" has *NOT* done you any favors.

Date: Tue, 27 Feb 2007 14:25:18 EST
From: DJED1@aol.com
Subject: Re: [R-390] RF Alignment Questions

I'd say use the signal generator and align per the manual. A wider bandwidth like 8 Kc is good, especially if your generator drifts a bit. But all you have to do at this point is set the frequency on the radio and tune the generator to peak the signal in the passband.

Remember that the receiver should be in manual gain control setting, and the generator output should be set for the -4VDC at the diode load using your VTVM. As others have noted, there are specific high and low frequencies in each RF band (e.g., 1-2, 2-4, 4-8 etc) at which the capacitor trimmers or slugs are tuned, so follow the instructions.

I noticed that these tuning frequencies are also printed on the RF module cover for quick reference. Other things to check- note that there are two capacitors in the first RF transformer- the front one is a balance adjustment, and the rear one is the trimmer. You can check the balance if you intend to use a balanced twinlead type feedline.

Watch how the capacitance trimmers respond as you turn them: you should get two peaks as you turn each- otherwise your at the limit of capacitance and may need to change a fixed capacitor later. (I wouldn't bother unless the measured performance is not up to spec)

You may need to give some caps a shot of Deoxit to clean the contacts- I had to do that to one of my caps when doing my recent alignment.Sounds like you're making good progress- enjoy
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Date: 27 Feb 2007 22:25:32 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] RF Alignment Questions

>>You would be tweaking them at a single frequency. The caps are supposed
>>to be tuned at one end and the slugs at the other. I think the slugs are adjusted at >>the lower frequency and the trimmers are adjusted at the higher frequency.

I misunderstood what you were intending to do with WWV and CHU signals. I think you mean you'd use 2.5mc and 3.3mc instead of 2.2mc and 3.8mc. Using those frequencies might get you pretty close, provided you can hear them with the radio out of alignment.

Date: Tue, 27 Feb 2007 18:38:54 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] 200-kHz calibrator crystal

Be careful of the phase noise on some of the parts out there. If you put in a poor phase noise source for the 17 MHz oscillator you will significantly degrade the performance of the radio. Your best bet probably is to grab an old cell phone TCXO and divide it down to 100 KHz. Mount it under the deck where you can get voltages to it.

Date: Tue, 27 Feb 2007
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] RF Alignment Questions

Some random thoughts on why the 2-4 Mhz band might be weak:

Coils/trimmers badly misaligned.
Slug rack is sticking for the 2-4 Mhz RF coils.

One of the three RF cans for the 2-4 band may have an internal failure -

they are made to be unplugged and replaced easily - the screw holding them to the chassis is accessed through the coil slug - with a small phillips head - after removing the slug rack). Fair radio may have replacement cans. I have opened cans and replaced caps that were bad. I have also seen coils that were fried either due to a lightening hit or a powerful nearby transmitter wherever the radio was used last. Possible bad trimmer cap inside one of the RF cans for that band - give them a spin to loosen up any corrosion - if you cant get a double peak, then something is wrong in the can, either the trimmer itself or one of the fixed caps inside the can. Another possibility is poor contact or corrosion on one of the switch wafers under the RF deck on a contact associated with that band. If it is weak in just one segment of the band, then it may be a bad crystal for just that segment, such as 2 Mhz, 3 Mhz etc., or the crystal needs to be peaked using the associated trimmer on top of the oscillator subchassis. If its the whole 2-4 band thats equally weak, its probably an RF coil. Alternately, if its just one segment of 2-4, the trimmer cap for the associated crystal could have gone bad - yes I have had to open xtal oscillator boxes and remove and replace individual trimmers - very time consuming but they do go bad. These are just a few random ideas - good luck.

Date: Tue, 27 Feb 2007 21:27:24 -0600
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] RF Alignment Questions

Unplug the can, DeOxit the pins, and re-insert it. Just another random thought.

Date: Thu, 01 Mar 2007 22:18:32 -0500
From: Carole White-Connor <carolew@bellatlantic.net>
Subject: [R-390] New Project - Latest Issue

With your help, I'm getting there. The set is performing nicely.

My new issue is this: if I adjust the IF Gain per Chuck's instructions, I lose a lot. With weak stations, I have to adjust the AF Gain to maximum to be able to hear the station so that I can understand it. If I just the IF Gain high (about 1/8 turn from maximum), I get more background noise but I can hear the station with the AF Gain at about 6. The background noise does not drown out the station. This occurs both below and above 8 mhz. I don't think I'm losing sensitivity because I can still hear the weak stations. On strong stations, they come in loud and clear pretty much wherever I set the IF Gain. I've been listening a lot on 49m and 41 m. Those bands are alive with stations.

All the tubes in the set test good. The weak ones have been replaced. I haven't done any work in the IF module except for replacing the caps that Chuck recommends replacing. I haven't touched the RF module. Any ideas? Any particular things to suspect? Any troubleshooting tips? Again, thanks for your help (and your patience)

Date: Fri, 2 Mar 2007 03:21:44 -0800 (PST)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] New Project - Latest Issue

If you have a sig gen, set the IF gain for the minimum signal required to hear the tone, or whatever measure you use. I've seen articles about setting the pot at a certain clock position. That is too elementary. The object of the game is optimal performance, and you obviously need some gain to do that.

Date: Fri, 02 Mar 2007 09:13:20 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] New Project - Latest Issue

Joe, by "Chuck's Instructions', I take it to mean that you are following those instructions given here:

http://r-390a.us/R-390A%20Alignment%20v2.htm to the letter. Now, Connect your signal generator to your R-390A antenna as follows.

1) center pin of RF goes to one pin of the balanced input. Shield goes to the other pin. There is an adapter for this, or you can look it up.

2) Set generator to:
   * 750 kHz.
   * 4 uV.
   * 30% mod at 440 Hz (the new standard has been 1000 Hz for about 30 years, but I find 440 Hz more soothing :) Does anyone out there know why the modulation standard was moved to that annoying 1000 Hz?
   * RF On.
   * Modulation On.

3) Connect VTVM to Diode Load (DVM acceptable, VOM is not).

4) Tune R-390A for best signal. Adjust Ant. Trim for strongest signal. Set AGC to MGC, and adjust RF Gain to maximum. Volume should be about 3 (if you have a 600 ohm speaker). Bandwidth should be 16 kc.

5) On the speaker, the volume should be at least comfortable. The meter reading should be more negative than -7 volts. Switch bandwidth to 8, 4, and 2 kc, noting that the Diode Load voltage stays more negative than -7

volts DC.

6) Switch back to 8 kc. Switch AGC to FAST. Switch AGC to Medium. No radical audio change should be noted on either position. Switch AGC to Slow. Audio should mute for about a second and a half. Carrier meter should PEG!, then drop down to its previous reading.

7) Increase RF Generator output to 400 uV. No radical audio change should be noted. and the signal strength should change about 20 dB.

8) Repeat steps 4 to 7 at least every octave or so (1.5 MHz, 3 MHz, 6 MHz, 12 MHz, 24 MHz), or at every 1 MHZ (1.5 MHz, 2.5 MHz, 3.5 MHz...) if you want to get thorough.

What I am looking for is a basic Stage Gain and AGC test to make sure that the Stage Gain is right, and that the AGC is basically working properly. 4uV is an absolute maximum for -7 Volts out. Usually less than 2uV will give you -7 volts out of the Diode load. And I seem to remember that you seemed to be having AGC trouble before. Another note. the IF Gain adjustment is a simplified adjustment. Setting it by the manual results in excessive gain, not too little gain, the exact opposite of what you seem to be getting. Alternately, the AGC is not kicking in at a low enough level, which is why I suggest step 6 and 7. One thing Chuck does not cover is setting the IF Gain properly. First do the IF Gain setting as called for in the manual to insure everything is up to snuff. What will result is an R-390A that meets original specs. It also results (if your R-390A is working properly) in the receiver noise floor being set by the IF amplifier rather than the RF Amplifier! Now, if you want to optimize it, you can do an S+N/N measurement. Then reduce the IF Gain a bit. Repeat until you get max S+N/N. If you happen to have a signal Generator with external modulation input, a function Generator with square wave output large enough that if you feed it into the EXT. MOD. input of the Signal Generator it will cut off the RF Out (0% Modulation), and an Oscilloscope with a bandwidth of about 10 Hz to 3 kHz (even a sound card will do that!), then setting the IF Gain pot properly becomes a snap using a technique developed by ASA called tangential noise measurement.

Set up your equipment as follows.

1. RF Signal Generator:
   * Frequency of choice, say 1.5 MHz.
   * RF Amplitude, 4 uV.
   * Modulation External.
2. Function Generator:
   * Connect output to RF Generator EXT Mod Input.
   * Output Frequency, 100 Hz.

* Output Waveshape, Square Wave.
* Output Amplitude sufficient to cut off Signal Generator Output and drive to greater than 90% modulation. You may need to adjust DC offset, depending.

3. Connect RF Signal Generator to R-390A Antenna Input through adapter.
4. Connect Oscilloscope Channel A to Diode Load.
   * Set Channel A Coupling to AC.
   * Set Channel A gain to keep waveform on scope display. It should be a square wave of 100 Hz, with noise on the top and bottom of the square wave. * For better stability of the display, connect the trigger from the function generator to the ext trigger of the scope.
   Or use a T- connector on the square wave output.

5. Set up the R-390A to receive the signal generator output, AGC should be set to MGC, and the RF Gain to max. Bandwidth 16 kC or 8 kc.

6. Now comes the fun part.
   * Reduce the amplitude of the signal generator until the bottom of the noise signal riding on the top of the square wave is level with the tops of the noise signal riding on the bottom of the square wave. * Reduce IF Gain Pot. What you should see is the noise on the top and bottom of the square wave move apart again as the amplitude of the square wave is reduced. What you are seeing is the S+N/N ratio increasing in real time. No muss, no fuss, no calculator, Nein Flippen ze switches ud twisten zee knobs. If you do not, then you have a noisy front end, and you might want to substitute some of the V200 tubes to find a good on * Repeat the above two steps until you get no improvement.

7. Doing this manually has always been a pain for me. Since a 10 MHz scope is more than sufficient, and even E-Bay sells those for under a $100, it is probably worth it to get a scope just for this. And if not, I am sure a local Ham will let you borrow one.

Another Reference is
ftp://bama.sbc.edu/downloads/miltest/st32152/ST-32-152x.pdf It does not contain the above procedure in paragraph 6. But if you have a signal generator capable of FM Modulation, it makes alignment of the transformers in the IF Deck a treat.

Date: 9 Mar 2007 14:27:13 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] Measuring Sensitivity

I'm not the smartest guy on this list and I need to understand some things. I'm interested in measuring the sensitivity of my R390A and I have a signal generator (GR1001A) that has a 10-ohm output. I have an adapter that houses a 40-ohm resistor that matches the output to a 50-ohm cable. When I feed the balanced input with this, there is an obvious mismatch between the 50-ohm cable and the input.

If I had 10-ohm cable (probably not a real factor with such short connections but...) and the input to the radio was 10-ohms, then I could read the level on my generator and know that 1uV is 1uV on the input, etc. Since this is not the case, short of an RF voltmeter capable of reading microvolts or other measuring instrument capable of the same, how do I determine how much signal is present at the radio for a given setting on the generator? I realize I need to make up a matching network at the termination of the 50-ohm cable where it connects to the receiver, but not sure how all these matching networks play into the signal levels between the generator and the radio.

I assume that once this calculation is made, then when I feed the radio with a modulated AM signal with the BFO off and get -7V on the diode load, then I should be able to know the sensitivity level, correct? The reason I ask is that I'm having to crank the generator up to around 10uV to do the "switch the modulation on and off to get 10dB S+N/N readings and that seems high. The radio "hears" quite well, but I'm wondering just how sensitive it really is. The problem I'm having with the "modulation on, modulation off" method, is that the cable and generator make a very, very good antenna, especially on the BC band, making these measurements quite difficult.

Any advice here would be most appreciated.

Date: Fri, 9 Mar 2007 07:24:28 -0800
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: RE: [R-390] Measuring Sensitivity

Have you looked at the "Pearls of Wisdom". There is a section, pdf file with sensitivity adjustments and I believe your mismatch situation is discussed.

http://209.35.120.129/Pearls/index.htm

I may have this all wrong but here comes my $0.02. Since I use the R-390/A's in the shack for ham radio use, feed the antennas with open wire, use a tuner/transmatchs to make the transmitters happy: (read 50 ohms impedance here) this what I do. Looking at Chuck Rippels website I feed the balanced input as pictured, 50 ohms coax unbalanced and one side grounded to the frame. Then the output of my sig-gens URM-25D & HP 8640B are 50 ohms unbalanced, I believe; align the R-390/A's with no adapters, just BNC connectors and coax to set up the IF deck and peak the

RF coils/caps thru the balanced antenna input (now connected unbalanced). Treat the R-390/A's as though they have 50 ohm unbalanced antenna inputs. Could be all wet here, both sig-gens outputs end up less than 0.1uV on all bands. Using flowertimes's method of calculating S+N vs N ratio for the IF and RF sections, I've got 30dB thru the IF and 20dB thru the RF. Must be doing something right?

----Date: Fri, 09 Mar 2007 15:25:35 -0500
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Measuring Sensitivity

Low-impedance voltage generators driving high-impedance loads are an easy case: the voltage at the load doesn't depend much on the load or its impedance bumps/dips/peaks. Think about it: a 120VAC 100-watt light bulb has a DC impedance like 144 ohms or so, but that doesn't mean that you want 144 ohms of wire in series with it! In real life your wall socket has a source impedance in the fraction of a ohm range (drawing 15 amps will drop the voltage by a few volts).

Now, for maximum POWER TRANSFER you want the load to match the source impedance. But you don't care about power transfer in this case, just the voltage at the antenna terminals, all the extra power you're generating in the signal generator you want to be dumped. Now if you were sending complex (non-sine) waveforms you might be concerned about matching impedances to reduce reflections, but that's not a concern either because you'll either be using CW or audio-modulated RF modes, right?

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Date: Fri, 09 Mar 2007 23:48:42 -0800
From: John Kolb <jlkolb@jlkolb.cts.com>
Subject: Re: [R-390] Measuring Sensitivity

If the signal generator is outputing 1 microvolt across the 1/2 ohm resistor, the receiver will see 1 microvolt at its input with any reasonable receiver input impedance. The exact value of 1/2 ohm in parallel with 50 ohms is very, very close to the value of 1/2 ohm in parallel with 700 ohms. I believe that 50 ohm output signal generators are calibrated so that the output reads correctly when the generator is loaded with 50 ohms. So the receiver would see 1 uV at frequencies where it's input was 50 ohm, but almost 2 uV at freqs where it's input impedance is 700 ohms.

Date: Sat, 10 Mar 2007 20:28:37 -0500
From: roy.morgan@nist.gov
Subject: Re: [R-390] Measuring Sensitivity

> > If the signal generator is outputing 1 microvolt across the 1/2 ohm resistor, the receiver will see 1 microvolt at it's input with any reasonable >>receiver input impedance.

This is right - that is why I suggested the 100:1 attenuator with the output taken from the half ohm resistor.

> I believe that 50 ohm output signal generators are calibrated ....

MOST generators do operate this way. The HP 606, 608, the URM-25, and if I remember right, the Measurements Model 80 included. For other generators of a professional sort, just read the manual, or assume that it needs to be loaded by 50 ohms to produce indicated voltage across the load. The General Radio type 1001A, however, does NOT operate this way. It produces the voltage indicated by panel settings when the output is OPEN CIRCUIT. If loaded with 50 ohms on the 100 Millivolt setting, or with the 40ohm series unit and a 50 Ohm load, it will deliver HALF of what the panel indicates. The following is right, if the a generator intended to indicate correctly with a 50 Ohm load is connected directly to the receiver with no other load. (I'm sure that is what John meant.)

Date: Sun, 11 Mar 2007 13:33:43 -0600
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Measuring Sensitivity

I'm curious about this voltage divider. If the voltage at the output end of the cable when terminated in a 50-ohm load is 1/2 the value set on the generator's controls, then is it correct to say that the voltage at the connection between the 50-ohm and 1/2-ohm resistors is actually one-two-hundredth the value shown on the controls rather than one-one-hundredth? For example, it I set the generator to output 1mV (0.0001V), then would the voltage the radio sees be 5uV (0.000005V) and not 10uV (0.00001V)?

Date: Sun, 11 Mar 2007 21:47:28 -0600
From: "Barry" <n4buq@knology.net>
Subject: [R-390] Measuring Sensitivity - Ramblings...

Having some 150-ohm and 1-ohm 1% resistors, I made a 100:1 voltage divider as discussed. This definitely makes measuring the sensitivity an easier task. With this, I am seeing from 0.5uV to 1.5uV on the bands I tested. I need, though, to make a sniffer and see if some of what I'm seeing may be attributable to leakage. Hopefully, there isn't too much leakage and these figures are pretty close to accurate. By the way, I divided the observed output level by 200 to get these figures. If it is really only a factor of 100, then these figures are 1/2 what they should be. I need to find out which way to do this. Maybe I can measure it at a higher voltage level with my VTVM to know which is correct? I'm observing something I didn't expect, though. The radio seems to hear better when fed by the unbalanced connection. I hooked up the balanced connection by feeding it into the left-hand pin (as observed from the rear), but I did not ground the other pin. I just happened to think of that. Perhaps that will make a difference. At any rate, when I use the unbalanced input, the antenna trimmer maxes the signal at 3-o'clock with only one max point. Is this normal or should there be two peaking points on the trimmer like when using the balanced input?

Date: 12 Mar 2007 12:18:34 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Measuring Sensitivity - Ramblings...

> Barry- I think you have to ground the other pin on the balanced connector
> to get good results. What makes sense is to measure with the same setup you
> aligned with (or vice versa). Sounds like you're closing in on a reliable test.

Yep, grounding the other pin definitely made a difference in the signal levels.

Date: 12 Mar 2007 12:31:58 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Measuring Sensitivity - Ramblings...

I did some more testing last night. I cranked the generator down to the lowest frequency setting (15kc) and measured the output with my Fluke DVM. Feeding the 100mV output into my 50.5-ohm divider, it measured right at 50mV so it appears dividing by 200 is the correct thing to do here. Doing the same thing using the 10mV setting (using the 40-ohm series resistance adapter) into 50.5 ohms also showed 5mV (or something pretty close to that as I think my DVM was getting a bit flaky at those voltage and frequency values). At least I now know what the output voltages are at the various settings (or at least something pretty close to what they should be). Now to house the divider in something with proper connectors and make it convenient to use.

Date: Mon, 12 Mar 2007 08:09:11 -0500
From: "Joel Richey" <richey2@mindspring.com>
Subject: [R-390] Measuring sensitivity

Interesting thread, here's how I do it, don't need a bunch of antique signal gens or voltage dividers, I just turn on the old 390A let it heat soak for a half hour of so, go the band I wanna listen to, connect the antenna and if the noise level comes up (which it always does) then I know I have all the sinsitivity I can use. Hope I didn't step on anyone toes, but sometimes I think we get so far n woods we can't see the trees. Joel Richey W2DBO said that and I think my 390A and hear anything yours can and maybe better???

Date: Mon, 12 Mar 2007 10:19:47 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Measuring sensitivity

Good point. Being picky about the actual output level of the signal generator is only important in the following respects;

1. Making valid comparisons between yourself and others.

2. Establishing the receiver is working properly the first time, see #1.

Other than that, it really does not matter if the meter reads 1 uV when it is actually 3 uV. Sort of like having a twelve inch ruler that is eighteen inches long. The boards still come out the same length unless you try to mix the regular ruler with the long one.

Date: 12 Mar 2007 14:39:53 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Measuring sensitivity

My issues tend to fall in both categories. Other folks claim to get sensitivities around the 1uV range and the specs say something more like 3uV. My initial tests were looking like I was getting much less than spec, but without knowing if I was testing it correctly, I wasn't sure if something was wrong with the radio or my tests. Still not quite sure, but I think it was the latter.

Date: Mon, 12 Mar 2007 11:12:33 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Measuring Sensitivity - divider correction

R-390 folks with GR 1001A generators, I made an error in my email about making a divider to ensure getting the right voltage into a receiver:

I wrote:
> > Here is what I suggest,
> > Make up a voltage divider with a 50 ohm resistor and a one-half ohm
> > resistor in series from the input to ground....

> > - It will divide the voltage at it's input by 100....
> > The voltage at the antenna terminals will be one hundredth of the
panel
> > indication.

Barry wrote:

>Roy,
>
>I'm curious about this voltage divider. If the voltage at the output end of
>the cable when terminated in a 50-ohm load is 1/2 the value set on the
>generator's controls, then is it correct to say that the voltage at the
>connection between the 50-ohm and 1/2-ohm resistors is actually
>one-two-hundredth the value shown on the controls rather than
>one-one-hundredth?

Indeed, Barry is right (and has confirmed it by actually measuring some voltages!) Thanks to him for pointing this out. The GR-1001A produces one half the panel indicated voltage if its output is properly terminated. SO: Make a 50:1 divider to load it and deliver one hundredth of the panel indication by using a 50 (or 49) ohm resistor in series with a ONE ohm resistor (for a division ratio of 51:1 (or 50:1). Then use the 40 ohm series unit on the generator with the 100 micro volt multiplier setting, and the divider at or close to the receiver, and divide the indicated output voltage by 100. The generator is easy to read and deliver from zero to 2.0 micro volts by using the "OUTPUT" variable control. There, I expect this is right now.

Date: Mon, 12 Mar 2007 13:30:59 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Measuring sensitivity

Flowertime can probably back me up on this, he has worked on a LOT more R-390's than I have. By spec, the R-390A should have a 10dB S+N/N at 4 uV, 30% modulation, 8 kHz bandwidth, MGC, RF Gain Max, using the little Antenna Adaptor/Matcher that comes with the URM-25. In a Training environment, where we had the time to fool around with the occasional recalcitrant one , the R-390A on the bench for an Annual PM did not leave until it did better than 1 uV. That was an easy spec to meet. Anything worse than that, there was usually something wrong with it. Ether a component going bad, or a weak tube. I have seen traceable measurements down around 0.2 uV (probably 2khz bandwidth or less, it was not specified). Of course, the problem here is that most of the readings you see on the Internet are not traceable (to NIST standards), because calibration is expensive. We usually rely on the attenuator being in spec and leakages being in spec because we just do not have the equipment to calibrate voltages that low properly. Making it worse, there are at least three methods to measure S+N/N ratio. All valid. All giving different results everything being equal. I learned the Army way, I.E. disconnect generator from receiver, measure audio power, reconnect generator, dial generator output down to 10 dB greater than first reading, Note Generator output level. On the bench, we had a special coax switch that in one position, connected the receiver to the generator. In the other, it connected the generator to a 50 ohm load, and the receiver to another 50 ohm load. It helped reduce the URM-25 leakage to manageable levels. As good as a URM-25 is as far as leakage is concerned, we often had problems getting a good S+N/N reading on the lower bandwidths because leakage would screw the readings. Then we would finish off by adjusting the IF Gain using Tangential Sensitivity readings. A few times I remember going back to do the standard 10dB S+N/N test to see if I could measure the improvements, but by then the R-390A noise was so low that leakage from the test setup was just too great to get reliable readings. Even for a modern receiver, the R-390A is equal or better in sensitivity than most general coverage receivers out there.

Date: Mon, 12 Mar 2007 14:37:14 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Measuring sensitivity

>...I have seen traceable measurements down around 0.2 uV (probably
2khz
>bandwidth or less, it was not specified). Of course, the problem here is
>that most of the readings you see on the Internet are not traceable (to
>NIST standards), because calibration is expensive.

May I comment on the "NIST Traceable" idea that comes up from time to time? Note: I do work at NIST, but not in RF or Electrical calibration. I simply have a bit of information and some ideas on the topic of calibrations. If someone tells you that an instrument has been calibrated "traceable to NIST" here is what they likely means: The calibrations have been made in a laboratory which in turn has calibrated its instruments by means of materials or instruments that have been in turn calibrated against something that was actually AT NIST for calibration. Let's see how this works: Let's say you want to know that your RF Millivoltmeter is accurate.

The NIST website is http://www.nist.gov/
Click on NIST Laboratories: provide measurements and standards for U.S. industry. ... Electronics and electrical engineering
and get to: http://www.eeel.nist.gov/

The Eectronics and Electrical Engineering Laboratory provides the

fundamental basis for all electrical measurements in the United States.
Then find Calibrations:
http://ts.nist.gov/MeasurementServices/Calibrations/
Then find the AC and DC current and voltage calibrations information at:
http://ts.nist.gov/MeasurementServices/Calibrations/Voltage.cfm

Among the many many calibrations discussed, one is called "Special 25-Point Test of Digital Multimeters (DMMs), by Prearrangement (53202S-53203S) This is a special reduced cost, 25-point test covering all five functions (ac and dc voltage and current, and dc resistance) of most precision DMMs. ..." Under this test, we learn that the calibration point of 0.1 volt at 1 mc has a minimum uncertainty of 1000 parts per million. That is 0.001 volts. This calibration costs $1600.

Reading further, we can see that the uncertainty involved in higher precision measurements (done with thermal conversion methods) is about one third of that. Calibrations of this sort may cost $2000 or more. So a commercial calibration lab can send its very best millivoltmeter or thermal conversion cell to NIST with a couple grand and be reasonably sure that it is correct within a very small amount. Then the lab standards person compares the millivolt meter to be used for routine calibrations to the NIST calibrated standard to see if IT is right, and the accuracy drops an order of magnitude. Then when you add in the uncertainties associated with calibrating some one else's meter in the setup to be used, the accuracty may drop another order of magnitude. You can see that if someone reports the sensitivity of an R-390A to be 0.354 micro volts, that person is being quite cavalier with the numbers. Mark goes on to point out that there are uncertainties in our home test setups, and also "... there are at least three methods to measure S+N/N ratio. All valid. All giving different results everything being equal." It seems to me that we should pay attention to the setup we have, ask reasonable questions about how to get reasonable measurements, and pay attention to such things as leakage and what methods we use. THEN, we might be able to say that we measured a radios sensitivity as "0.5 microvolt, but it might be from 0.3 to 0.9" or some such. There's a lot I don't know about all this. For example, Mark says: "Then we would finish off by adjusting the IF Gain using Tangential Sensitivity readings."

I have no idea what that is, and would like to hear more about it.

Date: Mon, 12 Mar 2007 14:54:30 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Measuring sensitivity

Tangential Sensitivity is like astronomer's "averted vision" or like being more sensitive to something you see out of the corner of your eye. In radio, it means the set is more sensitive to something you weren't listening for, than for something you were. I hope that clarifies things, if anything can be clear on Time Change Monday.

Date: Mon, 12 Mar 2007 19:27:12 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Measuring sensitivity

Thank you, Roy. Always wanted to work at NIST :) I used to monitor an 'Atomic' Clock. As far as the Tangential Sensitivity test, see my msg dated 3/2/2007, Here is the test setup I use (from memory, you only have to do it once a year).... First perform all alignment steps as specified in the TM, including setting the IF Gain pot. This is a last, optional way of optimizing the noise floor of the R-390- and R-390A which i performed in the Army when we did not have to worry about variability in receiver sensitivity.

Equipment Needed:

* AN/URM-25 Signal Generator or equivalent with External AM Modulation Input.
* Oscilloscope, 500 kHz bandwidth or greater, Single Channel, External trigger preferred.
* Function Generator, Squarewave output, 100 Hz.
* Twinax to BNC Adaptor.
* 2 to 4 BNC Cables.

Set up your equipment as follows.

1. Use BNC cable to connect RF Generator Output to Twinax Adapter. Connect Twinax adapter to Balanced Antenna Input of R-390/R-390A.
2. Use BNC cable to connect RF Generator Ext. Mod. Input to output of Function Generator.
3. Use BNC cable to connect Function Generator Trigger output or a BNC T-connector to connect to Function Generator Output to External Trigger of Oscilloscope.
4. Connect Channel A Vertical Oscilloscope input to Diode Load jumper on rear of Receiver.
5. Set up Function Generator as follows;
    * Frequency; 100 Hz.
    * Amplitude; 1 volt PP.
    * Waveshape; Squarewave
6. Set up RF Signal Generator as follows;
    * Frequency; 1500 kHz.
    * Amplitude; 4 uV.
    * Modulation External.
    * Percent Modulation:100%

* Monitor High Level Output on Oscilloscope to insure that modulation is 100% (carrier wave cut off for half a cycle of the modulation waveform). Adjust Function Generator output and Ext. Modulation Level input accordingly.

7. Set up Oscilloscope as follows;
    * Vertical Gain; 1V/Div.
    * Vertical Coupling, AC.
    * Horizontal Timebase 0.005 seconds/div.
    * Horizontal Trigger; Normal|External.
8. Set receiver up as follows;
    * Power On.
    * Receiver Frequency 1500 kHz. Maximum output level.
    * Bandwidth; 8 kc.
    * AGC; MGC.
    * RF Gain; Maximum.
    * BFO; Off.
    * Audio Filter; Wide.
    * Line Level Meter; off.
    * Audio Level; comfortable.
    * Antenna Trim; maximum level.
9. What you should see displayed on the Oscilloscope is a 100 Hz squarewave with some noise riding on the top and bottom of the waveform. Adjust vertical and horizontal trigger levels on the Oscilloscope to display full waveform and stationary waveform.
10. Decrease amplitude of the RF Generator output until the negative peaks of the noise riding on the top of the 100 Hz waveform is at the same level as the positive peaks of the noise riding on the bottom of the 100 Hz waveform.
11. Adjust the IF Gain pot counterclockwise to reduce the IF Gain while observing the oscilloscope. What you should see is that the amplitude of the 100 Hz waveform will decrease. At the same time, the amplitude of the noise will also decrease at a greater rate than the modulation waveform, causing the gap between the negative noise peaks on top of the waveform and the positive noise peaks on the bottom of the waveform. Adjust oscilloscope vertical amplitude as necessary to observe this.
12. Repeat step 10 and 11 until the gap no longer appears.

What you are seeing in 9 and 10 is the S+N/N displayed on the Oscilloscope. The noise on the top of the 100 Hz waveform is noise without the carrier (if memory serves). The noise on the bottom of the waveform is the signal plus the noise. Normally the standard way of setting the IF Gain causes the IF amplifier to generate too much noise. When you turn the IF gain pot down, the IF amp is generating less noise as well as less gain. However, for a while the decrease in noise is greater than the decrease in amplification, thus the gap reappears again. You will get to a point where the generator exceeds 4 uV, or there is no longer a gap appearing when you decrease the generator and IF gain. This is the point where you will have maximum gain for minimum noise through the receiver. And where the RF amplifier will again set the noise floor of the receiver. As a final check, redo the standard sensitivity test to insure you got an improvement, and that the receiver sensitivity still meets specifications. I have seen R-390A's that barely meet the sensitivity specification after the standard IF Gain setting improve so much after using this IF Gain setting technique that you could no longer perform the 10 dBS+N/N test because of generator attenuator bleedthrough and cable bleedthrough. So you had to go to 20 dB S+N/N. Other receivers would keep getting improvements in the gap, then not pass the 4uV sensitivity. I guess they had very quiet RF amp tubes.

Date: Mon, 12 Mar 2007 21:36:07 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Measuring tangential sensitivity

Seems like I was off the mark. As is usual, one should do some research before hitting the keyboard, unless one's intent is to liven things up a bit.>From a blurb for Agilent wide range laboratory detectors: "Tangential sensitivity is the lowest input signal power level for which the detector will have an 8 dB signal-to-noise ratio at the output of a test video amplifier. Test amplifier gain is not relevant because it applies to both signal and noise. Agilent detectors are designed for optimal flatness and SWR." Since R-390s do not contain video detectors, I let the matter drop.

Date: 15 Mar 2007 14:41:08 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] Distortion on MGC mode and another question on sensitivity

Thanks for the replies about the MGC distortion. I was thinking someone had posted a while back that the R390* radios should not overload on strong signals, period, but I suppose that's only in AGC mode. Another question: When I'm testing for sensitivity, I'm looking for the signal level that will result in -7V on the Diode Load; however, when I connect the signal generator, there is atmospheric noise that is introduced before I inject any signal which results in a few volts on the Diode Load. Is it correct to increase the generator's output level to -7V total and read the sensitivity from there, or should the signal generator result in a 7V increase over the existing noise? In other words, if I'm getting -3V in atmospheric noise, then do I take my sensitivity reading at -7V or -10V?

Part of this problem is the rigged-up mechanism I have for connecting the generator to the receiver. I'm in the process of making a housing for the attenuator and feeding everything with coax thus eliminating the little "antennae" I introduce with the current setup.

I assume the -7V reading is accurate (or at least more accurate) if the test is done in an RFI-proof environment with a perfect signal generator that doesn't leak. Lacking those two things, what is the proper way to measure this?

Date: Thu, 15 Mar 2007 17:57:22 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [Distortion on MGC mode and another question on sensitivity

You don't need a cage. Disconnect the signal generator, leaving the cable and attenuator connected to the receiver. If the Diode Load is more positive than -7 volts, you can live with the leakage, but will not be able to do a good S+N/N test. Connect generator, and adjust output to -7V at Diode Load. What you are injecting is (Signal + Leakage Noise + Receiver Noise) / Receiver Noise. Since the signal adds to the leakage noise, the result is -10.

One thing you might want to try is this. Disconnect generator, cable and attenuator from the receiver. Note Diode Load voltage as N1 This is Receiver Noise. Connect cable and attenuator, but not the generator. Note Diode Load Voltage as N2. Perform following formula; (N2-N1)+N2=NS3. Connect generator and increase output until Diode Load voltage equals NS3. Read generator output and note as S1. This is the amount of leakage you have from your attenuator/cable in microvolts. Increase generator output until you read -7V on the Diode load. Note reading of generator output as S2. S2 +S1 is the total rf input for -7V at Diode Load.

N1= Receiver Noise
N2= Receiver Noise plus Leakage Noise.
NS3 = Receiver Noise + Leakage Noise + Signal Noise where
Signal Noise = Leakage Noise.
S1= Leakage Noise in Microvolts.

When you get the proper shielding on the attenuator (have you considered wrapping in Aluminum foil?) and coax cables (good ones), see how close it came out!

Date: Sat, 17 Mar 2007 00:28:06 -0600
From: "Barry" <n4buq@knology.net>
Subject: [R-390] Measuring Sensitivity

I finally got a chance to build the 50:1 divider Roy suggested.

http://www.knology.net/~thelanding/R390A/50to1Divider.jpg

It consists of three 150-ohm, 1% resistors in parallel (because I didn't have a 50-ohm resistor) and a 1-ohm, 1% in a divider configuration hooked to female BNC connectors for input and output. The cast aluminum housing is quite nicely sized for the job and was easily machined. It really made a difference in the noise I was getting using my old setup. With coax all the way and the divider in a sealed box, there is very little in the way of outside noise now when the radio is connected to the generator.

Of course, none of my equipment is closely calibrated, but it isn't all that far off either. I have both an HP410B and a WV-98C (Senior VoltOhmyst) connected to the Diode Load and both read within a few tenths of a volt of each other at -7VDC so I think I'm getting a fairly accurate reading.

With the divider setup, I'm seeing about 1.5uV on the BC band for -7V on the Diode Load point and around 0.7uV (yes, that's 7/10uV) on the 8mc band. Again, a lot of this may be due to calibration errors, and possibly some leakage, but I don't think it's all that far from a true reading. By the way, just to refresh, since the generator outputs 1/2 it's stated voltage into a 50-ohm load, the 50:1 divider effectively makes the actual output 1/100 of the reading on the generator. As far as leakage, I hooked up the radio's antenna input to a small loop of wire fed by coax from the radio and "sniffed" all around the generator. It heard absolutely nothing. I checked closely around the knobs, edges, top, and back and could not detect anything coming from the generator. Just to check, the generator has a 2V output that can be used to drive a counter or whatever. I pulled the grounding cap off of that and the signal was immediately heard with the loop several inches from this port. Plugging the port back up and running the loop right up against it still produced nothing on the radio. Yes, there is probably very slight leakages but the radio can't hear them so not sure if they are affecting my measurements or not. At any rate, this little project paid off very nicely in the convenience department. Thanks Roy!

Date: Sat, 17 Mar 2007 10:12:33 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Measuring Sensitivity

A normal correctly calibrated modern generator puts out twice the indicated voltage into an open circuit. It puts out it's indicated voltage when hooked to a 50 ohm load. The excitement with a one ohm pad is the small amount of series inductance on the one ohm that can mess things up. A good thin film chip resistor is a good idea there. Digikey sells them pretty cheap.

Date: Sat, 17 Mar 2007 10:44:56 -0600
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Measuring Sensitivity

I measured (as best as I could) the output of this General Radio 1001A. Using the lowest frequency and the highest output level, when terminated into 50 ohms, it measured 1/2 the value indicated on the generator. 100mV measured as 50mV, etc. This generator is a bit odd in that on all but the highest setting, its output impedence is 10 ohms so you use a 40-ohm series resistor and then terminate the other end of the coax into 50 ohms. As far as the resistors I used, they were whatever were available at the parts place. I think they are metal film, but not sure about that.

>A normal correctly calibrated modern generator puts out twice the
>indicated voltage into an open circuit. It puts out it's indicated voltage
>when hooked to a 50 ohm load.

Date: Sat, 17 Mar 2007 12:04:34 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] Measuring tangential sensitivity

Do I assume this method will also work on the Collins ham band receivers that have an IF gain adjustment such as the 75S-3 series?

Date: Sat, 17 Mar 2007 19:00:59 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Measuring Sensitivity

The GR 1001A must be calibrated different than a "standard" signal generator like the URM-25 or an HP 8640B.

Date: Sat, 17 Mar 2007 20:38:18 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Measuring tangential sensitivity

What this type measurement is originally developed for was for Radio Astronomy (if what I was told as a tyke is true. Might be since we traditionally had connections to Millstone/Haystack Radio Astronomy Observatory up the road in Westford) for measuring improvements in system noise. Someone in ASA had the bright idea to use it with the R-390'a, and later the R-390A's. Unlike most HF receivers, you can adjust the system noise in the receiver, only because the stage noise/gain for the R-390 and A is set in the IF Deck rather than the normal first RF stage. This was either a deliberate design choice by Collins, or a byproduct of making the R-390 and R-390A suitable for Diversity reception by allowing the system gain to be adjusted to match the other receiver.

Collins did this by allowing the IF Stage Gain to be adjusted by changing the bias on the first and second IF amplifiers in the R-390, and the third IF amplifier in the R-390A. All things being equal, the stage gain/noise for each stage of an R-390 and R-390A result in the 455 kHz IF setting the noise floor of the R-390 and R-390A when set according to the manual unless you have a really noisy RF/Mixer tube(s). When we did it in the shops, over half showed improvement, I guess. Some a little, some a lot. I can't remember specific figures. The R-390A I have shows about an eight to ten dB improvement, enough that leakage around the attenuator messes up the normal S+N/N measurement.

Stage Gain/Noise is simply the gain of the amplifier stage compared to the noise the mplification stage produces. This is the noise temperature of the stage divided by the sum of the gain of all previous stages. See
http://www.veron.nl/amrad/art/sysnoise.pdf
if you need more info. Usually the first RF stage of a receiver has a lot of gain, so it swamps the noise temperature of the following stages. The R-390 really does not have much gain at all through the RF and Mixer stages, I guess (never measured them), or else the IF stages are very noisy.

Does the Collins 75S-3 have the same stage gain/noise parameters as the R-390? I don't know. I do know the Hammarlund SP-600 has a similar setup, but adjusting the IF Gain does not help the noise floor. The RF Amp in the SP-600 is notoriously noisy, so much so that in the early 60's the Air Force bought a bunch of plug-in modules to replace the first RF tube with a cascode triode circuit.

Besides, it is simple enough to try out. Make sure you have the proper equipment and procedure to set the 75S-3 IF Gain pot. Do a measurement of the S+N/N as it is. Then try the technique. If you get results, check that the S+N/N has indeed improved. If it doesn't work, you can always return everything to normal.

Usually, worrying about dropping the receiver noise figure in an HF receiver doesn't pay below about 20 MHz. And for most high-level receiver, below 50 MHz. Because, lets face it, atmospheric noise is going to massively overpower the receiver noise unless you are working with very narrow bandwidths. Latest figures I have access to show a atmospheric noise level on average of -131 dBm at 400 hz bandwidth in a rural location (greater than ten kilometers from a population center). Suburban locations are around -110 dBm, and urban is a whopping -90 dBm! And these are daytime figures. When the skip comes in, these noise figures increase dramatically. Since your R-390A runs about -137 dBm noise floor, even a rural location will be sufficient unless you are working with small, low-gain antennas.

Of course, the previous paragraph is pretty irrelevant as far as most of us are concerned. We are in it to make our R-390's perform well above the originals. Sort of like who in their right mind would put an 1100 cu. in. Ford GAA Tank Engine in a 1970 Mustang? Sure, you can boost it up to about 1400 HP with stock parts, but you got to cut a hole in the hood big enough for the cylinder heads, valve covers, dual distributors, and an air cleaner that is higher than the roof! Not exactly something you want your son to take his Drivers Test in :-) (OK, maybe you would)

Date: Sun, 18 Mar 2007 13:48:50 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] Measuring tangential sensitivity

In the 75S-3, the IF gain sets the resistance in the cathode of the 1st IF amp. It has two stages of IF amplification. I guess as you say the best thing is to try it and see what happens. I have all the gear; HP 606B SG, TEK 465 scope, and a BK 3011 FG. The next time I have my R-390 on the bench, I will try it on that one too. I'm getting too old to take the R-390 out of the rack and move it to the bench unless it needs service.

Date: Mon, 19 Mar 2007 18:47:48 -0600
From: "Barry" <n4buq@knology.net>
Subject: [R-390] More Voltage Divider Stuff

A few days ago, I posted some info on my 50:1 voltage divider project. Someone posted that there's a possibility that the 1-ohm resistor in it might have some inductance, thereby throwing off the calculations. I wondered about this, so I set up a little test. I connected one input of the dual-trace scope to the same point where the signal generator is connected to the divider. I connected the other input to the divider point. The generator has a high-output level so I was able to drive the scope to a nicely-sized wave forms. I set the "high" input to 1V/div and the "low" input to 0.02V/div. The image below is at about 1.6mc.

http://www.knology.net/~thelanding/R390A/traces.jpg

Note that both waveforms are pretty much identical in amplitude. (The upper one doesn't appear to touch the upper line, but I didn't quite have the bottom of the waveform on the horizontal line either.) In fact, if I move them together, they appear as one. Just to verify things, I switched the inputs and reversed the V/div settings. The results were exactly the same. I assume that if there is any inductance at play here, it is quite negligible. I wish my scope had a higher b/w, but the TEK 561A with the plugins I have start falling off rapidly at this frequency. I wonder if it is worth checking at higher frequencies with a better scope?

Date: Mon, 19 Mar 2007 19:15:34 -0500
From: "Les Locklear" <leslocklear@cableone.net>
Subject: Re: [R-390] More Voltage Divider Stuff

Only if you want to hear that particular heterodyne on Pitcairn Island..............

Date: Fri, 30 Mar 2007 13:22:13 -0400 (EDT)
From: "William A Kulze" <wak9@cornell.edu>
Subject: [R-390] sensitivity, product detector, etc

I was just going through the postings and the discussion on sensitivity measurement, Softrock and IF gain adjustment caught my interest. Here's the latest setup I've been playing with. Now, mind you, I'm no engineer, not even sure I'd qualify as a tech anymore, but something about this seems like it makes sense to me. I'd be happy to hear anyone's thoughts on the subject. About a year ago I purchased a WiNRADIO G303i. By using command line switches I can disable the demodulator and use my choice of 3rd party demod software. Been playing around with FlexRadio Power SDR. I've connected the R390A IF out to the WiNRADIO (tuned to 455kHz) through a couple of surplus 20db attenuators. Turning the agc off on the 390a and winradio, with the antenna removed from the 390a and RF gain to minimum, I adjust the 390a IF gain until I just start to see an increase in the noise floor on the panadapter view. I set the 390a RF gain for the same. I adjust the manual IF gain on the winradio to place the noise floor at -140dbm on the panadapter. Any signal that comes in seems cleaner and easier to copy. I only did this a couple of days ago and only had that night to play with it, so I've no long term results and definitely no measured tests. But it seems (I hope) that I'm getting as much gain as I can without injecting any significant noise level. I can increase the rf gain on weak signals, but the noise just comes up with it. I don't know what litle microvlts and such is going on, but DRM signals seem to have a better SNR than before. FWIW re: MGC distortion, it's already been mentioned that this is normal when feeding too much signal into a circuit. AGC just -A-utomatically does what you would have to do -M-anually with the rf gain control. What I think is meant by not overloading these radios is that in AGC mode it would take a VERY strong signal to start producing harmonic images where they don't belong. With my outside wire antenna on the winradio I get MW signals in many different places that I shouldn't. The 390a does just fine with the same input.

I know some of this is not exactly 390 topic, but I'm having fun making the most of both old and new.

Date: Fri, 30 Mar 2007 16:43:40 -0400
From: Mark Huss <mhuss1@bellatlantic.net>

Subject: Re: [R-390] sensitivity, product detector, etc

Well, first, the RF Gain also controls the IF Gain, too. So what you are doing is shutting off the RF Amp, and the first, second, and third IF amps, then cranking up the gain on the third IF Amp. Then when you adjust the RF Gain up, you are increasing the gain on all those stages. Don't know how that would affect the noise floor of the receiver. One good thing is that the R-390 is acting as one honking big preselector.

Did not know about the command line switches on the G303I. That would be handy. And this is the first I heard about problems of overloading in the MW band. Are you close to broadcasters?

Date: Mon, 02 Apr 2007 17:58:59 -0400
From: Albert Santangelo <ve3ajm@sympatico.ca>
Subject: [R-390] 8-16 mc cam alignment

Been aligning a R-390A, and need to bring the 8-16mc cam to align to the index line on the cam plate. However this cam isn't secured to the gear with a clamp, as are all the other cams. Can this cam be adjusted/aligned independently and if so how. I do have the TM 11-856A technical manual. Any help would be appreciated,

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Date: Mon, 02 Apr 2007 20:42:29 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] 8-16 mc cam alignment

It has been so long, I should probably leave this to someone else. But the 8-16 mc cam is the 'home' cam. If more than one cam is off, or this one is off, you are going to have todrop the front panel and do a full mechanical alignment as specified in TM 11-856A, paragraph 138 (a)(3). Basically this means start with the 8-16 mc aligned, then align everything else to it.

Date: Tue, 3 Apr 2007 11:49:07 -0400 (EDT)
From: "William A Kulze" <wak9@cornell.edu>
Subject: Re: [R-390] sensitivity, product detector, etc

Hi Mark, thanks for your thoughts. In playing with this a little more I have noticed that the RF gain as I had set it was lower than optimum gain. I think it has helped me with finding a good setting for the IF gain adjust, though. As far as a big preselector goes, my thoughts were that I have heard a lot of discussion on the subject of R390 audio quality and SSB detection. I have been using the audio out via the diode load mod for a while now, and it results in much better sound. I get that same sound now through the PC and the same hi-fi amp, but I also get a full assortment of demodulation methods and a nice spectrum display. The R390 family is legendary for pulling in signals and I am using every bit of that. I just leave the bandwidth at 16kc and I can tune through the band with a nice old-fashioned analog knob while adding a few "modern" bells and whistles. Believe me, nothing will ever replace the R390a in my book, but I can still have a little fun with this, right?

As far as G303i command line switches, if you go to winradio.com and click on G303i in the middle of the home page, then select 3rd party developer info from the bottom of the G303i page, you should see the link for switches at the bottom of the page. The only one I need is /sd which stops the demod from loading on application startup. This lets you use any demod app that uses a 12kHz I/Q IF fed to the sound card. This opens a lot of choices, but that's for another group all together.

My nearest MW station of any power is about 70 miles. I have a couple of 5kw stations within 30-40 miles. The antenna is about 60ft 12 AWG THHN from house to tree about 20 - 25 ft up. I see the signals show up in 19, 20 and 39 meter bands. If I click the attenuator on the g303, the signals go away, but so do some weak ones that are really there. Using the loops I've made, I don't see a problem. I use the winradio 9:1 match for the wire ant. I may try making a tuner and using that instead.

Date: Tue, 03 Apr 2007 17:56:20 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: Re: [R-390] 8-16 mc cam alignment

Be sure a shaft coupling or gear clamp has not slipped elsewhere in the clockwork. The fix could be simpler than a complete mechanical alignment.

Date: Thu, 12 Apr 2007 11:50:40 -0400
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] Two questions

<snip> On the 7 mc sensitivity, this was discussed a few years back on the list and the thought was that the reduced sensitivity on that band was normal for the 390a. I have two which show a 1-2 dB reduction in signal (calibrator) level on that band. Not sure why, apparently something in the Xtal Osc or RF design. A complete realignment for that band may help some.

Date: Tue, 17 Apr 2007 10:16:42 -0700
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: [R-390] Z-201-2 RF coil

Got an issue with a R-390/A. Seems RF coil, Z-201-2 has something that has gone south. In peaking this coil the adjustment for the slug is within 2 turns of falling out of the holder. Too far down in it's adjustment range compared to the rest of the coils. When looking for a peak at 550KC and getting the sig-gen & receiver at the same frequency, there are two peaks. One is below and one above 550KC. Moving to 950KC the trimmer capacitor has two peaks, but not sharp and very little drop off in the voltage at the diode load connection, while rotating through 360 degrees. I've had this trimmer apart, cleaned, inspected, etc. I don't think the problem is with the trimmer.

Can't remember reading anything in the archives or Pearls of Wisdom with this challenge, so here we are looking for a guru who has been down this road. My thoughts are one or more of the silver mica caps have changed value. Before drill'en & blasting, using the wire cutters, and large hammers, what's wrong with this R-390/A??

Date: Fri, 20 Apr 2007 20:25:02 -0400
From: Albert Santangelo <ve3ajm@sympatico.ca>
Subject: [R-390] Receiver peaks off the m/c band detents

Anyone on the list ever dealt with a 390A where the receiver peaks off the MC band detents. It occurs on most of the bands, some more than others. I have done a complete mechanical alignment of the receiver, so I know the cams, crystal oscillator and bandswitches are aligned as per the manual. The slug racks and the slugs all move freely etc. Any ideas would be appreciated,

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Date: 20 Apr 2007 12:44:47 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Receiver peaks off the m/c band detents

You didn't mention whether you've done the electrical alignment. If you have performed a mechanical alighnment and it moved things (and it most likely did), you will need to do the electrical alignment. That should take care of it.

Date: Fri, 20 Apr 2007 08:43:51 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Receiver peaks off the m/c band detents

The RF slugs/coils aren't tracking perfectly. But this is not necessarily a failing.

They never will be tracking perfectly across all the bands, but they should match up at the frequencies where you aligned the RF deck. e.g. if you iteratively adjusted the slug position and the trimmer cap adjustments on the 8-16Mc band, then it should be set up correctly at 8800 and 15200kc. If this is severely out of whack, then maybe a gear slipped since alignment. Each can has two degrees of freedom (slug and trimmer) in aligning each RF band, so you can't expect it to peak on every single frequency throughout the octave.

Bad/wrong coils, or coils that aren't fully seated, or (gasp!) coils with broken forms can make tracking far worse than you'd expect. Others here have suggested modified procedures that involve iterating other than the two "official" per-band frequencies to use all six degrees of freedom available (three trimmers, three slugs) for each RF band.

Contrast with the PTO corrector stack where there are dozens of little correctors for each segment of the PTO. Wrong slugs will cause tracking to be much less than optimal (usually you can't align the band at all with the wrong slugs).

Date: Fri, 20 Apr 2007 07:44:54 -0700 (PDT)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] Receiver peaks off the m/c band detents

Sounds odd because those symptoms tell me that the RF deck needs alignment which is what you've already done. If the alignment is done properly you should not see peaks between detents. Easy for me to say from here, do the alignment again.

Date: Mon, 23 Apr 2007 14:24:57 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Diagnostic Help Needed (Part 2)

> I was fooling with the set some more and got something very weird.
> 1. At around 8.0 mhz I got a station (foreign language).
> Audio was good but the station stayed on over about 60
> khz as I rotated the KC control. When I get the garbed
> station at 780 khz, it stays on over about 20 khz as I rotate the KC knob.

PTO shaft is not turning (or not turning enough) as you turn the tuning knob. Either a loose setscrew, or a missing oldham coupler, or the PTO leadscrew is jammed up against its ultimate limit, or the zero set is engaged (purposeflly uncoupling of loosening the coupling between knob and PTO shaft), or the grease in the zero set clutch isn't transferring motion, or a combination of the five. It can be really disconcerting to turn

the kc tuning knob and all the RF deck clockwork turns... but underneath the radio the PTO shaft doesn't turn!

Date: Wed, 30 May 2007 09:26:22 -0400
From: "FISCH, MICHAEL" <mfisch@kent.edu>
Subject: [R-390] If alignment and low signal

I am finally getting close to completing my R-390a fix up. Last night I was aligning the IF. I would think when I put 455 kHz into the module (per wisdom, etc.) that the voltage on the diode load should be approximately independent of bandwidth for 2-16 kHz (thats as far as I am) 16 and 8 kHz are close, 4 Hz is about a factor of 4 smaller and 2 kHz an other factor of 2-4 smaller. The tunable caps seem to have minimal effect on these last 2 filters; however, the width of the filters seem about right. My guess is the silver mica caps need to be changed. Is that the correct diagnosis? Also will 500V capacitors work? Thanks Mike
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Date: 30 May 2007 14:00:13 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] If alignment and low signal

While I haven't had to replace those caps, I think that's the general recommendation. You should see two peaks with the trimmers and if you don't, the SM caps are either bad or need a different value to make the trimmers peak in their ranges.

Date: Wed, 30 May 2007 11:00:47 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] If alignment and low signal

Your working on a 1950 era receiver. 455 on your counter today is not the center of the filters. The wisdom is to drive 455 from the generator in the 455 crystal on the 0.1 band width.

Put the 455 into E211 on the Rf deck. hang the DC voltmeter on the diode load.

Rock the signal generator for maximum meter reading on the diode load with the band switch in the 0.1 position. That crystal under the Z501 transformer cover is your IF center frequency. If this frequency is within 1Mhz of the 455Khz you are OK. never mind those digital numbers displayed on test equipment. If they agree its just chance. You cannot move the filter center frequency by adjusting the caps. Some fellows did some test last year and find the caps just match the impedance and provide more signal pass with better matching. The filter centers are not exact.

The 455 crystal is within the 2Khz band pass. The 2Khz is within the 4Khz band pass and so on up the scale. They could all lay off to one side of 455 by 8Khz. (I have never seen a receiver that bad but it would be in spec if it did.)

You zero the BFO against the signal through the 0.1 crystal filter.

Once you get the signal generator centered into the crystal you leave it set and trim the caps on the mechanical filters for maximum signal out.

>You should see two peaks with the trimmers ....

The trimmer caps can be cleaned. The back clip slips off and the top comes off. You may have to unsolder the lead wire to get the back clip to slip off depending on lead length. I echo Barry, Good luck
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Date: Wed, 6 Jun 2007 07:52:23 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Question about R-390 Calibration Osc

Normally 10% low was the design target for this kind of thing. You might try simply bumping it up a little. If that's not it then the injection level may be low.

Date: Sat, 9 Jun 2007 12:54:20 -0500
From: "Bill & Becky Marvin" <wmarvin@hickorytech.net>
Subject: [R-390] RF Deck Alignment Question

I'm in the process of doing the RF deck alignment.......what are the cap trimmers
marked (BAL)?? on the slug assembly. Perhaps not used? Thanks for reading
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Date: Sat, 9 Jun 2007 11:09:44 -0700
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: RE: [R-390] RF Deck Alignment Question

The following is something I ran across and have used on a R-390/A. YMMV. I believe the bal caps are for the rare occasion you truly have a 125 ohm balanced antenna connected to the receiver. Note: It is my opinion that this is an important step which is often overlooked. You're basically nulling out any signals that are not balanced. Some noise is of this type. This adjustment can make the receiver quieter in the presence of common-mode noise. Connect the signal generator to the junction of two 68 ohm resistors. Connect the free ends of the resistors to the balanced antenna inputs. Connect a VTVM to the diode load terminals, adjust the signal generator output to give about –7 volts diode load voltage, and minimize this voltage at he following frequencies:

Frequency	Transformer	Trimmer
00 +000	T201	C201A
01 +000	T202	C205A
03 +000	T203	C209A
07 +000	T204	C213A
15 +000	T205	C217A
31 +000	T206	C221A

Be sure that a true balance is obtained, and not a minimum trimmer capacitance condition. If you have two dips during 360 degree rotation, either dip should be giving a true balance condition. If you only get one dip over the 360 degree rotation, some component value in the circuit has drifted too far away from its specified value and the dip is occurring at minimum capacitance.

Date: Sat, 9 Jun 2007 21:45:38 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] RF Deck Alignment Question

If you drive the radio through a transformer they are very useful for rejecting common mode noise. In a "one side grounded" drive they don't do much good.

Date: Wed, 13 Jun 2007 16:32:27 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] RF Deck Alignment Question

Good detail on the balance trimmer cap alignment.

The stuff is in the R390 TM. It is not in the R390/A TM. We ask every year to get the paragraph from the R390 TM inserted into the next printing of the R390/A TM. Problem is that the TM was never reprinted.

Date: Wed, 25 Jul 2007 09:26:28 -0800
From: "Tom Elmore" <TElmore@gci.com>
Subject: [R-390] Dial Calibration

Hello All, I was recently given an R390-A made by Motorola I believe. The radio seems to work quite well and is even tolerable to listen to SSB with once tuned properly. The dial readout on my unit seems to be out of sync though. If I want to listen to say 3.930 Mhz I need to set the Megacycle dial at 4 and the kilocycle at -930. In fact the kilocycle dial seems to only tune from about -900 or so to 900 and I can never get as far to bring up the + flag or indicator. I have removed the mechanical readout and can turn it by hand throught out the entire range and bring up the - and + indicators at both ends so I know it isn't binding.

Date: Wed, 25 Jul 2007 14:03:20 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Dial Calibration

A common failure mode is a broken gear clamp. You might check to see if the cams are moving the entire time you turn the KC knob. If so, then it could be a broken clamp on the PTO drive mechanisms. As you rotate the KC knob, look underneath the radio and see of the PTO shaft is turning. It could be loose clamps on the Oldham Coupler.

Date: Sat, 28 Jul 2007 11:38:25 -0400
From: "Keith Densmore" <densmore@idirect.com>
Subject: [R-390] 7 Meg low sensitivity

I have two R-390A's that exhibit the same problem--lower sensitivity on the 7 meg band but 6 and 8 are fine, as are all others. Good double peak on the crystal trimmer, and all other alignment issues seem fine. There might have been a previous thread on this, anyone remember year and month?

Date: Sat, 28 Jul 2007 08:52:41 -0700
From: "Leigh Sedgwick" <bipi@comcast.net>
Subject: Re: [R-390] 7 Meg low sensitivity

Yes, I have restored a R-390A (including RF deck) with all modules manufactured by Amelco (with the exceptions of the PTO). I have the same problem here, i.e., lower sensitivity on 7 mc only. I have gone through a complete alignment 4 or 5 times and cannot improve performance. I contacted Chuck Rippel for advice and he told me that some R-390A's exhibit this property and he has not heard of a work-around or definitive explanation for it. Not too big a deal for me but it there were a way to improve it, I would.

-

Date: Sat, 28 Jul 2007 09:30:40 -0700
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: RE: [R-390] 7 Meg low sensitivity

Tell us more. Lower sensitivity on the 7 meg band vs 6 & 8, how much

less? Can your sig-gen measure the output? How are you connecting the sig-gen? Good double peaks on the crystal trimmer, are you getting double peaks on the trimmer caps for the 4 to 8 meg bands? The position of the slugs in the
racks can be a clue. Are any of the bristol adjustment widgets way higher or way lower than others in the RF deck?

The reason I'm asking about the slug positions; the sensitivity on one of my R-390/A's was low on the broadcast band 0.5 to 1 meg. One slug was real low in the rack, almost falling out. The cure was to replace the silver mica caps in that coil assembly.

Date: Sat, 28 Jul 2007 16:41:12 -0400
From: "Keith Densmore" <densmore@idirect.com>
Subject: Re: [R-390] 7 Meg low sensitivity

If anyone would like to give their radio a 'quick' 7 meg sensitivity check, measure your calibration oscillator output on the db meter at 7 000 and then at 6 +000 Mine reads about 10 db lower on the 7 meg band You can also check at 7+000 and then 8 000. I get about the same loss at 7 + Like Leigh, I don't find it to be a huge issue, but if I could fix it, I would. I'd also be curious if anyone else finds the same problem.

Date: Sat, 28 Jul 2007 18:42:19 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] 7 Meg low sensitivity

7, 15, and 24 all run off the same 9Mhz crystal in the second mixer oscillator. At the first, second and third harmonics. Check 15 against 14 and 16. and 24 against 23 and 25. See if all three are a bit low. The crystal may have a stronger output on the second and third harmonic than on the fundamental so 15 and 24 may be Ok while 7 is low. One idea. Roger AI4NI.

Date: Sat, 28 Jul 2007 21:40:39 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] 7 Meg low sensitivity

Single band down, everything peaking ....
I would sure start poking at switch contacts.

Date: Sun, 29 Jul 2007 22:19:37 +1000
From: "Pete Williams" <jupete@bigpond.net.au>
Subject: [R-390] RE sensitivity below 8mHz

I have experienced the same problem of lower sensitivity on bands below

8 mHz . The first xtal oscillator V207 injects 17mHz into cathode of first mixer V202 for this range . I have suspected the injection level is possibly lower than optimum and while not actively investigating, I have made vast improvement in several radios by retuning the core of T207 which is the coupling xfmr to the first mixer cathode. One might also suspect that xtal activity in this circuit is below par-- hence the problem. There appears to be little reference to this alignment point in the literature .

Date: Sun, 29 Jul 2007 21:01:11 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] RE sensitivity below 8mHz

You are correct about there being little reference to aligning the first IF slugs and caps. The circuit is assumed to work just fine. Thus it needs little attention.

In the RF deck alignment procedure there is one paragraph.

Z213 gets tweaked at 1250 and 7250.
Z216 gets tweaked at 1900 and 1100
L215 gets tweaked at 1100
C205 gets tweaked at 1900
C213 gets tweaked at 7600

As you do the RF octaves, you just remember to stop on the 1,100 1,250 and 7,600 as you go by and do the IF stages.

We just used the RF into the antenna input. Used the same generator level we used for the RF octave adjustments. Stop on the needed frequency and peaked the proper coils or caps.

You tweaked T207 once any where under 8Mkz
You tweaked T208 once any where under 8Mhz.

Any time you change the tube in the first mixer or oscillator you need to peak T207.

If your receiver does not perform as well under 8Mhz then the first mixer and oscillator needs a look at. The receiver should have the sensivity under 10uv for all frequencies. But the receiver does have better sensitivity above 8Mhz. That extra conversion stage under 8mhz takes its toll on the signals.

Date: Sun, 29 Jul 2007 21:09:47 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] 7 Meg low sensitivity

After the switch contacts are cleaned with some deoxit and if the problem persists consider pulling the crystals and doing their contacts as well.

Back when (68-75) we did have crystals go weak and would replace them. Just cleaning the contacts would not always bring a band back up to par but a new crystal would fix the problem. I can believe the crystals are still going weak and causing problems. We just all cannot have a spare set of crystals around to swap out and try just to see if that's the problem. If you have a one band problem ask here to see if you can get a known good replacement to try. Postage and packing will cost more than the part.

Date: Sun, 29 Jul 2007 17:34:51 -0800
From: "Tom Elmore" <tom@telmore.com>
Subject: RE: [R-390] 7 Meg low sensitivity

I often wonder if crystals can go weak? I have a Collins KWS-1 that shows quite a bit of difference between the USB & LSB crystals positions. I have checked all the caps and coils associated with the crystal oscillator with my bridge and they check out.

Date: Sun, 29 Jul 2007 22:44:52 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] 7 Meg low sensitivity

Crystals can go "weak" over time. One way is for the metalization to oxidize or the cement to crack (high resistance contacts). Another way is for the crystal blank it's self to fracture over time.

Date: Mon, 30 Jul 2007 14:26:17 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] 7 Meg low sensitivity

All crystals do not put out at the same level. The level can change over time. Sometimes the frequency shifts and the tuned circuit around the crystal does not quite line up; thus you get a low output.

Date: Sat, 4 Aug 2007 10:56:44 -0400
From: "Keith Densmore" <densmore@idirect.com>
Subject: [R-390] T207 T401

Perhaps I'm missing it, but I cannot find a procedure for aligning T207 (17meg) or T401 (crystal osc) in any of the books here. Anyone know an accepted procedure for them?

Date: Sat, 04 Aug 2007 22:51:31 -0400
From: Carole White-Connor <carolew@bellatlantic.net>

Subject: [R-390] A Little Help Needed

Over the last few months, I've been working on and off on a St. Julien's survivor ('67 EAC) and need a little help. I cleaned and lubed it and replaced Chuck Rippel's troublesome caps (except for the RF deck).

1. The set plays fairly well but the sensitivity is not where it should be. I've checked the tubes and replaced all weak ones. The sensitivity is better on the higher bands. For example, I just listened to Radio Bulgaria. It came in just OK on 9.7 mhz but very strong on 11.7 mhz. The carrier meter deflects only slightly even on strong signals. When I switch from AVC to MVC, there is no noticeable increase in the signal strength. Any ideas? (I'm a rookie on R-390As soI need real simple instructions!).

2. A real dumb question: how do I replace the dial lights?

As always, thank you for your help and your patience.

Date: Sat, 4 Aug 2007 22:04:15 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] A Little Help Needed

Not a dumb question. Remove the four screws holding the dial escutcheon to the front panel. The panel lamps are behind the little connectors that swing out of the way. It's pretty obvious once you remove the escutcheon.

Date: Sun, 5 Aug 2007 15:24:06 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] A Little Help Needed

Also a pretty good test would be to check for the calibrator signal on each band and note it's signal level reading after peaking the signal with the antenna trimmer control...turn the BFO on while doing this...makes it a bit easier. Should be a difference between MGC and AGC in most all cases.
Date: Sun, 5 Aug 2007 19:22:55 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] T207 T401

You ask about, a procedure for aligning T207 (17meg) or T401 (crystal osc)

You are correct.

For T401 the procedure is to run the MC to 31 and peak T401 and the cap for maximum output.

In practice you find the MC band with the lowest output level and retune T401 to bring that band up enough to pass the 10:1 signal to noise ratio test on that weak megahertz band. There is no one best absolute setting for T401. You use it to get the bast of all bands out of it.

T207 the output of the first crystal oscillator is the same approach. That transformer always passes 17Mhz.

Pick any point under 8Mhz and adjust T207 for maximum output on the diode load for minimum RF input at the antenna input. You get like one clause of a sentence in the original TM on these subjects.

Date: Wed, 08 Aug 2007 21:57:48 -0400
From: Carole White-Connor <carolew@bellatlantic.net>
Subject: [R-390] Low Sensitivity Solved

Thank you to everyone who wrote to me to help with low sensitivity in my'67 EAC receiver. I found the problem. The slug on Z216-3 had broken off. I replaced it with a spare that I had on hand and the set really came to life. Sensitivity is now excellent on all bands.

I'm proud of this set. It's a St. Julien's survivor that had not been touched since it was rescued from St. Julien's. When I got it, the Oldham coupler on the PTO was disconnected and the filter caps were shot. It even still had the yellow stripe on the front. However, it was all there. On and off for the last few months, I've been working on it. Now, at last, it performs like an R-390A. Again, thank you to all who helped.

Date: Sun, 5 Aug 2007 19:55:13 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] A Little Help Needed

I hope you have access to a network connection with better than dial up speed. Wander over to the following web site. http://www.r-390a.net/ There is a manual there called the Y2K manual and original military TM's and lots of other stuff to read. As you are on the reflector there is also lots of archived topics to read. Download your self an electronic copy of the Y2K manual for starts. It is better organized and reads so much nicer than the original military TM's You will need any old Rf signal generator that will do 500Khz to 30Mhz and has am modulation. You will also need a DC volt meter and an AC volt meter. Any flavor that will read about 30 volts or less will work.

You would like an AC volt meter with a DB scale and enough knowledge to be able to use the meter on the audio output of the receiver and determine a signal to noise ratio when the RF generator is putting out straight RF and when the generator is putting out modulated RF. You can use two 1200 ohm resistors in parallel to make a 600 ohm load to go with the AC volt meter on the Local Line output on the rear panel of the receiver. If the AC volt meter does not have a DB scale you can convert the AC voltage across 600 ohms to DB and determine if you have the signal to noise ratio you need (10:1 is OK specified, 20:1 is very do able with the receivers today, 26, 27, 28:1 is often seen, 30:1 is a holy grail and still seen in receivers today, You may only get that on some bands) More equipment is always good, but this is all you really need to align and test your receiver. The first level is a cal tone at every 100Khz from 500Khz to 31,000+. Once you have a receiver that has all the knobs and functions working you can move on.

Worry not that MGC and AGC has little difference at this point.

Do pull the IF deck and determine if the old big fat plastic caps are all gone. There should be nice new caps in the IF deck. Someday you also want to pull the RF deck and see that some old big plastic caps have been replaced in that deck as well.

Check the two plug in electrolytic caps on the audio deck. These likely have been replaced. By caps under the deck. new caps stuffed into the old original cans. Some nice replacement work, some not so nice work you may want to upgrade someday. There is also an electrolytic cap in the audio deck on the circuit board that should have been replaced at least once or more in the life of the receiver. Inspect the board for a mess of corrosion and a nice new cap C609 a 8µF cap. Any thing larger than 8µF and 30 volts will work.

Many audio caps may have been replaced with larger value caps. This improves the audio band width (fidelity).

C553 a .01Uf cap in the IF deck keeps B+ from V501 off the mechanical filters. Check that this cap in the RF deck has been replaced with a modern cap. If this cap fails, the B+ kills the mechanical filters.

You will find all this stuff on W Li pearls of wisdom on the web page. As a new owner, or an old receiver, read it all once and make the inspections needed on your receiver. Down load the manual of your choice and go through the alignment procedures and test. As you get to a point and wonder what to do, post a question here on the reflector. Several Fellows will send you some good advice on what to do next. We have no idea of your skill level, Start where you can, do what you can do and start asking questions. We will help. Good luck and welcome to the group.

Date: Sun, 12 Aug 2007 16:12:32 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] T207 T401

Sorry to be off line and long in coming back to you. This is long but I hope it provides some insight. It is still not an exact step by step cook book.

The Second Osc alignment is about as clear as Mississippi River Water after a summer rain. After reading the TM a few times the subject clears up. It looks like the Beach Surf in Okinawa after a Typhoon just misses the Island. Once you the do the alignment a few times the subject looks like the crystal water and coral bottoms as viewed from the high beach cliffs of Okinawa and you wonder what the fuss was all about.

The TM says align the second crystal oscillator caps from the Cal tones and using the carrier meter as the output indicating level. That got some writer off the hook back in 52 for the R390 TM and was copied into the R390/A TM. See TM 11-5820-358-35 Paragraph 74 (page 114 in the 8 Dec 1961 printing) The process works. And you can spread peanut butter on bread with a pop sickle stick.

But I digress and you asked me about T401 and the trimmer caps in the Second Oscillator in the R390/A receiver. The TM says there is no adjustment for 0 to 7. But we know 0 - 7 lays over 17- 24. The TM says start adjusting the caps for maximum carrier level output on each Mhz band from 8 to 31. Mud in your eye. Do this from 31 down to 8. There is one obscure clause of a sentence in the R390 TM that suggest that T401 (numbered something else in the R390) be adjusted for maximum output at 31Mhz.

These two items, set T401 to max at 31Mhz and set C31 to max at 31Mhz, imply these two adjustments will peak the output of the second crystal oscillator for maximum receiver performance across all frequencies in the range of the receiver. Another fantasy that passed muster with the TM editors. Hey it reads good in jargon with no sarcasm showing.

In real life do the following:

- Turn the BFO off because BFO on masks the real signal level.
- Set the receiver to MGC to defeat the AGC which will cause output meter variations.
- Hang a DC volt meter off the diode load as you choice of output indicator as this is the most sensitive easily accessible point to meter the receiver output.

- Inject RF into the antenna input and use a level that gives a diode load reading in the range of -5 to - 10 volts. The RF may or may not be modulated but un modulated RF is mostly preferred for adjusting and testing.

The receiver has a range of 31,000+ - 500 = 31,500 hertz. There is one transformer (T401) and 24 caps that need to adjusted to optimize the second crystal oscillators output such that all frequencies at the receivers antenna input have optimum output at the headphone jack. Optimum output is left undefined as an exercise for the operator to complete.

The first crystal osc mixes RF input under 7,000+ Mhz with a frequency near 17Mhz and passes it on to the second mixer. Between 17 Mhz and 24 Mhz the second crystal osc uses a different crystal to mix that RF input under 7,000+ Mhz to a range of 3.455 to 2.455Mhz. The third mixer then mixes the VFO with this signal to produce a signal at 455Khz. On a good day this signal is centered into a crystal in the if deck with a band pass near 455Khz. Anywhere in the frequency range you can grab the zero adjust the and slide the VFO around a bit to peak the transfer.

The nonlinear VFO and its band spread will also impact the mixing frequency. One end of the VFO or the other may add or subtract from any given second mixer crystal error to increase the or decrease the receiver output.

So what is a good alignment? When do you quit?

Because the 17Mhz crystal is not exactly 17,000,000.000 you may find the optimum cap setting for 18Mhz is not the same set point as for maximum 1Mhz.

Likewise because some crystals at 17 -24 are not exact, the optimum setting for one of them may not be the same for the double conversion and the single conversion. If the 17Mhz crystal is off and the second mixer crystal is off the differences may add to make things poor, subtract to make things OK, cancel to make things good, do none of the above just to add reality.

Some of the second mixer crystals are used at more than one harmonic. You have a different cap to peak each of these harmonics. The output level at the harmonics may not be equal in amplitude or adjustable to equal amplitude while each frequency has a nice double peak on it's respective trimmer cap.

The thought is that crystal output is highest at low frequencies and drops off as frequency increases. If T401 is peaked at the highest frequency, it response will drop off as frequency decreases. The slope of T401's output plotted against the slope of crystal loss across frequency is considered to yield a near flat mixer output across the frequency span.

Thus the TM read to peak T401 at the highest frequency and adjust each cap in the second crystal osc deck from 8 to 31 Mhz. The procedure details using the Cal tone, BFO and carrier level meter. Me know this process is not the most sensitive.

We would like to think that peaking the trimmer caps only changes the impedance match to yield a better power transfer of the oscillator output and that the cap adjustment does not vary the frequency of the crystals. We would like to think every crystal is spot on exact to within under 100 hertz and stable as a rock.

What we find is one or more crystals have an output level below the curve.If it is off frequency, and in the range of the zero adjust, then zero adjust the VFO and peak the cap for the megahertz band and move on. This is just an off frequency crystal but still in specification. If the zero adjust it peaked and the output is low then the oscillator output is weak for that band. Try cleaning the crystal contacts, the tube contacts and the cap. But the first easy quick fix in a clean receiver where you know corrosion is not the problem
(1968 - 1975 era) is to adjust T401.

You slide the low frequency slope of T401 down. This lets more of the crystal output from the weak crystal through the circuit to bring the weak band up to par. You hope the top frequencies do not go so far over the hump they fall under par.

You find the low spot (a dip / a weak output crystal) in what would be the curve of the crystal output levels. Then move the cutoff slope of T401 by adjustment so that when the two functions (crystal outputs / T401 cutoff slope) cross, the output performance level of the second osc is of acceptable performance.

Start at 31 Mhz and adjust T401 and cap 31 for maximum output. Use a RF signal generator and DC volt meter on the diode load for best indication of adjustments.

Continue down the bands in frequency to 8 Mhz. Adjust each cap but do not reset T401 while doing these adjustments.

Mark the 17 - 24 cap setting (pencil on the deck in line with the screw driver slot) and continue down in frequency.

Reset the caps for best output on the 7 - 0 bands.

Look at the cap settings when you complete this process.
Are the caps still peaked at the same alignment point?
Are the 17 - 24 caps not all offset the same way (17Mhz crystal off frequency)?
Are the 17- 24 caps set above and below (the second crystals osc crystals off frequency)?

Now you have a choice.
Peak the caps for the low band (0-8) or the high band (17-24) or balance between the bands. If in the process of aligning the whole receiver you find one or some of the 1Mhz bands to be low you can now think about readjusting T401 to bring the bands up to par.

First consider if you have done all the other adjustments on the receiver. Working over 17- 31 Z206 and T206 will yield more improvement than trying to optimize T401 and C20 to bring up a weak 20Mhz band.

Second consider if you have a clean machine.
Clean contacts under, caps, transformers, tubes, crystals and connectors go further than peaking adjustments.

After you adjust T401 to bring up some low band you should then go back and check all the other caps. What ever the last setting for T401, peak all the caps without ever touching T401 again.

The TM implies that setting T401 is not an exact most critical adjustment.

The TM further implies that just close with a cal tone and carrier meter is good enough. But after 50 years, consideration and attention to detail can get more out of these adjustments than just a good receiver.

Put some time into your receiver working through these adjustments to come to an understanding of how your particular receiver balances out. In the end you will have a better receiver to listen to.

There are many other stages in the receiver that can compensate for the elected less than exact test book adjustment of the second crystal osc deck. Once you understand what bands of the receiver you want to optimize for your use, how the many adjustments interact and the limits of the exact parts in your exact receiver, you find a pattern of adjustments that optimizes the receiver for your enjoyment. I hope this helps.

Roger L. Ruszkowski AI4NI </HTML>

Date: Wed, 10 Oct 2007 21:36:26 -0400
From: "Bob Young" <youngbob53@msn.com>
Subject: [R-390] Need 390 help

I'm in the process of attempting to aligning a 390. I'm now in the fourth echelon, alignment section, #77 e. on page 94 for Alignment of the Second Crystal Oscillator. I have my VTVM set for negative voltage between E209 and ground with a CW signal from my URM-25F going between ground and E210. I can peak slug T402 but the problem is is that trimmer 31 does nothing at all when it is turned. In fact I am reading the PTO on my frequency generator which is hooked up to the URM-25F. It appears that I am getting nothing from the signal generator into the radio at all and it works fine, all I am reading is the PTO output. I have the receiver on standby as it says. I have to be doing something wrong but I can't figure it out. The frequency dial is set at 31 also. Could this be a bad crystal?

I just found a great way to read your PTO's frequency output though, hi! Mine was 3 kc off at 500 so I moved it the 3 kilocycles, this was after I encountered this problem. Up to this point everything went fine although parts of it were a PITA, by the way I'll see everyone at the NEAR-fest Friday rain or shine, don't want to miss the R 390A class, this is a R390/URR BTW not a R390A/URR,

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Date: Tue, 16 Oct 2007 10:52:09 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Need 390 help

Some of these mid stage setups do not work well.
Just inject the signal generator into the antenna input,
Have a volt meter off the diode load.
Set the receiver to MGC, RF to max. BFO off.

With the generator on CW and some where between 31 and 32.
Run the KC around to peak the diode load signal to the exact signal generator frequency.

Back the generator output down to the micro volt range.
You should be able to get the trim cap in the osc deck to peak.

The you can work the equation in two variables of T401 slug and the 31MHz
trim cap to the highest (most negative) value on the diode load.

If you get no peak on the cap this way, move down to 30 and see if other caps will peak for you.

If everything but the 31 will peak then you likely have a problem with that cap and its wire.

Remember that the osc deck also has a big rotary switch. That last contact may not be being made, do to a bit of wear and miss adjustment. This would likely be no 31 MHz output at all.

T401 should not peak very sharp.

You likely will see no difference from the slug the first few times through the receiver. Losses in other stages are masking the performance of the mixers output through T401.

Date: Tue, 16 Oct 2007 10:54:28 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Need 390 help

>...........I have the receiver on standby as it says.........................

Bob, this is a TM error. You need to be in MGC.

Date: Fri, 19 Oct 2007 02:54:51 -0400
From: n4tua@aol.com
Subject: [R-390] 390A ramblings

Just been working on the 390A. Symptoms, low sensitivity. Did the Y2K, 5.5.4 RF-IF gain test and could not get the required -7vdc from the diode load with 2uV into J103. I did have J104 shorted. I wonder if this should be shorted for the testing in table 5-5? I proceeded with table 5-5 step 8. Everything looks good through step 9. It seems that the line level is a good bit higher than the 0vu specified on some stages. Wonder why that is? On to step 10. This is unclear to me. The test instructions say tune KC dial above 900 to peak signal which is 3mhz? This will have to be tried tomorrow. Sound like I may be going in the right direction? Hope so.

Date: Fri, 19 Oct 2007 18:31:50 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] R-390a Image problem?

Hi everyone. This is my first post to the list although I've been following it for a long time now. A few months back I bought a 67 EAC R-390a. The only problem I had was an open Z-503 AGC coil. I replaced that and did an alignment and the radio seemed to be working real well. Sensitivity was very good on all bands.

Recently I've noticed broadcast stations coming through in the 3Mhz band. A local station on 1650KHz is about 40db at 3300KHz on the R-390a. I don't hear it on my R-392. Even moving the 2-4MHz RF slug rack by hand, I still hear the station (although it does get a bit quieter).

There are several other stations coming through as well on other frequencies. I didn't notice anything odd when I aligned it, everything seemed to peak like it should. Looking around at other frequencies with my signal generator, I started noticing all kinds of harmonic responses, but that is probably (at least to some degree) just my signal generator (a Boonton 102C).

I'm pretty sure something is wrong here but I'm scratching my head trying to think of a good explanation. If the BC station harmonic was that bad, I'd hear it in my other radios I would think. Ideas anyone? How do I track this one down?

Date: Fri, 19 Oct 2007 20:52:46 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Image problem?

Which antenna input are you running into? The situation you describe would be pretty typical if you run a long antenna into the "unbalanced" input.

Date: Fri, 19 Oct 2007 20:54:53 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] R-390a Image problem?

Tony, I'm brand new to the R-390 game so I speak only with regard to generalized receiver concepts. It sounds as if somewhere there is a degrading ground connection. As far as specifics go I can only say make sure module mounting is tight, cable shields are in good order, etc. You may be able to divide and conquer by injecting signal downstream of the antenna and learn something that way.

Date: Fri, 19 Oct 2007 18:58:28 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

Hi Bob, I'm using the balanced input. I bought a twinax to BNC adapter so one side of the balanced input is grounded. Same antenna doesn't bother the R-392.

Date: Fri, 19 Oct 2007 21:13:48 -0400
From: Bob Camp <ham@cq.nu>

Subject: Re: [R-390] R-390a Image problem?

I'd check the grounds as Jon suggested. The R390 can pick up "stuff" from the power line pretty easily. The AC line filter works both ways with a loose ground.. Next up would be to start swapping front end tubes. You may find that you simply have a defective tube. You may also find that somebody "improved" the design by putting in a tube that didn't belong there.

Date: Fri, 19 Oct 2007 20:05:06 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

Thanks Bob. I wonder what the symptom would be if there were no AGC getting to the 1st RF stage. I will check the tubes but I am pretty sure they are correct since I tested them all. I might have assumed that I pulled the correct tube out I suppose. I've done dumber things. One thing I didn't mention is that I put in the 2 diode SSB mod that Dallas Lankford came up with. It works great. The time frame for when I noticed this problem is not long after I did that now that I think about it. But then again, I don't tune around down on the low end that much so it was probably there all along.

Date: Fri, 19 Oct 2007 20:17:55 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

Aha! The 1st RF tube is correct (6DC6) but when I remove the tube and put a small cap from pin1 to pin 5 (grid to plate), the receiver works fine and NO image. I'm going to check the AGC to that stage.

Date: Fri, 19 Oct 2007 22:36:18 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Image problem?

I'd swap it for another tube just in case. With no input to the radio, there should be pretty much no AGC to the front end. It may be the problem, but only indirectly. If the radio is fine with no front end tube, you probably have one very large antenna.....

Date: Fri, 19 Oct 2007 20:48:00 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

I see what you mean about AGC. I checked it anyway. -11 volts on a strong local station. I swapped tubes with no improvement. I wonder if the

stage bias could be wrong? I guess I should measure the voltages just to be sure. When I said 1st RF stage, I guess I forgot this was an R-390a. Part of the cost reduction removed one of the RF stages didn't it? There is only one.
The antenna is a 100 foot longwire.

Date: Fri, 19 Oct 2007 23:06:32 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Image problem?

Stage voltages are a good idea if you have a VTVM. With an RF probe you can also check the injection levels at the mixers. Low drive to a mixer can cause all sorts of odd things. Your 17 MHz crystal oscillator may be a bit "sick" for instance ....Another stupid thing to check - did somebody put a couple of diodes up in the antenna relay to "overload protect" the radio?

Date: Fri, 19 Oct 2007 21:42:28 -0600
From: "ANTHONY CASORSO" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

Checking the injection levels is a good idea. I'll try that tomorrow.

Date: Sat, 20 Oct 2007 12:55:26 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] R-390a Image problem?

Some further thoughts. Again, I'm not really familiar with the 390 yet so these are just some general ideas. Could the screen or suppressor/cathode of the RF amp be lifting off of RF ground (bad C229, C227?). This could cause some instability. Another possibility along these lines is a problem with the parasitic suppressor, E212, or something downstream from it. E212's presence in the design is tip off that the stage could be *hot*. If the stage is oscillating at some frequency that's not immediately obvious (VHF range?), a non-linearity could be created that might generate the 2nd harmonic of 1650 kHz that you are seeing. You could try to *sniff* the existence of an oscillation using other receiver(s) you may have on hand. Use a short wire probe as the search receiver's antenna, put it next to the RF tube and start searching for any signs of life.

Date: Sat, 20 Oct 2007 11:13:30 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

I just finished checking the injection level at the first mixer. It seems more than adequate at 1 volt rms but I don't really know what is supposed to be.

First mixer cathode is at about 8.5 volts (manual says 9.7). I have a spectrum analyzer over in the corner. I might be able to use it to look for oscillations in the RF stage. Maybe I'll have time later today.

Date: Sat, 20 Oct 2007 18:21:47 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Image problem?

By any chance are we chasing a ghost here?

I used to have a 50KW AM station a stones throw away from my backyard. My long wire could get a reading on a Bird Termline with a good matchbox in between. It was always amazing to me just how different radios would and would not pick up which harmonics of that station.

See if you can get a signal generator you trust. Check the radio and see what it's really doing. If the front end of the radio is running OK, and it's properly aligned, there may not be anything wrong with the radio.

Date: Sat, 20 Oct 2007 17:03:08 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

That has occurred to me. The only thing is that none of my other radios do this on the same antenna, including my R-392. Plus, the signal strength is 40db on the meter. I didn't expect the R-390a to be weak in this area.

Date: Sat, 20 Oct 2007 20:26:25 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: [R-390] (no subject)

I had similar problem once. It turned out that the coax connector from the PTO canister was not twist locked in place.

Date: Sat, 20 Oct 2007 18:28:15 -0600
From: "DW Holtman" <tubestuff@comcast.net>
Subject: Re: [R-390] R-390a Image problem?

I also have a 50KW broadcast station in my area. It causes problems on both of my R-390A's, 51S-1 and R-392. The cross over distortion is mostly heard in the broadcast bands. I built a highpass filter with about a 3MHZ roll off. Put it in series with the antenna lead, going into the multicoupler and it works great. Ended the problem, can still receive broadcast bands with the filter inline because they are so strong.

Date: Sat, 20 Oct 2007 21:27:16 -0400-

From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Image problem?

I sure would start checking grounds. Pull the modules and the coax connectors. Make sure everything (including the inside of the antenna relay) is shiny and making good contact.

Date: Sun, 21 Oct 2007 12:11:20 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

I looked at it with the spectrum analyzer this morning and I did not see any oscillation. What I did see is that I have over 100Mv of signal from the KNUS broadcast station at the balanced antenna terminals. It is reduced to about a quarter of that by the antenna circuits (tuned to 3.3Mhz) so 20+ millivolts is going into the RF amplifier. There is no visible signal at the second harmonic (3.3 Mhz) going into the RF stage. At the grid of the first mixer with the receiver tuned to 3.3Mhz, the broadcast band signals including the huge KNUS signal are gone (below the floor of my spectrum analyzer) but there is about a 1 millivolt signal at 3.3Mhz. It would appear that some kind of non-linearity in the RF stage is creating a strong second harmonic in the RF stage.

Date: Sun, 21 Oct 2007 14:26:24 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] R-390a Image problem?

What are stage DC voltages doing? Also, can you reproduce the behavior with the sig gen at the input instead of KNUS's megavolt/meter signal. If so, conditions would be more controllable. You could easily see behavior over level change, etc.

Date: Sun, 21 Oct 2007 12:49:26 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

Actually, the signal generator has a fair amount of second harmonic in it
so
the radio station is cleaner on the spectrum analyzer. I did switch to the signal generator and the scope and I can see the distortion plain as day. Sine wave in, distorted out. Voltages are:

With no AGC applied:
Plate 201v
screen 178v
cathode 2.1v

grid -.5v

With AGC applied:
Plate 215v
screen 201v
cathode .22v
grid -4.2v

These was taken with a signal from the signal generator applied.

Date: Sun, 21 Oct 2007 15:03:20 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] R-390a Image problem?

Gee. DC readings look reasonable. I see why now you're hesitant about the generator. Yup. forgot about that. So Tony, when you say sine in - grunge out, you're talking about the KNUS's 1650 hHz signal as observed on the grid and plate of the RF amp. Just making sure we're in synch at this point. Here's a thought. Watch your grid and plate signals on the scope and yank the 1st Mixer, V202.

Date: Sun, 21 Oct 2007 13:19:21 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

No, I mean using the signal generator I have sine in and not-so-sine out. I only use the KNUS signal for the spectrm analyzer because of the sig gen harmonics. On the scope, The sign gen distortion is not really visible. A little bit of asymmetry in the sine wave will give that second harmonic blip on the analyzer. In one cycle of the input sine wave, the plate signal goes up, comes down about half way, goes back up, comes fully down and back up to the starting point.

I think this may be 'normal'. The plate circuit is tuned to 3.3 Mhz. When I hit it with the 1.65 Mhz signal it tries to ring at 3.3 Mhz. This combines with the 1.65 Mhz signal to produce the odd waveform I see. I'm not sure what to make of this. Either it's normal, or I'm not getting reasonable attenuation of the 1.65MHz signal through the antenna circuits (tuned to 3.3MHz), or the Q of the mixer input circuit is too high, or it's something else entirely. This is a good reason to have more than one receiver.

Date: Sun, 21 Oct 2007 14:01:11 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Image problem?

> Hmm,

>
> So then the only time you see distorted waveform out (plate) is when the
>radio and hence the RF amp's plate load is tuned to 3300. That all makes
> sense
>
> I guess where I was going was a much lower than normal plate AC plate load
> for the RF stage. Failed something in Z201-1 or -02, C254 or further
> downstream like the 1st Mixer.
>
> Need to think about this some more. should get back to you shortly.

Somebody just emailed me asking about KNUS. It is supposed to be on 710 kc AM. There is a "sister station" KBJD that simulcasts KNUS and goes by KNUS2. KBJD is at 1650 KHz and this is the one that I am havng issues with at the moment. I said KNUS because that's what I hear them saying at 3300KHz and at 1650KHz. Interestingly (for me at least), it looks like KNUS2 is going to cease operations on Oct 29th. I don't know if KBJD is just changing hands or what.

Date: Sun, 21 Oct 2007 14:37:16 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: RE: [R-390] R-390a Image problem?

I can see the "distortion" with the sig gen at -30dbm. Below that my scope can't see it very well. The radio station signal shows at about -12dbm on my spectrum analyzer at the antenna. BTW, during the day the 1650KHZ station signal comes through at +60db on my carrier level meter when tuned to 3300KHz. I just checked my R-392 as well. It is hearing it now as well. At night the R-392 does not hear it and the R-390a signal drops to 40db on the meter. I may just have to build a high pass filter like DW suggested. It wouldn't bother me if it registered a few db on the meter, but 60db just doesn't seem right. Especially after reading for years about the great strong signal performance of these receivers.

Date: Sun, 21 Oct 2007 16:51:21 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: RE: [R-390] R-390a Image problem?

Looks like KBJD is 10 kW non-directional daytime and 1 kW non-directional at night so that would reduce what your receivers see by 10 dB. If that relatively small reduction is enough to kill the birdie then it sounds like the receivers are running close to edge on their signal handling capability. What is the R-390A's strong signal capability?

Date: Sun, 21 Oct 2007 16:58:10 EDT

From: SHELLY199@aol.com
Subject: [R-390] Re: Image Problem

When you measured the voltages below what was the gen input voltage?
Voltages are:

With no AGC applied:
Plate 201v
screen 178v
cathode 2.1v
grid -.5v

With AGC applied:
Plate 215v
screen 201v
cathode .22v
grid -4.2v

The AGC, with the Langford mod, should be about:

10 Uv rf input = -4.36 Vdc
100Uv rf input = 6.66
1000 Uv rf input = 8.53

I don't know if this will help, but you are talking some very big RF input voltages (20mv). I also had a problem with the Ist rf amp not responding to the AGC voltag e once. Tube tested good and the AGC voltage was there. Was fixed with another RF amp tube. That took a lot of work. By the way, if you use IN914 or IN4148 diodes in that Langford mod I've found that one of the diodes will fail. I use 1N5060's. I think its breakdown when the AGC switch is turned from slow to medium. This has happened in at least 5 IF decks.

Date: Sun, 21 Oct 2007 17:07:17 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] Re: Image Problem

Could this be environmental? Corroded downspouts/eves troughs and who knows what else can sometimes turn into unwanted rectifying devices complete with integral antennas.

Date: Sun, 21 Oct 2007 15:11:25 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Re: Image Problem

I'm losing track now :). I'm no longer positive where the sig gen was. I tried it so many ways. I have checked the AGC before against the curve in the manual and it is pretty close. You could pick off -4.2 volts on the curve and have some idea what I was applying at that time.

Date: Sun, 21 Oct 2007 19:31:59 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Re: Image Problem

Roughly speaking, assuming that 1 µvolt is 0 db: then 100 mv is 10^5 µvolts = +100 db. If your carrier meter is calibrated for 0 = 1 µv then a +40 reading would be 60 db second order rejection. That's actually pretty good overload performance for that kind of input. One millivolt would be 40 db rejection which is not quite as good. You do have a *lot* of signal there .....

You have to be very careful how you measure levels inside an R390. The impedances are very high. Unless you have a real good FET probe, it's very hard to measure anything without de-tuning or loading the circuits. That said, a 5:1 reduction from the front end tuning doesn't sound like a real good performance from the front end.

Date: Sun, 21 Oct 2007 20:05:54 -0400
From: Scott Bauer <odyslim@comcast.net>
Subject: [R-390] image problem here too!!

We must be getting some type of weird propagation. Super Low Band DX! I am sitting on 8580 and am listening to 2 AM BC stations. One is the Dallas Cowboy BC Network. The other, Westward One. I cannot ID. I waited for the top of the hour and both faded out deeply. As I tune the 8MC band, I can hear stations all over the place but they are too weak to ID Anybody else having this experience?

Date: Sun, 21 Oct 2007 20:15:09 -0400
From: Scott Bauer <odyslim@comcast.net>
Subject: Re: [R-390] image problem here too!!

BTW, I am getting this on more than one radio. It is like I am tuning the BC band
on the 8 MC band but everything is weak. This is cool.

Date: Sun, 21 Oct 2007 20:20:53 -0400
From: Scott Bauer <odyslim@comcast.net>
Subject: [R-390] propagation

Good Propagation tonight. I am hearing a time standard station on 570khz. Spanish language I think

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Date: Sun, 21 Oct 2007 19:00:28 -0600
From: "DW Holtman" <tubestuff@comcast.net>
Subject: Re: [R-390] image problem here too!!

This months (October) Electric Radio Magazine has a great article on R-390A in regards to blocking, intermodulation distortion and reciprocal mixing, and how it compares to the R-390. It addresses some of the problems that have been discussed in this thread. It is an excellent article, great reading for anyone interested in the performance of the R-390A. It is a two part article, the second installment will be next month. Single copies are for sale at their web page.

Date: Sun, 21 Oct 2007 21:32:04 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Re: Image Problem

How do we know that the broadcasters aren't actually radiating a harmonic?
What are the FCC requirements for harmonics on the BCST band?

Date: Sun, 21 Oct 2007 22:19:20 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Re: Image Problem

I do believe that the transmitter output on a broadcast AM setup must have all harmonics at -60 dbc. Most gear that I have seen has the harmonics at -100 or so. It's sort of a "matter of pride" thing to keep your signal far more clean than the regs require. After the transmitter you have what ever is being done to match and phase the antennas. Your guess is as good as mine here. Let's say another 20 to 40 db.

Once you hit the antenna you are often feeding a sub 1/4 wave at the BC band. You might or might not have a 1/4 wave at the second harmonic. My *guess* is that the antenna isn't going to be very "hot" on the second harmonic. For guesses say -3 db, but it might be +3 or -20 ... More or less the radiated signal should have the second harmonic below -80 and likely way below. Normally you will get far more harmonics and crud from rusty fence wire, or loose downspouts on your house than directly from a broadcast transmitter. The main exception to that rule is stuff like remote repeaters that runs very low power with nobody paying much attention at all to it. You rarely see them on AM, but they do exist on FM.

Date: Mon, 22 Oct 2007 09:25:57 -0400
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: Re: [R-390] R-390a Image problem?

> I also have a 50KW broadcast station in my area. <snip>   We had a problem like that on field day one year. (This wasn't on an R-390) The cure was a can. We build a helical resonator to suck out the AM station. It was about 160 turns of #12 magnet wire on a 12" sonotube in a 45 gal drum. I like titanic engineering. The next year I used the R-390 without the can. No problems at all.

Date: Mon, 22 Oct 2007 09:41:48 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] R-390a Image problem?

I am less than a mile from a local 5kw broadcaster, and if I just stick a scope probe on my 80M dipole I see about 12V P-P on modulation peaks at 630 kc :-). That said, my R-390A's do fine in this environment.

The third harmonic of 630kc falls smack dab in the 160M band, and since IBOC the region +/- 25kc of 1890 is pretty much unusable. I'm 99% sure that the harmonics are coming from outside the radio because 630kc filters do nothing to the 1890kc harmonic. I don't know whether it's the transmitter or rain gutters, though!

Even the "good" consumer shortwave radios pick up images of 630kc all up and down the bands - but these evidently have no front end preselection. My Ten-Tec RX-320 does pretty well without a filter in front of it, but obviously does have images due to the 630kc station unless I have the filter in front.

Date: Mon, 22 Oct 2007 10:51:20 -0400
From: rbethman <rbethman@comcast.net>
Subject: [R-390] R-390A problems - rethink soil conductivity

I may well be a younger member, I "may" be less experienced maintainer/owner/operator of these fine radios. BUT - I "will" say that there is ONE FACTOR that has NOT been considered!! The EXTREME dryness has made OUR grounds pretty USELESS!!! Between my 3/4" Copperweld ground rods, I CANNOT get ANY conductivity, when the cabling is disconnected! Our ground systems are NIL. The ground from the power company is a center tap of the secondary. NOW - What is THIS effect on OUR signals AND those of the BCB stations? Go outside - pour about 5 gals of water on your (yous/youn) ground rod(s). Then try listening! Here in VA, we are about 20" below normal rainfall.

Date: Mon, 22 Oct 2007 13:51:44 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: [R-390] IBOC - was R-390a Image problem?

>What is "IBOC"?

http://www.udel.edu/nero/Radio/glossary.html
"IBOC In-Band On-Channel. System that would allow digital broadcasting over current AM and FM frequencies. Major companies promoting IBOC included Lucent and USADR USA Digital Radio, Inc. These companies have merged and are now know as <http://www.ibiquity.com/>Ibiquity. IBOC is now refered to as HD-Radio. "   <snip>

The various opinions of those folks seemed to be:
  - IBOC is the thing of the future. Gotta have it. Keep up with Progress!
  - IBOC it devilishly difficult to set up and adjust at the station
  - Careful engineering and diligent attention to the details will solve all those problems.
  - You (the station) need a whole new transmitting antenna to make it work (AM stations esp)
  - The whole thing is unnecessary. Who needs it anyway?
  - The FCC is forcing us little guys out of business
  - More Digits! More services! More money! YAY!!

So if you are tuning around on the AM or FM broadcast bands, and you find yourself trying to fine-tune the station so the fuzz goes away yet the signal is plenty strong, suspect IBOC. And welcome to the world of digital-everything. Ugh.   Roy
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Date: Tue, 23 Oct 2007 02:08:15 -0400
From: "Bob Young" <youngbob53@msn.com>
Subject: [R-390] IBOC

IBOC is trouble Roy, it is bad news on FM where it severely cuts the range, most people need an outside antenna to get across town stations and it is especially bad on the AM band. A station which used to be about 10 Kc wide now takes up 30 Kc, which means that for example WOR 710 now completely obliterates WLW 700 and WGN 720 here in MA. Although depending on propagation, some nights WLW obliterates WOR, other nights they ALL obliterate each other as they all run iBlock at night. It is becoming a big mess and it has hardly begun, less than 5% of AM stations are running it. The digital sidebands sound like some kind of terrible white noise and cover the adjacent channels with noise. If this is allowed to continue the AM BCB will die and be left to a few big 50 KW stations which is probably what they and iNiquity want anyway.

These links will provide you with some of the opposition from broadcasters, industry people and DX'ers alike, about the only people who like are the ones making money from it. It is a monoploy, ONE company owns the rights to it, licenses it and makes ALL the money from it.

http://www.wrathofkahn.org/

http://am-iboc.blogspot.com/

http://www.stopiboc.com/bythenumbers.html

Date: Tue, 23 Oct 2007 21:04:10 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] Image problem cause... sort of

I believe I have a handle (part of a handle) on my image problem. I compared the preselector selectivity of my R-392 to the R-390a and the R-392 is way way better. I put in a signal from the generator on the balanced antenna input and put the spectrum analyzer on the grid of the first RF stage through a 10x probe and a small capacitor.

With the generator at 1.5 Mhz I tune the receiver to 1.5Mhz and peak the antenna control. I note the amplitude of the 1.5MHz signal on the analyzer and then tune the receiver to 3 MHz. On the 390A the 1.5MHz signal drops less than 20db. On the 392 it drops over 50db. I also note that the peaking with the antenna trimmer is much sharper in the 392 than with the 390A. I want to look at some other bands and see if it is like this everywhere.

Date: Tue, 23 Oct 2007 23:48:25 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] Image problem cause... sort of

You may want to include like a 100k in your probe lineup. Make it the last in the lineup (Pictorially: PROBE---CAP---100k--->) to minimize shunt C from the probe.

Looks like circuit impedances are on the high side around there. The 100k ohm may not even be high enough. A trick might be to temporarily repeat the associated trimmer adjustment after connecting the probe so at least the probe's C will be absorbed into the circuit.

Date: Wed, 24 Oct 2007 00:57:52 -0400
From: n4tua@aol.com
Subject: [R-390] 390A ramblings

Still working on the 390A. Work sure does cut into my radio fixin. Oh well. I have got down to step 11 in the trouble isolation testing and have found something. I am putting 3mhz at 10uV with 30% modulation at 1000hz into E210.

I get the required 0 vU indication but it is noise. I can not hear the modulation tone. While back at E211 I could hear the tone fine. Some preliminary checks at V203 look good. Like plate voltage 225vdc and cathode voltage around 10vdc. Book says my problem is at V203. Any ideas from here?

Date: Wed, 24 Oct 2007 07:43:50 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Image problem cause... sort of

I would be surprised if the 392 has more front end selectivity than the 390A up to the first RF amp plate. It's been a long time since I was last inside a 392 though. The 392 is a "390 not an A" clone in that it has two RF stages and a second deck of RF tuning in front of the first mixer. That should give a bit more selectivity in front of the mixer.

Date: Wed, 24 Oct 2007 10:06:11 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] 390A ramblings

Top side first and then the bottom side.

The three filter sections of Z216 are between the two test points. An open wire in one off the cans will get you. A bad slug in one of the cans will get you. There is a lot of circuit in there that you cannot ohm or voltmeter check. However, it does disassemble it parts you can test.

I have not read all your input.
Did this receiver use to work for you and just quit?
Or did you receive the receiver as is and now trying to get it working?

Pull the slug rack and check the slugs in Z216.

You can then remove the cans by removing a Philips machine screw in the bottom of the slug rack tube.

You are looking for crud in the transformer pins and sockets.

You push the clips on the side of the cans in a bit and the cover will slide off.
You then inspect for crud and eyeball the trim caps.
Look at the schematic and test the coil winding for continuity (low ohms).

Put that all back to gather and try it again.

If you do not find a definitive problem on the top side of the RF deck then you will need to pull the deck and do some checking under it. Almost every one has recapped the IF deck.

But the RF deck also has a couple of the plastic caps that fail. Your deck may still have some old caps that need to be replaced. Often someone will run a tube to death and char a plate resistor or cathode resistor to near death.

They change the tube and the receiver works. The charred parts get left under the deck.

Pull the deck and do some measurements on the resistors.

Check the continuity of the signal paths for a cold solder joint or broken wire.

Check your band switch alignment while you have the deck removed.

Check for a bad pin in a tube socket. These crack once in a while.

In order the problems are mostly:

Crud in contacts
Bad cap
Charred resistors
Cold solder
Open wire at a solder point.

Date: Wed, 24 Oct 2007 23:23:17 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] Image problem solved

I was using an BNC to twinax adapter which grounds one side of the balanced connection. When I remove this and run the signal generator or antenna two the balanced pins without tying one side to the chassis, I can see nothing on the spectrum analyzer. That is, with the receiver tuned to 3 Mhz and the sig gen at 1.5MHz, I see nothing at the input to the RF amplifier.

Looking at the schematic, they show a field change which grounds one side of the balanced input but SWAPS J105 AND J106. They were not swapped in my receiver. Swapping them and then going back to my adapter gives much improved performance. I don't hear the 1650KHz

broadcast station at 3.3MHz any more but I can again see some a 1.5 MHz signal at the RF amp input when the receiver is tuned to 3 MHz. But it is way down from before. The best performance for the preselector seems to be with J105 and J106 not swapped and neither side of the balanced input grounded to the receiver chassis.

Date: Thu, 25 Oct 2007 02:03:12 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] Image problem solved

Please see inline.

>I was using an BNC to twinax adapter ....

So it sounds like you are saying that you are feeding the two balanced twinax pins in common mode, i.e. the twinax pins are tied together and fed with the center conductor of the coax. Coax shield to radio case/ground. Is this correct?

>Looking at the schematic, they show a field change which grounds one
>side of the balanced input but SWAPS J105 AND J106.

It sounds like the intent of the field change is to ground one side of the balanced input and transfer the other side of the balanced input so that it would appear at the single ended connector referred to at least on my schematic as "J103 Whip Unbalanced". Is this correct?

> They were not swapped in my receiver..............

I'm not getting this part because it sounds like the balanced input is being fed common mode.

Maybe I'm misunderstanding what you mean swapped and not swapped.

Date: Thu, 25 Oct 2007 07:24:26 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Image problem solved

Swapping around the cables on the back of the radio can have you routing the signal into the "whip antenna" input when you think you are running with the normal antenna input. You *will* overload the radio if you put much of an antenna on the (unbalanced) whip antenna input.

Date: Thu, 25 Oct 2007 06:36:12 -0600
From: "Tony Casorso" <canthony15@msn.com>

Subject: Re: [R-390] Image problem solved

No, I am not feeding the two balanced inputs the same signal. I tied the shield of the coax to one sine of the balanced input amd the center of the coax to the other side. I just don't tie either side to chassis at the same time. This seems to give the best results.

The field change connections look odd to me as well but I tried it because it was shown that way on the schematic.It does seem to work much better, but not as well as lifting the chassis ground from one side of the balanced input.

The schematic I am referring to is in TM-11-856A.

Date: Thu, 25 Oct 2007 08:14:15 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Image problem solved

Now that I look at it more closely, I see that the field change just moves the whip input to the balanced connector while grounding one side of the balanced input and connecting the other side of the balanced input to the unbalanced connector on the back of the radio. A mouthful. The net of it is that swapping the cables and using my twinax-BNC adapter is exactly the same as using the unbalanced input without swapping any cables. Also, with the cables swapped, the unbalanced input becomes the same as using my twinax-BNC adapter when the cables aren't swapped. I recall that when this all started, using the unbalanced input seemed to work better, but I never made any measurements on it. As for overloading, I guess I don't see why you say that. From the schematic, both antenna inputs end up at the grid of the RF amplifier. The antenna trimmer is in the exact same place in the circuit. Unless the preselector RF transformers have a step-down turns ratio, I wouldn't expect the unbalanced input to exhibit any more tendency to overload than the balanced input. From this, it sounds like I am saying that grounding one side of the balanced input is a bad thing. This contradicts conventional wisdom. So, either conventional wisdom is wrong, or there is still something going on in my radio and all of this is just another clue. One other thing, the neon bulb is only connected to the unbalanced input.

Date: Thu, 25 Oct 2007 11:45:27 -0400
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] Image problem solved

Can you give a page/figure reference for the field change? I'm looking at "TM 11-856A Dept. of the Army, January 1956" and I'm not seeing the

field change. My copy may be too old. If so, might you be able to direct me to a newer copy?

Date: Thu, 25 Oct 2007 12:10:42 -0400
From: "Bob Young" <youngbob53@msn.com>
Subject: [R-390] Image problem solved

I'm a medium wave DXer with two 400' LW's going through a phaser which does not amplify the signals, I have a 50KW station less than 10 miles from me. I have my antennas connected through the phaser then going to the balanced input with one side grounded and have no image problems. The radio is much more sensitive connected that way than if you use the unbalanced input. This and other close by stations used to overload my old phaser to the point of which I couldn't use it, many people use this one with no problems, the reason I mention this is to let you know how much RF I have here especially with the long antennas. I don't know if J105 and J106 were swapped although I suspect they were.

Date: Thu, 25 Oct 2007 10:10:47 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Image problem solved

I am looking at a PDF of the manual. Lets see how many ways I can describe it. The schematic sheet I am looking at is spread over 6 PDF pages. On page 202 of the PDF document is the last of the 6. It says "Figure 5-13 (schematic diagram) sheet 1 of 4. Then below that it says 5-37,5-38 which look like section and page numbers to me. This giant sheet is a schematic of the front end starting at the antenna on the left edge. The PDF page with the antenna stuff is page 197. The border of the schematic here shows zones A through E up the left edge and zones 16 down to 13 on the top and bottom edges. The FC is in area D and E, 16 and 15 where it says FC NO. 5 see note 3. The unmodified circuit is shown in area B and C , 16 and 15. Hope that helps.

Date: Thu, 25 Oct 2007 12:19:55 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Image problem solved

Get and print the "Y2K Release 2" manual ....   "NOTES:
1. REVERSE CABLES TO J105 AND J106. USE J103 AS ANTENNA INPUT JACK.
2. SHORTING PLUG REQUIRED ON J104."

Date: Thu, 25 Oct 2007 17:40:53 -0600
From: "Tony Casorso" <canthony15@msn.com>

Subject: Re: [R-390] Image problem solved - Not.

Sorry everybody, I lied. I didn't mean to but I did. Tonight I tried to repeat the experiment and it doesn't work. Lifting the ground from one side of the balanced input does absolutely nothing to help the situation. I'll bet that I had a bad connection to one side of the balanced connector since I had to jerry rig it to connect my BNC from the antenna to the balanced input without ground. I hear no harmonic at all when only one pin of the balanced input is connected to the antenna. I also hear only a faint hint of a harmonic when I use the unbalanced input. So, I still have the problem (if it's really a problem). It's not an image problem really. I'm sorry I called it that. It has nothing to do with the IF. I'm going to go away now. I'll make sure everything is repeatable before I bring it up again. I feel like the Rockies must feel after the disaster in Fenway last night. Well, maybe not quite that bad.

Date: Thu, 25 Oct 2007 19:49:20 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Image problem solved

Page 5-44 in the Y2K manual shows the RF input to the radio.

The unbalanced input goes straight to the grid of the RF amp via C212 (39 pf) on the 2 to 4 MHz band. The input impedance at this point is around 10K ohms.

The balanced input goes into the tuned circuit L214 + caps. It's coupled to the second tuned circuit 215 and associated caps. The input impedance on the L214 side is around 400 ohms or so. When you put a low impedance antenna or generator in via the C212 route you de-Q the front end big time. That's can give you the "image" problem.

Date: Thu, 25 Oct 2007 19:51:13 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Image problem solved - Not.

If you are going to run with one side of the balanced input shorted to ground - the radio must be aligned in this configuration. Grounding "half the input" noticeably throws off the alignment.

Date: Thu, 25 Oct 2007 21:05:54 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Image problem solved - Not.

Just out of curiosity, how "hot" is the receiver on the bands in question? The CAL signal should be probably no more than mid scale on the signal meter (if using an original meter). The manual says about 2 units minimum. If your front end RF amp is not getting AGC it could cause an overload and make the radio appear to be very hot (sensitive). The front end AGC can be affected by things like oil on the Ant trim shaft insulator (seriously), a leaky AGC cap in the RF module, etc. Have you replaced the RF amp tube?

Date: Thu, 25 Oct 2007 21:40:15 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Image problem solved - Not.

For what it is worth, Tony, I asked around about your problem with people who have had extensive experience with troubleshooting R-390A's. All four said the same thing. AGC on the first RF stage is driving it too hard, and into distortion. I just gave the symptoms, not that you had worked on the AGC transformer. That may not be it, but it is the first place they would start.

Date: Thu, 25 Oct 2007 22:01:47 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Image problem solved - Not.

What about the first mixer V202 (6C4) - if it isn't getting good AGC, or insufficient oscillator injection, can an overload in that stage cause this?

Date: Thu, 25 Oct 2007 20:03:52 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Image problem solved - Not.

Thanks for asking around for me. I did check the AGC (-11 volts to 1st RF amp grid on a strong local station). The thing is, the actual signal at the frequency I am tuned to is not that strong. I am tuned to 3.3MHz where there is actually no signal being transmitted. The signal that I am hearing is being transmitted at 1.65MHz. Normally, AGC does not even operate in this situation because there is no signal at 3.3MHz where I am tuned. So, once I hear this harmonic, it's already too late for AGC to prevent it. I don't think I am explaining this very well.

Suppose the 1.65MHz signal was just below the threshold of causing this problem? I would hear nothing at 3.3MHz and there would be no AGC at all. Now turn up the 1.65MHz signal a little bit and I have the problem. How could AGC have prevented it? I'm not sure thats much better. Anyway, I still say that the front end preselctor is way too broad in this situation. Talking to Bob gave me an idea that is probably all wet. If the impedance of my antenna system at 1.65MHz were really low, say a few ohms, would this kill the Q of the preselector at that frequency? Putting a

220 Ohm resistor in series with one side of the balanced input reduces the 1.65MHz signal at the input to the RF amplifier enough that I no longer hear anything at 3.3MHz. Increasing it to 2200 Ohms reduces the 1.65MHz signal at the RF amp grid when tuned to 3.3MHz by 30db while only reducing the signal when tuned to 1.65MHz by 8db.

This says to me that the Q is much better. I wasn't going to keep this up here on the list but people keep asking me questions... :).

Date: Thu, 25 Oct 2007 22:15:02 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Image problem solved - Not.

If you have one and only one station giving you a second harmonic you have no problem. Its easy to get enough second harmonic from an AM station. The harmonic is not necessarily being radiated from the station antenna. Lots of junk in any yard will get you a harmonic. If you are getting lots of stations moved up on frequencies think about a strong station mixing every thing up to some new sums. There are stories of every thing from gutters to ground wires acting as mixers. I have my own horror stories myself. Do the sensitive and signal to noise test for your receiver. If its up to snuff for sensitive and signal to noise then I would expect you have some external mixer in the neighborhood. The fact you do not have the problem with any other receiver is no positive test that the problem is in your R390A/URR.

Date: Thu, 25 Oct 2007 22:36:55 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Image problem solved - Not.

Second order distortion should follow a normal power law. More or less, you should get a larger drop in the "spur" than in the signal generating the spur. I'd have to dig out my old course notes to be sure, but a 2:1 ratio in db sounds right for second order.

Date: Fri, 26 Oct 2007 06:28:40 -0400
From: "Jay Rusgrove" <JRusgrove@comcast.net>
Subject: Re: [R-390] Image problem solved - Not.

A 2nd order product (2*F1) drops 2 dB for each 1dB drop of the input signal and a 3rd order product(2*F1-F2 and 2*F2-F1) drops 3 dB for each 1 dB drop of the input signal. A step attenuator in series with the antenna will help answer the question as to whether the problem is in the receiver or external to it. While listening to the undesired signal click in say 6 dB of attenuation.

If the undesired signal drops by ~12 dB it's a 2nd order product. If it drops by ~18 dB it's a third order product. If the undesired signal drops by 6 dB it isn't a 'phantom' signal being generated by the receiver, however, it could still result from poor image rejection.

Running the known frequency and oscillators numbers will show whether or not it could be an image.

It's a good idea to click in an a few dB before running the test and leave it in to help 'flatten' the match between antenna and receiver.

Date: Fri, 26 Oct 2007 08:37:16 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Image problem solved - Not.

Just a fine point that may help: A harmonic from an AM station does not sound like the fundmental signal. All the signal is doubled (or tripled) including the modulation sidebands. So it won't sound right. A mixing product will sound right or at least more intelligible. Some other signal combines with the AM station one to produce a signal shifted in frequency, just like in the receiver as signals are mixed (usually down in frequency) to the lower IF frequency. I think that in this situation, a lot can be learned with a signal generator fed into the antenna jack.

Date: Fri, 26 Oct 2007 09:22:19 -0400
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Image problem solved - Not.

Now that is a handy tip.

Date: Fri, 26 Oct 2007 10:19:28 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Image problem solved - Not.

Roy, Good points. Most of the stuff I hear then has to be mixed products. Because the side bands are not doubled and sounding like garble. I have a bunch of mixed signals hear from a local powerful AM station. I have always liked in urban areas and have just accepted the birdies.

Date: Fri, 26 Oct 2007 13:47:26 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Image problem solved - Not.

I turned the Collins 390a on today with a quiet 2-4 Mhz band and tuned around. It is connected to an inverted vee outdoor antenna. I also have a second 390A (Stewart Warner) in the garage connected to a wire in the attic. Here's the scoop:

The Collins 390A:

Wow, talk about images! I never noticed before. Here is my nearby strong signal environment: One broadcaster operates at 1240 (75 dB signal) and is now carrying Rush Limbaugh. Another strong signal at 920 is carrying Bill O'Reiley (82 dB signal). An oldies music station is bombing in on 1560 (85+ dB signal). All within a few miles. Switching up to the 2 Mhz band, on 2480 Mhz (twice 1240) I see a 32 dB image which is a mix of oldies music (from 1560) and Bill O'Reilley (from 920 AM), but I hear no Limbaugh (from 1240). Up the band, there is a 2800 Mhz image that has a strength of 20 dB, and is a mix of oldies (from 1560) and Limbaugh (from 1240), but not Bill O. I mention the broadcast content only because it was easy to recognize by ear where they were coming from. Next band up, on 3120 Mhz I hear a clean image (30 dB) of the oldies station (from 1560) all by itself. I hear nothing at higher frequencies.

Now for the Stewart Warner in the garage: No images detected at all on the SW, even though the original signal meter strengths of the stations is about the same as for the Collins. (unfortunately there was a 30 dB line noise from attic wiring, but I heard no image carriers under the noise with BFO turned on).

So.... This Collins 390a (with Collins RF deck) is hopping with images from AM broadcasters, I just never bothered to notice them before. But apparently not the Stewart Warner. When I get the chance, I am going to connect the SW to the outdoor antenna for another comparison. It is unknown what the differences between the two RF decks could be, however I have noticed that the Collins does tend to be a much "hotter" receiver than the SW, good AGC action... but tending to pop up the noise floor when no signals are present. Maybe too hot.

Date: Fri, 26 Oct 2007 14:19:00 -0400
From: Barry <n4buq@knology.net>
Subject: RE: [R-390] Image problem solved - Not.

This may not have anything to do with it, but do you know if both IF decks are stagger-tuned?

Date: Fri, 26 Oct 2007 15:34:51 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Image problem solved - Not.

I don't know about the Collins (never aligned the IF), but I did align the

SW's IF, but not staggered tuned. Regardless, I don't think that IF alignment would cause these images. I think there may be a stage in the RF front end that is running too "hot" in terms of gain, or in need of more AGC control. I don't have the energy now to take them out of their cabinets now to do any A-B comparisons.

For what its worth, I just turned on the Icom 775DSP to the inverted vee and tuned to the same image frequencies I saw on the 390a, and I do indeed hear the same images (!), but not as intelligible and quite a bit closer to the noise floor.
On the 775, the images are all between about S-6 about S-8, and seem to decrease normally (following the noise floor) as I add attenuation, using the 775's built in attenuator. The 2480 image sounds like a "beat" between two modulated carriers close in frequency, with a beat rate of about 4 per second. The 2800 image is hearable but right at the S-6 noise floor.   The 3120 image (from the 1560 oldies station) is S-9 but distorted. I wouldn't expect the 775DSP to have a bad image or overload problem, especially with the built in attenuator. So now it looks like these image signals are really coming in on the antenna to some degree. Maybe produced by some external mixing phenomenon. Now back to square one.

Date: Fri, 26 Oct 2007 22:59:35 -0700
From: Renée Deeter <k6fsb.1@gmail.com>
Subject: Re: [R-390] Image problem solved - Not.

I have an original 390A all Collins sn 122 as well as an all original EAC sn 6k? (I forgot to note sn at the rear- no front tag). The Collins has an extremely hot front end, two things I do note the oscillation suppression grid resistor is missing, and the AGC voltage divider were non existent both since fixed/upgraded. The problem has nothing to do with IF decks. The early IF decks are not stagger tuned (I have two) and the later ones are. Having swapped IF decks -Stewart Warner (my development deck) both Collins Decks and the EAC. The IF decks made very little difference on how hot the RF section runs. AGC has been extensively modified. both are similar in images present however far worse in the Collins. Both run Great! the Collins I run with the RF gain just a touch off max.I have not taken the time to figure why...it is on my list of things to do.......

Date: Sat, 27 Oct 2007 08:09:46 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] Re: Spurious Resonances

I should have thought about it for a few more minutes. Maybe the sweeper has a strong second harmonic that is visible near 1.5MC.

Date: Sat, 27 Oct 2007 08:35:55 -0600
From: "Tony Casorso" <canthony15@msn.com>

Subject: Re: [R-390] Re: Spurious Resonances

How lucky can I get? I posted a set of images this morning that had a "spurious response" in it. It turns out it was cause by the settings on my sweeper (DC Offset was cranked over to one side for some reason). The mailer was unable to post it for some reason so I get to try again with good pictures.

Here are links to couple of pictures. I am sweeping the preselector in my R-390A. The left edge of the sweep is 1.5MHz. The right edge is 4.5MHz. The center is approximately 3MHz. The receiver is tuned to 3.00MHz and the power is off. I am measuring the response at the grid of the RF stage.

The broader response picture is with the 25 Ohm (gen with 50 Ohm terminator) sweep gen directly connected to the balanced input. The sharper response is with a 2.2K resistor in series with one side of the balanced input.

It looks like I was right that low source impedance broadens the frontend response.

http://i25.photobucket.com/albums/c90/tonysradios/IMG_0825.jpg
http://i25.photobucket.com/albums/c90/tonysradios/IMG_0826.jpg
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Date: Sat, 27 Oct 2007 10:45:28 -0400
From: "Steve Hobensack" <stevehobensack@hotmail.com>
Subject: [R-390] Adjusting a frequency standard

Here is a nice easy and accurate method of adjusting your frequency standard crystal inside your modern transceiver. Tune an auxiliary receiver to WWV in the AM mode. Run the audio to the vertical input of an O'scope. Put your transceiver in sideband mode and tune the dial accurately to the same wwv signal. Go for dial accuracy, not zero beat. Run the audio to the horizontal input. Wait until the WWV signal has the typical AM tone modulation (440 or 600 cycle). When your rig is near zero-beat, you will see a wobbling circle on the o'scope. Adjust your rig's frequency standard until the circle stops wobbling with the plane of the circle broadside to your eyes. Your rigs frequency is now set.

Date: Sat, 27 Oct 2007 11:04:01 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Re: Spurious Resonances

What are you picking off the output with? Picking off at the plate would be a *much* better idea if you are trying to measure the input circuit. You

will have far less impact from the probe that way. If you want to suppress the effect of the output tank, swamp it with a low probe impedance.

Date: Sat, 27 Oct 2007 09:39:53 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Re: Spurious Resonances

I'm not sure what you are getting at. I used a 10x scope probe connected to the grid of the RF stage. I want to measure the response of the preselector. I do not want to swamp anything. The two pictures show a sharp response from the preselector in one case, and a not so sharp response in the other case. The only difference is the impedance of the signal source connected to the antenna.

Date: Sat, 27 Oct 2007 09:51:04 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Re: Spurious Resonances (was images)

Maybe the "spurious response" subject is confusing. I should have titled it differently. I made it spurious because I shouldn't have titled the original thread "images". These are produced by non-linearity, not by mixing at the receiver mixer. Also, when I took the pictures at first, there was an extra peak near 1.5MHz so I had "spurious resonance" on my mind. The problem was the offset control on my sweeper. As I said, the pictures just show the response of the preselector. With a 25 ohm source I am getting about 15 db attenuation at 1.5MHz relative to the peak at 3MHz. With a 2K source it is more like 25 to 30db (it's hard to be sure how fat that line is at 1.5MHz). Maybe the title should be "spurious thread" ;) .

Date: Sat, 27 Oct 2007 12:27:08 -0400
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: RE: [R-390] Re: Spurious Resonances (was images)

When you connect a test probe to a high impedance tube circuit, especially the grid, the probe may change the circuit parameters and cause strange behavior.

A "10X" probe may not be high impedance (in terms of tube type circuits).

Also, any signal picked up by the probe itself can show up in the measurement.

A VTVM or RF voltmeter having very high impedance probe inputs is preferable (10's-100's of megohms).

Not sure this is affecting your tests or not...just my 2 cents worth.

Date: Sat, 27 Oct 2007 12:36:14 -0400
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Re: Spurious Resonances

Any filter is going to respond to it's termination impedances. Both the input and output impedance are significant. The grid of the RF stage looks like > 100 meg ohms resistive at RF. It's got a bit of capacitance, but not a whole lot.

If you look at the preselector like a single tuned circuit, it's going to have Q. The Q is going to be determined by:

1) The resistive portion of the source resistance driving the preselector, relative to the
reactances.
2) The Q of the coils themselves
3) The resistive portion of the load resistance, relative to the reactances.

The "relative to the reactances" part gets a bit crazy because you normally have part of the resistances in series form and the other part of the resistances in parallel form. There is a great thing called the "Q formula" that lets you convert them all back and forth. It was a staple in EE texts up through about 1954.

Vacuum tubes have really low Gm compared to just about anything else. To get a stage to have gain, you need very high impedances. The normal way to make stuff work was to run impedances way higher than we do today. You can easily fake yourself out going from solid state to tube. Loading is a much bigger deal when checking tube circuits.

A measurement you can make on a solid state amp with very little interaction, is much more difficult to make on a tube circuit. An easy way to see this is using a DVM on an R390. The numbers don't come out right. The input impedance of the DVM is not as high as that of a VTVM. The DVM is fine on solid state, it's not up to the task with tubes.

By going to the plate for your measurement, the load resistance is no longer interacting with the preselector at all. The source resistance is still there, but the antenna has source resistance as well. Once you have the load impedance out of the way you can be reasonably sure that what you are measuring is "real".

Since you are after second order distortion, every db you knock down the input counts as two db at the output. If you were talking about third order (intermod) distortion, each db of attenuation would count three db. A 30 db selectivity in the preselector will take second order distortion down 60 db and third order down 90 db. At low levels, a tube amp should have second order distortion down > 30 db with no preselection at all.

If the response you see is at exactly twice the input frequency, it's second order distortion. The conversion scheme in a 390 does not produce other spurs that follow a 2:1 ratio like that. You can write a book about all the possible spurs that can occur (and people have). The math is pretty simple. It's been mentioned before in this thread. Take the two sine waves, add them or subtract them. Take that and raise it to an integer power. Powers of 0,1,2,3,4, and 5 are commonly
used. If you have a mixer you have three signals rather than just two. The same "raise it to a power" is used. You can include AM, FM, and PM in the signal equations. AM, and FM modulation transfer differently through each spur generating process. AM is transfered by all of them to the extent that the amplitude of the output will follow the amplitude of the input through the db/db ratio for that response. So much fun .....

Date: Sat, 27 Oct 2007 10:44:36 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Re: Spurious Resonances (was images)

I used a 10x scope probe which has about 10pf and 10Meg. The extra capacitance just shifts the resonant peak a little to the left. I can re-peak at 3MHz with the antenna control. At 30Mhz the probe would make a much bigger difference.

Date: Sat, 27 Oct 2007 11:10:24 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] Re: Spurious Resonances

OK. I get this. But I was not trying to show any distortion in the pictures. All I was trying to show is that the Q of the preselector degrades when the source impedance is low. Thats it. If it's no surprise then so be it. The consequence of this is that, with the receiver tuned to 3 MHz, a 1.5Mhz signal at the antenna terminals is going to be 10 to 15db stronger at the grid of the RF stage if the antenna impedance is low . This stronger signal is more likely to cause overload and harmonic generation in the RF stage. The downstream filtering in the plate of the RF stage and the plate of the mixer stage will kill the 1.5MHz signal so the AGC does not respond to it. So the RF stage has a strong signal at it's grid (1.5MHz) and no AGC to compensate for it. So it distorts and produces harmonics in the plate circuit which is tuned to 3MHz. The harmonics are amplified and fed through the mixers and onward right through the receiver. I don't think the loading of a 10Meg probe is going to kill the Q that much at 3MHz (my "sharp" picture is made with the probe connected after all). The capacitance will shift the resonant peak slightly at 3MHz. Even if I did reduce the Q with my scope probe by some amount, the low impedance source reduces it by a much greater amount. If I had a 100x probe I might see a 40db attenuation at 1.5MHz relative to the peak. But I would still see the 15 db attenuation with the low impedance source.

I found an antenna impedance calculation program on the web for inverted Ls where you can specify the length of the horizontal part and the vertical part as well as the length and gauge of the ground lead and the gauge of the antenna wire. I tried it for my antenna dimensions using zero for the length of the vertical segment. Not that I believe it, but it came out 18 ohms at 1.65MHz. I wonder if I could sweep it with the antenna connected?? Probably too much BCB stuff to see what is going on down there.

Date: Sat, 27 Oct 2007 14:55:39 -0600
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] Antenna sweep

This is a sweep of my antenna from 1MHz to 5MHz. I made it bigger so that the details can be seen. The underside of the curve (the cutout) is the antenna response. The flat(ish) top is the output of the sweep generator. This is put through a 2200 Ohm resistor to the antenna. The antenna resonse is with the probe on the antenna side of the 2200Ohm resistor, and the flat top is on the generator side of the resistor. The horizontal scale is 500KHz per division with 0KHz on the left edge of the screen and 5MHz on the right edge of the screen. The vertical scale is 10db per division. The antenna response peaks at about 3.75 MHz with another peak at 2MHz. The peak is 20db down from the generator output. This means the antenna looks like about 220 ohms at 3.75MHz. There are valleys at about 1.4MHz and 2.5MHz that are about 40db down from the generator output which means the antenna impedance is about 22 Ohms there.You can see a lone peak sticking above the generator output at about 1.65 MHz. Thats my friendly problem station.

http://i25.photobucket.com/albums/c90/tonysradios/IMG_0828.jpg

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Date: Sat, 27 Oct 2007 17:25:16 EDT
From: SHELLY199@aol.com
Subject: [R-390] Re: Images

I've got two R390A's sitting next to one another. Both are fed thru a HF Multicoupler from a Pro-67 antenna. The pro-67 is 2 elements on 40 mtrs with the normal stuff for a multi-element beam above that. The audio from each rcvr is fed into a 16 channel Roland mixer. The Multicoupler is 50 ohms in and 50 ohms out and has a 10 db switchable pre-amp. The balanced antenna is being used with the one side grounded. Both rcvrs were aligned with a 50 to 120 ohm 10db pad between the generator (HP 8656B) and rcvr. Both rcvrs, one a 67 EAC and one a 63 Imperial, were both totally restored within the last year. That means completely torn down and any suspect component from any of the units replaced. All bands of both rcvrs have a 10db S+N/N sensitivity of >.5uv

The qth here is the north end Staten Island, 3 or 4 miles from lower Manhattan. We have a great deal of very strong signal am broadcast stations in this area. I've been following the thread since day one. I've always noticed that on all my r390a rcvrs there is some image activity in the 2 and 3 mhz bands. Some time back, I've gone to the trouble of sitting 3 ea. R390A's side by side and observing exactly the same thing on each rcvr.

As an example from today, 1560 KHz and 1130 KHz are both coming in on 2690KHz. Both 1560 and 1130 are about 95 db on the carrier meter. Listening on 2690 and detuning the antenna trimmer to 4 increases the audibility and decreases the rcvr noise. The birdie sig strength on the carrier meter is about 35 db. Turning on the preamp increases the signal level of the birdie by 20 db while increasing an actual signal by only 10 db. Another example, 2790 is the birdie and 1130 with 1660 are combining. Also see that 1280 is coming in on 2560. 1280 also comes in on 2410 with some other signal and read 52 db on the carrier meter. There are a total at least 14 birdies between 2 and 3 MHz and all from broadcast band signals. The antenna was also connected directly to the antenna without the multicoupler and it made no difference. I have listened with both rcvrs on the 3 MHz band and don't hear anything that shouldn't be there.

I also listened for birdies on the IC781 and found none from 2 to 3.5 Mhz.

What's this mean? I have a headache from listening to the radio right now.

Date: Sun, 28 Oct 2007 17:49:16 -0400
From: "Gregory W. Moore" <gwmoore@moorefelines.com>
Subject: [R-390] A little off topic, satellite TV receivers and image freqs

Does anyone in the group have any experience with NEW (as opposed to the 1970-80 vintage satellite recievers? Specifically the IF of the LNB, the LO and also the IF of the reciever/descrambler. I have a strong CW signal on 32 (Actually 29.998 Mhz) with an audio image on roughly 600Hz intervals, as documented by a spectrogram, using Spectrum Lab. I can't copy the MixW waterfall, as the 'puter which I am using for all my radio equipment doesn't have any photo programs with screen capture capability.

It not only is effecting my Digital Cable and Digital voice thru Comcast, but is S9 on my gud ole ICOM 746PRO. Had a cable tech out (one who actually knew something about electronics, after going thru about 6 doofuses) with his handheld spec analyzer, and he ID'd the sig coming from my neighbor. I suspect that this could be wrong, as there are at least 8 dishes on my block (row house neighborhood, all the houses next to eachother), and most of them are aimed differently. I can ID at least 3 aimed right toward my property.

OK, the 32MHz freq is actually one harmonic, as I have heard the same CW sig as far down as 6 MHz, and it appears to attenuate above the 32Mhz. I have, just to be informative, informed the Friendly Candy Company about this, and they are going to send a "sniffer" out to try and seriously DF the signal, as with my present antenna configuration, I simply don't have HFDF capability without building a couple of loops and a sense ant from scratch, as well as the electronics involved.

Now here's some add'l info... I don't know who the satellite service provider of the neighbor is, but I do know the neighbor on the other side from the suspected source has a 3LNB dish and simply thru a little dectective work, learned that he has broadband computer uplink capability.

I don't want to look like I have my tinfoil hat ready to don, unless I have some more info than I already possess. Sri guys, I have been HF/VHF/UHF all my life (both an electrical and aeronautical engr, but spent most of my time in the pointy end as a comml pilot in Flight Test, until a closed head injury and venous stasis retinopathy in my left eye made the FAA yank my medical, as well they should, considering I have vertigo in the QTH, and wind up "flying IFR" by using horizontal surfaces as a horizon, just like using one's ADI/Gyro horizon to fly
IFR --hi-- so the training still pays off..)

Any info that would be offered would be greatly appreciated, because I do suspect that I am dealing with a real dirty LNB here, and don't want to go around pointing fingers at neighbors who have been really great about my "antenna farm", and never have complained about any interference from this station. I am going to x-post this msg on my other radio groups in hopes that
someone will have the info I need. If anyone wants to see the spectrogram display, I will put it up on my website, but will wait until someone actually wants to see it....

Date: Tue, 6 Nov 2007 08:27:53 -0700
From: "Tony Casorso" <canthony15@msn.com>

Subject: [R-390] BCB "images" on R-390a - progress

Hi everybody. I believe I have gotten to the heart of the issue with the spurious BCB images that appear on some of our receivers above 1.7MHz and below about 3.4MHz. I have a simple experiment that will demonstrate this on your receiver and it would be interesting to see results from others who try this. First the causes I have found. There are three that I have seen here and a fourth that has been brought up as we talked about this before.

1. BCB station harmonics. The broadcaster is the cause. The station that was a problem for me in my previous threads changed ownership last week and the new owners are producing a second harmonic that is 45 db down from the fundamental. Since the fundamental hits over 90db on my s-meter, I still get a good signal at the second harmonic. If you don't have a spectrum analyzer, you can buy or build a simple BCB filter. If the filter does not reduce the signal at the second harmonic then it is not the broadcaster.

2. RF stage being overloaded by a super strong broadcast signal. The overload produces second harmonics in the RF stage. These will abate when a BCB filter is installed as long as the cutin frequency of the high pass filter is high enough. In my case the station was at 1650 so a typical filter that you buy off the shelf would not help much because it was only 3db down near ths frequency. I built one with a cutin at about 2.5MHz. A characteristic of this one is that you only hear the the offending station at the harmonic frequency rather than a mix of stations.

3. Same as 2, overloaded RF stage but you hear a mix of several stations on top of each other in the 2 MHz band. The cause is mixing of less strong broadcast stations with the super strong one in the RF stage. In my case I could hear the 1650 station and a 950 station simultaneously at 2600 KHz. This is the sum of 1650 and 950. The mixing products of all of the signals present in the RF stage will be heard. Mixing signals between 500 and 1700KHz will have first order products in the range of 1Mhz to 3.4MHz.

4. External mixing. I have not observed this but it has been well documented in the past.

Case 3 is easily reproduced with two signal generators and a BNC Tee. In my case I set one signal generator to 600Khz with 1KHz modulation and the other to 1.5Mhz with no modulation. I tee the outputs together (OK when the generator has 50 Ohm output with attenuation) and plug them into the receiver antenna jack. I tune the reciever to 600Khz and adjust the RF level for about 40db or 50db on the carrier meter to simulate a moderate to weak broadcaster.

Then I tune the receiver to 1500KHz and adjust the other signal generator for 90+db on the carrier meter o simulate my strong broadcaster. Now tune the receiver to 2100KHz wich is not a harmonic of either 600KHz or 1500Khz, and you will hear the mixing product signal. Now you can reduce the 1.5Mhz signal until the mixing signal disappears and tune back to 1.5Mhz to measure the relative strength of the signal necessary to induce the mixing.

On my R-390A, the threshold is about 77db. The nice thing about this experiment is that the choice of frequencies makes the harmonic content of your generator less important. Case 2 cannot be measured unless the generator harmonics are way down.

Moving the BNC tee over to my R-392 I find that the threshold is about 10db higher. Maybe because of the 2 RF stage design. I have 26FZ6 tubes in the 392. I might try 26A6s just for fun. It would be interesting to look at an R-390 but I don't hve one.

As mentioned in earlier posts, the antenna impedance at the frequency of the strong station can make things worse if it is unusually low by loading the preselector and broadening it's response.

Date: Sat, 17 Nov 2007 13:41:40 -0500
From: Jon Schlegel <ews265@rochester.rr.com>
Subject: Re: [R-390] Alignment tools

Hollow State Newsletter Number 29 regarding alignment recommends TV Alignment Tool set # 64-2223 from Radio Shack.

Date: Sat, 19 Jan 2008 16:26:27 -0700
From: "Tony Casorso" <canthony15@msn.com>
Subject: [R-390] R-390a Front End Selectivity

You all probably remember the thread I started about my problems with a strong local AM station (groan). I mentioned this problem in another forum and was chastised and told to "fix the radio". Well, I'm still not convinced entirely that my radio is OK and today I swept the front end of the R-390a and compared it to my R-392. I have a picture of the results to share:

http://i25.photobucket.com/albums/c90/tonysradios/IMG_0856.jpg

The sweeps of the two radios are shown on the same display using the memory feature of the spectrum analyzer. I am sweeping from 0 to 5MHz and both radios are tuned to 3.3MHz. The sharper response with the lower peak is the R-392. The wider, taller response is the R-390a. As I mentioned last time, I can't find anything wrong with the R-390a. The same sort of result is obtained on the 1-2MHz band. I am attributing the higher response of the R-390a to the turns ratio of the front end RF transformers. In both radios I am monitoring the grid of the first RF stage with the power off using a 10x scope probe. The input signal is about 160mv peak to peak for this picture. I am using the balanced input on the R-390a.

To get the picture I am using the sweep generator to sweep at about 1 or 2 Hz sweep rate and the spectrum analyzer in peak-hold mode. I have checked for a proper RF ground at the AGC feed point. All resistance checks look correct. I just can't believe that this is the way it is supposed to look. If somebody else could duplicate the R-390a result (or refute it) I sure would appreciate it.

Date: Sat, 19 Jan 2008 18:37:11 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Can't post links at all

You just cannot put addy on in the mail. This is old technology here on the reflector with lots of traps turned on to keep the trash, span and bugs to a minimum. You can type in a web site address, but if your mail tool turns the link a color it indicates the link is active and it will not pass the forward filters.

No art not active links no photos imbedded in the mail.

Sorry it is just the way it is.

Put up some new mail.
Ask if someone will post the photos for you.
You can then mail them the photos direct.
They will post the photos on their web page
And put out a mail with the web page address.

Then we all have to go and look at your new photos.

Its all a round about but it gets the message out and we do not get a lot of spam. Looking forward to seeing the photos.
Sorry I do not have a web page my self to offer you.
Alternate rough is to direct mail to any one that ask for a direct mail with attachments.

Date: Sat, 19 Jan 2008 18:52:38 -0500

From: roy.morgan@nist.gov
Subject: Re: [R-390] R-390a Front End Selectivity

May I paraphrase? I have two vehicles, and the intake ports are not the same at all. One is a tractor and has an intake port about three inches in diameter. The other one is a Ferrari with eight ports, each only an inch and quarter in diameter.Why the difference? Well... I suggest it might be good to try the two radios each as a whole.

> As I mentioned last time, I can't find anything wrong with the R-390a.

There may be nothing at all wrong with the R-390A OR the R-392.

> ... I am attributing the higher response of the R-390a to the turns ratio of the front end RF transformers.

A number of factors affect the frequency response of the first stage in a radio: among them would be: The Q of all the tuned circuits, the coupling of the input circuit to the secondary, The load on the secondary, the value of the driving impedance (antenna or signal generator).

> I have checked for a proper RF ground at the AGC feed point. <snip>

Its not clear to me what you mean here: The AGC feed point might have very little to do with the RF ground used for RF input, or for the detector (the scope probe in your case.) when you say "...I am monitoring the grid of the first RF stage with the power off using a 10x scope probe. The input signal is about 160mv peak to peak for this picture." Where is the signal taken from that is shown in the vertical deflection of your picture? Is that from the 1st grid? (I suspect so because with power off, you won't get any amplification from the tube.)

> I just can't believe that this is the way it is supposed to look.

I suggest you test the whole receiver for band pass/ out of band signal rejection and the like.

Date: Sat, 19 Jan 2008 17:27:29 -0700
From: "Tony Casorso" <canthony15@msn.com>
Subject: Re: [R-390] R-390a Front End Selectivity

Hi Roy. I have done all of the usual performance measurements on my receiver and it seems to be fine with the exception that the Ferrari is being hammered by a strong local AM station while the tractor is immune. The secondary of the antenna coil is tied to the RF amp grid on one side and to the AGC on the other side. The point where it is tied to the AGC is at RF ground through a 5000pf cap. If this ground were missing, the antenna coil Q would probably be affected. This is why I mentioned the AGC feedpoint as being intact. This is the only spot I have identified in the circuit that would affect multiple bands. I'm not sure what you are getting at with the Ferrari reference. Are you suggesting that the R-390a is being overwhelmed because it is a superior receiver (much more sensitive)? I am probably missing the point here. The R-392 performance also checks out. Not as sensitive and not nearly as quiet as the 390a but it is in good working order.

Date: Sat, 19 Jan 2008 19:34:12 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] R-390a Front End Selectivity

What matters is the response into the normal load on the coils. The only way to properly check the response of the grid network is to pick off of the plate. If you use a low impedance on the plate (say 10K ohms) you will swamp the plate coil's response and only "see" the front end.

Date: Sat, 21 Jun 2008 19:46:27 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] modified R390A

Did you find the R390/A receiver drifted, or was it the read-out that drifted? The read out would have had a time base crystal for what was essentially a frequency counter. The counter would have summed the VFO, and LO plus 455Khz and provided a display. Back in 1974-75, the goal was to get a counter that would do 50MHz in TTL logic for under $100.00. It was a "73 Magazine" type project. My 1968 military version had Nixie readouts and filled a 19" rack with "repairable" logic chips. I remember when we got Texas Instrument logic chips to repopulate the wire wrap back plane with these new little black chips in 1970. There were several versions of digital readouts built for the R390/A. Most were several hundred dollars back then and done mostly for the WOW factor. Today you use a micro processor chip and a surplus LCD display. The receiver is still rock solid and the display counter drifts as much as every because the processor crystal is just not very stable.

[from the Collins reflector ed]
Date: Wed, 13 Aug 2008 21:08:04 -0600
From: "Dr. Gerald N. Johnson" <geraldj@storm.weather.net>
Subject: Re: [Collins] kwm-2a dial speed

In that day, 100 KHz per turn was very good resolution, and with a little tenderness applied to the outer edge of the knob, it wasn't hard to set the dial to the nearest Hz. (I once achieved 1 ppm frequency measurement with my 75S-3B with such careful tuning and use of calibrator leakage and images). Except for the 75A-4 with the optional vernier reduction knob (these days costing at least $100 if you can find one) it was the Collins standard for amateur, commercial, and military HF dials to cover 100 KHz per revolution. Since the rack and PA tuning require similar precision for proper operation, it behooves the operator to develop that fine tuning facility. Except for the epicyclic vernier used in some Heathkit gear (prone to having a sloppy knob) the verniers with friction drive that could have been applied have been all used up and their friction losses made tuning unfriendly. I'm sure had Collins designers like Arnie Spielbauer who did the S-line and KWM-2 dial wanted finer resolution they could have achieved it with a finer thread on the PTO shaft. But they didn't. Even at 100 KHz per turn cranking a 51J nearly a MHz is a pain. The mechanical verniers didn't allow two speeds so making that 40 turns instead of ten turns isn't a nice option. Of course, the M-2 and S-line only cover 200 KHz per band segment so there aren't so many turns. The other thing achieved with the direct drive to the PTO shaft in Collins gear is a complete lack of backlash. That's hard to keep out of a vernier, whether friction or geared. The best vernier for such a project was probably one sold by HP for use in the HP606 signal generator. I have no idea where to find one today. Otherwise Jackson made some pretty good ones, and there might be some available at Dan's Small Parts or Fair Radio or Surplus Sales of Nebraska or some British (since Jackson was a British company) surplus stores. It will be hard to mount without having the tuning knob stick out and without carving up the escutcheon and spare engraved escutcheons are not a common item anymore.

Date: Thu, 11 Sep 2008 19:03:50 -0400
From: <jrusgrove@comcast.net>
Subject: [R-390] Boat Ancor Receiver Dynamic Range Measurements

I've always been curious how boat anchor receivers stacked up in terms of minimum discernable signal (MDS), blocking and two-tone dynamic range so I
made measurements on some of the highly prized receivers 'of the day'. Turns out they did pretty well! http://www.w1vd.com/BAreceivertest.html

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Date: Sun, 14 Sep 2008 12:36:56 -0700
From: "Mike Hardie" <mike46@shaw.ca>
Subject: [R-390] Theory Question - RF Transformer Alignment

I'm not having any difficulty performing the alignment, just don't understand what's happening.

When peaking the RF transformers the technique is to tune to a "lower" frequency, adjust the slug, then tune to a "higher" frequency, adjust the trim cap, and repeat as necessary. I can understand why the two adjustments are inter-related, can anyone explain how it is that eventually both the lower and the higher frequencies are peaked?

In other words the slug adjustment seems to affect the lower frequency more than the higher frequency, and the trim cap the other way around. If this wasn't the case the transformer couldn't be peaked for the lower and higher frequencies, every time one was adjusted the other would "move" too far.

Date: Mon, 15 Sep 2008 09:44:32 -0400
From: Gord Hayward <ghayward@uoguelph.ca>
Subject: [R-390] RF Transformer Alignment

The trimmer capacitor for alignment is usually a small part of the overall resonating capacitance so at the high frequency end where the main adjustment is at its minimum, the trimmer has its biggest effect and can be most accurately adjusted. At the low frequency end, the coil is the most important so it is best adjusted there. Of course changing the capacity will affect the coil adjustment but this interaction has the least effect when the cap is adjusted at the high end and the coil at the low end.

Date: Mon, 15 Sep 2008 10:49:54 -0400
From: "Miles B. Anderson, K2CBY" <k2cby@optonline.net>
Subject: [R-390] Theory Question - RF Transformer Alignment

Actually, Mike, you answered your own question.

The coil slug does have a greater effect at low frequencies and the trimmer capacitor does have a greater effect at high frequencies.

First, let's consider an "ordinary" receiver -- one that is tuned with a variable capacitor rather than moving coil slugs the way am R-390 is tuned. At the low end of the band the tuning capacitor is fully meshed -- maximum capacitance. At the high end of the bank the tuning capacitor is fully unmeshed -- minimum capacitance. The trimmer capacitor is in parallel with the tuning capacitor, (say somewhere between 15 pF and 360 pF for AM broadcast band) depending on whether iot is set to the low end or the high end, so the total capacitance in the circuit equals the total capacitance of the tuning capacitor plus the capacitance of the trimmer (say 15 pF) plus stray capacitance from the tube, wiring, bandswitch, etc. (say another 10 pF or so). When the tuning capacitor is at maximum value (low end frequency) the total capacitance would be 360 plus 15 plus 10 or 385 pF. The trimmer represents 15/385 or aboiut 3.9% of the total capacitance. When the tuning capacitor is at minimum value (high end frequency) the total capacitance would be 15 plus 15 plus 10 or 40 pF. The trimmer would then be 15/40 or 37.5% of the total capacitance. Thus, the trimmer capacitance is a much greater percentage of the total capacitance and has a much greater effect on the frequency at the high end than it does at the low end. One other point. In the "ordinary" receiver, the value of the inductance remains the same regardless of where the tuning capacitor is set. Thus, adjustment of the coil slug had just about the same effect on the resonant frequency at the low end (maximum tuning capacitance) as at the high end (minimum capacitance) of the band. The net result during alignment is as follows:

Adjusting the trimmer capacitance at the low end of the band has very little effect on the frequency. The result of adjusting the trimmer capacitance at the high end of the band has a huge effect on the resonant frequency. Adjusting the coil slug has about the same effect on the resonant frequency at both ends. The trimmer capacitor therefore has the effect of stretching out or compressing the dial calibration by moving the high end frequency higher (less trimmer capacitance) or lower (more trimmer capacitance) with very little effect on the frequency at the low end of the band. The coil slug in effect sets the "starting point" at the low end of the band. What all this adds up to is the old maxim: "Set the coil at the low end of the band. Set the trimmer at the high end of the band." How does this work for the R-390A where the tuning is by adjusting the inductance instead of by a big mechanical variable capacitor? Just take the foregoing discussion and substitute the words "variable inductance" for the words "tuning capacitor" leaving everything else the same.

Date: Mon, 15 Sep 2008 09:19:31 -0700
From: "Dan Merz" <mdmerz@verizon.net>
Subject: RE: [R-390] Theory Question - RF Transformer Alignment

Mike, it seems you answered your own question. But not in detail. Your adjustments chase after the right amounts of inductance and capacitance until you find that magic combo where both are right at the two frequencies. The reason you don't miss the combination that is right for both is because you make adjustments that correct any initial deviancy of inductance and capacitance toward the right values and never away from the right values, and hence towards the right values in seqential adjustments. This is how it must be if the final point is found. And the core/coil has to be designed so that such a point actually exists.

Others have suggested why L is adjusted at low freq and C at high freq but haven't pointed out one difference that moveable core tuning causes so I'll offer my limited insight.

I've convinced myself that the cam does not enter into why the adjustment works. Instead the change of inductance when the core is moved relative to the bracket does affect the success in finding the magic position. Once the cam is set, it simply brings the bracket back and forth to the same two positions during the adjustment when you go from low to high frequency (i.e. the bracket is tied to the digital dial readout via the cam. But how the inductance varies with core position at these two points is very important in understanding why the magic point ends up being found. In fact, you can easily show by calculation that if adjusting the inductance at the lower freq. simply shifted the inductance at the higher freq by the same amount, the sequence of your adjustments would lead you away from having the two frequencies adjusted at the same time. In fact, you would have to adjust inductance at the higher freq and capacitance at the lower freq (just the opposite of the recommended method) to have the tuning converge on simultaneous tuning for both points if the inductance span stayed fixed. By working with a spreadsheet experiment, I convinced myself that sequences of adjustments only converge to the magic point if the change in inductance at the higher freq. bracket position is much less than the inductance change at the low freq. brack position. That is if you tweak the inductance at the low freq by moving the core in the bracket and then move the bracket to the high freq position, the inductance change there has to be less than the inductance change at the low position frequency. How much less does it have to be.

My conclusion was that it has to be less by a factor of the square of the ratio of the two frequencies. Otherwise sequential adjustments result in divergence away from the magic point. In other terms, this means if you plotted the inductance versus core position, the slope would be much steeper at the low freq end than it is at the high freq end. Perhaps someone else has more specific info on this. I was surprised when a simple spreadsheet calculation lead me to my conclusion that if a change in core position changed inductance by the same amount at low and high positions, the magic point would not be found and sequential adjustments would lead one away from that point. This is different from the usual case in radios that tune across the tuning range with a variable capacitor rather than a moveable core inductance. I'm guessing the inductance versus core position was designed to be flatter at high frequency than at low frequency. Intuitively it would seem that if you shoved a core through a coil the inductance would increase more and more as the coil was entered (the curve would become steeper) and then would flatten out as the core filled the coil and finally decrease again as the core was shoved thru. I'm guessing an appropriate segment of this overall curve could be picked with an appropriate shape that meets the above condition for successful adjustment. I notice the manual adjustment procedure advises alternate positions be selected within the the recommended pair if the recommended pair are not used. I don't know if this relates to inductance/core position curves or to some other consideration.

Perhaps someone has data on inductance versus core position for a typical tuning unit in the 390a or 390.

Date: Mon, 15 Sep 2008 10:51:11 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: RE: [R-390] Theory Question - RF Transformer Alignment

So close... Collins coils are wound in a nonlinear fashion (Variable-Pitch Progressive), such that the resonant frequency is linear - exactly proportional to core position. (In tuning caps, this plate profile is called Straight Line Frequency.) Therefore, when you adjust a slug, the entire band is shifted without changing its shape. (This permits use of spiral-cut cams; easy to manufacture, and a small error in cam angle can be trimmed out by adjusting the core.)

On the other hand, even though the variable reactance is an inductor not a capacitor, the trim cap still affects the high end more than the low end. f = 1 / (2 pi sqrt(L C)), so changing C has the effect of multiplying the resonant frequency by a constant K (close to 1). Think of it as changing the frequency by K percent. This radio tunes octave bands, so the frequency at the top of the dial is twice that at the bottom of the dial, so at the top, K % is twice as many Hz as at the bottom. Meanwhile, moving the core affects top and bottom equally. To converge, at each end you trim the item that has the most effect at that end, so here you want to move the cap at the top and the core at the bottom. When you set the top, you throw off the bottom by half. When you reset the bottom, you throw off the top by the same amount, so like Zeno's Paradox, each L-C cycle gets you halfway closer. Trimming L in an octave-band conventional tuning-capacitor radio changes the top twice as much as the bottom, but moving the trimmer cap changes the top four times as much, so you still adjust C at the top and L at the bottom. The most interesting case is inductance tuning with a conventionally-wound coil. f is still proportional to 1 / sqrt(L), but L is proportional to theta (tuning dial angle). When L is small, a given change in theta has a large effect on f, while
when L is large, the same change in theta has a smaller effect. In a medium-wave radio (about 3:1 ratio), a given change in theta (i.e. core position) is 9 times more effective at the top. Meanwhile, the cap is only 3 times as effective at the top, so if you want to converge, you adjust L at the top and C at the bottom! (This is not speculation; I have exactly such a radio and indeed it converges only if you align it backwards.) I think a profile exists for which convergence is impossible, but it makes my head hurt to think about it.

Date: Mon, 15 Sep 2008 14:19:56 -0400
From: Barry <n4buq@knology.net>
Subject: Re: RE: [R-390] Theory Question - RF Transformer Alignment

> Collins coils are wound in a nonlinear fashion<snip>

That demystifies those cams just a bit, at least for me. I didn't realize they were spiral. It makes sense, though, as the PTO is probably wound the same way and its slug position is controlled by a linear movement of PTO's lead-screw.

Date: Mon, 15 Sep 2008 14:24:40 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Theory Question - RF Transformer Alignment

Good job on this one. I liked David Wise's input. All that math made my head hurt. This topic needs to get collected and entered into the pearls of wisdom.
It would be nice to detail how the cams make an octave set of transformer in
the RF deck track so nicely across their band span.

Date: Mon, 15 Sep 2008 13:12:11 -0700
From: "Dan Merz" <mdmerz@verizon.net>
Subject: RE: [R-390] Theory Question - RF Transformer Alignment

Dave, thanks for coming in with specific info about the coil design in the 390. It all makes sense. I didn't realize the cams were spirals and thought they were trial and error shaped to linearize the inductance change to a linear frequency change. Makes much more sense that the coil would be designed to be frequency linear with displacement and the cam a spiral to couple core displacement linearly with the dial rotation. The linear frequency dependence of core position more than ensures that the change of inductance at the high freq position is sufficiently smaller than the change at the low freq. position to make convergence occur. I think the inductance change is about 1/8 (= 1/2^3) smaller at the higher freq than it is at the lower freq for the progressive type core. To get convergence it would only have to be less than 1/4. You like to talk in terms of frequency change, while I chose inductance.

I was glad to hear that your radio with a conventionally wound coil and inductance tuning is adjusted just the opposite, L adjusted at high freq and C at low. This was what my spreadsheet calculation indicated when I tried to reach convergence with a coil that had a linear inductance profile. I have no doubt an inductance profile could be imagined that would defy adjustment with either combination of L and C adjustments. but might mean assuming a strange combination of the trimmer cap with the main cap. This also makes my head hurt; maybe when that stops I'll think about it more Dan.

Date: Wed, 15 Oct 2008 13:23:47 -0700
From: "Ed Zeranski" <ezeran@ezeran.cnc.net>
Subject: RE: [R-390] Theory Question - RF Transformer Alignment

.... I didn't realize the cams were spirals and thought they were trial and error shaped to linearize the inductance change to a linear frequency change. ..... This was what my spreadsheet calculation indicated when I tried to reach convergence with a coil that had a linear inductance profile. I have no doubt an inductance profile could be imagined that would defy adjustment..... I'm more impreesed with the '390 receivers every time I see posts like this. Those Collins guys must have had really excellent integration of electrical and mechanical design efforts, all to the tune of juggled slide rules.

Date: Mon, 15 Sep 2008 13:40:39 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: RE: [R-390] Theory Question - RF Transformer Alignment

The coil info comes from the R-390 Final Engineering Report, a fascinating read all around, but they were doing the same thing at least back to the 75A/51J. The complex cam is the one in the coil-winding machine. You can bet there was some trial and error to compensate for distributed capacitance and edge effects. But they only had to do it once, that's the beauty of it. I follow your inductance arguments, but if I tried it myself I'd err; I can hang on better through the
frequency reasoning.

Date: Mon, 15 Sep 2008 16:45:56 -0400
From: Gene Beckwith <W8KXR@neo.rr.com>
Subject: Re: [R-390] Theory Question - RF Transformer Alignment

Excellent series of posts...all added to the R-390x files...for pondering and reflection on these great Heavy Metal radios...

Date: Wed, 24 Sep 2008 20:19:43 -0400
From: "Andy Vavra" <avavra1@verizon.net>
Subject: [R-390] Oldham Connector piece needed plus deaf band question

Hello to the group. I am restoring an R-392, little cousin to the R-390 series and am in need of the small piece of plastic material that goes between the two halves of an Oldham connector to join the bandwidth shaft to its switch assembly in the IF strip. Does anyone have one to donate or sell?

And my question for the group is this: The receiver is slightly hard of hearing on the bands between 7 - 16 mHz. Crystal oscillator is strong as measured at the diode load jack and other bands perform well. I figure the common genealogy between the 390 and 392 should share some common problems and fixes as well.   Is this a sign of an alignment issue in the RF deck or something else?

Date: Wed, 24 Sep 2008 20:17:17 -0500
From: Gary Pewitt <n9zsv@magtel.com>
Subject: Re: [R-390] Oldham Connector piece needed plus deaf band question

Andy, if you want top performance out of a 392 split the power supply. Put 24v on the filaments and 32v on the plates. The power cable has only three working connections, filaments, plates, and ground. Normally the plate and filament lines are hooked together. Works great.

Date: Sat, 27 Sep 2008 23:39:00 EDT
From: Flowertime01@wmconnect.com
Subject: Re: Oldham Connector piece needed plus deaf band question

Did you get some help with the Oldham coupler parts?

>And my question for the group is this: The receiver is slightly hard of
>hearing on the bands between 7 - 16 mHz. <snip>

Is this a sign of an alignment issue in the RF deck or something else?
Actually, two Octaves of the RF deck need some adjustment. One is the 4.0 to 7.999 it needs some peaking to get the top end back up to par. Second is the 8.00 to 15.999 it needs some adjustment to get that whole octave back up to par. Time for the signal generator, power meter, or AC voltmeter and resistor on
the audio output.

Date: Sat, 06 Dec 2008 10:20:56 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] WWV Frequency Standard

This IS true! However, Amateur Radio as a whole has not been taught this methodology. Therefore my statement stands in the context that it was used.

Second, also having served back then - THERE WAS A REGULARLY SCHEDULED CALIBRATION SYSTEM! This system went down to TS-352s and TS-505s.   The calibration shops WERE traceable back to what was then the NBS, now NIST. This meant that frequency counters, signal generators, and oscilloscopes were ALL calibrated on a regular basis! We,

as a hobby, do NOT have this, and to my knowledge, with "perhaps" a handful of exceptions, do
NOT do this.

Bob - N0DGN

Perry Sandeen wrote:
> Gentlemen,

> Uh, if all that is true, please don't tell the USAF and Hewlett Packard or they might become confused. (At least in the past.)
>
> Using the well known formula of a kebelsa sausage divided by the length of the ballast tube (or something like that) they use the 1ms (which is five cycles of 1kHz) tick for frequency calibration by feeding that one tick per second tick to the input of an external scope trigger and the source to be checked or calibrated to the vertical amp. Then on watches which direction and the rate at which the wave appears to move. Using a watch or clock one can then accurately calculate the difference. One can also reverse the input configuration and watch the "tick" move.
>
> Watching the "tick" move was how we kept the receiver site HP 105 at Karamursel Air Station in Turkey, 40 years ago, calibrated even though we had a muti-thousand mile path from Boulder Colorado.
>
> HP also recommends this as one method for the HP 5335A frequency counter(among others)time base calibration. They also list a frequency offset table for rates from 1E6 to 1E10.
>
> The beauty of this technique is anyone at home having a scope with external trigger capabilities can calibrate their "house standard" oscillator to extremely fine tolerances at a very low cost and effort.
>
> Regards, Perrier

Date: Sat, 6 Dec 2008 11:33:06 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] WWV Frequency Standard

There is a difference between absolute time and frequency. Count time ticks from WWV and time ticks from your local standard. After six months or so review the difference on your two counters. Then adjust your local time standard up or down a bit. You frequency standard is within one 1 second time tick over six months. I suggest that is close enough for government work.

In 1975 in Okinawa we would trigger two counters and let it run 24 hours. We expected zero difference. We perfomed this test as a monthly maintenance procedure. This was just for a frequency standard. For time we used a dual trace scope and an off set time delay number provided by the military to us. There was a document with lots of locations and expected time delay. Again we measured the delay with a dual trace scope and averaged the delay over lots of time (weeks). The "clock" had an offset in it. The frequency standard tick edge was any where it wanted to be. The clock would let us have any number of steps up to 1,000,000 between the frequency edge and the time edge. Then you could set the time display to tick any second from the time edge.

In the Army with lots of techs working 24 X 7 you could put 6 or 8 guys on the job of guarding the "maintenance procedure" for 3 or 4 days each month. You did not watch it all shift but you set up the procedure and passed it from shift to shift. In the Army you just did not clown around with some activity going on. Hundreds of guys and girls worked in the radio rooms and just left things alone for ever and ever. You can have a standard in your shop that is closer than a RCH. And then I ask you what for? The American Military has run planet wide RF communications and reportedly off planet communications with R390's, TS505s, TS352s, TEK 505s, and AN/URM25's since the 1950s. What are you doing in your hobby that needs better resolution than what you can get with that equipment? You cannot prepare kebelsa sausage with better resolution.
Roger

Date: Sat, 06 Dec 2008 12:39:05 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] WWV Frequency Standard

I never said "our" hobby needed the level of accuracy that Uncle Sam maintains. I was referring to a "very"minuscule difference between a signal generator output, the counter reading it, and it's "zero beating" in a receiver. In THAT context, the use of WWV was problematic, ESPECIALLY at 2.5MC. It would be preferable to use 10MC signals. This was what manufacturer's of old boatanchors built-in to their equipment for "calibration" of the internal crystal calibrator. This is MORE than adequate for Amateur Radio use. Uncle Sam has needs that FAR exceed what "WE" require.

Date: Sat, 6 Dec 2008 13:00:19 EST
From: Flowertime01@wmconnect.com
Subject: [R-390] WWV Frequency Standard

I think I understand what you are saying here.
And in violent agreement with you

Date: Sat, 6 Dec 2008 12:34:09 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] WWV Frequency Standard

Roger, you've written some excellent stuff for this list, but I'm a time-nut so I have to disagree with your first sentence.

The relative time between cycles is equal to 1 divided by the frequency of the cycles. Time and frequency are exactly related. You did say absolute time, and that's a different story. Absolute time was completely independent of frequency until the atomic clock came along.

Absolute time was related to an image of a star passing through the cross-hairs of a telescope. It had nothing to do with frequency. This produced a pulse that marked the time of day in terms of rotation of the Earth. The pulse was distributed by telegraph and then radio. In between star crossings, counters were used to measure elapsed time from the last crossing. The oscillators that made the counters count were adjusted so that there was negligible error between the counter and each crossing. Of course, it wasn't that simple because the Earth goes around the sun.

Since 1972, when UTC replaced GMT, absolute time of day is reckoned from the oscillation of Caesium atoms (cesium for you CPS fans) because there was too much noise in the star crossing detection for modern science. You don't have to wait for star crossings. You can listen to WWV or a set of GPS satellites and adjust your clock's oscillator to match as closely as the laws of physics and probability allow. It's possible to match within 1 part in 10 to the -15 power (14 zeroes before the 1), but that gets expensive.

Matching the frequency is necessary for long term accuracy, but the counter has to start from some number that is derived from counting the 9 GHz frequency of very cold Caesium atoms since 1972 - not a trivial task. In fact, there is no single time standard. Absolute time is derived from an average of 50 or more atomic clocks. Leap seconds are introduced because the Moon slows the rotation of the Earth with tidal forces. Fortunately, WWV and GPS also broadcast the correct time. You can do this at home with a GPS receiver that sends data to a computer to decode the data stream. I've got an HP Z3801A GPS receiver and the SatCom program running under Windows 98, which synchronizes the other computers on my network. I've got some 1970 vintage time code receivers that could be used for station clocks, but aren't.

Ah, but this is more than most people want to know. Roger is right - R-390 class sets don't need that kind of accuracy. The run-out on a carefully

adjusted PTO may be 0.1 KHz, which is a tenth of the digital dial resolution. You can find WWV on the dial and then switch to CAL and adjust the local crystal to match. Now CAL can be used to find 100 KHz points on the dial. This gets you close enough for all practical porpoises.
<snip>

Date: Sat, 6 Dec 2008 13:43:25 EST
From: Flowertime01@wmconnect.com
Subject: [R-390] WWV Frequency Standard

I was thinking the frequency of an oscillator in my shop and the time we use
on a wall clock in my shop. Those two things coming from separate sources and not being closely related. I agree with every thing you wrote in the context you presented. Roger AI4NI

Date: Tue, 09 Dec 2008 11:34:09 -0500
From: sdaitch@kuw.ibb.gov
Subject: [R-390] WWV Standards and other sources

"The American Military has run planet wide RF communications and reportedly off planet communications with R390's, TS505s, TS352s, TEK 505s, and AN/URM25's since the 1950s."

While that might have been correct years back, interestingly enough, digital comms these days may require far greater frequency stability than produced by
any of the other equipment. This might be dated a bit, but some years ago, the USAF had upgraded an in-country telephone network from an analog based system to a digital system, using Rockwell MDR-8 radios and FCC-98 mux systems. The plan was to have LORAN receviers at each radio and MUX terminal to keep the digital system in time and reduce the jitter on the network. At one terminal point, with multiple radios, there was so much RF generated by other equipment, the LORAN unit would not lock up to the signal properly and output a stable timebase for the terminal. The owners of the system brought in an older HP cesium beam standard, and that cured all the problems.

Similarly, my employer has used GPS based time references to stabilize digital networks used for our older digital audio distribution system. While it is possible to develop the digital timebase data from the incoming digital signals, with multiple sources, the time base jitter can be the source of bit errors. Using an external timebase, with far greater stability, to drive all the in-house equipment, reduced the bit error rate on our incoming signals and virtually eliminated the losses of program audio due to time base slippage.

Date: Wed, 7 Jan 2009 18:11:58 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] UnBal for R-390A

> Stick with your un-bal methodology. ....

Bob, makes a good point here about what the receiver gets peaked to depending on how you hook the signal generator to the receiver. Most of the time we do not really care what the signal generator level is. We just couple the generator to the receiver and hang a meter on the output. Then we tweak whatever for the highest meter level. If you have some matching device out front of the receiver then we want it in place and we want to couple the signal generator through it to the receiver. Use what ever signal level you need, Just hang the signal generator to the antenna with a small 1,000 - 100 pf CAP. Then trim up the RF input transformers to get the most signal into the receiver. This will at least get you the best match between the antenna you have and your receiver through the coupling circuit you are using.

Date: Thu, 15 Jan 2009 05:48:02 -0500
From: "Ed G" <ed.goss@comcast.net>
Subject: [R-390] A Few Questions

I have been restoring a Capehart R-390A.it was in pretty good shape, and I have done the recommended cap substitutes, cleaned up the gears, put the spring back on the Oldham coupler (surprisingly enough I found the spring still floating under the chassis). No further alignment has been done yet, but it sounds like a very sensitive receiver. Some initial observations and questions for the group: I notice on strong and even moderate CW signals that I am hearing both sides of the signal as I tune, even with BFO knob set to what I think is proper position. Is this a BFO alignment problem or normal 390 behavior? I find I much prefer the WIDE audio response setting even for CW; the narrow setting seems much too sharp and attenuates signals too much. Again - alignment problem or normal 390 operation?

Date: Thu, 15 Jan 2009 10:05:19 EST
From: DJED1@aol.com
Subject: Re: [R-390] A Few Questions

Sounds pretty normal to me. If you center the BFO in the passband, you will hear both sides of the signal as you tune off. If you choose 2 Kc bandwidth, for example, and offset the BFO by 1.2 Kc, you should eliminate most of one sideband, while the other sideband should be good until you've tuned off by about 2 kc. To check the BFO alignment, set the BFO to center on the narrowest passband (0.1 Kc) by peaking up the signal at that filter setting, then loosen the BFO knob and set for 0 when it is zero beat with the signal.

The audio filter is intended for very tight CW work, and if I remember right is tuned to about 700 cycles. So you must peak up the signal in the IF filter, then set the BFO to give you a 700 cycle beat note, then turn on the audio filter. It's very effective for weak CW signals.

I'm not much of a CW man, but I used the audio filter to make a frequency measurement a while back: I bought a HP synthesized generator that reads out to 1 Hz, and I wanted to see how accurate it was by comparing it to WWV. I coupled the generator to the antenna so I could hear the beat note between WWV and the generator. Well, between the modulation and noise on WWV I couldn't tell the zero beat to much better than 10s of Hz, so I offset the generator to 10.000700, turned on the audio filter, and hooked up a frequency counter to the audio output. The filter cleaned up all the noise, and the counter could read the 700 Hz signal to about +-1 Hz, and that was close enough for me. Generator was dead on. The generator makes it a snap to check the linearity of the PTO without taking things apart to hook up a counter to the PTO.   Ed

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Date: Sun, 1 Feb 2009 08:29:16 -0500
From: Roger Gibboni <rgibboni@dulye.com>
Subject: [R-390] Receiver Sensitivity

Hey- I could use some help. Picked up a Collins 390a and when I powered it up on the bench, the sensitivity was terrible-between 200 and 700 microvolts. So I started checking the usual stuff; tubes, front end alignment, etc---nothing. Then while I was tuning and testing, I found that the receiver had good sensitivity---less than 1 microvolt at 3.88 MHZ. Only at that frequency! 100KHZ either way and the sensitivity died. So I checked the frequency alignment of the 2nd LO and that seemed fine. It would also appear that the lower 3/4 of the 0 MHZ band is dead---really dead! Needless to say, I'm at a little bit of a loss here. I should also add that this radio had a Miltronix makeover (well done) so I see that caps, etc have already been replaced.

Date: Sun, 1 Feb 2009 10:46:11 -0500
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Receiver Sensitivity

Sounds like a clamp in the gear train has loosened or broken. Do the slugs move up and down? If they do check to see that the PTO shaft underneath is really turning as you tine. It may be that the clamp on the PTO shaft is loose and the PTO is not turning, but the preselector gears are, so it shows best sensitivity at only one spot.

Date: Sun, 1 Feb 2009 19:25:01 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Receiver Sensitivity

Off you go to the Internet and find the R390 home page: http://www.r-390a.net/ R390 web page by Al Tirevold and http://www.r390a.com/ web page by Chuck Rippel. Al's page has the original TM's in Adobe PDF.

But you really want a copy of the Y2K manual the fellows wrote for what else, the Y2K disaster year. Get your favorite beverage and down load a copy of either the Y2K or the hard to read and follow TM 11 5820 358 35. The R390/A only tunes down to 500 Khz. So while you can dial it down under 500Khz it is deaf. always has been likely always will be unless you do some very serious receiver changes. Don't ask me here. Those things are not allowed under the current administration and were even off limits under past administrations. Good fellows do not do those kinds of things to boat anchors. But I digress.

The fact that you think you have 200 to 700 microvolt sensitivity across all the bands and anywhere tells you that the mechanical stuff is OK. The hot spot at 3.8MC is just a red herring to put you off the trail. If the receiver has not had a cleaning in a while you are looking for some crud in a tube socket. Deoxit and some quality time are in order. Tube sockets, and sub chassis connector pins get treated first. Likely the receiver was run until one or more tubes have reached the end of their useful life. Time to push all of them through a tube checker.

Get the TM and start with paragraph 73 gain adjust potentiometer R519. Input 455kc at 150 microvolts into J 513. Hang any AC voltmeter across the local line output with a 600 ohm 1/2 resistor. (two 1200 ohms in parallel). AC volts across a 600 ohm load gets converted to DB. (some math involved). Hang any DC volt meter across the diode load. Set the band width to 0.1 and rock the generator into the 455 crystal in the IF deck (under Z501). set the band width to
2KHz.

Set the gain adjust to get - 7 volts on the Diode load with the BFO off and the generator to CW.

With the generator set to AM and with about 30% modulation, you expect about 1/2 watt on the local audio line out on the rear panel.

P = E/I = (E x E) / R so P x R = E x E

0.5 x 600 = E x E = 300 square root = 17 volts AC or some where around 27 DB.

Turn the generator modulation off and you expect to see a clean drop of 30 DB at the local output audio level.

If a 150 micro volts will not drive the IF and audio to at least a 1/2 watt output then you have an IF audio deck problem. If you cannot get - 7 volts on the diode load then you have an IF deck problem. If you cannot get a good clean 25 (30 preferred) DB difference in power on the local audio output with just modulation vs no modulation the IF deck and Audio deck tubes have too much noise and new tubes are in order. If you cannot get the signal to noise in the IF deck and audio deck there is nothing you can do in the RF deck to cover the IF audio deck problems.

Once you get the IF deck and audio deck in order then you can start on the RF deck. Of course mechanical alignment comes first in the RF deck.

Likely you just have a bad tube or some crud in a tube socket. The most common problems in the receivers these days. Your receiver has been recapped so you are OK on that front. There is not any thing in an R390/A that cannot be fixed by you.

The Military taught thousands of Fellows to fix these receivers. But like the receivers, most of the Fellows are getting old. There are a few holding out in Never Never Land with Peter but they have no RF there, thus no need for radio's. Good luck with your receive and let us know what you find. That's how we Fellows learn what the problems are.   Roger L. Ruszkowski AI4NI

Date: Mon, 23 Feb 2009 10:03:21 -0600
From: "Bill Breeden" <breedenwb@cableone.net>
Subject: [R-390] R-390A On 160 Meters

I had an experience over the weekend that I thought I would share with the group. I have a fine EAC R-390A from the 1967 production run that I purchased from Bill Neill a few years ago. I have never performed an alignment on the radio, but have spot checked the sensitivity on various bands of interest with an HP 8640B and the sensitivity appears to meet or exceed the specifications everywhere I checked. While listening to the K5D DXpedition on 160 meter CW this weekend, I found that my R-390A could hear K5D when my FT-920 transceiver and my NRD-525 receiver could not. At the time, all three were sharing the same antenna via a Stridsberg MCA104 receiver multicoupler. While I have made this type of comparison a number of times in the past, this is the first time in my experience that my R-390A has clearly outperformed the receiver in the

FT-920. My FT-920 has an excellent receiver and always outperformed my NRD-525. I made the same comparison between the FT-920 and the R-390A on 12 meters yesterday afternoon, and the FT-920 may have had a slight edge there, but it wasn't as dramatic as the 160 meter comparison. I realize that the alignment on the R-390A is a band by band issue, and looking back at my notes, I don't see that I have ever checked the sensitivity on 12 meters. Bill Breeden - NA5DX (ex: AB0FX) Saucier, Mississippi 1967 EAC R-390A #1828

Date: Mon, 23 Feb 2009 11:29:26 -0500
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] R-390A On 160 Meters

On 160M, sensitivity is really not the issue. The issue is how the receiver deals with intermod from local BCB stations and whether the filtering system rings when hit by noise. The 390A is certainly the winner in terms of freedom from intermod thanks to the tuned front-end. Modern ham crystal filters or DSP concentrate very heavily on shape factor, which is great for SSB in crowded
conditions but can cause horrible horrible ringing on CW on the low bands.

Not all crystal filters or DSP systems concentrate only on good numbers for shape factor... but almost all ham rigs do. That's a shame. A linear-phase crystal
filter doesn't have nearly the shape factor but is far far better for CW listening in noisy conditions. In my experience the 390A's crystal filter (you didn't say what bandwidth you were using) has a poor shape factor, which makes it look
not-so-good in a technical comparison of numbers but makes it markedly superior for actually listening to CW. It is very possible that with some attenuation that your solid state rigs could have done better on 160M. 12M, that's where noise floor starts mattering. 15M was surprisngly open to Europe this past weekend for the ARRL DX CW contest.

Date: Fri, 15 May 2009 19:34:41 EDT
From: DJED1@aol.com
Subject: Re: [R-390] R 390A RF Deck problem

Hmmm- it sounds to me like you've tracked it down to the need for an alignment. If changing the tubes makes no difference, and the problem travels with the RF deck, it sounds like it either needs an alignment, or a tuning cap has gone bad. Have you checked the sensitivity on all bands, so that you can determine if it is one particular set of transformers that need work? Note that the RF is broken down into octave bands, so you just need to check somewhere in the bands .5-1, 1-2, 2-4, 4-8, 8-16, and

16-32. My experience with sensitivity tests is to determine the signal level at which there is a 10 dB change in audio output when a 30% modulation is switched on and off (this seems to be the standard for the radio). I get a sensitivity of about 0.5 microvolts, although the mil-spec only calls for 2 or 3. Let us know what you find out.

Date: Sun, 14 Jun 2009 09:09:30 -0600
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: [R-390] R-390a misbehaving this morning

We've had a lot of lightning in the area lately so I've had my antennas disconnected. I plugged everything back in this morning and started tuning around. I found that the background noise drops off rapidly as I tune above 950 on all bands. Oh joy. The only thing that comes to mind for all bands is the PTO. I will pull the cover and check it. Has anyone seen this symptom before? I had the front panel off about 2 weeks ago to fiddle with a couple of the gears. Maybe a connector is not seated somewhere...

Date: Sun, 14 Jun 2009 09:23:59 -0600
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: Re: [R-390] R-390a misbehaving this morning

Well, its not the PTO. No drop in PTO output as I tune up there. Hmmm. The drop off is really fast. Using the line meter, at 970 its 0db and 980 it is down 6 db. At 990 its down 15db or more.

Date: Sun, 14 Jun 2009 10:10:29 -0600
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: Re: [R-390] R-390a misbehaving this morning

Oops. It looks like the mechanical alugnment is waaay off. The cams all come into alignment on the marks at +7.93 instead of +7.00. Wow. How did that happen? The only gear I had removed was the big one right behind the tuning knob. Could that have done this?? The dial and the PTO are still correct. What the heck did I do?

Date: Sun, 14 Jun 2009 12:11:39 -0600
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: Re: [R-390] R-390a misbehaving this morning

That was it. I must have gotten sloppy when I was in there last time. Mechanical alignment restored and electrical alignment rechecked. All OK now

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Date: Sun, 14 Jun 2009 17:35:03 -0400
From: Steve Hobensack <stevehobensack@hotmail.com>

Subject: Re: [R-390] R-390 misbehaving

Be sure a slug rack is not hanging up or wedged diagonally. Years ago I had a nearby lightning strike zorch the cardboard coil form in the first antenna coil. The cardboard seized the slug, preventing it, and the rack from moving. All racks should move freely and remain level. Check that all slugs are properly attached to the wire hangers. Also, put the dial on 7+000. All the egg shaped cams should point to a scratch or paint mark. This shows that the clockwork is aligned. You might put a frequency counter on the pto output to see that the frequency does not suddenly jump to something strange.

Date: Sun, 14 Jun 2009 22:50:40 -0400
From: triode45@aol.com
Subject: [R-390] R 390A Gear Train

I am working on my old Motorola R 390A and decided to rebuild the RF deck. I followed the directions in the manual and have all of the cams aligned and have the overshoot of the Veeder root counter at +035. Everything is now smooth but I have a problem. Let me say that I was able to tension all of the anti backlash springs properly. The problem is if I turn the kilocycle knob quickly to the bottom of the band and back up, the Veeder root counter will be a little lower, say +034. If I repeat this a number of times, the counter will continue to drift lower. I have double checked all of the nonmar clamps and all are reasonably tight.? Any help will be appreciated.. Thanks, Alfred SWL and Ham Band Listener

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Date: Mon, 15 Jun 2009 13:00:00 -0700
From: "Dan Merz" <mdmerz@verizon.net>
Subject: Re: [R-390] R 390A Gear Train

Hi, my first thought was that either one of the clamps is not tightened enough, or one of them may actually be broken and tightening doesn't help prevent all slippage. I had a broken clamp on one of my shafts that was hard to detect visually but defied tightening and I discovered the clamp was broken on the side away from the screw. The clamp appeared to be normal to the eye. And the broken clamp "almost" worked. I made a replacement that was designed better than the original, which to my thinking can be too easily broken by overtightening. Not knowing the metal spec on the original clamps, it is hard to say what causes this kind of failure, other than in my case it appeared that overtightening may have caused it. In looking again at my 390, I wonder however whether your problem may have to do with the clutch on the zero adjust, which may not be engaging strongly enough in the usual tuning condition to transfer one to one to the counter, i.e. some small amount of slippage between the two gears involved. Look down behind the front panel and see if the two gears involved always move together. They are coaxial with the zero adjust shaft. I've never worked on these two gears so know little about their maintenance but can easily see them disengaged when the zero adjust knob is tightened and moving together when the knob is loosened. Does the frequency tuned always remain the same at the endpoint? Or does this frequency also change as the counter changes at the endpoint. If the endpoint frequency isn't changing, then it would seem your problem is just the counter gear link to the KC tuning shaft and slippage between the shaft and the counter. Others may know more about your symptom. Dan.

Date: Fri, 4 Dec 2009 11:04:09 -0800 (PST)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Rubidium Oscillator Questions

A while back I bought a Lucent 3 piece GPS, - Rubidium Oscillator, and Xtal Oscillator set. As of now I have had the Xtal oscillator running for several months and it seems very stable compared to the rubidium oscillator. I have yet to hook up the GPS receiver.

My questions are:

Does the Rubidium oscillator need to be on continuously or as some information on the net seems to imply that as soon as one gets a ?lock? light that it is stable to 10Mhz at E to the minus 12 or so?

Is there a limited operational life to the Rb oscillator so that it is better to leave it off until needed? The MTBF for the oscillator is 50 years at 25C but one does not know how long it ran and at what temperature it was used.

Does anyone have any knowledge or experience on how to phase-lock the GPS to either one or both? The Rubidium osc data sheet states 0 to 8 volts for locking, with nominal being +2.5 volts. I got two nice simple phase lock circuits of the web from James Miller G3RUH in England. They are far less complex than the one from QST by Brooks Shera. Right now one can buy the Lucent Rubidium from $60 to $150. Should I buy one ore two for spares or do they have a limited shelf life? I don?t mind getting inside the units and modifying them.

If anyone would need it I have two useful divider circuits. One is divide by 1.5. The other is a N1 divide 1 up to N+12. (Please reply off list.)

All this accuracy is, of course, is to be able to measure frequencies and drift of my R390A?s precisely. (BTW Dallas Lankford got his R390A BFO drift down to 1 Hz per hour.)

Date: Fri, 4 Dec 2009 14:29:58 -0500
From: "Shoppa, Tim" <tshoppa@wmata.com>
Subject: Re: [R-390] Rubidium Oscillator Questions

> All this accuracy is, of course, is to be able to measure frequencies and
> drift of my R390A?s precisely. (BTW Dallas Lankford got his R390A BFO
> drift down to 1 Hz per hour.)

That last part is easy: using pretty much any old counter with a 1s or 10s gate time, measure the rubidium oscillator as the standard, then the BFO or other oscillator in the 390A. It's a lot of overkill though. I find my 30+ year old HP5381A counter to be stable to way better than 0.2PPM. Of course I find that by hooking it to the 10MHz output of my Z3081A :-). So I end up with multiple tiers: the really accurate GPS-locked OCXO or Rubidium proves my HP5381A to be stable to better than 0.2PPM, then I can use my HP5381A on the radios.

Date: Sun, 6 Dec 2009 10:29:27 -0500
From: "Shoppa, Tim" <tshoppa@wmata.com>
Subject: Re: [R-390] Rubidium Oscillator Questions

That's a great idea but I find that my 5381A is always better than to a fraction of a ppm whenever I check it. There's "perfect" and then there's "better than good enough" and I feel little compulsion to use a part per billion type reference to check a 50 year old radio which can be serviced just fine without a counter at all :-). I will admit that a counter is very very handy.

Date: Thu, 24 Dec 2009 13:56:14 -0500
From: frankshughes@aim.com
Subject: [R-390] frequency counter connection point

Could someone please tell me where I last placed my senility pills? I seem to have forgotten. I posted a question some months ago asking where I could connect a frequency counter to obtain a numeric value that would (approximately) track the Veeder-Root display on my R-390A. Many replies and good suggestions, and I can't locate any of them in the archives, <snip>

Date: Thu, 24 Dec 2009 17:41:17 -0500
From: Jim <jbrannig@optonline.net>
Subject: Re: [R-390] frequency counter connection point

I found one of your pills and remember the earlier exchange.... There is NO place to place to make a measurement that will reflect the dial reading. The R-390A is a superhetrodyne receiver. It takes the input signal and mixes it with an oscillator to produce another (IF) signal. That signal is mixed with another oscillator to produce yet another IF signal and lastly (in SSB or CW) another oscillator mixes with the IF signal to produce an audio signal. The deduce the original signal, all the oscillator signals must be recombined, in the correct order/polarity, and the result may be measured.

Date: Thu, 24 Dec 2009 17:56:30 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] frequency counter connection point

It is not possible to use "simply" a frequency counter to replicate the readout on the Veeder Root Display. That being said, there IS a Digital Display that IS available to work on the R-390A:
<http://www.aade.com/>

Click on the Digital display picture. I believe that it requires the Programmable one. <IIRC!>

Date: Thu, 24 Dec 2009 17:57:34 EST
From: djed1@aol.com
Subject: Re: [R-390] frequency counter connection point

It's true that you need to measure all the oscillators to get the actual frequency the radio is tuned to. You could just measure the PTO, which would give you the kilocycle reading, but even there it's complicated. The PTO tunes "backward", so you would have to have the counter count backward. Then you would have to have some means of correcting for the inaccuracy of the other crystal oscillators. Too much trouble. I long ago decided that if I need frequency accuracy better than 300 Hz I'll just fire up a ricebox. The R-390 was a marvel for it's time, and for most listening purposes it's still good enough.

Date: Fri, 25 Dec 2009 09:56:07 -0600
From: Tom Frobase <tfrobase@gmail.com>
Subject: Re: [R-390] frequency counter connection point

You know what band you are on by virtue of the MHz counter on the Veeder Root, only the KHz really matter. I would connect it to the output of the PTO. The problem with offset arises because the PTO tunes from 3.455 - 2.455 MHz the counter would have to subtract the result form 3.455KHz to get the correct number. The other problem, as we all well know, are the minor variations in the crystals in the first and second mixer. So in the end, the accuracy would depend on the other mixers. ...

tom, N3LLL

Date: Fri, 25 Dec 2009 20:41:52 -0500
From: frankshughes@aim.com
Subject: [R-390] frequency counter project is working!!

Thanks to all for curing my acute senility, here is how the project turned out:
http://i180.photobucket.com/albums/x257/fish1_07/displays.jpg

I bought the counter from Ron: http://electronicspecialtyproducts.com/

I understand that as it only detects the PTO frequency, accuracy is not ideal w/o the other inputs properly accounted for. I might experiment with this other unit (Thanks Bob) http://www.aade.com/dfd2.htm to see if I can adapt it to the R-390A for more accuracy.

If not, I'll put it on the 32S-3. What I am trying to accomplish, (other than collect more piles of lights, displays, knobs, buttons...) is to find a way to use the 32S-3 to transmit on a known frequency for SSB, and be able to easily tune the R-390A to receive on that frequency. There is probably a better way, but as I am new to this hobby, collecting more piles of gear seems indicated.

Date: Sat, 26 Dec 2009 10:36:37 -0800 (PST)
From: "Drew P." <drewrailleur807@yahoo.com>
Subject: Re: [R-390] frequency counter project is working!!

Very nice. The only improvement I would make is to modify the display to nixie tubes, remove the Veeder-Root, and put the nixies where the Veeder-Root was. That would be beautiful, simply beautiful...

Date: Fri, 8 Jan 2010 16:37:25 -0600
From: "Bob" <rfay@charter.net>
Subject: [R-390] R390A alignment question

OK gentlemen, here is my first question for today. In TM 11-5820-458-35, section 72,(Alignment of Fixed Tuned IF) it states to align T501 to 467kc which I assume is setting stagger tuning. I have an old Stewart Warner R-390A and this transformer is currently set for 455kc. Do I just peak the IF strip at 455kc or do I set it up stagger tuned as listed in the book. Side note - The process for aligning the PTO to the RF deck with the freq counter went well just as everyone described.

Date: Fri, 8 Jan 2010 15:09:45 -0800
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>

Subject: Re: [R-390] R390A alignment question

A quick stab at the question/answer. Some of the first R-390A receivers had IF strips set at 455kc. The top cover of the mechanical filter was flat, no indentation where the nut to hold the cover is located. So, if your IF strip has that recess on the filter cover, stagger tune. I don't have the Y2K in front of me, Bob, keep one close by.

Date: Sat, 9 Jan 2010 13:57:58 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R390A alignment question

The stagger tuning is to maintain the bandwidth of the radio when operating with a 16 KC bandwidth setting. If you seldom use the 16KC setting like when listening to a nice, clean SW or BCB station then you "could" go with a more conventional alignment and just peak to 455 Khz.

The IF gain will be higher with everything across the board at 455 Khz but the overall bandwidth will be reduced. The stagger tuning is to give the radio a more linear response across the maximum bandwidth. If sensitivity and selectivity were your only concern then the tank circuits could be changed to eliminate any Q-spoiler components. In a non-perfect world the Q would be so high that the radio would have absolutely no bandwidth and only be good for listening to CW.

So it all depends upon how faithful you want to stay to the original design and intent of the radio or how much you want to modify it to fit your listening needs. I find that the 16 kc bandpass filter is just a bit too broad. I wish they had an additional 12 kc setting that would be a better fit for SW/MW listening.

Date: Sat, 9 Jan 2010 15:04:20 -0600
From: "Les Locklear" <leslocklear@cableone.net>
Subject: Re: [R-390] R390A alignment question

In actuality, the 8 kc filter is 11 kc wide.

Date: Sat, 9 Jan 2010 16:24:29 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: Re: [R-390] R390A alignment question

IIRC, increasing the gain of the IF strip makes it oscillate, or somehow detracts from overall performance. That's why there is an IF gain control pot on the module.

Date: Mon, 11 Jan 2010 18:38:45 EST

From: flowertime01@wmconnect.com
Subject: Re: [R-390] R390A alignment question

I find that the 16 kc bandpass filter is just a bit too broad. I wish they had an additional 12 kc setting that would be a better fit for SW/MW listening. This is where you wish you had a good sweep generator. You can set the band switch to 16 KHZ. then retune de tune mis tune the IF cans until you get a nice 12KHz band pass in the IF strip. Then you can just set the IF gain to give you needed overall receiver gain want to also get good short wave and AM signal to noise and sound.

Date: Tue, 12 Jan 2010 08:26:57 -0500
From: William A Kulze <wak9@cornell.edu>
Subject: Re: [R-390] R390A alignment question

This has been giving me some ideas. I've got a winradio that I've run the IF into via some attenuation, using the SDR for demodulation. I could probably use the panadapter as an aid to the alignment process. I've heard that some were stagger-tuned and some were 455kHz straight through, but didn't know about the indent in the top of the cans. Once I get done working on this old house and get settled in I hope to do the full-on alignment, including the mechanical on the RF deck. That should be fun! ;)

Date: Tue, 12 Jan 2010 12:52:43 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R390A alignment question

Until I recently changed jobs I had access to the best Rohde Schwartz gear for radio alignment and a nice lab to work from Now I use my HP 3324A and an assortment of other HP devices to do "paying myself" radio work. I was able to use the sweep generator and a Hameg spectrum analyzer to build a roofing filter for the R-390A. The roofing filter uses one of the torsion Collins filters with impedance matching circuits on either side to improve the 3IP on the radio. I barely notice the difference when listening with the radio and the improvements only show up on test equipment. The Dallas Langsford document on roofing filters was my inspiration. It is really useful if you plan on going down this path.

Date: Tue, 12 Jan 2010 13:10:15 -0600
From: Ben Loper <brloper@gmail.com>
Subject: Re: [R-390] R390A alignment question

To help me understand, if each of the filters in a R-390A has a slightly different bandpass + or - 455 and the IF is tuned precisely to 455 won't you get some loss of gain anytime you select a filter slightly off of 455. I now understand why aligning a radio with one filter you tune for max using the center of the single filter. With the R-390A isn't the stagger tuning to account for the multiple filters giving ample gain for each filter? I ask this question because I don't have the equipment to stagger tune the IF and wondered exactly why it was stagger tuned in the first place.

Date: Tue, 12 Jan 2010 14:37:04 EST
From: djed1@aol.com
Subject: Re: [R-390] R390A alignment question

The IF bandwidth of the R-390A is determined by the mechanical filters. The only exception would be a case where the transformers have a narrower bandwidth than the mechanical filter. I expect this is the case with the 16 Kc filter. So the only reason to go through the stagger tuning process is to assure that the 16 Kc bandwidth is correct. Most of us don't bother because we don't use the 16 Kc much. But if you want to do it up right, I think you just have to offset the signal source to either side of 455, then peak up alternate IF transformers. I haven't done it, so I can't offer an exact procedure.

Date: Tue, 12 Jan 2010 13:43:23 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R390A alignment question

On most radios the IF's are all set by peaking while injecting a signal into the receiver. If done right this usually results in all of the IF's being at the same frequency. Hopefully this is the same frequency as whatever filters the receiver is using (crystal, mechanical, LC, etc..

I have seen that not happen. ie, something has happened to the IF in a big way, either through a component failure or some well meaning person just "tightening down" those loose slugs (don't laugh, I did that on my first ever radio back in the 70's). You can end up with the IF strip set to one frequency (like all stages set to 460 khz) but the filters maybe at 455 khz . In the R-390A I have had a similar experience when I tried to use the BFO oscillator as my reference, only to find out that my adjustments made it all worse because the BFO in center position was 'not' at 455 khz (the frequency counter was on vacation that day). In general, you end up with horrible performance across the board.

In a perfect world every filter would be dead on at 455.000000 KHz but we are talking about old radios. Things can happen inside of the mechanical filter that would either make it non-linear across it's passband or shift the frequency. There have been some dissections done on the mechanical filters used in the R-390A's and it appears that the foam falls apart and makes a mess of everything. Even on the manufacturing line there had to be some sort of +/- tolerance for what would be considered a good filter.

On the R-390A, since the radio was intended to provide a flat response at its widest bandwidth setting (16 KHz according to the switch) they had to stagger tune the IF to give it a broader passband.

Just brainstorming here but you may be able to do the tuning without a sweep generator... Use a signal generator with an unmodulated carrier. Set the frequency of the generator spot-on the desired frequency and peak the first IF. Then the generator frequency to be slightly higher (without retuning the radio) and set the second IF, now set the generator to be slightly lower than the center frequency and peak the third IF. You will probably need to bounce back and forth a couple of times through the IF deck but as long as one IF is center, one IF is high and the other IF is low you should be able to accomplish the same thing. The +/- spread is shown in the manual.

Date: Tue, 12 Jan 2010 12:58:33 -0700
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: Re: [R-390] R-390A Alignment Question -- Tisha Hayes

>...link to the Dallas Langford roofing filter article?.................

It can be found at this link: http://www.kongsfjord.no/dl/dl.htm
Scroll down to the "Collins" section and you will see it in the list.

Date: Tue, 12 Jan 2010 14:12:10 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: Re: [R-390] R390A alignment question

You don't need a counter to set the IF frequency, just a generator that doesn't drift. If the alinement isn't way out, select the 100 Hz crystal filter and peak the amplitude with the generator. This is the center for that IF strip at that temperature. Then proceed to align on that frequency. Or not, as the spirit moves you.

Date: Wed, 13 Jan 2010 18:05:51 EST
From: flowertime01@wmconnect.com
Subject: Re: [R-390] R390A alignment question

>.........wondered exactly why it was stagger tuned in the first place................

I think Tisha posted a good response to most of your question. The stagger tuned decks and straight tuned decks had different IF cans. While the schematic and part count are exactly the same in the stagger tuned and straight tuned decks, the actual circuit response and performance are different. You do not straight tune or stagger tune a R390/A deck on whim. Your specific deck is one or the other. It is not both. The question is how do you know which deck do you have.

Each mechanical filter will give you a different gain, but not because it is off frequency. If your filter is off frequency far enough to cause loss you would replace it. The trimmer caps were added to help "balance" the differences in gain between filters. Practice is not to balance gain but to "peak" each filter for what ever max signal can be achieved.

Once upon a time it was known which contracts were which. It was never cleanly printed in a TM, thus it is lost. We will not mention depot deck swapping to add to the mix-up. There was once a nice article in a monthly Army magazine that provided all the ugly details. I am sure some Fellows remember Connie. We could wish someone collected that publication and would cull the R390/A articles for us. Maybe in the next life time. (:, One clue is newer decks have trimmer caps on the mechanical filter. If your deck is new enough to have trimmer caps on one end or both ends, your deck is new enough to be straight tuned. The square can with the indent for the nut was to get enough height under the square can to clear the trimmer caps. The indent was to keep the bolt and nut height under the top cover plate.

And I add some more thoughts.

- In the beginning long long ago:
- The mechanical filters were centered on 455KHz.
- Decks that were stager tuned had different parts than later decks that were
  all centered on 455KHz.
- Only one mechanical filter is used at a time.
- The whole IF strip and its cans are used all the time.
- Les just pointed out to us that the 8KHz filter is in fact 11KHz wide.
- Always has been.
- The IF cans without filters have a band pass wider than 16KHz. This in fact
  makes it hard to use a sweep generator to tune the cans when the 16KHz
  mechanical filter is slicing off the corners of the band pass before we can see
  the real band pass of the IF deck cans alone.
- The best we can do with the sweep generator is make sure the cans do not
  "crimp" the 16KHz band pass.

Because of the fact of circuit, it was always questioned why any one would even try to use the sweep generator to align the IF deck any way. We were hard put to find a deck that was stager tuned to start with. Any straight tuned deck was just easier to peak with a AN/URM25 set to 455 as determined with the frequency counter setting under it on the bench shelf.

While any mechanical filter may not be exact on 455 we do not expect the 8KHz filter to be off by 4KHz or more. If it was you would replace it. The 4 and 2 filters can be even further off center and still not be outside the 16KHz skirts we expect from the cans.

The cans in the straight tuned IF deck do not really come close to having 16KHz skirts. The cans perform more as impedance transforms than filter functions. The can peaks are way up above the flat filter tops.

As you tweak a can slug around the metered receiver output goes up and down, not because you are just moving the band pass of the can around, but more because you are getting a better or poorer impedance transform between two
stages.

Understand the tweak operation is dynamic, and multi faceted. It's not simple.

Roger AI4NI

Date: Wed, 13 Jan 2010 17:28:10 -0600
From: "Les Locklear" <leslocklear@cableone.net>
Subject: Re: [R-390] R390A alignment question

Aaaaaah Roger, You put it so nicely................ Your expertise far exceeds any of the techs I ran across in the Air Force while working for the DOD for over 30 years. All R-390's and R-390A's should have been so lucky as to pass through qualified hands such as yours. Unfortunately, such was not the case, witnessed by most of the jumbled, butchered nightmares left in DRMO facilities.

Date: Wed, 13 Jan 2010 16:01:59 -0800
From: "Craig C. Heaton" <wd8kdg@worldnet.att.net>
Subject: Re: [R-390] R390A alignment question

Now you have me scratching my scalp and trying to save what hair is left. So, what came first; straight tuned or stagger tuned? I seem to remember most of the threads hinted straight came first.

Second question; the Y2K manual leans to stagger tuning the IF cans, is this because most of the R-390A's were modified with the trimmer caps or left the factory with such and thought to have IF cans meant for stagger tuning????

Guess without those ugly details in a monthly Army magazine the correct method might as well be try something and measure the results, then try the other method.

Date: Wed, 13 Jan 2010 19:43:10 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] R390A alignment question

I guess one way to tell which deck one has, is to look at the components around the base of the cans. I'll need a little help with this because I usually forget which way is which but in one case Q spoiling components were added to reduce the peaky gain of the stage.

I'm thinking it was for the straight tuned decks. The stagger tuned decks could use the full gain because they didn't all line up on the bandpass.

Determining if you have those caps and/or inductors at the base of the cans could answer the question. You wouldn't want to mix them up....ie try to straight tune a deck that was designed to be stagger tuned because it would probably oscillate as someone mentioned... on the flip side stagger tuning a deck with the Q spoiling components would result in insufficient gain.

If I have this all wrong Roger please clear it up as I don't want to add any confusion to this discussion.

Date: Thu, 14 Jan 2010 10:14:40 -0600
From: Barry Williams <ba.williams@charter.net>
Subject: Re: [R-390] R-390A Alignment Question -- Tisha Hayes

You mean PM Magazine with Connie Rodd?

http://dig.library.vcu.edu/cdm4/results.php?CISORESTMP=results.php&CISOVIEWTMP=item_viewer.php&CISOMODE=thumb&CISOGRID=thumbnail,A,1;title,A,1;creato,A,0;illust,200,0;none,A,0;20;title,none,none,none,none&CISOBIB=title,A,1,N;creato,A,0,N;illust,200,0,N;none,A,0,N;none,A,0,N;20;title,none,none,none,none&CISOTHUMB=20%20(4x5);title,none,none,none,none&CISOTITLE=20;title,none,none,none,none&CISOHIERA=20;creato,title,none,none,none&CISOSUPPRESS=1&CISOTYPE=link&CISOOP1=all&CISOFIELD1=title&CISOBOX1=index&CISOOP2=all&CISOFIELD2=creato&CISOBOX2=&CISOOP3=all&CISOFIELD3=illust&CISOBOX3=&CISOOP4=all&CISOFIELD4=CISOSEARCHALL&CISOBOX4=&c=all&CISOROOT=%2Fpsm

That's a long adress that ends in 'psm'....just to be sure you get it all. This is the complete index of articles by year. This is a collection of all the magazines from 1951-1971. They did a good job on them.
http://dig.library.vcu.edu/cdm4/index_psm.php?CISOROOT=%2Fpsm

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Date: Mon, 18 Jan 2010 19:38:53 EST
From: flowertime01@wmconnect.com
Subject: Re: [R-390] R390A alignment question

Les weighed in here with some mail. My server will not let me read it. Likely I am missing the best laugh in months. I thought the short flat top can over the filter with no trimmers came first. I thought these were stagger-tuned IF decks. Today I am 61. Back then I was not real keen on trying to become a R390 history buff. I was just trying to keep a whole bunch of them running one dirty PM at a time. I tried not to think about these small details. My TM 11-5820-358-35 Dated 9 March 1962 Page 91 Section II Alignment. Paragraph 76. Alignment of 455-Kc IF stages, is a straight forward 455 alignment. Put the signal into the last Mixer of the RF deck at test point E210. Peak the generator through the 455 .1KHZ crystal. Set the band width to 16KHZ and peak all the slugs. Work the bandwidth down and continue peaking until you get the deck centered up on the 455 KHz crystal band pass. I have no stagger tuning procedure in the original paper book I have in hand. If you have the equipment and can measure the difference, try your deck both ways and see what the results are. As my mail from Les Lochlear will not open and I do believe in Murphy, I expect the real answer is in that mail.

Date: Tue, 12 Jan 2010 12:58:33 -0700
From: ANTHONY CASORSO <canthony15@msn.com>
Subject: Re: [R-390] R-390A Alignment Question -- Tisha Hayes

>...link to the Dallas Langford roofing filter article?.................

It can be found at this link: http://www.kongsfjord.no/dl/dl.htm

Scroll down to the "Collins" section and you will see it in the list.

Date: Fri, 12 Mar 2010 16:45:04 -0600
From: "Bob" <rfay@charter.net>
Subject: [R-390] R-390A help needed

I have been cleaning and working on a Stewart Warner R390A sn65 for the past year. So far I have disassembled, cleaned, and replaced broken parts in the RF deck.

Replaced all paper and electrolytic caps, gone through the alignment of the mechanical and electrical components.

Replaced 7 bad crystals in the crystal osc. I also replaced many weak tubes. My problem is that I have never seen an operating R390 to compare with and my training is mainly digital so I look for a signal to be there or not. I am not familiar with troubleshooting stage gain.
Current state of receiver:

1. All stations receive about 3-5Kc high as read on radio.

2. All received signals have low audio, both from Local Audio and through the IF BNC connector in rear of rec fed into a separate amp. This also happens when the Signal strength meter reads a 40-50 db signal. I can feed a 3 microvolt signal into the ant in jack and it is loud enough to zero beat.

My question is how do I approach troubleshooting this?

Date: Sat, 13 Mar 2010 21:54:13 -0600
From: "Bob" <rfay@charter.net>
Subject: Re: [R-390] R-390A help needed

Thank you to all that answered my questions. It looks like I do have some work to do. It may take awhile as my wife just had knee replacement surgery and she can be somewhat demanding. I will post what I find, also there was a question of which way that I aligned the IF. Set it for 455Kc only, not the stagger tuned method. Also there was a question about how the PTO was adjusted. I used a freq counter to set the PTO to 2455KC at the 7Mc +000 point. I then maxed a received signal by slightly tweaking the Oldham coupler.

Date: Sun, 18 Apr 2010 12:35:11 -0700
From: "mparkinson1" <mparkinson1@socal.rr.com>
Subject: [R-390] R-390a dead below 8 Mhz

OK I will help jump start this reflector.
I have not seen to much action except on the Cosmo PTO issues.

So here it goes dead below 8 MHZ; could it be T207 shorted or could it be the 100PF capacitor shorted under the transformer Could it be the Switch under the RF deck misaligned??? The RF train is aligned ok for 7MHZ plus. Could it be the 17Mhz osc dead not likely. Hum did I miss something else please chime in guys this is good for the reflector archives just jump starting something else. This is a famous problem for sure.

Date: Sun, 18 Apr 2010 15:47:29 -0400

From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] R-390a dead below 8 Mhz

One piece in collecting Roger's tips. This came on reflector in 2005:

> ....Above 8 MHz the receiver uses only two of the 6C4's <snip>

Note the 6C4 - two for ABOVE 8Mc. Three total. Try swapping one for another. I'd use a "known" in use one for the No. 1 6C4. Good first idea that I see.

Date: Sat, 4 Sep 2010 18:57:11 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] the saga continues part 2

<snip> With your generator and a couple of meters, you should be able to get things aligned. If you are not getting 30 DB difference in the IF and audio with modulated to un modulated signal you will never get the receiver up to par. This value is published NOWHERE. Some thing the manuals never told you. Checked and working is no merit figure of signal to noise or sensivity. Fair radio is good. I like them. But there are limits to what they can do for us and still sell it at a reasonable price. Checked and working is checked and working. It's what you expect the receiver to work like before you start the semi annual PM not after you finish the PM. Go to paragraph 6.2.8.2 in the Y2K manual and hook the generator up for the 150 micro volts. Hang a DC voltmeter on the diode load. Hang an AC voltmeter on the local audio output on the back panel with a 600 ohm load resistor.

1. Adjust the IF gain R519

___ 01 Set the Line Meter OFF
___ 02 Set the Line gain to 0
___ 03 Set the ANT Trim to 0
___ 04 Set the AGC to MED
___ 05 Set the LIMITER to OFF
___ 06 Set the Band Width to 2KHz
___ 07 Set the BFO Pitch to 0
___ 08 Set the Audio Response to WIDE
___ 09 Set the Breakin OFF
___ 10 Set the Function to MGC
___ 11 Set the BFO to OFF
___ 12 Release the Zero Adjust
___ 13 Release the Dial Lock
___ 14 Set the Local Audio to max
___ 15 Set the RF to max

___ 16 Remove P114 from J514
___ 17 Remove P213 from J513
___ 18 Remove P218 from J518
___ 19 Remove J116 adapter from the back panel if necessary
___ 20 Couple P114 to J513
___ 21 Couple P116 to J116
___ 22 Couple J116 to the signal generator RF output
___ 22 Adjust signal generator for 455 KHz output frequency
___ 24 Adjust signal generator for 150 micro volt RF output
___ 25 Adjust signal generator for 30 % audio tone modulation (400 Hz)
___ 26 Meter diode load output for -7 volts DC
___ 27 Place a 600 ohm load across the local audio output
___ 28 Place a 600 ohm load across the line audio output
___ 29 Meter local audio output for 450 milliwatts, 27 db, or 17.3 Volts AC
___ 30 Adjust the IF gain R519 for -7 V DC on the diode load
___ 31 Observe the local audio output level is greater than 400 milliwatts
___ 32 Local Audio should be 17.3 Volts AC across 600 Ohms 450 mw
___ 33 Line Audio should be 2.45 Volts AC across 600 Ohms 10 mw
___ 34 Phone Audio should be .78 Volts AC across 600 Ohms 1 mw
___ 35 Line Audio at .78 Volts across 600 should be Line Meter Zero VU
___ 36 Set the Line Meter to +10
___ 37 Set the signal generator modulation on
___ 38 The Line Meter should read above 0 VU (10 mw)
___ 39 Set the Line Gain off max until the Line Meter reads 0 VU (10 mw)
___ 40 Set the signal generator modulation off
___ 41 Set the Meter Switch to -10
___ 42 Observe 30 db change (20 db on switch plus 10 db on meter scale)
___ 43 The Line Meter should read less than -10 VU (SN + N > 30 DB)
___ 44 Set the Line Meter to OFF
___ 45 Set the Line Gain to 0

The volt meter on the local audio should also give you a 30 DB difference between modulation on and modulation off. If the IF deck and audio deck will not give you this 30 DB difference, there is nothing you can do in the RF deck to overcome this poor performance. No RF deck will let you have good signal to noise if you can not get this 30 DB difference from this test of the IF deck and audio deck.

If you are not getting this 30 DB difference its time to start swapping tubes.

While measuring the local audio, you can also watch the line meter and see the same 30 DB differences. Mostly you just have a larger better eisier to read meter to hang on the local audio than the line level meter.

2. IF And Audio Module Tube Optimizing

Optimizing the vacuum tube lineup in the signal path is another technique to maximize performance. Start with the tubes in the IF strip. These are the 5749W's IF amps, V-501, V-502 and V-503. The 6AK6 4th IF amp V-504 and the detector, V-506, a 5814A. Continue with the Audio module tubes. Then do theRF module tubes last. The tubes can be optimized before any alignment is conducted. But the usual procedure is to do a signal alignment, conduct the tube
optimization and then do another complete signal alignment. Normal procedure is to conduct the signal alignment and tube optimization together in module by module stages IF and Audio modules, then RF and oscillator modules. Watch the noise level of each tube with the modulation off. The meter should lie quietly. If the meter needle is bouncing then consider this as additional noise from the tube. It may take several passes in a poor receiver to grade
other noisy tubes out of the receiver and reach acceptable levels of performance. Use the best tubes on hand and place them in the optimum performance order. New tubes may not be better than existing tubes. When new tubes are received, grade them against all like tubes on hand. Keep track of the spares and their values. If the signal to noise ratios are good some meter bounce is expected. If you reach the point where you believe you have good tubes through the receiver and the meter just will not lie quietly, then you have to start looking for, leaky caps, poor resistors, bad solder joints, dirty tube sockets, dirty connector pins, loose or corroded tie lugs.

___ 01 Set the Line Meter OFF
___ 02 Set the Line gain to 0
___ 03 Set the ANT Trim to 0
___ 04 Set the AGC to MED
___ 05 Set the LIMITER to OFF
___ 06 Set the Band Width to 2KHz
___ 07 Set the BFO Pitch to 0
___ 08 Set the Audio Response to WIDE
___ 09 Set the Breakin OFF
___ 10 Set the Function Switch to MGC
___ 11 Set the BFO to OFF
___ 12 Release the Zero Adjust
___ 13 Release the Dial Lock
___ 14 Set the Local Audio to max
___ 15 Set the RF to max
___ 16 Remove P114 from J514
___ 17 Remove P213 from J513
___ 18 Remove P218 from J518
___ 19 Remove J116 adapter from the back panel if necessary
___ 20 Couple P114 to J513

___ 21 Couple P116 to J116
___ 22 Couple J116 to the signal generator RF output
___ 22 Adjust signal generator for 455 KHz output frequency
___ 24 Adjust signal generator for 150 micro volt RF output
___ 25 Adjust signal generator for 30 % audio tone modulation (400 Hz)
___ 26 Meter diode load output for -7 volts DC
___ 27 Place a 600 ohm load across the local audio output
___ 28 Meter local audio output for 450 milliwatts, 27 db, or 17.3 Volts AC
___ 29 In pass one gather all the spare 5749's
___ 30 Pull the BFO and VFO 5759 tubes (V505, V701)
___ 31 Pull the AGC IF AMP (V508)
___ 32 Remember the goal is best signal to noise ratio or each tube
___ 33 Set the signal generator modulation on and record the audio output
___ 34 Set the signal generator modulation off and record the audio output
___ 35 The difference in these two values is the merit of the tube in V501
___ 36 Place each spare 5759 into V501 to find a merit value for the tube
___ 37 Grade the spare 5749's from worse to best
___ 38 Place the worse tube in V503
___ 39 Place the second poorest tube in V502
___ 40 Start over and re-grade the 5749's in V501 (32, 33, 34)
___ 41 Select the very best signal to noise 5749 for the V701 (VFO)
___ 42 Place the second best 5749 in V501
___ 43 Place the third best 5749 in V502
___ 44 Place the fourth best 5749 in V503
___ 45 Place the fifth best 5749 in V505 (BFO)
___ 46 Place the sixth best 5749 in V508 (AGC IF AMP)
___ 47 In pass two gather all the spare 6AK6's
___ 48 Remove V604 Line Audio
___ 49 Set the signal generator modulation on and record the audio output
___ 50 Set the signal generator modulation off and record the audio output
___ 51 The difference in these two values is the merit of the tube in V504
___ 52 Place each spare 6AK6 into V504 to find a merit value for the tube
___ 53 Place the worse tube in V603 Local Audio
___ 54 Start over and re-grade the 6AK6's in V504 (49, 50, 51)
___ 55 Place the best 6AK6 in V504 (4th IF Stage)
___ 56 Place the second best 6AK6 in V603 Local Audio
___ 57 Place the third best 6AK6 in V604 Line Audio
___ 58 In pass three gather all the spare 5814's
___ 59 Remove V507, V509, V205, V206
___ 60 Set the signal generator modulation on and record the audio output
___ 61 Set the signal generator modulation off and record the audio output
___ 62 The difference in these two values is the merit of the tube in V601
___ 63 Place each spare 5814 into V601 to find a merit value for the tube
___ 64 Place the worse tube in V602
___ 65 Place the second worse tube in V506
___ 66 Start over and re-grade the 5814's in V601 (60, 61, 62)

___ 67 Place the best 5814 in V506 Detector
___ 68 Place the 2nd best 5814 in V601 1st AF AMP and Follower
___ 69 Place the 3rd best 5814 in V602 Local AF AMP
___ 70 Place the 4th best 5814 in V507 Limiter
___ 71 Place the 5th best 5814 in V205 Calibration Oscillator
___ 72 Place the 6th best 5814 in V206 100 KC Multivibrator
___ 73 Place the 7th best 5814 in V509 AGC Rectifier
___ 74 Adjust signal generator for 455 KHz output frequency
___ 75 Adjust signal generator for 150 micro volt RF output
___ 76 Adjust signal generator for 30 % audio tone modulation (400 Hz)
___ 77 Meter diode load output for -7 volts DC
___ 78 Set the Band Width to 2 KHz
___ 79 Adjust the IF gain R519 for -7 V DC on the diode load
___ 80 Meter local audio output for 450 milliwatts, 27 db, or 17.3 Volts AC
___ 81 Set the signal generator modulation on and record the audio output
___ 82 Set the signal generator modulation off and record the audio output
___ 83 Meter local audio output for 1 milliwatt, 0 db, or .775 Volts AC
___ 84 If the difference must be greater than 27 db. (30 likely)
___ 85 Remove all test equipment
___ 86 Return the receiver connections to their original configurations

Once you get the IF and audio up to par, you can start on the RF deck.

I think you just need lots of alignment in the Rf deck at this point. You have played with the cams and its all off peak. Just drive what ever level you have to through the reciever and make several passes through the whole alignement of the Rf deck. It will come back to life.

Date: Sun, 5 Sep 2010 18:26:33 -0500
From: <ka9egw@britewerkz.com>
Subject: [R-390] the saga cont. part 3

<snip> So...I did the audio sensitivity measurement as suggested by feeding 150uV/30% into the IF chain and verifying the audio out went from measured >19V to <.6V when modulation was removed. Good deal, eh?

Onwards to rf sensitivity measurements...feed the unbal ant in ~1uV@30%, tune sig gen off freq, peak ant trim on noise, set local gain for ~1V across a 600 ohm load, [ok, an 8-ohm speaker fed through a 600:8 xformer and read the ac voltage on the primary], tune sig/gen back to freq and measure amount of sig/gen output needed to raise audio out to ~3.2V from ~1V [the "~" is in
reference to the fact I haven't yet demothballed my analog VTVM and the digital one bobbles a bit].

Sanity check: 3.2V:1V = 10dB, yes?

That being the case, worst-case sensitivity for 10dB S+N/N at 1kC 30% modulation and 4kc IF B/W [checking 100kc in from each end of each 1Mc segment] appears to be .51uV @ 11.1Mc. Of the bands I consider important, namely .5-1, 1-2, 3-4 7-8 and 10-11 [BCB, 160, 80, 40 and 30, in other words] worst case is just a froghair under .3uV.

I have yet to go through the RF deck alignment, crystal filter neutralization, etc. I believe I will hook the sweeping voltage of my old sweep gen into the scope's external sweep input and the scope's veryt input to IF OUT so I can see the actual bandwidth plot on the xtal filter right there on the CRT...haven't done that since my old HQ-129X back in about '79.

Anyone care to comment on similarities and differences between the HQ-129's single-crystal filter and the 390A's? I note the 390A has no "phasing" control on the front panel...

Anyone know where I might find a manual for my Measurements Corp 82 sig/gen?

Date: Sun, 5 Sep 2010 20:19:13 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] the saga cont. part 3

<snip> You have reached 10 :1 and 3 UV sensitivity. Great. You now have a working R390/A.

Time to put some work in it and get it up to 20:1 and push the sensitivity toward 2 UV or better. This is all in tube selection and more passes through the alignment. But if you do not have tubes on hand. Be happy and use the receiver as is. 10:1 is good and enjoy. Buying new tubes may not help. I have often brought brand new name brand tubes and had then be more noisy than the tubes I have on hand. Just spending money is not a sure solution. For real let the receiver run 24 x 7 for a couple weeks (turn it off it it's going to rain, no reason to lose it to a lighting strike in the neighborhood). It will help the electrolytic caps and may quite some of the tube noise down. Spin the knobs and switches to help keep the oxide off the contacts and work the lube through the gear train.

Good Job happy you have endured all the frustration.

Date: Tue, 21 Sep 2010 19:48:23 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] rf alignment vs. sensitivity [a/k/a saga pt 8]

>Getting ready to do the rf alignment. Haven't found a published spec on how
>many dB I can expect to gain/lose going to/from the unbalanced input to the
>balanced input. Observations, anyone? 73, Brian KA9EGW

I was introduced to the R390 and R390/A back in 68. To this day I have no idea why I would try to do a signal to noise ratio on the unbalanced input. If the only connectors you have will mate to the unbalanced input, then move a balanced line over to the unbalanced connector so you can get connected. Then just short the other balanced input wire to ground.

On the bench where you only have one signal coming in to the first RF mixer from a generator, it makes no difference how you get it to the grid. Either path will have about the same small loss. Then you measure noise and signal plus noise. You still have no idea of the absolute sensitivity of the receiver. You have a signal you can detect or you do not detect the signal. There are no absolute values.

The balanced or unbalanced path of the single signal from the generator will have the same ratio of signal to noise. You got to get low to detect the difference in the noise path between the antenna connectors and the RF tube grid. Either of those entrance ramps are in good shape and have low noise additions and low signal path loss.

At the level of the receiver's sensitivity, you need a very good screen room to get any useful values.

In the real world where the antenna brings a spectrum of signals into the grid of the RF tube, the balanced input "filters" "most" of the out of band signals from the antenna to ground. Thus providing much more "selectivity" than the unballanced input. As out of band mixing products are deducted at the output of the RF tube the "noise" is reduced compared to the signal of choice. Thus a smaller/weaker signal of choice can be detected from amongst all the signals available to the antenna when the filter path of the balanced input is used.

Thousands of these receivers were run with one pin of the balanced input grounded and the center conductor of a coax line shoved into the other pin of the balanced input. There is a $25.00 plus right angle connector that was made just to get the job done. It accepts a "C" connector just like the unbalanced input uses.

Antenna farms larger than some small counties, were coupled to bunches of R390's that way and no one through their was a better passive way to

get the job done.

Date: Wed, 22 Sep 2010 09:29:57 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] rf alignment vs. sensitivity [a/k/a saga pt 8]

No question regarding the "screen"! The AN/URM-25(X) leaks horrendously! I used one for a sand state receiver. Even six feet away, I dialed the attenuator down to absolute ZERO! I was STILL receiving a carrier at over S-4/5.

I use Chuck Rippel's suggestion of grounding one side of the balanced input and feed the center conductor of the RG-8/RG-58 to the open side. I was "attempting" to get this across, however - I FAILED MISERABLY!

Using the older test gear works fine when one takes in all the issues.

Line-up: AN/URM-25(D)
TS-505D/U (VTVM)
TS-585D/U (Audio load/meter)

Nothing fancy here. Except the Tek 5440 scope, and a B&K frequency counter.

Date: Sun, 26 Sep 2010 16:03:16 -0500
From: <ka9egw@britewerkz.com>
Subject: [R-390] the saga cont. pt 10

Doing the RF alignment. Working from the idea this thing may have been over-diddled at some point. Almost every adjustment so far has required multiple turns of slug or significant movement of the cap to dial things in. All well and good til the top band, [16-32] Mc cans. The way this ckt is put together, do you all think the antenna trim control should have much effect when using the balanced input, or is it simply coincidental that on the other bands it does?
I swapped in a different can from my spare RF deck, and same deal...

Date: Sun, 26 Sep 2010 14:12:25 -0700
From: "Craig C Heaton" <wd8kdg@att.net>
Subject: Re: [R-390] the saga cont. pt 10

On all the racks, I've left the antenna trim at "0". Peaked n' tweaked as if it is a 50 ohm input receiver. The reason is my R-390A's are paired with transmitters and the antenna tuner/transmission line/ antenna is adjusted for 50 ohms to keep the transmitter happy.

Hopefully, with the receiver aligned this way, "0" on the antenna trim should be the peak reading (it is on mine) on the carrier meter when the antenna system is adjusted for the transmitter. YMMV.

Date: Sun, 26 Sep 2010 16:17:07 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] the saga cont. pt 10

Interestingly, although the schematic shows the center tap of the primary grounded, the wire connecting the two halves of the primary [the winding with 2 pins and one fixed cap] is laid right on the supporting frame of the can but not soldered to it. Neither primary pin shows any continuity to ground. It's this way on both cans. One's a teledyne and one's unmarked. It IS 2 pins on the primary end and 4 on the secondary side, right? I'm not misreading the schematic, right? *Now* I *AM* confused.

Date: Sun, 26 Sep 2010 16:26:38 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] the saga cont. pt 10

I'm sure it's the primary winding is wound in 2 pies over the secondary, right? The inside winding done as a single solenoid has 3 silver mica's on it whose values match the ones on the secondary on the shcematic in TM11-856A and TM-11-5820-358-35.

The wire goes from the pin, to the trimmer, through the frame, a couple turns on one pie, back out, along the frame, back in through the frame, the other pie, and back to one of the little radial-leaded cylindrical fixed caps [I think that's what it is] thence to the other pin. Seems to me if that center tap is supposed to be grounded, where that wire runs over that frame member is the only place it could be done, but it is apparent neither of them has ever been soldered there. The Teledyne can does show what looks like it might have been fluxed there at one point, but solder, no. Plus it looks like magnet wire [enameled].

Date: Sun, 26 Sep 2010 18:16:28 EDT
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] the saga cont. pt 10

I am looking at the schematic in the TM. I do not see any ground points on the coils in the RF deck cans. The effects of the antenna trim will vary from octave to octave. No logic to operation is known YMWV.

Just one pass through the receiver after pulling it apart and changing tubes will not get you in good alignment. Make at least three full passes before you think you are getting close. Burn the tubes in for a month and

then do the alignment again. You can expect things to be way off after changing tubes. A bath and or mechanical alignment will also leave things way off. Sounds all normal to me.

Date: Sun, 26 Sep 2010 17:48:41 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] the saga cont. pt 10

TM 11-856A, figure 106, page 187, upper left corner....er...[scraping egg off face]...dang, I must have misread the schematic. Time to swipe the FXYL's lighted magnifier... Looks like the cap and trimmer form a capacitive divider across the primary to make a "wannabe grounded center tap". Yer right, there's no DC ground. Hmm. Virtual-grounded for what? Just to tune out common-mode noise? Or is there a greater and more nefarious purpose I'm not catching?

Date: Mon, 27 Sep 2010 13:51:11 -0500
From: <ka9egw@britewerkz.com>
Subject: [R-390] saga cont pt 12

Well, it's coming together. I got all but the highest octave aligned after many, many iterations of back-and-forth; the first octave I was wondering if something was drifting. It looks like this may be a fairly sensitive receiver as R390A's go.

One thing--on the 16-32 octave, tuning the front can has no effect feeding it balanced, this with either of 2 front cans, although there's a very definite peak feeding it unbalanced. Is this normal behavior, or should I expect it to resolve itslef after my 62-ohm resitors arrive and I do the frontmost-trimmer balance alignment?

Date: Mon, 27 Sep 2010 13:33:34 -0700
From: "Craig C Heaton" <wd8kdg@att.net>
Subject: Re: [R-390] saga cont pt 12

On mine, from memory isn't it 68 ohm resistors? I think you will find the 2nd ones in from the front panel have the least effect, 3rd one in the most, 4th one from the front panel a good 2nd place. Craig,

PS: Look out for the slugs! If you find one that is adjusted just about to come out of the rack, a silver mica in that can is bad. Another hint on bad silver mica caps in those cans is when, no matter what, one octave loses its sensitivity. You go back get it peaked again and several days later that octave has gone south. Most cases, just one RF can is the culprit.

Date: Mon, 27 Sep 2010 13:45:52 -0700

From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] saga cont pt 12

Leakage is a frequent failure mode in molded mica caps today. Besides messing up the DC operating point, it spoils the Q. And most of the ones I've seen, only leaked under voltage. As some of the caps are in the R-390A.

Date: Mon, 27 Sep 2010 17:05:40 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] saga cont pt 12

The brown molded mica, (postage stamp mic), are paper caps inside. Same failure mode of the Black/Brown Beauties and Tiny Chiefs. The Red mica caps are the silver mica construction, and suffer from silver migration, throwing values all over the map. Replace them with a good quality disc ceramic.

Date: Mon, 27 Sep 2010 16:14:23 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] saga cont pt 12

How about the little cylindrical radial-leaded ones and the mint-green ones?

Date: Mon, 27 Sep 2010 17:21:23 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] saga cont pt 12

Personally, I'd unsolder one end and test them. Although I haven't had an issue with them to date. There are some "smallish" Sprague silver ones with radial leads. Those have all tested good.

Date: Mon, 27 Sep 2010 17:05:09 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] saga cont pt 12

The ones I'm talking about [there's one on the primary side of the 16-32Mc first can] are a little bigger around than a pencil lead. I know it's a cap 'cuz the schematic tells me so, but it looks like a miniature version of a VERY old resistor...

Date: Mon, 27 Sep 2010 17:21:14 -0500
From: <ka9egw@britewerkz.com>
Subject: Re: [R-390] saga cont pt 12

After some can-swapping, I can report that all my slugs have at least 3 or 4 threads showing above the rack...:-)

Date: Sat, 2 Oct 2010 17:31:37 -0500
From: <ka9egw@britewerkz.com>
Subject: [R-390] the saga cont pt 13

So after swapping a bunch of cans, I got the alance alignment done and started doing the rf alignment 'for real'. My God this thing is turning out to be sensitive--whoever said it'd take a screen room and a good one to get a meaningful sensitivity measurement was right. I had to cap the unused inut with some aluminum foil to blank out leakage from a non-local BC station, and having done that, on 850kc [first freq I tried this at] it has no problem hearing 0.1 uV/400/30%.

Onward and upward...after I finish the RF alignment "for real" the first time [since it's been burning in for a week now], I may go back and peak the IF's on 455 across the board rather than stagger tune them. The rx is now sensitive and quiet enough I can hear the difference as I tune across a 1uV sig with the 16kc filter...there appear to be 2 peaks a couple kc apart with the trough ~1-2 dB down...is that typical for a 16k filter or am I hearing the separate peaks of the stagger tuning? What do you suppose it'd do with more than a couple feet of wire for an antenna? HI HI

Date: Sun, 03 Oct 2010 09:18:03 -0400
From: djed1@aol.com
Subject: Re: [R-390] the saga cont pt 13

I wouldn't be surprised to see a couple of dB ripple in any of the mechanical filters.

Date: Tue, 9 Nov 2010 07:30:47 -0600
From: "Dan Cotsirilos" <k9dtc@comcast.net>
Subject: [R-390] dead bands

I just picked up a very nice R-390A over the weekend and I just noticed now that the 7 mc band is dead. This lead me to check all the bands and it seems that 15 24 and 32 are also dead. Is there one crystal that is in common with these bands? If not what else could it be?

Date: Thu, 11 Nov 2010 19:27:21 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] dead bands (caution Evil Images Invoked [sorry])

As a new owner you must be told about the killer cap in the IF deck. Y2K 3.2.9.3 The mechanical filters are separated from plate B+ by C553. This cap will fail and then kill your mechanical filters. Pull your IF deck and look for this cap. If all you see is big black or brown plastic .01uf caps, leave your receiver off. Read about black beauties of death.

At least replace this cap with a new modern good quality cap. There is also a small electrolytic in the audio deck that leaks acid and eats stuff. The two plug in electrolytic power supply caps on the audio deck get old and leak, let power supply voltage ripple or fail with a mess. These are all easy fixes.

So you have some work ahead of you. No problem. It will just take time and care.

7 and 24 go together. 1st and 3rd on one crystal...... 15 is by its lonesome.

32 does not exist. The receiver will tune to 31.999 + over run of 30 or so to 32.030.

But there is no real 32 on the receiver. Your Mega hertz detent is not adjusted well. You can set your receiver to 32 on the MHz and run the KHz knob from end to end but you get no signals.

The thing in common is a receiver that has just been allowed to set without exercise. In specific the Crystal oscillator band switch and the crystals in the heated oven compartment. The switch changes on every Megahertz change. A couple of contacts have gotten dirty / oxide and do not make good enough contact. Or a crystal or two in the oven have oxide in the sockets. We do not open up the oven cover to unplug and replug the crystals in their sockets. It is just a one time procedure to exercise and clean up some contacts.

Find the Y2K manual on the R390 web page and down load it. r390/a.net

This text is easy to down load if you have slow dial up modem. It will take time but it will down load. This text is easy to read. It will not send you off on a Rip van Winkel 20 year sleep like the Army TM will. Lots of nice steps on how to get the receiver apart so you can do some cleaning and then alignment checking to get the receiver back to excellent operating condition.

As you think you have 32 on your receiver, you will have some mechanical adjustments to make. These are all in the Y2K manual. Much easier to read it and do it than try it from a short mail post.

Using the manual, open the crystal oven cover and check the crystals for seating. This could solve some problems. If the gear train is clean and the cam rollers well lubed and running free, then just use the receiver a lot as it sets. Runing the mechanical parts helps to clean up the contacts.

If the gear train is coated in dust from time and things are stiff. Then do a cleaning process before you go to just grinding crud into the gear train while trying to get a switch to clean up that may or may not come around with ease.

Your problems are not severe or hard to cure. They are all in the range of normal cleaning and alignment. You could have a bad crystal or two. They do go bad. Good used crystals are available here from some of the Fellows. Post some mail and just ask for the parts you need by value. IE the 7mhz crystal from the second oscillator deck. You will get a response back direct to you and some prices that include the postage. The Fellows are nice and do not have minimum order limits. You will get good used parts from receivers that are being parted out.

Deoxit from an electronic supply store is well liked for cleaning. Radio Shack stuff will work (caution counter ideas on quality) Do a search on Julian Creek Massacre and you will learn why there are parts available this way. Once you poke a R390/A with a fork lift much of its value and many of its attributes are lost.   Roger Ruszkowski

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Date: Sun, 14 Nov 2010 13:15:44 -0500
From: "Ed G" <ed.goss@comcast.net>
Subject: [R-390] R-390A Dead Band

Is there one weak component that can typically be held accountable for a dead band segment? My 390A seems to be a fairly hot performer, except for the 14 mHz band, which is dead. Perhaps a crystal, or something else?

Date: Sun, 14 Nov 2010 14:35:50 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] R-390A Dead Band

Check the large rotary switches in the oscillator? I would think that one dead band would not be a crystal, etc.

Date: Sun, 14 Nov 2010 14:55:40 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] R-390A Dead Band

There is the switch contacts PLUS a 14 Mc crystal.
So it may NOT be a simply located problem.

The Mc switch detents "can" be an issue. There is a hole that allows one to see the "desired" MC, but you must ensure that the detent is actually "dropped" into.

Date: Sun, 14 Nov 2010 15:10:37 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] R-390A Dead Band

Correct; however, if the crystal for 14mc is out, then that wouldn't be the only band out, right?

Date: Sun, 14 Nov 2010 12:42:47 -0800
From: "Craig C Heaton" <wd8kdg@att.net>
Subject: Re: [R-390] R-390A Dead Band

Looking at the Y2K manual; the 14mHz position on the MC knob is also common with the 31 MC position. Y41 a 17 MHZ crystal is common to both, so if this crystal is bad, 14 & 31 should be dead. If only 14 mHz is dead or lacking in sensitivity, could be a silver mica in one of the RF cans in that octave.

Date: Mon, 15 Nov 2010 11:15:56 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] Dead Band

I had a "dead band" problem with one of my receivers on the 2-3 mHz band position. The detent looked good on the crystal oscillator selector switch. I pulled the oscillator and RF decks and spent about an hour with cotton swabs and DeOxIt on the contact positions. The problem went away.

One of the other slight annoyances that went away as well was the slight scratchy sound and sensitivity changes that happened when I would wiggle the mHz bandswitch.

Date: Tue, 16 Nov 2010 04:14:31 -0500
From: "Ed G" <ed.goss@comcast.net>
Subject: [R-390] More On 14 mHz Dead Band

Craig's tip got me to check 31 mHz (as that's in common with the 14 mHz band using the 17 mHz crystal); 31 mHz also appears to be dead. I've got a crystal on order, and will let you know if that fixes the problem.

Date: Tue, 16 Nov 2010 20:32:14 -0600
From: Barry Williams <ba.williams@charter.net>
Subject: Re: [R-390] Dead Band

>spent about an hour with cotton swabs and DeOxIt on the contact

positions.

That works wonders. I also did all connectors, tube pins, and crystal pins.

Date: Wed, 17 Nov 2010 11:49:41 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] Dead Bands and bad connections

Another trick on "dirty" connections is to use No-Ox-Id from Sanchem. It is actually a conductive "grease like" substance that I first used in the power industry on bus-bar connections. All it takes is an incredibly tiny amount on tube pins or the center pin of coax connectors.

You definitely would not want to use this on a rotary switch where you have a wiping contact as you can end up making a conductive track across switch positions. I think the last place I saw it sold went for around $5 for a 4 oz container. That would be enough to last you for the rest of your life in our type of application. http://www.sanchem.com/aSpecialE.html

We also used it inside of compression fittings for 500-MCM AWG cables and on split-nut type connections.

Date: Fri, 26 Nov 2010 11:09:23 -0500
From: "Ed G" <ed.goss@comcast.net>
Subject: [R-390] Follow-Up 14 mHz Dead Band

Thanks to all those with suggestions for things to check when I reported a dead 14 mHz band in my R-390A. Turns out is was a bad crystal - the 17 mHz Y412 crystal. Replaced with one from Fair Radio.

Date: Wed, 12 Jan 2011 19:31:44 +0000
From: <normn3ykf@stny.rr.com>
Subject: [R-390] 10 turn stop out of alignment

My 390a won't go to the top of the 1MHz band. The ten turn stop is preventing it. OTOH it will tune below the MHz setting by a larger amount than it should. Looked through the manual. Can't seem to find the procedure to reset the ten turn stop for the KC set. Receiver is aligned and does work. It's been moved three times. If I have anything to do with it, she'll be in this rack for a LONG time to come. Do I have to do a complete mechanical/electrical alignment in order to reset it? (as I suspect..)

Date: Wed, 12 Jan 2011 19:51:38 -0500
From: <normn3ykf@stny.rr.com>
Subject: Re: [R-390] 10 turn stop out of alignment

It was an easy fix. Being that the receiver was correctly electrically AND mechanically aligned I wondered how it could be that the 10 turn stop would be out of adjustment.

Somehow during the last move, the stop pin jumped over the top of the stack and caused the drive to stop 1 turn too soon. This allowed it to tune lower than would normally be the case (and short on top of the band). By GENTLY prying the stack apart from the stop disk (and rotating the kc change knob) so that the pin would clear the stack, it returned to being in alignment.

Spent a bunch of time staring at it and using the mark 1 mod 1 cranium filling. I love easy fixes. Since it's apart, I think I'll work on another one I have. Want to swap IF decks on my 1347 and see if that fixes an AGC problem on the other receiver.

Date: Mon, 24 Jan 2011 20:29:27 -0500
From: "John L. Ahrens Sr." <kc2fxe@gmail.com>
Subject: [R-390] R390A going deaf

I have a strange problem with my R390A just started Wednesday nite i notice that the signal where getting weaker and weaker i was on 3.880 MHz than i changed over the to another rec. and found the the signal weren't getting weaker the R390 A was going deaf so i check some diff. bands and found that the 3mhz band is deaf low signals. So not having any test gear i used the cal. for a test signal all other band seem to be OK with 50db signal on meter but the 3mhz band only show 10db signal so with all of the R390A master out here could someone suggest a possible cause...

Date: Mon, 24 Jan 2011 22:22:46 -0500
From: Glenn Little WB4UIV <glennmaillist@bellsouth.net>
Subject: Re: [R-390] R390A going deaf

You possibly have a bad RF coil for that band. It is not uncommon to have a bad coil for the 80 M band. A lot of the radios were originally used on nets in this frequency rand with high power transmitters near by. Check the capacitor that resonates this coil.

Date: Mon, 24 Jan 2011 21:25:42 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Capacitor Replacements Vitamin Q

I would think CD would be fine...

Date: Mon, 24 Jan 2011 23:18:55 -0600 (CST)

From: nryan@mchsi.com
Subject: Re: [R-390] Capacitor Replacements Vitamin Q

On one or two decks I did wholesale paper cap replacement including Vitamin Q's, but quickly realized it's best simply to go after the BBODs and the potential mechanical filter killer cap, C553.

After pulling any VQ and testing it, I've found it good in each instance -- thus my remorse. Orange Drops in lieu of BBODs are my choice despite the challenge of fitting them in.

Date: Sat, 26 Feb 2011 11:34:00 -0600
From: "KA9EGW" <ka9egw@britewerkz.com>
Subject: [R-390] IF sweep alignment

Trying to do IF sweep alignment so I can look at the bandpass visually. I haven't done this since '79, and then the receiver under test was an HQ-1W29X, with a then-30-year-old 500kc Heathkit scope and a 1950's Eico sweep generator. Now I'm trying to do it with a HP8640B sig/gen and a 20MHz dual-trace Hitachi.

So I feed the FM-modulated RF into the antenna input of the 390A, feed the scope's vertical plates from the IF output on the rear of the 390, and feed the scope's horizontal plates from the 400Hz sinewave output of the 8640B. Can't get her to sync up with the scope in x-y mode.

Before I consume too much more bandwidth, is the fact I'm feeding the horizontal plates with the 400cps modulating freq the problem? Seems to me last time I did this that old Heath scope had a sawtooth output on the back with which I fed the external sweep input on the sweep gen, which sawtooth output the Hitachi scope doesn't have. :-(

I'm thinking I ought to see if I can borrow a function generator from work that does sawtooth and feed both the external modulation input of the generator and the scope's horizontal plates with that. [Of course I'm also thinking this would be a good excuse to buy a better scope, but alas, having just acquired that 8640B I dunno if I could get a new scope past the "Appropriations Committee" HI HI]. Am I on the right track here? I mean as far as my test setup goes.

Date: Sat, 26 Feb 2011 13:17:42 -0500
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] IF sweep alignment

When I became a Tektronix field engineer, one of the first things I did was to borrow what I needed and did a swept alignment of my R-4A. I did it pretty much like you are, using a nice triggered scope and programmable generator. The results were predictably good.

Now, here is my impression of an alternate and very simple way to do same with no real equipment... Use a noise generator..lots of info around..basically a conducting diode junction. Feed into the rig. THis produces a broadband"flat" input. Now, look at the output of the rig in the frequency domain using one of the free PC software tools like Spectran. What you see is a perfect, textbook display of the response of the DUT.

I have not performed a full alignment this way YET, but have looked at the setup and output using only off-the-air atmoshpheric noise. It works quite well. Anyone else use this method? To do just an IF strip, you would need a flat detector but that too is pretty simple.

Date: Sat, 26 Feb 2011 14:31:55 -0500
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] IF sweep alignment

Yes..that is absolutely correct. One can identify the frequency peaks via Spectran, but they are at the frequency of the audio input. It would require an additional step with a signal gen to get the whole response at a particular frequency.

For those of us without a lot of test equipment, it is definitely worth looking at I think, but as I indicated, I haven't actually performed a real alignment this way..just looked at the end to end response including the audio response.

Picking off the audio at the detector output helps eliminate the audio response issue. It sure was nice when I could just go to the demo room and check out what I needed ;)

Thanks for your input.

Date: Sat, 26 Feb 2011 14:38:19 -0500
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] IF sweep alignment

Yep. You need a sawtooth to feed the horiz plates via external...the sine input makes the display non-linear in X. Another way might be to get a sync pulse out of the generator and use it to trigger the sweep of the scope. You just need to make sure that what is sweeping the generator and the scope need to be same-same. (technical term)

Date: Sat, 26 Feb 2011 16:50:42 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] IF sweep alignment

I have a couple of receivers or receiver sections of transceivers that specify this methodology for alignment. However, unless this is a "personal" exercise in curiosity, I don't see where a sweep alignment of the IF on an R-390 or R-390A has ever been part of an alignment. This simply is not in ANY of the numerous manuals out there for these receivers. It leaves me puzzled as to the reason for doing so. Just my $0.02 worth.

Date: Sat, 26 Feb 2011 17:43:17 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: Re: [R-390] IF sweep alignment

<snip> ....There was also at least one thread in the good old days of this list that strongly advised against trying sweep alignment of the IF strip, because the ringing filters distorted the wave form. Perhaps you could use a wide band 455 KC receiver before the filters to see the response curve of the IF transformers before the filters...................................<snip>

Date: Sat, 26 Feb 2011 18:01:08 -0600
From: Tom Frobase <tfrobase@gmail.com>
Subject: Re: [R-390] IF sweep alignment

My usual process to check the filters and the IF alignment on a R-390 is to use my network analyzer to feed a signal into the IF amp and take the output at the IF output.

I started doing this with 51J series receivers it takes a little over 5 minutes with the analyzer to align a 51J IF. On the R-390's, A and not, the analyzer provides a quick visual check to see of the IF is working as it is supposed to ...

Date: Sun, 27 Feb 2011 08:26:17 -0500
From: "Shoppa, Tim" <tshoppa@wmata.com>
Subject: Re: [R-390] IF sweep alignment

> Ringing mechanical filters, IIRC.
> There was also at least one thread in the good old days of this
> list that strongly advised against trying sweep alignment of the
> IF strip, because the ringing filters distorted the wave form.

It's not that mechanical filters prevent sweep alignment. It's that mechanical (or, indeed, any higher-order) filters can have a large group delay and there can be milliseconds of "skew" between the "in signal" and "out signal". As a result a sweep generator at a fast sweep rate (as might be appropriate for a couple of simple IF transformers) can produce misleading indications because the "out" is delayed so much from the "in".

Sweep generators above the bottom rung of the TV-radio-repair-shop-level usually have a knob/switch that sets the sweep rate, and if you slow the sweep rate they will do just fine.

Some filter theory: it's the variation of group delay across the passband that results in ringing. IMHO the Collins mechanical filters are not quite as optimal as a constant-group-delay or Gaussian shaped filter, but they aren't bad compared to some other options (including many modern quartz crystal filters). It's not that any one filter component is necessarily superior to the others, but mostly that there's been a trend in the past half century in filter specsmanship to optimize the shape factor at the expense of increased ringing. The fact that the ham radio magazine reviews publish the shape factor, but do not say anything about ringing, has led to this unfortunate situation. CW-oriented homebrewers have been singing the praises of constant group delay filters for a long time now but few of the ham manufacturers have listened (but note that many of the military radios have had constant group delay filters for digital modes for decades now.)

Date: Wed, 9 Mar 2011 16:46:05 -0500
From: Barry <n4buq@knology.net>
Subject: [R-390] Okay, don't laugh at me but...

I am aligning an old FM radio and I want to sweep the IF transformers but I don't have a sweep generator. I know that my function generators with VCO input can function as a sweep generator, but they don't cover the 10.7MHz range.

Here's the dumb question: Can I use my HP-8640B (in FM mode) and feed the modulation input with a triangle waveform from a function generator to essentially cause the 8640 to sweep the center frequency?

BTW, the reason I want to use the scope and sweep it is something doesn't seem quite right using the VTVM method. It's adjusting the secondary of the last IF transformer is supposed to cause the measured point to go through a zero point (e.g. +V on one side, through zero, and then -V on the other). The procedure is to set it zero volts but I'm only able to get a non-zero null point so I suspect something else is not right and a picture might help me confirm what I'm seeing on the VTVM.

Again, please don't laugh at me. FM is just weird to me...

Date: Wed, 09 Mar 2011 18:19:39 -0500
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] Okay, don't laugh at me but...

I was reading an article in the HSN archive that described just what you are suggesting.. I think it should work. Can't hurt anything to try it. It talked about keeping the sweep freq low and the deviation controls the span of the display.

Date: Wed, 9 Mar 2011 15:20:01 -0800
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Okay, don't laugh at me but...

In the 8-16MHz range, the 8640B can only sweep +/- 80kHz, which is not really wide enough to align a broadcast FM IF. I can think of three ways around this.

1. Another VHF generator and a mixer. Tune the 8640B to, say, 60.7 and the other gen to 50. Drift will equal the second generator's drift. Another 8640B would be great. You can get by with a 608 if you warm it up beforehand.

2. An 11710B Down Converter. Tune the 8640B to 60.7 .

3. Amplify the 8640B's 5MHz timebase and mix with 8640B output. Tune the 8640B to 15.7 using underrun on the 16-32 range. See Agilent App Note AN171-2, "Extending the 8640B Frequency Down to DC".

Date: Wed, 9 Mar 2011 21:37:45 -0600
From: "Bill Hawkins" <bill@iaxs.net>
Subject: Re: [R-390] Okay, don't laugh at me but...

That last transformer that goes through zero is the discriminator. It demodulates FM to audio. Maybe this is too basic, but FM modulates the frequency with audio like AM modulates the amplitude of a fixed frequency. So an FM transmitter broadcasts a band of frequencies at a more-or-less constant level. Broadcast FM uses about 100 KC which is 1% of a 10.7 MC carrier, not much of a strain on the bandwidth of the IF strip in the receiver. Then there's narrow band FM, but never mind. The FM IF strip has too much amplification for AM. It deliberately limits (clips) the amplitude to get a uniform level across the 100 KC band. This top must be flat. If you can get a DC connection to the discriminator output, and have a high impedance voltmeter or DC scope, it doesn't matter how fast you sweep it. A stable signal generator capable of fine adjustment (.01%) is all you need to slowly sweep across the 100 KC band and verify that the signal level to the discriminator is flat. If it isn't, the discriminator output will vary with the IF amplitude, which causes distortion. The discriminator is designed to linearly change output across the frequency band. The adjustment is to center it (zero VDC) on the IF center frequency. If you can't get it to zero then something in the IF strip is oscillating at a spurious frequency. At least, that's how I understand FM.

Date: Wed, 9 Mar 2011 22:56:07 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Okay, don't laugh at me but...

Okay on the explaination. I do have a general understanding of FM - I suppose I was just being a bit self-depracating. It does make sense and is sort of what I thought. I was just trying to get my head around the idea that "modulating" the 8640B with a triangle signal would "pull" and "push" the frequency that way and I don't understand how that works (given it's using a tuned cavity for the center frequency and not a VCO).

The primary on that last IF peaks at a very odd position (core is quite a bit further out of the can that I think it should be). Furthermore, tuning is "touchy". If I don't get the stating centered just so-so, I get some distortion. Definitely something's amiss. I would suspect another bad cap but there isn't one across the primary of that transformer. There are some in the secondary so that still could be part of the problem.

According to the alignment sheet, if using a scope and a sweeper, one should see a double-S curve with the S-es crossing zero at the center frequency of the IF. That makes sense to me and I suspect that if I could see the pattern, it would not look at all like it should and that's what I'm trying to verify. Thanks for the reply,

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Date: Wed, 9 Mar 2011 21:20:35 -0800
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Okay, don't laugh at me but...

The 8640B does use a cavity, but there's a varactor diode inside.

Date: Mon, 14 Mar 2011 14:39:47 +0000
From: Mark Johnson <mvjohn@sympatico.ca>
Subject: Re: [R-390] Spectrum Analyzer

Sorry, my previous post...I mis read - the models I stated are for the Spectrum Analyzer....For a Sweep Gen, I use the HP 8601a and a Heathkit

IG-1275. I like the Heathkit as it goes low in frequency and like all Heathkits, it's easy to fix and get parts for.

>From experience, always use a capacitor, (.01 mmf), in line with the output of the generator. I once blew a non replaceable HP IC in a previous HP-8601a I had due to voltage being put back into the generator due to my mistake!

Date: Mon, 14 Mar 2011 10:50:14 -0400
From: "David C. Hallam" <dhallam@knology.net>
Subject: Re: [R-390] Spectrum Analyzer

I would agree that a sweep generator is more useful for receiver work. I do a lot of work with Johnson Invader transmitters and have found that my spectrum analyzer has saved me hours of work.

The spectrum analyzer was very useful in stage alignment as it was a revelation that maximum output did not correspond to the best signal. Just a slight tweaking of mixers and drivers could really affect the signal.

Date: Mon, 14 Mar 2011 10:16:51 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Spectrum Analyzer

Sounds like a good choice. I use one quite often. It's handy for looking at oscillator levels to be sure they are clean and somewhere near the proper output level. Stage gain. Mixer outputs.

You will find things to use it for and if you work on other things it will come in handy. If you don't now you will once you have the ability to do so.

Date: Mon, 14 Mar 2011 12:43:40 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Spectrum Analyzer

Along the lines of "please don't laugh at me but...", how does the AGC affect the bandpass, particularly its shape. I thought all the AGC did is change the gain at the various stages so the shape would be the same just translated "up" or "down" depending on the signal. Is that a horrible way to understand AGC (or its effects on the passband)?

Date: Mon, 14 Mar 2011 10:41:13 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Spectrum Analyzer

Nope. All of the R-390 family's selectivity comes from LC tuned circuits, mechanical filters, and crystal filters, and their Q is not affected by AGC. The tubes around them might exhibit a variation in input or output admittance, which affects overall circuit Q and tuning, but it's too small to notice.

Date: Mon, 14 Mar 2011 22:05:50 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Spectrum Analyzer

Hmmm, I think I need to chew on that one a while. I'm not sure all of that makes sense to me just yet.

I do appreciate the explaination, Don.

Date: Tue, 15 Mar 2011 10:10:40 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Spectrum Analyzer

>..... but it affects your VIEW of.........................

The above is the part I don't quite understand. I thought that the AGC would attempt to keep the IF output as constant as possible. When the sweep signal is outside of the bandpass, then the reduced AGC voltage would result in an increase in the gain in the IF stages. When the signal is inside the bandpass, then the AGC voltage increases and thus decreases the gain. If that's correct, then why would the IF output pop to full output? It would seem the opposite would be true. I'm not saying it doesn't, but I don't quite understand why it would act that way. BTW, when you say "perfect AGC with infinite slope", do you mean an AGC with an instantaneous response time?

> AGC tries to hold the IF output level constant, ...

Yes, that part makes sense to me. I just can't seem to make this agree with the explaination above.

Date: Tue, 15 Mar 2011 10:05:52 -0500
From: Randy and Sherry Guttery <comcents@bellsouth.net>
Subject: Re: [R-390] Spectrum Analyzer

> The above is the part I don't quite understand. I thought that the AGC would attempt to keep the IF output as constant as possible.

Yes -

> When the sweep signal is outside of the bandpass, then the reduced AGC voltage would result in an increase in the gain in the IF stages.

Yes - so - as indicated above - as the sweep signal approaches the passband - at some point the IF's bandwidth will allow some signal to pass. (In real life) from that point - and "up to" -100db - a spectrum analyzer will show the signal being passed.

> When the signal is inside the bandpass, then the AGC voltage increases and thus decreases the gain.

What complicated matters in the example given - the passband is arbitrarily given as -100db -- so that as soon as the sweep signal "crosses" into the passband - the AGC limits the gain so that the passed signal never exceeds -100db... resulting in a "square" pass band (flat topped)...

> If that's correct, then why would the IF output pop to full output?

It won't - it is flat BUT *at -100db* since that's the maximum signal allowed by the agc (again - in this theoretical example - real life ain't that perfect).

Date: Mon, 19 Nov 2007 10:17:39 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: Subject: Re: [R-390] Alignment tools

Thanks for that link. While aligning an SX-88 recently, I made alignment tools that fit the powdered iron slugs from bamboo kebob skewers. They were just the right size to go into the can holes, plenty strong, and required only modest work with the exacto knife to fit the oval-with-straight-sides holes in the slugs. AFTER the job was done, I came across in my tool box a commercial tool of old that was the correct one. I doubt that shape is included in the kits available.

Date: Mon, 23 May 2011 16:25:50 -0400 (EDT)
From: Paul Dulaff <pdulaff@embarqmail.com>
Subject: [R-390] Repair of Crystal Oven for 1.0 Mhz Calibrator Crystal

I am repairing an R390 and I am having trouble getting the calibrator signal adjusted precisely beating with WWV at 10.000 Mhz as the adjustment runs out of range. I found that the oven for calibrator crystal is not working and may be keeping the crystal frequency low. I suspect the thermostat is not contacting.
Has anyone been able to open the thermostat and clean the contacts ?

Date: Mon, 23 May 2011 21:49:41 -0500 (CDT)

From: nryan@mchsi.com
Subject: Re: [R-390] Repair of Crystal Oven for 1.0 Mhz Calibrator Crystal

The likely cause of failure in the crystal oven is corroded wiring inside. The wire usually is braided untinned copper and apparently the solder flux used on it has eaten through the connection. Open up the oven, take the crystal out and I think you will see what I'm referring to.

I haven't found a way to repair crystal ovens easily, so I just reach for a working oven and place it and the crystal back in service. Replacement ovens are easily found at hamfests, but take your multimeter along for continuity testing. You do want the oven to heat your crystal so that it may work at its specified frequency.

Date: Tue, 24 May 2011 10:37:16 -0400 (EDT)
From: Paul Dulaff <pdulaff@embarqmail.com>
Subject: Re: [R-390] Repair of Crystal Oven for 1.0 Mhz Calibrator Crystal

You were correct. Inside the oven actually looked good overall, but the wires to the heater element were corroded and one wire dislogded from the heater element. I had a spare oven and have installed it. How much do these ovens go for at hamfests ?

Date: Thu, 14 Jul 2011 11:08:47 -0700
From: "Chris Kepus" <ckepus@comcast.net>
Subject: [R-390] Polished front panel R-390A

For those of you who can look at a R-390A with a polished front panel and not have a seizure, please check out ePay 280708350502. I don't remember this guy's work being discussed here but I coulda missed it. (monitoring and learning from list members since 2003)

I have quoted part of the seller's answer to a question because he mentions some reference or procedure with which I am not familiar and have not heard about on this list or anywhere else.

" .... I really should write up the stuff I have discovered, which maybe you also used in the service -- such as using not only 7 +000 to align the cams, but also 3+000 and 15+000; how to use the variac to find weak tubes and off spec resistors, etc etc. Will be experimenting with Ray Osterwald's Zener AGC mod next.(ER #150, 11/'01) After the gears, slug racks, shafts, and slugs are properly cleaned, aligned, adjusted and lubed, the carpal issues totally go away. Then deburring the brass Veeder Root drive gear and adjusting the split gear springs smooths it out so zero beating can be done quickly. I'll bring one to Nearfest so you can feel the difference. The going rate at Ebay over the past year has averaged $1400 and change.

After parts and a week's work, not enough to quit my day job."

What is he specifically referring to:? "7 +000 to align the cams, but also 3+000 and 15+000"?? Yes, I know I could ask him directly and probably will, but he obviously thinks it's pretty cool and I value this list's objective opinions very highly.

Also, since many of you live in the NE, have any of you ever gotten up close and personal with one of K1QAR's polished panel R-390A's? ...I kinda like it...but being a modified car guy, I like polished aluminum. ;-) Does it tune as smoothly as claimed? TIA for any and all comments.

Date: Fri, 15 Jul 2011 13:28:11 -0400
From: "Shoppa, Tim" <tshoppa@wmata.com>
Subject: Re: [R-390] Polished front panel R-390A

At the top of every octave (e.g. 0+000; 1+000; 3+000; 7+000; 15+000; 31+000) some or all the cams align with the little black marks. Those that aren't, are off by some simple fractional number of rotations. This seems to be guaranteed by the gear ratios. But maybe there's some "wrong" way to put the gears together that I didn't find :-) Maybe it's simply a reference to a cross-check that there's no clamp slippage.

Date: Tue, 6 Dec 2011 10:04:30 +1100
From: "Pete Williams" <jupete@internode.on.net>
Subject: [R-390] Sensitivity below 8 Mhz

LOW SENSITIVITY -390A below 8 Mhz

G'day list...Apart from the obvious lack of activity in the 17Mhz xtal oscillator. I found a fault not mentioned to best of my knowledge in the literature that contributes to low sensitivity below 8 Mhz.

All voltages checked OK on the tube elements EXCEPT the voltage at E209 test point was less than half the listed figure of around 8 V. Altho' the xfmr tuned to a peak, further examination concluded the only explanation -apart from tube- od bad ground, would be the feed back capacitors in the oscillator circuit or the one in parallel with the xfmr. Removing the RF module a pain and a shotgun approach not the best practice but removal and replacement of all 3 produced success.

Full gain and voltage at test point per manual. Caps SEEMED to check OK on a static test.

ALTERNATIVE SOLUTIONS WELCOMED .

Date: Mon, 5 Dec 2011 18:28:22 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Sensitivity below 8 Mhz

I think this may be similar to the problem Chuck Rippel reported for a different xfmr:

http://web.archive.org/web/20080112212428/http://www.r390a.com/ProbCaps.html

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Date: Mon, 05 Dec 2011 17:28:39 -0600
From: Randy and Sherry Guttery <comcents@bellsouth.net>
Subject: Re: [R-390] Sensitivity below 8 Mhz

Check at RF - (easy way is with a good ESR tester).

Date: Tue, 6 Dec 2011 11:55:31 -0800 (PST)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Sensitivity below 8 MHz II

Wrote: Altho' the xfmr tuned to a peak, further examination concluded the only explanation -apart from tube- or bad ground, would be the feedback capacitors in the oscillator circuit or the one in parallel with the xfmr.

Removing the RF module a pain and a shotgun approach not the best practice but removal and replacement of all 3 produced success. Full gain and voltage at test point per manual.

Thanks for the info Pete. Perhaps the fact that the 17 MHz oven runs at 85C might have contributed to the caps failure.

Wrote: Check at RF - (easy way is with a good ESR tester).

Ok. No Argument. It would work but how practical would that be? First is the cost. Second you?d still have open up the RF deck. Then can it test in-circuit? I don?t know the cost of such and instrument but I suspect one could buy all the resistors and capacitors for several R390A?s for the cost of such an instrument.

A shotgun approach is not a substitute for reasonable trouble-shooting. (If one needs help see Rogers?s excellent advice the Y2KR3 manual.) However, us non-professionals face test equipment limitations. So sometimes an educated ?best guess? is not only the most expedient but cost effective method.

An additional note. Continued occasional postings to the list of mica capacitor failures, particularly the ?postage stamp? variety, suggest that it may be time to replace all if one is doing a major overhaul or if one is having problems with a particular module.

A good example IMNSHO, is the I.F. deck where the paper caps seem to be notorious for devilish-to-find AGC problems. Agreed it is a PITA but to me I?d rather replace all the resistors and capacitors once and be done with it.

FYI Ron Baldwin who is on this list has a hobby-business of selling mica caps. Probably much cheaper than Mouser, etc.

Date: Wed, 7 Dec 2011 22:52:22 +1100
From: "Pete Williams" <jupete@internode.on.net>
Subject: [R-390] IF module ---

G'day list..... thanks to the respondents on the 1st Osc problem... fixed that with replacement of capacitor C327 across T 207. <Snip>

Date: Tue, 28 Feb 2012 19:07:45 -0600
From: <wb5uom@hughes.net>
Subject: [R-390] The OLE receiver sensitivity test revisited

Ok Now that there are some awake from the PING Test:

I know that there is the 'standard' +30 plus year old method(s) of measuring receiver sensitivity on the R-390.

But, since I took delivery of my AeroFlex 3920 service monitor, (primarily for working on P25 digital radios) and after a couple of firmware upgrades to get the SSB generate fuction on track with the correct readings, and seeing as how it now goes down to -138DBm, I though I could put it to use at
home as well.

In SSB mode and with a 1000cycle tone, I can hear it all the way down to -138DBm on my R-390 (I get down to various levels on my other receivers,but not that far, which tells me I could copy a CW signal pretty much down in the mud (If I had headphones on) My idea is to make a test tape of sorts into a .wav file on the pc and play it back thru the external mod input on the service monitor
to see how far down I can go with VOICE. Actually,I thought about recording an actual broadcast of whatever (AM/SSB) and play that back thru to give me more realism, and crank the level down and see how I can go. What the heck Ive got over $50K in the machine, might as well put it to use!

Date: Tue, 28 Feb 2012 20:59:09 -0500
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] The OLE receiver sensitivity test revisited

That is interesting.. I also have a generator that will go down to -138. I haven't tried it but that would be under no noise conditions..only internal noise. On HF, it is my experience that for the most part, we are never limited by the sensitivity or the noise floor of the Rx but the level of QRN present.

Date: Tue, 28 Feb 2012 21:44:03 -0600
From: <wb5uom@hughes.net>
Subject: Re: [R-390] The OLE receiver sensitivity test revisited

Good point Curt, I've been sitting here pondering your thought. So, would I use the standard method up to the point of setting the reference noise level with the line level meter /adjustment and THEN use the actual ssb audio signal from then on..... OR......do we care because we KNOWwe are never going to actually hear a −138 (or -128 ,or -118DBm) station because we are not (in normal operating conditions) going to have a noise level that low on hf anyway. (although in years gone by my QTH has has some pretty quiet late nights). Just a thought.

Date: Wed, 29 Feb 2012 01:14:26 -0600
From: Randy and Sherry Guttery <comcents@bellsouth.net>
Subject: Re: [R-390] The OLE receiver sensitivity test revisited

That's pretty much the way it is in most places - with 390s working as they should.

Date: Wed, 29 Feb 2012 08:50:48 -0500
From: Curt <cptcurt@flash.net>
Subject: Re: [R-390] The OLE receiver sensitivity test revisited

Well, to me, I would like to see it in absolute terms. i.e., not "adjusted" for any arbitrary noise level. It surely is possible to copy CW below the noise level, because noise is random and the human brain can do remarkable integration over time, The EME groups have worked this down to a science and can compare good CW ops to digital modes for copying into the noise.

Also, I suspect that some of these receivers were used with specialized detection that could integrate signals out of the random noise...similar to averaging when using a digital scope. Integrators were standard fare back in the 60's for doing weak signal detection at VHF.

I am amazed that the RF seals on some of the older test equipment can actually be trusted down to -138.

I am very curious as to what others might add to this as I am really a novice in the front-end measurement arena.

Date: Wed, 29 Feb 2012 10:48:44 -0500
From: "Todd, KA1KAQ" <ka1kaq@gmail.com>
Subject: Re: [R-390] The OLE receiver sensitivity test revisited

You might find some useful info here:
http://www.w1vd.com/BAreceivertest.html

Jay has been working on this for a number of years now, specifically dealing with older tube gear. He's quite fluent in such things, and I'm sure would be more than happy to exchange thoughts and ideas on the process and results. He also has links to older test data as well as Bob Sherwood's data.

Date: Thu, 1 Mar 2012 00:25:15 -0500
From: John Wendler <wendlerjrv@gmail.com>
Subject: [R-390] R-390 Power Supply update; receiver voice testing

<snip> Testing with voice signals is tough, and ultimately it is subjective. At
one point I was involved in voice quality testing. One test involved stock recordings of different men and women reading particular phrases. The idea
is to have a large number of people listen to the recordings through a receiver and score. Afterwards, you apply some statistics. (Think of an older and slightly deaf man listening to a soft and breathy soprano woman -
you want to make sure that score is diluted by others who can make out her
consonants)

I have also performed VHF / UHF radio receiver testing per TIA-603 (conventional FM) and TIA-102 (P-25) There are procedures for setting the
voice level input at the transmitter. In general, Analog RX sensitivity tests were defined with a 60% of peak modulated 1 KHz sine wave at the transmitter and if I remember correctly, a 12 dB SINAD at the receiver. Preemphasis and deemphasis per particular curves.

I have not done formal AM or SSB testing professionally, so no direct experience with any standards, yet. I would research what standards exist for AM broadcast and AM Aircraft Receivers as a starting point; I would also examine the R-390A alignment and final acceptance test procedures. (Sorry, haven't gotten there yet.)

There are the usual NF / MDS / IP3 measurements. Once you get to modulated
tones, you have to define things like percentage modulation on the transmitter, etc.

.wav recordings into an external modulation input can be a great way to try
different tests rapidly - I did some of this, too. Discrete tones, swept tones, bandlimited noise, all repeated at several different levels. Noise power ratio tests are another way of getting at broadband distortion. Don't forget that the TX output has to be clean and in-channel, and your levels into your recorder should not be driving distortion or falling into the noise floor there, either. Watch out for ground loops and noise coupling; audio isolation transformers can be your friends.

Standardized testing is useful because everyone can independently pull the standard and try for themselves. In this kind of testing, it is most important that everyone agrees to what the standard is, and much less important that it accurately characterize some rare confluence of conditions.

Per an earlier comment - QRN and QRM as filtered by the operator's brain is the ultimate test. Probably more than anyone wanted to hear...

Date: Thu, 1 Mar 2012 11:44:56 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] receiver sensitivity testing

If you are looking to test down in the -130's and -140's you would really need to do it in a Faraday cage with a lab-grade signal generator, precision RF connections and attenuators. There are just too many variables and outside sources of noise to make any numbers you get down there to be meaningful.

Everything would need to be buttoned up tight, every cover in place, all the screws and modules completely in place, the best tube line-up's in the right positions and pulling your monitored signal off of the diode load connection to minimize distortion from the audio deck.

One thing the R-390A does not suffer from is a lack of sensitivity. If anything was to be done to enhance certain receiver characteristics it

might be to improve the selectivity and IP3 points. Roofing filters, changes in the way the IF's are staggered tuned, etc... could all help you with selectivity but at the trade off of any high fidelity performance with the 16 khz filter position.

Date: Thu, 01 Mar 2012 13:01:22 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] receiver sensitivity testing

Amen! My HP-3336B is still in calibration as so tagged by the USAF. Frequency is accurate +/- 10Kc. While its output is 75 ohm, I can either take 50 ohm off the attenuator internally, or go nuts and spend an additional $150 to obtain the HP
Option Board to add it for the external WECO jacks. Have the requisite silver plated copper expanded mesh to close the whole mess in, or could get copper screen to do same.

Date: Sat, 17 Mar 2012 16:17:56 -0600
From: Anthony Casorso <canthony15@msn.com>
Subject: [R-390] R-390a sensitivity measurement observation

I have not measured the sens of my receiver since 2007 so I thought I would check it out today. While I was making the measurement I noticed something that I thought was interesting. I am measuring AM sensitivity with 30% modulation. I started with the signal vs no-signal method and got .31uv at 9.5Mhz. Then I measured using the modulation vs no modulation method and got .9uv. So far so good. For some reason I turned on the limiter at it's minimum setting. The signal-no signal sens improved to .23uv while the modulation-no modulation sens stayed at .9uv. Depending on which method you subscribe to, here is a cheap way to improve you sensitivity :) . By the way the radio actually measures a touch better than it did in 2007 except at the top band where it is slightly worse. I don't have it on much though. I'd be interested in any comments about measuring sensitivity with the limiter on. Tony
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Date: Sun, 18 Mar 2012 19:50:25 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>

By definition the limiter is suppose to limit noise. You would think that by turning it on you would clip some of the noise off around the signal and thus get a better ratio with the limiter on. How much is not calibrated. So to keep thing nuts equal to thing nuts all advertised results are just done with the limiter
turned off. Roger AI4NI

Date: Sat, 24 Mar 2012 22:33:22 +0000

From: Peter Wittenberg SR <k2lrc@k2lrc.com>
Subject: [R-390] R-390A sensitivity below 8 MHZ

I am aware that this issue has been discussed before but I cannot find any notes on what can be done to improve the performance of the R-390A below 8 MHz?? Can anyone direct me to an answer to solve this issue?? Thanks...

Date: Sat, 24 Mar 2012 18:25:20 -0500
From: <wb5uom@hughes.net>
Subject: Re: [R-390] R-390A sensitivity below 8 MHZ

http://www.r-390a.net/Y2K-R3/09_Chapt_09_Sect_1.pdf

Date: Sat, 24 Mar 2012 18:24:05 -0500
From: Thomas Frobase <tfrobase@gmail.com>
Subject: Re: [R-390] R-390A sensitivity below 8 MHZ

More than once I have seen a defective C327 which is across the second oscillator transformer. Check good but isn't ... tom, N3LLL

Date: Sat, 24 Mar 2012 21:17:50 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] R-390A sensitivity below 8 MHZ

I think that's one that Chuck Rippel has identified as a regular trouble-maker as well.

Date: Mon, 26 Mar 2012 11:08:24 -0600
From: Anthony Casorso <canthony15@msn.com>
Subject: [R-390] Questions about receiver sensitivity

I am making some measurements of the sensitivity of my R-390a and I have some questions. Hopefully the collective wisdom can guide my thinking in the right direction. The basic question is whether there is a fixed relationship between AM and CW sensitivity. In other words, if I measure the CW sensitivity at some bandwidth, is it really possible to infer what the AM sensitivity should be at another bandwidth and modulation percentage? I am measuring AM sensitivity as modulation-on vs modulation off. That leads me to ask if it is possible for a receiver to have excellent CW sensitivity but lousy AM sensitivity (modulation on-off)? If so, what kinds of things could cause this? Last, and this feels like a dumb question, why does the receiver output noise rise when I give it an unmodulated carrier in AM mode with the AGC off? What is the source of the noise? I am assuming that my signal generator is not the issue (Boonton 102C) but I suppose anything is possible. Thanks in advance, Tony

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Date: Mon, 9 Apr 2012 10:38:18 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Mixer Tube Substitution

Has anyone substituted the 6BY6 pentagrid mixer for the 6BE6 in either one or both of the SP 600? ?If so, what were your results?

The 6BY6 had about three times the trans-conductance of the 6BE6 according to my RCA tube manual which implies that it would have better performance just as it has proven to be the case by replacing the 6BA6 RF amplifier tubes with the 6BZ6 types.

Also Hallicrafters used it in their receivers and Blakeslee used it in his SP 600 conversion article.

Date: Tue, 10 Apr 2012 12:24:48 -0400 (EDT)
From: chuck.rippel@cox.net
Subject: [R-390] Tube substitutions

I've done the 6BZ6 mod in an R390A documenting the useable sensitivity before and after. The 6BZ6 had more gain but it only served to amplify the noise along with the signal. When measuring the net 10db S/N + N performance between the 2 tubes, there was no improvement in specifications. Only the meter deflected higher. Seems that demonstration is in the 2nd R390A video but I could be wrong.

It would be interesting to see if the 6BY6 mod for the SP-600 actually improved the real sensitivity (10db S/N + N).

Date: Wed, 11 Apr 2012 17:55:44 -0400 (EDT)
From: chuck.rippel@cox.net
Subject: [R-390] More "Must Replace" Caps

<snip> A question to the group. Anyone have documentation on how to tune T401 on the 2nd xtal oscillator deck? I've never found any documentation on that. Got a few ideas on how that MIGHT work but nothing firm. It’s interactive with all the ceramic caps used to peak the individual xtal outputs. Its my GUESS those caps are pre-set to a certain capacitance then the coil is peaked, perhaps at the lowest fundamental xtal frequency then the caps for each band(s) are subsequently peaked. That's not gospel, I've not tried it, don't turn your radio into a brick by experimenting. Lets try and find out. Chuck Rippel

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Date: Wed, 11 Apr 2012 23:57:38 -0400

From: Roy Morgan <k1lky@earthlink.net>
Subject: [R-390] T401 alignment

I scanned my collected posts from the list, and a couple of saved web sites, and came up with the following LONG collection of discussions. The most complete is by Roger from his "Trilogy", and is at the very end of this message.
In "HSN No 29 rewritten (wm).pdf" I find:

"After the RF subchassis has been aligned, each of the ceramic crystal oscillator trimmers should be peaked. Tune to any CAL signal in the band indicated above the trimmer (see Fig. 7) and peak the signal. Not shown in Fig 7, eight of the trimmers can be peaked in either of two bands: 0-17, 1-18,
2-19, 3-20, 4-21, 5-22, 6-23, 7-24. After peaking such a trimmer in one band, you do not need to peak it again in the other band. Peak T401 (also marked T207)."

In ...Walt-Wilson-KK4DF/R-390A Alignment v2.htm in the variable IF alignment section, the last steps are: "Repeat the above until you no longer make big changes to the trimmer caps, then stop.

Set the signal generator to above 8MC (about 10 MC), and peak T208 and T401 for maximum diode load voltage."and in the crystal oscillator section: "Crystal Oscillator You may use the CAL function for peaking the trimmer caps for maximum diode load voltage. But a better method is to use the line meter output and your ear with nothing but RF deck noise to peak each crystal for maximum audible noise and deflection of the line level meter. Peak the 17-24 MC trimmers at the lower bands (0-8 MC). After all are done, peak T401 (again) for maximum output at about 10 MC. T401 will peak differently on the higher and lower bands, so 10 MC is a compromise."

From my collection of posts to the list, I find:
----- Original Message -----
From: "MURPH" <rickmurphy1001@earthlink.net>
Sent: Wednesday, January 15, 2003 7:06 PM
Subject: [R-390] T- 401

> What is the proper way to align T-401?
> I peaked mine at 22mc with a DVM between e210 and ground with the
> function switch in standby. Then peaked all trimmers on the module at their
> appropriate frequency. Richard

From: "Keith Densmore" <densmore@idirect.com>

Date: Sat, 4 Aug 2007 10:56:44 -0400
Subject: [R-390] T207 T401

Perhaps I'm missing it, but I cannot find a procedure for aligning T207 (17meg) or T401 (crystal osc) in any of the books here. Anyone know an accepted procedure for them?

From: Flowertime01@wmconnect.com
Date: Sun, 5 Aug 2007 19:22:55 EDT
Subject: Re: [R-390] T207 T401

You ask about, a procedure for aligning T207 (17meg) or T401 (crystal osc)

You are correct.
For T401 the procedure is to run the MC to 31 and peak T401 and the cap for
maximum output. In practice you find the MC band with the lowest output level and retune T401 to bring that band up enough to pass the 10:1 signal to noise ratio test on that weak megahertz band. There is no one best absolute setting for T401. You use it to get the bast of all bands out of it. T207 the output of the first crystal oscillator is the same approach. That transformer always passes 17Mhz. Pick any point under 8Mhz and adjust T207 for maximum output on the diode load for minimum RF input at the antenna input. You get like one clause of a sentence in the original TM on these subjects. Hope this helps Roger AI4NI

From: Flowertime01@wmconnect.com
Subject: [R-390] R390/A T401
Date: March 15, 2009 12:42:23 PM EDT

Does anyone have an alignment process for the tunable inductor T401 in a R-390A Xtal oscillator ?

Very good question.

R390/A TM11-5820-358-35 Para 74 omits this subject. More than once we tried
to get it into a new edition of the TM. (1968 - 1975). R390 TM11-5820-357-35 Para 77 give a procedure to do the alignment in the R390. We just used this procedure on the R390/A. I do not have my Y2K manual on this computer to see if the subject is covered.

From the R390 TM:
Hang a Neg DC voltmeter into E210 grid test point of second mixer.
Set the slug of T401 at about 1/4 out from all the way in.

Set the receiver to 31 Meg.
Get a tweeker on the 31 meg trim cap in the osc deck.
Get a tweeker on T401.
Get the Voltmeter scale readable.
Spin the cap around.
It should peak twice.
Turn T401 out.
Spin the cap around.
It should peak twice.

Repeat
Turn T401 out.
Spin the cap around.
It should peak twice.

Or
Find the point of the trim cap between the two peaks. (max cap)
Adjust T401 out until the meter peaks)

At some point the cap it will only peak once. (max cap but not enough cap)
Now set the trimmer cap off peak a bit and reset T401 for max reading.
---Adjust T401 back in.
This should leave T401 peaked for best response.
You should get two peaks on the cap again.

Sometimes you will have a weak crystal or harmonic of the crystal. Then you may do this process on that frequency with that trimmer cap to bring the weak 1Mhz band up as best you can. Then retrim all the caps to T401 as adjusted for the poorest crystal in the osc deck.

If the poor crystal will not let you trim it up and get every thing else to pass, then it is time to change that crystal. This process being used to judge when it is time to call a crystal bad.

If you have a band that does not peak twice with the trimmer cap, this is a band worth trying to reset T401 for higher output. You may have several crystals that need to have the socket cleaned or the crystal replaced.

Adding small caps to bring a trimmer up to peak twice with T401 can be more
work than finding a different crystal that will work.

Roger Ruszkowski AI4NI

From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] T- 401

Date: Wed, 15 Jan 2003 21:45:06 -0500

Hi, that's been a debate here for as long as there has been a list. A few things people agree on:

1) Don't touch it after you have started peaking trimmers
2) If you run out of range on the trimmers moving T401 may help
3) If all the trimmers are in range (not at max or min) then there may be room to fiddle T401
At that point the best advice is to peak it for your least sensitive band *if* you can do that and still keep all the trimmers in range. Take Care! Bob Camp KB8TQ

This following message from Roger seems to be the most complete discussion of the topic:

From: Flowertime01@wmconnect.com
Date: Sun, 12 Aug 2007 16:12:32 EDT
Subject: Re: [R-390] T207 T401
...
This is long but I hope it provides some insight.
It is still not an exact step by step cook book.

The Second Osc alignment is about as clear as Mississippi River Water after a
summer rain. After reading the TM a few times the subject clears up. It looks
like the Beach Surf in Okinawa after a Typhoon just misses the Island. Once
you the do the alignment a few times the subject looks like the crystal water
and coral bottoms as viewed from the high beach cliffs of Okinawa and you wonder what the fuss was all about.

The TM says align the second crystal oscillator caps from the Cal tones and
using the carrier meter as the output indicating level. That got some writer
off the hook back in 1952 for the R390 TM and was copied into the R390/A
TM. See TM 11-5820-358-35 Paragraph 74 (page 114 in the 8 Dec 1961 printing) The process works. And you can spread peanut butter on bread with a popsickle stick.

But I digress and you asked me about T401 and the trimmer caps in the Second Oscillator in the R390/A receiver.

The TM says there is no adjustment for 0 to 7. But we know 0 - 7 lays over 17- 24. The TM says start adjusting the caps for maximum carrier level output on each Mhz band from 8 to 31. Mud in your eye. Do this from 31 down to 8.

There is one obscure clause of a sentence in the R390 TM that suggests that T401 (numbered something else in the R390) be adjusted for maximum output at 31Mhz.

These two items, set T401 to max at 31Mhz and set C31 to max at 31Mhz, imply these two adjustments will peak the output of the second crystal oscillator for maximum receiver performance across all frequencies in the range of the receiver. Another fantisy that passed muster with the TM editors. Hey it reads good in Jargon with no sarcasm showing.

In real life do the following:
Turn the BFO off because BFO on masks the real signal level.
Set the receiver to MGC to defeat the AGC which will cause output meter variations. Hang a DC volt meter off the diode load as you choice of output indicator as this is the most sensitive easily accessible point to meter the receiver output. Inject RF into the antenna input and use a level that gives a diode load reading in the range of -5 to - 10 volts. The RF may or may not be modulated but

Un-modulated RF is mostly preferred for adjusting and testing.

The receiver has a range of 31,000+ - 500 = 31,500 hertz. There is one transformer (T401) and 24 caps that need to adjusted to optimize the second crystal oscillators output such that all frequencies at the receivers antenna input have optimum output at the headphone jack. Optimum output is left undefined as an exercise for the operator to complete.

The first crystal osc mixes RF input under 7,000+ Mhz with a frequency near 17Mhz and passes it on to the second mixer. Between 17 Mhz and 24 Mhz the second crystal osc uses a different crystal to mix that RF input under 7,000+ Mhz to a range of 3.455 to 2.455Mhz. The third mixer then mixes the VFO with this signal to produce a signal at 455Khz. On a good day this signal is centered into a crystal in the if deck with a band pass near 455Khz. Anywhere in the frequency range you can grab the zero adjust the and slide the VFO around a bit to peak the transfer.

The nonlinear VFO and its band spread will also impact the mixing frequency.
One end of the VFO or the other may add or subtract from any given second

mixer crystal error to increase the or decrease the receiver output.

So what good alignment? When do you quit?

Because the 17Mhz crystal is not exactly 17,000,000.000 you may find the optimum cap setting for 18Mhz is not the same set point as for maximum 1Mhz.

Like wise because some crystals at 17 -24 are not exact, the optimum setting for one of them may not be the same for the double conversion and the single conversion. If the 17Mhz crystal is off and the second mixer crystal is off the differences may add to make things poor, subtract to make things OK, cancel to make things good, do none of the above just to add reality.

Some of the second mixer crystals are used at more than one harmonic. You have a different cap to peak each of these harmonics. The output level at the harmonics may not be equal in amplitude or adjustable to equal amplitude while each frequency has a nice double peak on it's respective trimmer cap.

The thought is that crystal output is highest at low frequencies and drops off as frequency increases. If T401 is peaked at the highest frequency, it’s response will drop off as frequency decreases. The slope of T401's output plotted against the slope of crystal loss across frequency is considered to yield a near flat mixer output across the frequency span.

Thus the TM read to peak T401 at the highest frequency and adjust each cap in the second crystal osc deck from 8 to 31 Mhz. The procedure details using the Cal tone, BFO and carrier level meter. Me knows this process is not the most sensitive.

We would like to think that peaking the trimmer caps only changes the impedance match to yield a better power transfer of the oscillator output and that the cap adjustment does not vary the frequency of the crystals. We would like to think every crystal is spot on exact to within under 100 hertz and stable as a rock.

What we find is one or more crystals have an output level below the curve. If it is off frequency, and in the range of the zero adjust, then zero adjust the VFO and peak the cap for the megahertz band and move on. This is just an off frequency crystal but still in specification. If the zero adjust it peaked and the output is low then the oscillator output is weak for that band. Try cleaning the crystal contacts, the tube contacts and the cap. But the first easy quick fix in a clean receiver where you know corrosion is not the problem (1968 - 1975 era) is to adjust T401.

You slide the low frequency slope of T401 down. This lets more of the crystal output from the weak crystal through the circuit to bring the weak band up to par. You hope the top frequencies do not go so far over the hump they fall under par.

You find the low spot (a dip/a weak output crystal) in what would be the curve of the crystal output levels. Then move the cutoff slope of T401 by adjustment so that when the two functions (crystal outputs / T401 cutoff slope) cross, the output performance level of the second osc is of acceptable performance.

Start at 31 Mhz and adjust T401 and cap 31 for maximum output. Use a RF signal generator and DC volt meter on the diode load for best indication of adjustments.

Continue down the bands in frequency to 8 Mhz. Adjust each cap but do not reset T401 while doing these adjustments.

Mark the 17 - 24 cap setting (pencil on the deck in line with the screwdriver slot) and continue down in frequency.

Reset the caps for best output on the 7 - 0 bands.

Look at the cap settings when you complete this process.
Are the caps still peaked at the same alignment point?
Are the 17 - 24 caps not all offset the same way (17Mhz crystal off frequency)?
Are the 17- 24 caps set above and below (the second crystals osc crystals off
frequency)?

Now you have a choice: peak the caps for the low band (0-8) or the high band (17-24) or balance between the bands.

If in the process of aligning the whole receiver you find one or some of the 1Mhz bands to be low you can now think about readjusting T401 to bring the bands up to par.

First consider if you have done all the other adjustments on the receiver. Working over 17- 31 Z206 and T206 will yield more improvement than trying to optimize T401 and C20 to bring up a weak 20Mhz band.

Second consider if you have a clean machine. Cleaning contacts under, caps, transformers, tubes, crystals and connectors go further than peaking adjustments.

After you adjust T401 to bring up some low band you should then go back and check all the other caps. What ever the last setting for T401, peak all the caps without ever touching T401 again.

The TM implies that setting T401 is not an exact most critical adjustment. The TM further implies that just close with a cal tone and carrier meter is good enough. But after 50 years, consideration and attention to detail can get more out of these adjustments than just a good receiver.

Put some time into your receiver working through these adjustments to come to an understanding of how your particular receiver balances out. In the end you will have a better receiver to listen too.

There are many other stages in the receiver that can compensate for the elected less than exact test book adjustment of the second crystal osc deck.

Once you understand what bands of the receiver you want to optimize for your use, how the many adjustments interact and the limits of the exact parts in your exact receiver, you find a pattern of adjustments that optimizes the receiver for your enjoyment. I hope this helps. Roger L. Ruszkowski AI4NI

Date: Thu, 12 Apr 2012 16:27:18 -0400 (EDT)
From: chuck.rippel@cox.net
Subject: Re: [R-390] T401 alignment

All good information and the procedure makes sense IRT the hetrodyned crystals. I knew the info was out there somewhere and will give it a try. Thanks for making the investment in time to send it.

Date: Thu, 12 Apr 2012 17:07:11 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: [R-390] T401 alignment

Did Roy's response provide you sufficient insight to enable you to develop a procedure to get T401 adjusted? Today it’s not so much a matter of just whipping an alignment on the deck. It’s more a matter of trying to get the most out of the receiver and parts on hand for what the operator wants to use their receiver for. For certain there are minimum acceptable levels of performance. But a lot of the alignment is subjective. You have all the trimmers and T401 that you are trying to optimize without going into wholesale crystal replacement.

Date: Thu, 19 Apr 2012 11:47:25 +1000
From: "Eric Gauja" <ericgauja@optusnet.com.au>
Subject: [R-390] Greetings from Sydney, Australia.

<snip>.... I do have 2 initial questions that I would like to put to the group.

<snip>.... 2) Calibrator circuit . What sort of variation should be expected in the Carrier Level Meter reading for different calibration frequencies? Calibrating my 390A at frequencies XX.700 MHz gives zero beat Carrier Level Meter dB readings of between 20 and 30dB in the 0 to 15 MHz range. At 16.700MHz the reading drops down to only 0dB, (although the signal off zero beat is still easily audible). From 18.700MHz to 24.700MHz , the carrier level at zero beat stays at 0dB. It goes back up to 10 dB until 29.700 MHz, before dropping down to 5 and 0 at 30.700 and 31.700MHz. I have checked the RF deck alignment using the procedure outlined by Dallas Lankford in Hollow State Newsletter 29 , and it seems fine.

Date: Thu, 19 Apr 2012 11:20:14 -0400 (EDT)
From: djed1@aol.com
Subject: Re: [R-390] Greetings from Sydney, Australia.

I think that a well-working R-390A should have fairly uniform calibrator signal on all bands. I get 30-40 dB on all bands. If you think the alignment is OK, then the radio might need some further attention. However- a couple of suggestions-
check that the calibrator is zero beat on each band: It's not uncommon for the band crystals to be off by several KHz. If centered in the pass band, then an alignment or component problem may exist.. Have you checked all the tubes? Maybe the IF is low. See how much the meter changes if you crank up the IF gain If you have, or can borrow, a signal generator, you can check the gain on each band. You can also use the manual procedure to set the IF gain. In theory, the meter should indicate dB relative to 1 microvolt. This is affected by the IF gain, and most listeners set the IF gain for best noise figure, not most accurate meter reading. Keep us informed of your results.

Date: Sun, 6 May 2012 23:26:17 +1000
From: "Eric Gauja" <ericgauja@optusnet.com.au>
Subject: [R-390] R390A- Intermittent sensitivity variation

I have mentioned in previous posts (Greetings from Sydney, Australia) that I have noticed variation in calibration signal levels with my 1963 Imperial R390A. After a longer period of investigation, I note that the problem is actually confined to the 16 ?32 MHz octave. On any one of the 16 ?31 MHz segments , a calibration signal level of say 20dB as read on the carrier level meter can suddenly shift downwards to 10 dB or lower.

The problem is not in the calibration signal, because if I switch back to a signal off the antenna, it has also dropped in level. This shift in sensitivity is intermittent ? it does not coincide with warm up after switch on , but can occur at any time ? another observation is that sometimes sensitivity can be restored by moving the MCs knob a few notches ? but not always- sometimes the sensitivity restores by itself after an unpredictable period. I am quite new to the group, but have been studying the Y2K manual , and the wealth of information on the R390A FAQ page, as well as past posts to the group, but have not yet seen any specific mention of my problem. Since the sensitivity variation is confined to the 16- 32 MHz range, I suspect a problem with the RF deck 16-32MHz circuitry. Could it be a problem with the bandswitch contacts in the 16-32MHz section or could it be a problem with the coils and/or capacitors in this section? Any advice from the group would be most appreciated. There are no problems with sensitivity variation below 16 MHz.

Date: Sun, 6 May 2012 20:28:45 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] R390A- Intermittent sensitivity variation

I will move back over to the other computer and send you a couple of long posts.

The up-shot is that you have a dirty switch contact in the RF deck band width switch.

An easy fix.
All you have to do is pull the RF deck, clean the switch and readjust it a bit. Watch for about 20 pages of detail to explain " all ".

You describe a fairly common problem. It likely has been in the receiver for some time. It is just a mechanical adjustment of the RF deck band switch.

Do not set this adjustment as it says in the TM.
You will want to pull the RF deck and do this adjustment by eye.

The band switch has 6 segments and 6 stops. Thats 36 contact points. Moving both up and down. Some have B+ (some power) on them. Its a matter of wanting the most surface area between the wiper and the contact on each switch segment possible. So it becomes a subjective adjustment. What looks best for the RF band switch you are trying to get adjusted is the correct answer.

You may feel the need to clean a contact or wiper in the RF band switch. Take the time to get good stuff.

Go slow.
Be carfull how you touch it.
Repairing a band switch wafer after it has been over-petted is hard to do.
Better to go gentle first.

Date: Mon, 7 May 2012 11:02:14 +1000
From: "bernie nicholson" <vk2abn@bigpond.net.au>
Subject: [R-390] Fw: 390A

guday Eric , your problem could be a number of things but most likely a problem with the silver plating on one of the resonating trimmers for the 16-30 band , you only need a little bit of dust under the contact ,especially if its been re-aligned and the trimmer is now making contact with part of the trimmer that might be oxidized or dusty, Are you using a unbalanced input or the balanced because different trimmers are involved ?

Date: Sun, 6 May 2012 21:57:58 -0400 (EDT)
From: Flowertime01@wmconnect.com
Subject: [R-390] R390A- Intermittent sensitivity variation

Try the R390.net page and W. Li's pearls of wisdom
Look for stuff on the RF band switch adjustment.

Jump in and get your reciever fixed.
It is just a slow screw job.
It will take about 8 hours to just pull the receiver apart, do some cleaning, do some mechanical adjusting and get it all back to gether.

You will need the spline wrench, and long #1 Philips screwdriver to get to the green screws along the top back of the RF deck.

You will want to do a complete RF deck alignment once you get the mechanical work completed.

A good brand of electrical contact cleaner and cotton swabs.

More detail than you ever wanted.

Use the Y2K manual to get the Rf deck out of the receiver.
Turn the RF deck up on it top.
You should be able to run the MHZ shaft through it range without the RF slug studs sticking out of the top of the deck and jacking the deck up off the bench.

If not set the deck on what ever to make a suitable working arrangement.
As you dial the MHZ shaft through its range you will see the octave gear,

change the RF band switch at the needed points.
[.555 - .999, 1,000 - 1.999, 2.000 - 3.999, 4.000 - 7.999, 8.000 - 15.999, 16.000 - 31.999]

Do not worry about the KHZ shaft.
Do check the cams and the mechanical alignment before going on.

see end H. Mechanical Alignment

As you rotate the MHZ shaft and the band switch changes, look at the wipers and the contacts. Check all six sections and all six positions. You are likely looking for a discolored contact on the last contact (16- 32 position) that is just oxidized and needs some cleaning.

You may want to clean all the switch contacts
And change out the big brown caps under the RF deck if you have any.
As long as you are this far in, clean and lube the whole RF gear train.

As you rotate the MHZ shaft through it range and the octave gear switches
the RF band switch through its six contacts, look at each wafer section and
each contact as the wiper makes with the contact. Look at the mechanical mating as the octave gear switches the RF band switch through its six contacts
both working up the bands and down the bands. Due to mechanical play the
contact will not be equal going both ways.

A very small adjustment will get you better contact.

Over time these switches have been not adjusted for optimum wiper to contact mating. Thus a barely making contact and wiper will have its corner burn off or oxidized away. So it becomes a matter of just doing your best eye ball and selecting an adjustment that gets the best contact at all the right places at all the right time. This is one of those simultaneous equations that needs to be solved for every combination.

The actual adjustment is to lossen the clamp on the RF switch shaft gear and just nudging the shaft one way or the other counter-clock or clock-wise a very small RCH or less. Then tighten the clamp and repeat the eye-ball inspection.

The TM implies you can do this without looking under the deck. That author is no longer living. That author did not understand what he was writing about (mechanical challenged). That author had no real experience or would never have written what he did write. Doing it like the TM says it what gets the switch contact area reduced.

In an extreme case you may need to actually replace a switch section because it is beyond adjustment. As your receiver works, there is some adjustment point that will return your receiver to good operation and solve the drop out problem you are experiencing.

Do let us all know what you find and how it turns out.

Roger Ruszkowski 33C4H 68-75 AI4NI

H. Mechanical Alignment
___ 01 Set Oven switch to OFF
___ 02 Loosen the dial lock, check the knob and lock operation
___ 03 Check the zero adjust knob adjustment operation
___ 03 Set the zero adjust to center
___ 04 Check the over run and under run on the KHz knob (10 turn stop)
___ 05 Adjust the KHz counter as needed (greater than 25 -963 , -972)
___ 06 Check the over run and under run on the MHz knob (10 turn stop)
___ 07 Adjust the MHz counter as needed
___ 08 Set the R390A to 7+000 Set the R390 to 2.000
___ 09 Check the cam alignment starting with the 8-16 MHz Cam
___ 10 A If the 8-16 MHz Cam need adjusting then loosen the following
___ 10 B Release the clamp for 2-4 the slug rack should fall
___ 10 C Release the clamp for 4-8 the slug rack should fall
___ 10 D Release the clamp for 16-32 the slug rack should fall
___ 10 E The 8-16 slug rack should also fall
___ 11 Hold the 8-16 and 16-32 cam in place
___ 12 Tighten the 16-32 MHz Cam clamp
___ 13 Hold the 4-8 cam in place
___ 14 Tighten the 4-8 MHz Cam clamp
___ 15 Hold the 2-4 cam in place
___ 16 Tighten the 2-4 MHz Cam clamp
___ 17 Adjust the 1-2 MHz Cam if needed
___ 18 Adjust the . 5-1 MHz Cam if needed
___ 19 Adjust the 1st Variable IF Cam if needed
___ 20 Adjust the 2nd Variable IF Cam if needed
___ 21 Adjust the VFO if needed

Date: Mon, 7 May 2012 11:30:23 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] R390A- Intermittent sensitivity variation

If "buzzing" doesn't reveal bandswitch trouble, look to the mica caps.

I could be remembering wrong, but I think there are fixed mica caps that are in service over the 16-32MHz octave and not used elsewhere. One could be shifting in value or intermittently partially opening or leaking, which would mistune the affected coil or reduce the Q, respectively. A little electrical "jostling", in the form of transients that occur during switching, can temporarily restore operation. This happened to my receiver, although it was in the IF not RF. Unfortunately, you have to lift one end of each suspect to check this. Even though most of these caps see no DC voltage in operation, applying voltage, say with a TelOhMike-type cap analyzer, can drive this kind of problem into the open.

Date: Tue, 22 May 2012 23:30:05 +1000
From: "Eric Gauja" <ericgauja@optusnet.com.au>
Subject: Re: [R-390] R390A- Intermittent sensitivity variation

An update: Thanks to all those who made helpful suggestions - it seems that my problem was in fact caused by aged silver mica capacitors. After checking the bandswitch operation and cleaning of contacts, the intermittent behaviour was still present. After reading David Wise's comments, I looked more closely at the circuitry around the 16-32MHz RF transformer stages, and noticed that of the transformers T206, Z206-1 and Z206-2, only Z206-1 has mica capacitors connected to the B+ line. My hunch was that it was more likely that the Z206-1 caps had problems with value change or breakdown with B+ voltage stress.. Since Z206-1 and Z206-2 have identical capacitors and coils , I decided to swap over these transformers. After realignment at 17.6 and 30.4 MHz, sensitivity was restored , and no more intermittent behaviour! I'll see what happens over
time - for a proper fix, I will replace the mica capacitors in these transformers with newly manufactured silver micas or ceramic capacitors at a future date. I'm also slowly working my way through past posts , and problems with the old silver mica capacitors are well documented. Heartfelt thanks to all involved in archiving and maintaining this information!

Date: Tue, 22 May 2012 11:01:07 -0400
From: "Charles P. Steinmetz" <charles_steinmetz@lavabit.com>
Subject: Re: [R-390] R390A- Intermittent sensitivity variation

>it seems that my problem was in fact caused by aged silver mica capacitors.

Before you can properly conclude that the mica caps in Z206-1 caused the problem, you would need to swap the transformers back and have the problem reappear, then go away again when you replaced just the caps (even then, you couldn't absolutely rule out soldering, broken wires at the joints, etc., etc.). Right now, you just have an intermittent problem that appears to have gone away during troubleshooting -- like so many do with old equipment.

Date: Tue, 22 May 2012 13:12:35 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] R390A- Intermittent sensitivity variation

Don't celebrate too soon. You may have simply fixed things inadvertently by the de-soldering and re-soldering of the two transformers. You won't know for sure. It may be working without an issue of the silver mica capacitors. Time will tell.

Date: Tue, 22 May 2012 22:29:03 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: [R-390] R390A- Intermittent sensitivity variation

Happy to read you have the receiver working.
Enjoy it.
Take the cures any way they come.

Date: Sun, 9 Sep 2012 16:49:52 -0400
From: frank hughes <fsh396ss@gmail.com>
Subject: [R-390] R-390A DIY alignment completed at last!

Using the training videos from Chuck, I was able to complete the alignment of my R-390A this weekend! This is the first time I have done any work on this receiver. I bought it from Rick Mish in 2008, and after 4 years of use I was told to expect the receiver to require this maintenance.

It has taken me a couple of years to acquire the test equipment. After initially watching Chuck's videos four years ago, I started looking for the same test equipment he was using. The idea was since I have only a vague idea of the principles and procedures involved, using the same test equipment would let me skip the step of learning test equipment configuration, and just let me concentrate on the radio part.

I have frequently bought broken HP equipment and repaired it. Many times a fresh set of Electrolytics restores functions. Sometimes a shorted Tantalum needed to be located and replaced also. When I could not find a repairable unit, I just bought a refurbished one. (The 8640B was rebuilt)

The other reason that I have been trying to learn how to align the R-390A, and have acquired test equipment, is that I need to figure out how to align my R-390 and R-392.

No training videos exist for these receivers, so hopefully they are not very different to align from the R-390A, and the training methods will transfer over.

The only thing I had trouble with (and have yet to understand how to do) is the "10db signal to noise" performance adjustments. I understand how to set up the HP 3400A and the receiver adjustments, but don't understand how to set up the AM and modulation on the HP 8640B the way Chuck is doing it in the video. I have the HP 8640B manual, but it was written for an electrical engineer, not for me!

Also, after all the alignment was completed, I used the "alignment adapter" from Kurt DH3PJ to set the RF deck "balance" capacitors to maximum common mode rejection ratio (CMRR), worked great!

Date: Mon, 10 Sep 2012 19:16:01 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] R-390A DIY alignment completed at last!

The R390 goes down just like the R390/A does.
Find a PDF version of TM 11-5820-357-35 on the R390.net pages.

The TM will walk you through the IF deck alignment of the R390.
As the R390 IF "tunes" bandwidth rather than peaking filters, it is a bit different.

Out in W Li's Pearls of Wisdom is an alignment procedure. It runs from A- Z and 20 - 50 steps in each section. Use it to walk your self through the R390/A or the R390.

Having watched Chuck's videos you are in great shape. You know where things are located and how to adjust them.

The test equipment is not all that critical. Any good signal generator and good meter will do the job. You can always cut the generator level alternators if it's output is to high.

An exact value beyond bragging rights is not even necessary. You clean, adjust and tweak until you can not get any more stations from your current antenna. Once you can hear all their is to hear, and have pushed the noise as low as it will go, then readings from the test equipment are not of any value. You do not listen to test equipment. You are just after signals from the antenna.

In the A -Z maintenance procedures is a couple way to do the signal to noise test.

Us old kids who did this daily for a living found that if the IF deck would not give you at least 27 DB difference with 150 uv in and - 7 volts on the diode load,, there was nothing you can do in the RF deck to overcome the noise in the IF and audio decks and thus achieve 10 or better signal to noise end to end (antenna to terminal board). Thats' no where in any TM. The R390 procedure is the same as the R390/A procedure. The connector numbers are different, but the process is the same.

For the noise, you need CW on the antenna to mix in all the mixers through the receiver chain.and you get a low level noise output.

Then you turn on the modulation. The exact frequency is not important as long as it will get through the audio deck (400 Hz to 2500 Hz) The exact level is not real important but to carry on a conversation about 30% modulation. This should get you almost 1/2 watt of power out on the terminal board for Local Audio across a 600 ohm load.. Some what less at the head phones. The line audio out is attenuated to 100MW across a 600 ohm load.

Modulation ON vs Modulation OFF.
From antenna to terminal board needs to be more than 10 DB different as measured with a meter on the terminal board across 600 ohms. Do it in AC volts with a resistor and convert that to DB if your meter does not have DB scales. See the Pearls of Wisdom for that look up table if you need it.

Any good R390 R390/A R392 will give you at least 20 DB scale difference between modulation on and modulation off. If you do not have at least 18 then back to the tubes and find some low noise tubes.

Hope this helps point you in the right direction.
Let us know when you find the procedures in the Pearls Of Wisdom.
Use it on all three of your receivers. Roger 33C4H (68 - 75)

Date: Tue, 11 Sep 2012 12:27:12 -0400 (EDT)
From: chuck.rippel@cox.net
Subject: [R-390] R390A Noise Floor and otherness

If the receiver is working properly AND it has aged kindly, rotating the ANT TRIM control with no antenna attached will result in a noise peak.

When the receiver peaks on ITS OWN NOISE, you "have arrived."

Be careful setting the IF Gain pot ! Too much gain results in excess RX noise and unrecoverable audio ! There is a "sweet spot" for setting the IF gain; I'm sure that technique is demonstrated in the videos. Unfortunately, it takes test equipment to set that properly.

Tune 'em up now ! The season is approaching fast ! Who's planning on doing SWBC DX or MW DX besides me ? Also, is anyone interested in seeing some of the loggings the SWBC heavy hitters are harvesting? I can post them on the list or...? Gives you some targets to go after. Here is a recent example. Go get 'em:

ETHIOPIA 5950 V.O. the Tigray Revolution. First hrd w/simple HoA Washint flute IS at 0252 under R. Taiwan Int. In the clear when RTI went off between pgms at 0258. Canned echo ID by M, then M w/opening ID anmnt including apparent sked w/abt a half dozen ments of "meterband" and website as www.dimtsiwoyane.com. More Washint mx and RTI returned. Finally diff. HoA mx at 0917. Another song at 0921. Vcl songs after 0326. W anncr at 0336 but had weakened a lot by this time. Nice and clear when RTI off. (9 Sept.)

ETHIOPIA 6110 R. Fana Signal on the air at 0250:20. OC till brief tone at 0254:21, then chime IS. 0259 M anncr w/ID "?? Fana Broadcastings
Corporation ??", then another ID over instru. mx, followed by live M w/opening anmnts including at least 2 more Fana Bdcsting Corp. IDs. and ment of radio until 0301. 0301 mx bridge, coo-coo clock SFX and canned M anncr very briefly, and hammering on wood. 0302-0306 lively instru. mx. 0306-0311 M vcls w/HoA mx. 0311-0318 tlk by live studio M w/ID ".one nation, one ??, Fana Broadcasting Corporation." At beginning. Ment of Somalia. 0318-0323 lively booming HoA vcl and choral mx. 0324-0325 canned tlk by W in echo mixed w/mx. 0325-0343 discussion between live M and W anncrs w/occas. instru. mx bridges. 0343 more HoA mx w/M vcl. Of course the signal faded and was pretty much inaudible by 0420. Fair w/quick QSB. A little slop QRM from 6105. (9 Sept.)

CHAD 6164.96 R. N'Djimena Signal suddenly on at 0451:55 w/Hi-life African mx. M anncr briefly at 0458 w.ment of N'Djimena, Africa. Finally in the
clear at 0458 w/Japan going off. Tlk by M at 0501. Really great mx. 0508 M anncr in FR returned including couple quick "R. Diffusion Tchadienne" IDs. (9
Sept.)

PIRATE (EUROPE) 6285.4 R. Focus Int. Noted as soon as I started the Perseus
recording at 0243 w/"Down Under" by Men at Work. 0307 "I'm Only Human"

by Human League. 0312 R. Mi Amigo theme, then M anncr briefly. 0332 "Nothings Going to Break My Stride" by Mathew Wilder, then "Love Grows (Where My Rosemanry Goes" by Edison Lighthouse. Jingle at 0438 w/ment of International. Good at 0348 on peak. Decent signal at 0443, then M anncr w/e-mail addr repeated at 0445, then into "Who Can It Be Now" by Men at Work. 0449 "Wishing" by A Flock of Seagulls.
0453 jingle and back to mx. 0456:10 ID "This is Focus International...free radio".
0523 "Stray Cat Strut" by Brian Setzer. 0526:45 anmnt mentioning "...shortwave
band...", followed by "All the Day and All the Night" by The Kinks, then "Elenore"
by The Turtles. 0615 "Band on the Run" by Wings, followed by "You Wear it
Well" by Rod Stewart, then "Baker Street" by Gerry Rafferty, and "Mr. Blue Sky" by ELO. Fading after that and lost audio by 0650. Last saw the signal around 0745. Surprised to find this here. (9 Sept.)

No sign of R. 6150 on 6070. CFRB was on 6069.96 and there was another
signal on 6070 the entire time until I stopped the recording at 0952 which must be part of the CFRB signal. (9 Sept.)

PERU?? 4790.02 R. Vision (pres.) Back on apparently. First hrd carrier 2
days ago but no audio to speak of. This morning, definite M in SP w/live preaching at 0953, brief mx bridge at one point, then cont. tlk. 1004 audience noise. Fairly strong but horribly distorted 'rumbling' audio. Looked like there were multiple carriers on the signal. Could see at least 5 distinct peaks. Also
noticed most of the distortion was in the lower side. In USB with the PSB shifted away from the carrier, it was almost readable. (9 Sept.)

Chuck Rippel

Date: Sat, 13 Oct 2012 19:27:40 -0500
From: n4buq <n4buq@knology.net>
Subject: Re: [R-390] A vs non A

I, for one, always look forward to reading Don's posts. They are intelligent, informative, and usually written so that someone like me (who isn't an electronics engineer by trade) can understand. Don can dive deeply on technical subjects without being stuffy or pretentious. While he took a different slant on the subject than Roger, nowhere did I see any name calling or arrogance in his post. Thanks, Don, for the information. I appreciate it. I think it might keep me from destroying the alignment in

the IFs in my R390 as I would have probably thought the process was a bit more straightforward. I would guess the IFs could be set a number of different ways and would sound "okay" (or not) but it appears there's a depth to this subject that needs to be well understood to do it correctly (or at least the way the engineers had in mind when they designed it).
7--
Date: Sun, 14 Oct 2012 09:56:43 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] A vs non A

The Alignment procedures are in TM 11-5820-357-35, 9 March 1962. This begins on page 91. Test equipment utilized/specified:

Electronic Voltmeter TS-505*/U.
Signal Generator AN/URM-25(*)
Voltmeter, Meter ME-30(*)/U
Insulated Alignment tool.

Note that *NO* sweep generator is specified NOR used. So the whole Sweep Generator methodology is exactly as Roger states. Following the U.S. Army procedures will not screw up your R-390.

Date: Sun, 14 Oct 2012 11:18:51 -0400 (EDT)
From: djed1@aol.com
Subject: Re: [R-390] A vs non A

I also just finished looking through the R-390 manual to see what it said about alignment and confirmed there is no reference to sweeping. To be fair, the description of transformer coupling to achieve the passband is correct, but unless there is a means to adjust the coupling then the best you can do is to align all at the center frequency, and sweeping won't make it any better. I've tried sweeping my Hammarlund, which does recommend sweeping the crystal filter. I found that it wasn't much different than aligning by ear. Speaking of Hammarlund- they incorporated variable coupling to provide an effective variable IF bandwidth, so the technology was known in 1936.

Date: Mon, 15 Oct 2012 00:36:27 -0400
From: "Charles P. Steinmetz" <charles_steinmetz@lavabit.com>
Subject: Re: [R-390] A vs non A

Peaking works to get the undercoupled stages on center frequency, but not the overcoupled stages. If you peak an overcoupled stage, you will end up with one of its two peaks at the IF center frequency and an asymmetrical overall response. If I had to do this in an emergency without sweep facilities, I'd try peaking the overcoupled stages on a good strong broadband noise source like a noise diode rather than at a single frequency, and I'd do those stages last, after peaking the undercoupled stages. It's been a long time since I fiddled with a 390 IF, but ISTR there is one overcoupled stage.

Regarding the alignment procedures given in the 390 TMs, as I said in my 10/9 post:

>Note that the IF alignment
>procedures given in the TM-11-5820-357-35 (1962) and TM-11-856 (1955)
>manuals do NOT stagger-tune the IFs -- if you read carefully, they
>both state "Perform the procedure outlined . . . below only when the
>transformer cores have been displaced greatly from their normal
>positions within the cores." In other words, "This procedure will
>get you back on the air, but will not return the radio to its proper
>IF alignment."

This is at TM-11-5820-357-35 p. 93 paragraph e(2) and TM-11-856 p.118 paragraph d(2). So yes, there is a procedure given in the TMs to align 390 IFs. But the authors were clear that it was not a routine procedure. Rather, it was to be used "only when the transformer cores have been displaced greatly from their normal positions within the cores" due to damage or previous gross misalignment. The reason, which the authors clearly knew but did not see the need to explain, is that the procedure given will not return the IF to its factory alignment condition but could restore basic functionality.

Date: Mon, 15 Oct 2012 00:55:57 -0500
From: Raymond Cote <bluegrassdakine@hotmail.com>
Subject: Re: [R-390] A vs non A

Now you all are going to have me checkup books again although I don't have my original lesson plans. I use to teach alignment and I remember a little about staggering for increased BW by setting the first of a little sly of 455 and the others on center and a little high. I wonder where this procedure originated.

Date: Mon, 15 Oct 2012 12:50:21 +0000
From: William A Kulze <wak9@cornell.edu>
Subject: Re: [R-390] A vs non A

To take a side road off from 390's briefly, I must say I found sweeping to make a difference in aligning my HQ-129x. The first time through it I just peaked everything at 455kHz. I don't own a sweep gen and wasn't sure how I'd even do it, but I found a way by using a urm-25f and an o-scope. I also used a winradio, but only for a visual guide to where the generator was set. I connected the scope to the cathode of the detector, same as connecting to diode load on the 390a. The stronger the signal, the higher negative DC voltage there.

Using this setup I found that just peaking at 455 didn't mean the actual peak for the filter was at 455. I would run the generator back and forth between +6kc and -6kc, looking for where it peaked and how balanced it was on each side. I kept at it until I had the peak at 455 and the +/- points were the same level.

It made a very noticeable difference in audio quality. When I just peaked at 455 the audio was tinny and it was hard to tell if I was centered on a station. After re-doing it the audio was much flatter in response and more pleasant to the ear.

I noticed when tuning it that I could really flatten it out, but at a reduction in gain, so I didn't go too far past peak in the middle and balance at the sides. I may have another go at it and see what happens if I flatten it more. There seems to be a lot of gain to spare, so I'm curious to see what happens.

I may be off target, but the way I see it, if your bandpass peaks 1 kc off center, then you would have an audio peak around 1 kc, but only on the sideband where the peak is. And if it's peaked on center, but not very flat, you would get a real drop in response at higher audio frequencies. Like I said, I may be wrong about that, but that's the picture I get in my mind when I ponder it.

Date: Mon, 15 Oct 2012 15:36:42 -0500
From: Randy and Sherry Guttery <comcents@bellsouth.net>
Subject: Re: [R-390] A vs non A

First - never officially* worked on an R-390/A during my time on Proteus. Besides - as far as "staggering" on the Tender - Unless it was prescribed in the official documentation, not a chance. Have a problem with a receiver not done "by the book"?? - heaven help the poor SOB that's involved with that! * I was a Nav ET - (SINS specifically) - we had nothing to do (officially) with Comm gear aboard ship - there were regular ETs for that. Sherry and I had a lot of comm gear over the years as a hobby - but I didn't "officially" touch a Navy 390/A until I was helping my charges study for advancement at Naval Weapons Station, York Town, VA.

That said - while aboard Proteus - i.e. 1971 - 1975 - we had a number of 390s - (25+) so sure - Sherry and I staggered tuned my R-391 and her R-390 just to see what - if any -

difference we could "hear". In our opinion - no where near enough "results" to be worth the effort... And considering the IF in an "A" - figured the results would be even less
impressive... so never tried.

Date: Mon, 15 Oct 2012 19:50:28 -0400
From: John Vendely <jvendely@cfl.rr.com>
Subject: Re: [R-390] CV-157

In my opinion, the CV-157 is a fascinating, useful and greatly underappreciated piece of equipment. The CV-157 was designed specifically for pilot-carrier independent sideband multichannel voice-frequency reception. This includes multi-channel teletype, as well as mixed-mode systems with various combinations of RTTY, FAX, and voice channels. 16 teletype channels were routinely handled, and experiments demonstrated that the CV-157 could handle up to 64 narrow-shift RTTY channels. This required the highest quality, wide bandwidth IF filters with minimum ripple and low group delay, plus very high linearity demodulators to ensure the low intermodulation distortion required in multitone systems. In the heyday of the CV-157, low-level pilot carrier AFC was common, to provide a means to phaselock the receiver to the transmitting station to ensure proper demodulation, and the CV-157 has a sophisticated and highly effective phaselock AFC system.

Although ISB is not so common as it once was, and pilot-carrier AFC is nearly (but not entirely) extinct, the CV-157 still shines as a high quality synchronous AM demod for HF broadcast reception. The complex IF filters in the CV-157 are flat within +/- 1 dB from 100 cps to 6kc, and the demods, with proper alignment, have distortion products better than 55 dB down. The carrier recovery IF is only about 10 cps wide, which means the CV-157 can maintain lock during very deep carrier fades, and with no sideband-locking tendencies. Its AFC is in fact a sophisticated carrier track-and-hold system which measures both carrier level and carrier/noise ratio and will hold the demod carrier phase for
the better part of a minute when either carrier level or CNR are insufficient. I compared one against the highly-touted Sherwood synchronous demod, and the CV was vastly superior during deep carrier fades which caused the Sherwood to lose lock and make weird noises. The carrier tracking performance of my WinRadio Excalibur Pro in synchronous
AM mode is greatly inferior. Some HF broadcast stations exhibit significant frequency error and drift (e.g. WBCQ), so that AFC system really helps. The ability to select the sideband with least interference is absolutely essential in the crowded HF broadcast bands.

Now for the drawbacks--and I won't dwell on the obvious ones like size, weight, power consumption, heat, etc. I assume if yer into boatanchors, you've already risen above such trivial matters. Obtaining the high performance described above is predicated upon finding a CV-157 with a good set of crystal filters and which hasn't been abused. This can be a real problem in equipment of this age. Many of the crystal filters have aged out of tolerance over the years or have failed altogether. They will not withstand a lot of physical bashing and crashing. Many CV-157s have fallen into the hands of barbarians and suffered accordingly. And with 44 toobs, retoobing one is an expensive proposition, especially the now-expensive 5751 dual triodes in the AFC system, which have been "discovered" by the guitar amplifier crowd. However, rumors that the mixer tube is scarce are untrue--it's the relatively common 6BA7 pentagrid converter. Make sure the AFC motor and gear drive system is in good shape, as a worn-out gearbox with too much "play" will cause lousy AFC performance, with the carrier phase wandering around. Some units exhibit oscillation problems in the 100 kc carrier recovery IF which can be tricky to tame. I've noticed that, for some reason, a fair number of CV-157s have open coils in the carrier level meters. Good luck finding a replacement. Alignment is difficult and time-consuming, and you need some decent test equipment to do it right--and I don't mean a URM-25 and a Simpson 260. That defective power transformer will be a problem. The original has several filament windings, some with high current. The CV-157 AFC will not reliably maintain lock with the driftier HF receivers of the day such as the GPR-90. The SP-600 is marginal. The receiver's drift rate must be pretty low to begin with--it was, after all, designed as a companion to the R-390/390A. If you can find a CV-157 in good shape at the right price ($100 or so), and are willing to make the investment in tubes, time, and effort, they are a very high quality demod system capable of excellent audio and are a great asset, particularly for the serious shortwave broadcast listener. I strongly recommend it.

Date: Mon, 15 Oct 2012 19:51:55 -0500
From: Raymond Cote <bluegrassdakine@hotmail.com>
Subject: Re: [R-390] A vs non A

Right SINS tech--like I was. Another world. You are right about working only on NAV. equipment. A friend had a A model when he lived in Agat south of the base and that was when we tried to stagger time the 390-a with staggering it. If I remember am signals were a little better but that was 42 years ago.

When my bench is back up and ready I will try again just for drill and test the BW before and after. I forget why we were doing it in C school at Great Lakes.

Date: Mon, 15 Oct 2012 19:55:42 -0500
From: Raymond Cote <bluegrassdakine@hotmail.com>

Subject: Re: [R-390] A vs non A

While we are on the subject, do you recall the manual where this is delineated? My books are stored in one of my shipping containers with my test equipment and not available. Don't jump through hoops to look just curious if you or any one else knows where it was described. Others have already mentioned that it wasn't in the manuals they had.

Date: Mon, 15 Oct 2012 20:38:50 -0500
From: Cecil <chacuff@cableone.net>
Subject: Re: [R-390] A vs non A

As I remember all IFs were not setup to be stagger tuned. There were caps across the IF transformers to increase the Q in either the ones that the manufacturer designed to be or not to be....I can't remember. The thought was that those that were intended to be, we're electrically different to maintain spec. Stager tuning one that was not intended to be would probably have low IF gain...and not stagger tuning one that was designed to be would probably have excessive IF gain.

I've always wondered how one tells the difference...short of looking for the caps.
Was this just an "A" thing or was there both in the earlier R-390 series as well.
Of course maybe this is all myth...

Date: Mon, 15 Oct 2012 20:28:36 -0500
From: Thomas Frobase <tfrobase@gmail.com>
Subject: Re: [R-390] A vs non A

After Hurricane Rita blew through Beaumont TX a local surplus dealer here in Houston emptied out his warehouse and sold a large lot of really nice test equipment. I was fortunate enough to purchase a 3577A HP network analyzer 5hz -210MHz.

At the time I had several 51J Collins to restore, one of which the IF was totally hosed, after messing with the set for over an hour I still was not satisfied with the alignment or the filters. I then fed the network analyzer output to the mixer output and its input to the IF out on the back of the set. In less than 10 minutes I had aligned perfectly. I have done the same with 390's 390A's in short order as well. All I can say is a picture is worth a thousand words.

Date: Tue, 16 Oct 2012 01:28:27 -0400
From: "Charles P. Steinmetz" <charles_steinmetz@lavabit.com>
Subject: Re: [R-390] A vs non A

>As I remember all IFs were not setup to be stagger- tuned.<snip>

In the 390A, the mechanical filters provide the actual IF bandwidth response (the interstage LC filters do clean up the stop band, where the mechanical filters have zeroes and ripple, so they give the IF a lower ultimate stop band attenuation than it would have had with the mechanical filters alone). Think of the interstage LC filters in the 390A as a roofing filter, although in this case they follow rather than precede the mechanical filters that actually set the IF bandwidth.

In some cases, the LC "roofing" filter in a 390A may have a narrower or more peaked response than the 16 kHz mechanical filter. If that is a worry, the interstage LC filters can be stagger tuned to broaden the overall LC response so that even the 16 kHz mechanical filter effectively sets the IF response.

I'm not aware of there being a version of the 390A IF that was designed to be stagger tuned, but that's not to say there wasn't one. In practice, the Q of LC tuned circuits is invariably determined by the Q of the inductor. It is possible that some IF strips had higher-Q inductors than others, and that these were identifiable by some other characteristic (for example, presence of additional capacitors), so radio techs learned to stagger tune those in particular. The only real benefit of stagger tuning a 390 IF is to broaden the 16 kHz response, and I suspect most 390As were never switched to the 16 kHz position by operators during their entire military service lives. Heck, I virtually never use the 16 kHz filter, and I tend to favor SW and MW broadcast targets.

>Stagger tuning one that was not intended to be would probably have low IF gain...

The 390A has so much extra IF gain available, and such a wide range of IF gain adjustment, that this would not likely have been an issue. Of course, the 390 is entirely different -- it has no mechanical filters, so the interstage LC networks do set the effective IF bandwidth (and are, therefore, designed very differently than the 390A interstage networks).

Date: Tue, 16 Oct 2012 12:13:53 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] A vs non A

Any day of the week more test equipment is better. But when we are all done doting the i 's and crossing the t 's lets not scare any more would be R390 owners and maintainers way from some thing they may enjoy doing. Remember history, hundreds of GI's keep thousands of R390's working for years all over the planet and all they had to get the job done was a meter and a signal generator. There was not even an expectation that the test equipment was working any better on any given day than the receiver that was under alignment. Thanks Don for a lot of insight on doing an alignment with a sweep generator. Better test equipment used well will likely produce better results than just any old meter and signal generator.

Date: Tue, 16 Oct 2012 13:01:52 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] A vs non A

Sweeping did come along about 1971.
It is not in the manuals.

At best there was a study guide not even a real TM publication on how to set up the test equipment and do an alignment. We also had a frequency counter to adjust the end points on the VFO and to set the BFO, we also used that to set the AN/URM 25 output frequency. The counter is not in the TM either. The sweep generator and frequency counters helped. More toys is always good. Not required but desired. As some of the Fellows describe, A sweep and a scope make alignment so much slicker. If you got-em use-em. If not, worry not.

Date: Tue, 16 Oct 2012 17:51:18 +0000
From: William A Kulze <wak9@cornell.edu>
Subject: Re: [R-390] A vs non A

I feel like I need to clarify my thoughts on sweeping. As I mentioned, it did make a difference on the old hammarlund, but I haven't seen a need for it on the R-390a. Mainly, on the R-390a, I have found hooking up the IF out to an SDR to be a great tool, also. You can see the shape of the bandpass. I haven't found a problem with the filters not being flat. But I have noticed that my 8kc filter isn't centered on 455kc, it's a little above that. It's more of a curious thing than a problem. I have tuned mine staggered and all peaked at 455, but not since doing it this way, where I can see it. Maybe I'll check it out sometime, see if there's a difference.

I'm sure that even though a meticulous alignment would get the radio closer to what the engineers had in mind, it wasn't needed for the beast to perform it's day to day duties, and guys in the field did what they could with what they had, and it sufficed.

I went to keesler for ground radio, learned Rx principles on R-390 schematics with colored pencils and everything, but I got sent to hickham to work in the airways/scope station and never saw another one (except the one they used for recording WWVH on the big 10 channel tape recorders) until I got my own R-390a quite a few years later.

I am most grateful for everybody out there that shares their experience and knowledge on these radios. They are most certainly a thing of technological beauty.

From: Mack McCormick <w4ax.mack@gmail.com>
Subject: [R-390] Alignment of the Mechanical Filters and IF with a Spectrum Analyzer

I have a calibrated high quality spectrum analyzer and tracking generator.
Does anyone have experience with using a spectrum analyzer to:

1) *Adjust the mechanical filters? *There is some literature that suggests just peaking for noise can adversely affect the filter skirts.

2) *Stagger tune the IF?* My thought is that you could look at the overall spectrum of the IF and make optimal adjustments.

I would of course make sure that I don't load the circuit with the spectrum analyzer to skew the results. Does anyone have any experience or suggestions?

Date: Thu, 13 Dec 2012 11:08:38 -0800
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a Spectrum Analyzer

You'd drive the filter with whatever source impedance it's used to, and same on the other end, loading with the appropriate resistor and using an active probe to isolate the SA's 50-ohm input.

1. I hope you're not thinking of tweaking the resonator disks! The only official adjustment is the trimmer caps on the input and output coils of later-production IF modules, and nobody ever did anything but peak them at the center frequency. If you sweep a filter and find that the trimmers have a pronounced effect on the skirts,
I guess a compromise would be possible. Tell us what you see.

2. The LC portion of the R-390A IF chain is fairly broad and not stagger-tuned; perhaps you're thinking of the R-390.

Date: Thu, 13 Dec 2012 19:30:54 +0000

From: <kirklandb@sympatico.ca>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a Spectrum Analyzer

Not familiar with r-390 details but, other than input/output matching, the mechanical filters have no adjustments. Playing with i/o matching does alter skirts etc including insertion loss. I regularly use a sig gen/ spec A (0 span mode) for IF alignment.
Have to be careful with multiple IF transformers that you don't use one to cancel the effects of the other. I would use the basic procedure to get "close" and then use the spec A to fine tune, e.g. minimum ripple in the passband.

Date: Fri, 14 Dec 2012 01:20:28 -0500
From: "Charles P. Steinmetz" <charles_steinmetz@lavabit.com>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a Spectrum Analyzer

>1. * * * The only official adjustment is the trimmer caps on the
>input and output coils of later-production IF modules, and nobody
>ever did anything but peak them at the center frequency. * * *
>
>2. The LC portion of the R-390A IF chain is fairly broad and not
>stagger-tuned; perhaps you're thinking of the R-390.

Except possibly for the 16 kHz bandwidth, the IF adjustments will affect the IF bandwidth only way down in the filter stop band. Here's what I wrote in a previous message:

>In the 390A, the mechanical filters provide the actual IF bandwidth
>response (the interstage LC filters do clean up the stop band, where
>the mechanical filters have zeroes and ripple, so they give the IF a
>lower ultimate stop band attenuation than it would have had with the
>mechanical filters alone). Think of the interstage LC filters in the
>390A as a roofing filter, although in this case they follow rather
>than precede the mechanical filters that actually set the IF bandwidth.
>
>In some cases, the LC "roofing" filter in a 390A may have a narrower
>or more peaked response than the 16 kHz mechanical filter. If that
>is a worry, the interstage LC filters can be stagger tuned to broaden
>the overall LC response so that even the 16 kHz mechanical filter
>effectively sets the IF response.

Even if the IF response turns out to be narrower than the 16 kHz filter itself (these filters often measure more like 20 kHz), I'd still just peak them because 20 kHz (or even 16 kHz) is really too wide for almost any practical use on today's bands.

Date: Mon, 17 Dec 2012 18:36:40 +0000 (GMT)
From: chuck.rippel@cox.net
Subject: [R-390] Alignment of the Mechanical Filters and IF with a Spectrum Analyzer

I have a very nice Tektronix 2712 here. The short answer is yes, you can adjust the trimmers to minimize ripple in the passband of the mechanical filters. However, that comes at the cost of an input output mismatch @ 455kc and the filter exhibiting some loss. In the receivers I experimented with, the return was barely noticeable and not worth the loss. I stick with injecting exactly 455 kc and peaking each filter and T-503 only VIA a VTVM connected to the Diode Load. The other 2 transformers accommodate the 16 kc bandwidth for MUX. As long as they have not been diddled with, are usually fine although there is a procedure for aligning them. That alignment is very broad. A spectrum analyzer and tracking generator would absolutely be the preferred method to align the IF in an R390 or SP-600.

Date: Mon, 17 Dec 2012 14:17:31 -0800
From: "Leigh" <bipi@comcast.net>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a SpectrumAnalyzer

I have a document, ST 32-152, "Visual Alignment of Radio Receivers, R-390/URR and R-390A/URR", dated March 1969, US Army Intelligence School, Fort Devens, MA. This document describes stagger tuning the IF chain, in general and for the R-390 and R-390A. The procedure uses a sweep generator and scope but the same procedure holds (in fact is easier) with a spectrum analyzer and tracking generator. I will take it to work with me tomorrow, scan it, and send you (and anyone else) who may want a copy of it.

Date: Mon, 17 Dec 2012 17:18:36 -0500
From: Mack McCormick <w4ax.mack@gmail.com>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a SpectrumAnalyzer

Thank you! That will be great! BTW, I lived in Edmonds for seven years and really miss the area. Mercer Island is absolutely fantastic.

Date: Mon, 17 Dec 2012 17:22:37 -0800
From: "Leigh" <bipi@comcast.net>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a SpectrumAnalyzer

Too many requests to reply individually....will send out to all who have (or will request) or if too many, will post the PDF on my Web site. Nice to see the interest.

Date: Mon, 17 Dec 2012 22:29:27 -0500
From: Roy Morgan <k1lky@earthlink.net>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a SpectrumAnalyzer

That document is in places very specific to the equipment used. In particular, it gives instructions on how to manage the sweep images from the sweep going "up" and then coming "down" in frequency. Many sweep generators nowadays (or even from some decades ago) have the equivalent of retrace blanking to eliminate the trouble of accounting for both up and down traces. With any of these systems, one important thing is to get the frequency sweep speed down low enough to avoid distortion in the picture you get. That document is online already: www.r-390a.net/faq-refs.htm

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Date: Mon, 17 Dec 2012 21:09:56 -0800
From: "Leigh" <bipi@comcast.net>
Subject: Re: [R-390] Alignment of the Mechanical Filters and IF with a SpectrumAnalyzer

Very good. I didn't realize it was already online. Guess it is covered then. Thanks for the information.

Date: Sun, 17 Feb 2013 16:35:42 -0600
From: "mlmccauley@att.net" <mlmccauley@att.net>
Subject: [R-390] [off topic] HQ-180A alignment craziness

I'm having big trouble doing an alignment on this set, and to my thinking what I see just doesn't make any sense. Any help anyone could give me would be greatly appreciated.

As I tell this tale, bear in mind that, as is, the set will receive stations and properly demodulate AM, SSB and CW. Sensitivity is poor, but the radio does basically work. Selectivity is super tight, standard HQ-180A behavior.

The very first step in the procedure is an initial rough alignment of the 60KHz 3rd IF. You connect a voltmeter to the AM detector and a 60Khz CW source to the coupling cap going to the grid of the 2nd mixer (presumably, leakage though the self-oscillating mixer gets the 60Khz out the back of this stage (?)). You are instructed to tweak the 60Khz IF transformers for maximum negative voltage at the test point.

The directions say to keep reducing the signal level as you tweak so as to keep the test point from going no more negative than -5VDC. Problem is, I see -.35VDC, which never changes, 60KHz injection or no, low or high injection level.

I've verified the generator freq at 60KHz with a counter that tests one Hertz off at 10MHz against a Cesium standard. I even swapped voltmeters. I've verified the injection and test point about 47 times.

Any ideas?

A guess - could it be that the 2nd oscillator (395KHz), mixer, and IF transformers have been jacked with *so badly* that the IF strip is tuned to a totally different frequency than 60KHz? These sets are notoriously super-selective, maybe my "real" 60KHz is being chopped off, totally outside the bandpass of the IF strip.

I'm stumped. I've aligned entire radios and had them working great in the time that I've been messing with step #1 on this set. Again, thanks in advance for your help.
Mike, WB5MYY

Date: Sun, 17 Feb 2013 18:09:41 -0600
From: "chacuff" <chacuff@cableone.net>
Subject: Re: [R-390] [off topic] HQ-180A alignment craziness

Depends on which manual you are using. There is a mistake in the majority
of manuals as to the settings of the front panel controls for alignment of the 60Khz IF. I'll see if I can find the info...I went through this same issue with the HQ-170. It does make you crazy...

Date: Sun, 17 Feb 2013 18:22:17 -0600
From: "mlmccauley@att.net" <mlmccauley@att.net>
Subject: Re: [R-390] [off topic] HQ-180A alignment craziness

Thanks a lot for the quick reply, Cecil! I got the manual from a guy who sells them "buy it now" on the standard online auction place. And I've noticed a few subtle differences between my set and the schematic in that manual. I'm going by the alignment procedure in that manual, so that may be part of my problem, maybe all of it. Your procedure corrections will probably set me straight.

Date: Sun, 17 Feb 2013 21:35:11 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>

Subject: Re: [R-390] Stagger Tuning and IF craziness

Oddly enough I was churning through different combinations of coil wire gauges, winding counts and things with the mechanicals (wonder what got me going on that) and I found that the best info we had on the mechanical filters was for 610 turns of #41 on a 1.1mm bobbin, 2.515mm long. I ran the numbers and figured out the inductance, opposed mutual inductance, k factor, M factor, value of the parallel cap when resonant at 455 kHz and ended up with the bandwidth of the RLC of each side of the filter.

It turns out that the mechanical filter coils have a bandwidth of right around 20 kHz (awful convenient) but it also explains a discrepancy I found too where some filters use something other than #41 wire. By tweaking things I was able to get the bandwidth of the mechanical filter down to 12.85 kHz with a different wire gauge and turns ratio (with less parallel capacitance to boot).

Just like the different stages in the IF deck, the mechanical filter is nothing more than a very unique IF transformer. Each stage of the IF deck has a bandwidth and stagger tuning allows you to flatten out the bandwidth response to where the wider mechanical filters are not clipped off at the edges.

The traditional response is to set everything to 455 kHz and peak away. If you do not care about the wideband response at 16 kHz you could either stagger tune to narrower values (like was mentioned setting them all the same and ending up with maybe 4 kHz of BW, it sort of invalidates the reason to have the 8 and 16 kHz mechanical filters) or you could still leave them stagger tuned but set them closer.

One of the tech documents actually called for the IF covers to be removed and drilled out for access (no more of that "no user serviceable parts inside approach"). There are ways of aligning the IF's without high end test equipment but it would be "so" much easier with a sweep generator and a spectrum analyzer.

I suspect the early idea of "leave these settings alone" was based upon what would be the perceived difficulties of field aligning the IF's. We all know the easy way is to tune to a known signal, put a voltmeter on the diode lead and adjust for maximum value. If they are stagger tuned at the factory then by letting the field folk do the adjustments might mean that a receiver had hot performance but would not hold a lock on a RTTY signal.

Of the things we can "do" to a receiver (snipping out parts and other evil activities) the idea of optimizing the IF settings to peak for your type of listening is benign and so easily reversed with a tuning tool.

From: Gordon <gordon@n6wk.com>
Subject: [R-390] Scale varies band to Band

Is it normal for the scale to vary a couple Kc's band to band? For example, If the Calibrator is dead on 7.500 on the 7 Mcs band, is it normal for it to be maybe on 8.502 on the 8 Mhz band and maybe 9.497 on the 9 Mhz Band? I do not see any trimmers to bring each crystal dead on. Am I missing something?

Date: Mon, 13 May 2013 13:50:39 -0700 (PDT)
From: Norman Ryan <nnryann@yahoo.com>
Subject: Re: [R-390] Scale varies band to Band

It's due to the crystals aging. It'd be a chore to find ones that match, but it's theoretically possible through trial and error.

Date: Mon, 13 May 2013 17:51:32 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] Scale varies band to Band

A *long* time ago I ran into the guy who designed the oscillator deck in the R-390A. When asked "why no trimmers?" the answer was - It wasn't in the spec. Put another way, they could do everything they needed to do without them, and they cost money. If you can come up with a big enough pile of crystals, you can sort them into groups that match fairly well. It's a time consuming process and should be done to the radio you will be using them in.

Date: Mon, 13 May 2013 15:06:41 -0700
From: Gordon <gordon@n6wk.com>
Subject: Re: [R-390] Scale varies band to Band

Well, that explains it. Sure would have been nice if they had put trimmers in there though. LOL I don't have any "Extra" Crystals, so looks like it will be a while before I can find all that closely match..hi hi.. Another question, What makes a crystal go bad..ie (stop working)? Isn't it just a piece of quartz ?

Date: Mon, 13 May 2013 18:13:20 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] Scale varies band to Band

Indeed a crystal is just a chunk of quartz in a fancy enclosure. The R-390 crystals that have failed on me have had features in them. My guess is that either the radio or the crystals got dropped. Once the fracture propagated far enough the resistance went high enough to stop the oscillator.

One thing that does bring up - as the crystal oscillator tube wears out, the weakest crystal in the bunch will go first. I've never actually tried swapping out tubes to see if it brought "dead" crystals back to life. It might be an interesting experiment. Gm is what counts in this case, so a tube tester should be able to verify good / bad tubes.

Date: Mon, 13 May 2013 20:52:38 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] Scale varies band to Band

Your receiver is operating exactly as designed.

You have to remember what is going on within the receiver.
Under 8 Mhz there is an extra conversion.
In the R390A its all offset by 17 Mhz.
In the R390 each of the 8 Mhz under 8 offset with a different crystal frequency.

Above 8 you have a crystal for each Mhz band.

No one ever said that any one of those crystals was exactly on frequency or even has an advertised output level. The crystals in the second oscillator deck are only advertised to be close enough to get the signals within the zero adjust range. The receiver has a zero adjust. It has a use. Use it. Receivers never had a set of crystals that would place each band close to zero on every band.

I would be common for a couple bands to be way out on the margin. It depended on what the receiver was being used for. Even the spooks did not tune every receiver to every band all the time.

If it got critical to an op who needed to do a couple band swaps to chase his dits and the crystals made getting zeroed an annoyance, we would swap some crystals between receivers to bring his problem under control.

You can swap crystals to get a set that's closer than the current set. It depends on how many receiver and spare crystals you have to swap around. It is a hit and miss exercise.

As every crystal in the second oscillator deck could be at any frequency give or take some you never expected to get an exact zero from band to band. The trim cap may pull a crystal a bit but its function is to peak output. We do not care exactly what the output frequency is as long as its within say 2 KHz.

If you can get the band to peak up within the range of the zero adjust and do not have to actually reset the VFO coupler or are not actually against the zero adjust limits with the band the crystal was considered with speck frequency wise. As long as the output level is high enough to get the signal to noise ratio (better than 20:1) for the band, the crystal is considered to have sufficient output. The fact that its like 4 KHz off from the band beside it or else where has nothing to do with the acceptability of the crystals performance.

The TM alignment procedure says reset the zero adjust with every frequency change as you go through the alignment procedure. The process expects each crystal in the second oscillator to be not on exact zero.

Consider the cost of making sure every crystal on all the frequencies in all the many manufacturing runs of these receivers had to be within some small
zero beat of matching.

Just letting a crystal be within a couple KHz on a band is big cost saving from a production stand point. There are reasons there are many part numbers that look as if they will get you a crystal on a frequency and in a can that looks to fit the socket. Some are transmit crystals on frequency. Some are receiver crystals sort of on frequency and lots of other things like output level and harmonics and operating temperature. There is a trade off in cost for each feature. We would never build a receiver today that acts like an R390.

Date: Mon, 13 May 2013 21:05:22 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] 17.000 Mhz Crystal

Yes you can swap the first mixer crystal with the second mixer crystal just to check that the second mixer crystal is the problem on 14 and 31. I have no idea how far off frequency it will be. You may get lucky and it will work very well.
Back when we just had two many parts on hand and never had to resort to this level of maintenance. I always had 400 plus receivers in the building and more than one of them was not in exact use a any given hour. I could always find an exact part to swap.

As this is a rebuild, look for some crud in a socket pin or a shorted trim cap wire. But first just plug in a different crystal.

Thunk the crystal a time of two as it may have crud inside.
Crystals do go bad and is the most likely problem.

Just resetting the crystal a time of two in the socket may clean up the contacts.

If you have a scope, you do not need an exact crystal.

Swap any crystal within reason 15 - 20 Mhz into the socket and look for a signal with the scope on the RF mixer tube pin.

Date: Mon, 13 May 2013 22:33:52 -0400 (EDT)
From: djed1@aol.com
Subject: Re: [R-390] Scale varies band to Band

If I remember correctly, the R-390A spec says that the receiver must be within 300 cycles of frequency when the set is calibrated at the nearest 100 Kc point. It also says that the band to band variation must be less than 4 Kc. So there never was a requirement for close band to band matching. As noted, it was a cost reduction design to a spec.

Date: Mon, 13 May 2013 20:18:13 -0700 (PDT)
From: Norman Ryan <nnryann@yahoo.com>
Subject: Re: [R-390] 17.000 Mhz Crystal

I wonder if oven temperature is critical to crystal performance (other than limiting frequency drift). Oftentimes a heater will fail due to corroded leads from the pin(s) to the heater element.

Is a working oven heater element an issue, given that most of our receivers are operated in generally stable ambient temperatures? That is, would a failed heater element put a harelip on performance?

Date: Tue, 14 May 2013 06:41:31 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] 17.000 Mhz Crystal

The heaters on the main crystal deck are not critical to performance at normal temperatures. The crystals will move 10's of ppm as they heat up. That's < 1 KHz at 30 MHz. The heaters are there in case you happen to be operating the radio at -40 F.

Date: Tue, 14 May 2013 09:47:32 -0400
From: Steve Hobensack <stevehobensack@hotmail.com>
Subject: [R-390] 17 MHz Crystal

Usually a bad crystal can be repaired. dismantle and remove the crystal. Soak everything is soap and water. I have found that degreaser spray does not work as good as soap and water. Use a toothbrush. rinse several times, final rinse use distilled water. Also check electrical continuity between the pins and contact plates. Dry the crystal with a clean cotton dish towel. Use a hair dryier on the holder. It works most of the time for me. It even improves chirpy/lazy crystals.

Date: Tue, 14 May 2013 10:32:46 -0700
From: Gordon <gordon@n6wk.com>
Subject: Re: [R-390] 17 MHz Crystal

Well, I took the crystal apart and found the problem.http://www.n6wk.com/R-390A/17Mhz-Crystal.JPG There is no repairing this one. LOL

Date: Tue, 14 May 2013 19:03:47 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] 17 MHz Crystal

That's a late model crystal. Those mounts were not in use when the radio was originally designed.

Date: Tue, 14 May 2013 20:06:58 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] 17 MHz Crystal

This may work for pressure holder / FT-243 type crystals. It's not a real good idea on a solder sealed crystal like the 17 MHz part in the R-390A. The 17 MHz blank is so thin that anything close to a toothbrush will destroy it.

Date: Tue, 14 May 2013 19:50:42 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] 17 MHz Crystal

So, it's the thickness that matters more than overall size, correct?

Date: Tue, 14 May 2013 22:40:40 -0400 (EDT)
From: Gordon Hayward <ghayward@uoguelph.ca>
Subject: [R-390] Crystals

> So, it's the thickness that matters more than overall size, correct?

Yes. For a first overtone crystal the thickness is a half wave at the acoustic frequency corrected by the mass of the metal electrodes and, as seen on the picture, by the extra metal used for the final frequency trim.

> Actually it's still two 17 MHz crystals. ....

I assume you mean half of the cracked crystal. It probably wouldn't run because the moving part (these crystals are AT cut and move in a thickness shear mode) is where the electrodes overlap. There is no overlap where the usual connections are made. If it did oscillate there would be a lot of spurious modes. The R-390 is stable enough that I listen to crystals to hear the neat modes the crystal goes
through when water or other liquid on the surface evaporates. <snip>

Date: Wed, 15 May 2013 08:04:07 -0400
From: "Lester Veenstra" <lester@veenstras.com>
Subject: Re: [R-390] 17 MHz Crystal

Sounds like a process for FT-243s but not for HC-6/U

Date: Wed, 15 May 2013 10:14:12 -0400 (EDT)
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] 17 MHz Crystal

Is that ratio expressed correctly? It seems that should be a diameter to thickness ratio > 100 (or it's Wednesday and I'm not thinking clearly...).

Date: Thu, 30 May 2013 21:27:48 -0700
From: Gordon <gordon@n6wk.com>
Subject: [R-390] Stability

Since I am fairly new to my R-390A, I have a question. How long does it normally take from cold turn on, until the radio is stable and no longer drifts? 10 minutes, 30 Minutes, an hour? What is considered normal and how much can I expect it to drift during that time?

Date: Fri, 31 May 2013 07:34:14 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] Stability

A lot depends on the environment your radio is in and how long it's been off. If you are trying to run narrow shift RTTY unattended with sharp demos filters, the answer may be days. If you are trying to listen to a local AM broadcast, the answer may be a few minutes with occasional intervention. In normal operation these radios were not used like the R-1051 in set / forget mode. It was expected that you would have to tweak them from time to time.

All that said, a good radio running continuously, in the right conditions, will hold < +/-40 Hz all day long. I certainly would not toss one out because it doesn't. It's also tough to fix if it does not, since the conversion crystals are as much part of the problem as anything else.

Date: Fri, 31 May 2013 08:11:36 -0400
From: Tom Chirhart <k4ncgva@gmail.com>
Subject: Re: [R-390] Stability

In the Navy we never turned them off but on occasion when shifting from shore power to generators when getting underway we did lose power... prayed that they survived the surge... Like Bob said, the 1051's were left on too, as guard channel receivers for HiComm nets, ship-shore RATT, HF broadcast receivers etc.. The only time we turned off a 390 was when the ET decided to complete the preventive maintenance so he could get his liberty card from the Chief ET... Been there, done that doing PM on antenna couplers at the end of the yard arms up 90 feet just to get off the ship for a cold 807 on the beach... Be patient these old receivers were built and weigh like tanks..

Date: Fri, 31 May 2013 13:37:22 -0400 (EDT)
From: djed1@aol.com
Subject: Re: [R-390] Stability

I've measured mine and it drifted 400 Hz over 3 hours from a cold start (heaters turned off). As noted, whether that's good depends on what you need, but I was comparing it to a WWII Super Pro which drifted 70 KHz in the same 3 hours. Quite an improvement over 20 years.

Date: Sat, 1 Jun 2013 09:04:54 -0400 (EDT)
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] Stability

In the past I have determined that most of the initial warm-up drift comes from the main VFO tube V701. The initial turn-on drift might be several hundred Hz or nearly zero in the first ten minutes. The other oscillators are all crystal controlled so their turn-on drift is fairly low.

I found that by swapping several different 6BA6 tubes for V701 I would usually hit on a "good" tube that had nearly zero drift from a cold start. Worth trying if you have several spare 6BA6 tubes available. There may still be some small long-term drift while the receiver stabilizes thermally but the main drift seems most noticeable in the first ten minutes from a cold start and seems mainly due to the V701 warm-up characteristics.

Date: Sat, 1 Jun 2013 09:37:31 -0400
From: Bob Camp <ham@kb8tq.com>
Subject: Re: [R-390] Stability

If you are on a band where Y201 in the first crystal oscillator contributes, it's got a pretty well documented warmup.It's an AT cut ovenized crystal with turn point up around 85˚C. That's going to give you a 50 to 70 ppm shift as it heats up. That alone will give you about 1 KHz of drift. It will always go down in frequency initially. It may come back up a bit right at the end.

The rest of the crystals would do something similar if you heated them up that far. Over the range you do heat them they probably move 10 to 20 ppm. If you are listening to 10 meters, that would give you 300 to 600 Hz. Again, the warmup shift will always be down. Run the radio with the covers on in a tightly packed rack and the numbers will be higher. Run it will all the covers off and six fans, the numbers might be lower.

On most of the bands things aren't quite so simple. You have some crystals converting bands up, and others converting them back down again. The drift you see will be the delta between the various oscillators. Different bands will have different drift. Not so simple.

Date: Sat, 1 Jun 2013 20:12:42 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] Stability

In the day the military turned the receivers on and left them on forever. It was common to come time for a 6 month preventive maintenance PM and find the micro switch was stuck on and the receiver would not turn off.

The only time we experienced warm up drift was after this PM and we put the receiver back in the operators rack.

But it is a tube radio and has a thermal mass that needs to come to temperature. R390 and R390/A are and were considered as stable as you could get with the technology. Give yours a 1/2 hour and it will warm up and settle down. If it does not, consider the tubes first. Todd's point on the VFO 701 is to be taken as serious. Not all tubes are equal and it is worth swapping tubes around not just for the signal to noise but for these drift problems in the oscillators.

There is a ballast tube in the VFO and BFO filaments.
It is there by design.

You have to ask your self, Self how stable is my power voltage. I lived 20 years in LA and San Diego counties. Brown out was common during the hours I wanted to operate my R390/A. So a little drift that would be obvious with CW was present.

But it was not a problem with the receiver per se.

It will be hard to judge if the drift is in the receiver tubes. In a ballast tube with a bright spot. Or in the power line variations. Roger AI4NI

Date: Sun, 2 Jun 2013 12:53:24 -0600
From: <wb5uom@hughes.net>
Subject: Re: [R-390] Stability

My R-390A has been ON continously now for about 3 years being run thru a Tripp-Lite 12 volt Inverter/Charger. With a couple of exceptions where we had a power failure that lasted for several hours where I turned it off. The Tripplite makes a great surge protector. The R-390A just sits there on frequency, I dont remember the last time I tweaked the frequency, as I ususally leave it parked on 8903 KHZ The power fluctuations here in the country are numerous and have in the past been wild. I run the PC , sattellite modem, other radios etc all thru the Tripplite.

Date: Sun, 4 Aug 2013 22:40:07 -0500
From: Raymond Cote <bluegrassdakine@hotmail.com>
Subject: Re: [R-390] RF deck alignment

"During times of universal deceit, telling the truth becomes a revolutionary act." George Orwell Isn't there a procedure for that already? I seem to remember something about replacing slugs and tweaking the stages. Perhaps it was something in my Navy R-300a trouble shooting school. But that was in 1965. Memory cells are also 50 years and dwindling down.

I know that this generally falls under the "leave it alone" category but has anyone ever gone through the process of aligning the RF deck stages and bands for linearity?

Generally I know that we pick a few spots on each band and peak through the RF stages for performance but what happens when a slug has been replaced, repaired or the spring was accidentally stretched? That one slug will have a different peak than the other in the string when the band selector switch is lined up that way.

The only way I could think to do it would be to inject a known RF signal level and to use a RF microvoltmeter (like a Boonton 92) at test points to walk through the stages.

Am I wrong-headed to think that the more selective the RF stages are the better the desired response would be at the IF?

Date: Mon, 05 Aug 2013 08:01:01 -0400
From: "Charles P. Steinmetz" <charles_steinmetz@lavabit.com>
Subject: Re: [R-390] RF deck alignment

The RF tuned circuits are substantially wider than the widest IF filter, so there is considerable room for RF misalignment without any performance penalty.

To adjust linearity (tracking), you would have to adjust cam profiles -- not practical, and not necessary given the large margin for RF misalignment. If a spring has been stretched, you want to get the slug back to its original height in the coil form. If a slug has been replaced or repaired, you may want it at a different height than original if the mass, length, and permeability differ significantly from the original slug. A two- or three-point check should be sufficient to set this properly.

>The only way I could think to do it would be to inject a known RF signal
>level and to use a RF microvoltmeter (like a Boonton 92) at test points to
>walk through the stages.

The RFs are all peaked, so you should be able to just monitor the level at the IF. This will also account for the offsets of the crystal oscillators (although, again, those should be much less than the large margin for RF misalignment).

>Am I wrong-headed to think that the more selective the RF stages are the
>better the desired response would be at the IF?

Because the RF tuned circuits are substantially wider than the widest IF filter, the IF response will be determined solely by the IF filters unless something is broken. The RF filters are there to limit the out-of-band signals the front end has to deal with, not to affect the ultimate response. There would not even be any practical benefit in terms of out-of-band rejection or in-band insertion loss. Indeed, if one made the RF as narrow as the IF, it would almost certainly be detrimental because of the inevitable mistracking.

Date: Mon, 5 Aug 2013 10:19:17 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] RF deck alignment

Mostly this is a moving target. You could sweep the tuned section of interest with a sweep generator, detector and scope. As the mechanical tuning sets still we would see a peak on the scope display where the tuned circuit was currently tuned to and the band pass skirts of the tuning as it sets. While the sweep generator is running, we could then run the mechanical tuning through its range and watch the peak move along the scope display. We could watch the peak point for good level across the tuning range. We could watch the band skirts for symmetry. We could watch that the peak point matched the receivers dial read out to see that the mechanical track was in line with the electrical track.

A sweep generator is a bit more graphic but you could use a signal generator and a voltmeter at the test points.

A real common practice was to use the signal generator and the diode load voltage. But rather than just look at the given points in the TM we would look at a bunch of points. On the 16 - 32 octave we would check each megahertz band as the crystals changed.

You may want to peak the 2 - 4 octave for best output across 3.5 - 4.0 Mhz and the 4 - 8 octave for best output across 7.0 - 7.3 Mhz. Maybe you would like to peak the 8 - 16 across one of the international software bands.

We had some receivers that were used on fixed frequencies. These got special treatment to peak performance on those frequencies. You will be amazed at how badly you can pull the band pass out of shape.

Consider that while you may not gain much in peak in band performance, how much more out of band stuff you can filter out of the mix to reduce the noise floor also counts. The peak signal may not gain but if you can take out the software AM above 7.2 at night you may hear a whole lot more CW at 7.0 for DX. There is rhyme and reason for taking on these exercises you suggest. You can take your general coverage receiver and optimize it for some specific select frequencies with just your spline tool and flat blade non conductive
screw driver (tweeker). Conversely you can get a whole lot better flatter general band pass by testing more than the minimum points presented in the TM.

Some simple math shows the band points in the TM are not the best exact corners. they are set on the 100Khz cal tone points so you can use the cal tones to get close in alignment. We know there are better frequency values to use on each band to get a better flatter total performance from the receiver. Once you get the signals up out of the noise to a good level, more work does not get more signals and aggravation begins to exceed return

on investment. But until you get to that point all work is productive.

Date: Mon, 5 Aug 2013 07:57:03 -0700 (PDT)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] RF deck alignment

In a related matter, a sure sign that your RF stages need alignment is that if you move the MHZ change dial a tad and the signal gets better before it changes bands, you need to realign.

Date: Mon, 5 Aug 2013 12:21:13 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] RF deck alignment

Charles already said that the RF is wide enough not to cut into the IF passband. I'll add that the R-390 and R-390A are not short on gain, _and_ that I think it's a very bad idea. The cams were built linear, and the coils specially wound so _they_ were linear. If the system law is not linear and the cams aren't worn, it points to deterioration of a coil or a manufacturing defect therein. I can't imagine rewinding one and getting it better than before. Also, one cam affects several coils. Unless they're all off the same way... even then, I'd never mess with a cam except to replace one that was obviously off.

Overall, if you're in the mood, it would be an interesting exercise to map out the RF response, but an extremely frustrating one to attempt to change it by any means other than the approved trims.

Date: Fri, 4 Oct 2013 22:05:25 -0700 (PDT)
From: Mike Bracey <mikebracey@att.net>
Subject: [R-390] Newbie needs help

I need some direction from the gurus please. My 390a works fine in every respect except for distorted audio on the broadcast band. All other bands are fine. It is the same no matter what the settings on RF or AF gain. Bandwidth has no effect. All tubes check good. It's hooked up to a 40' inside long wire antenna. Could someone point me in the right direction?

Date: Sat, 5 Oct 2013 12:56:20 +0000
From: <chacuff@cableone.net>
Subject: Re: [R-390] Newbie needs help

The broadcast band is unique in that it usually has very strong signal strengths compared to most of the SW bands.

With no additional information I would have to guess some kind of AGC problem. I have to assume the RF gain control works properly in that when you turn it counter clockwise the signal strengths decrease, the signal metering comes up through mid scale...and when fully CCW no signals at all? Does the Antenna Trim control seem to work properly peaking the signal?

How does it tune the calibrator on that band...and others. Distorted also?

I have to believe a couple of other bands are also experiencing the problem but you may not have noticed because there is not much to listen to there... I can?t remember off the top of my head the frequency range of the slugs/racks in that band on the RF deck. Maybe a core is broken loose and no actually moving causing a mistuning of the front end and widening the front end band pass. Reaching here with little to go on.

Date: Sat, 5 Oct 2013 07:32:02 -0700
From: Dan Merz <mdmerz@frontier.com>
Subject: Re: [R-390] Newbie needs help

Hi, agc problem was my first thought since BC band signals are usually very strong. Can you tame the problem by setting function switch to mgc, manual gain control, and see if reducing rf gain helps? Can you tune in a weak broadcast band signal and see if distortion is reduced? Also, is your indoor antenna just a wire connected to set such that the front end tuning by the antenna trimmer has no effect in peaking a signal? Maybe you have a nearby strong BC signal that is causing the problem because it isn't adequately rejected. Dan

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Date: Sat, 05 Oct 2013 11:44:24 -0600
From: Robert Moses <rhmoses@earthlink.net>
Subject: Re: [R-390] Newbie needs help

Sounds like an alignment issue.

Date: Sat, 5 Oct 2013 11:57:21 -0700 (PDT)
From: Mike Bracey <mikebracey@att.net>
Subject: Re: [R-390] Newbie needs help

Sorry for the reply delay. I was called into work early this morning. I tried Roy's idea first. I put a 3' wire on for an antenna and it fixed the problem. It is overloading with the 40' long wire. Is that normal or do I have a problem? This is my first 390a and I'm still getting a feel for it.

Date: Sat, 5 Oct 2013 12:32:59 -0700 (PDT)
From: Norman Ryan <nnryann@yahoo.com>
Subject: Re: [R-390] Newbie needs help

Try reconnecting the 40' antenna and tune in a signal that distorts as you mentioned earlier.? Then switch FUNCTION to MGC and gradually reduce RF GAIN to where distortion clears up.? If it does, I'd suspect a leaky cap in the AGC circuit.? It doesn't take very much leakage to throw the AGC off kilter. The R-390 AGC is very robust, and thus very difficult to overload with strong signals. Best of luck and keep us posted,

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Date: Sat, 05 Oct 2013 15:39:56 -0400
From: k2cby <k2cby@optonline.net>
Subject: [R-390] Newby needs help

This sounds obvious but the first place I wood check is to be sure that the shorting straps are in the right places on the rear terminal strips. Terminals 1 and 2 connect the front panel RF Gain control and should be strapped together. Terminals 3, 4 and 5 connect the AGC bus for either local control or diversity reception. 3 should be strapped to 4 for normal operation.

Second, I'd make sure the IF gain pot (one of two on the top of the IF chassis) isn?t set wide open. The R-390A has a prodigious amount of IF gain. This pot is usually adjusted to minimize noise but that setting is typically no more than 1/3 to -open.

Third. Turn the noise limiter off and keep it there. Particularly at high settings, it distorts the audio like crazy, and it isn't much use unless you have ignition noise.

If none of this seems to produce the desired result you should suspect a problem in the AGC system. To troubleshoot it satisfactorily you need a vtvm or a digital meter with an input impedance of at least 1 meg (preferably 10). You also need a signal source capable of pushing the AGC voltage high enough to be in the control region. Your long wire antenna with the receiver tuned to a loud AM station should do the trick.

Tune the receiver to the signal source (BC band station). Back down the RF Gain control on the front panel. Set the VTVM to 10 volts dc full scale (preferably 30 volts or whatever the next higher setting is). Connect the positive lead of the VTVM to chassis ground (Terminal 16). Connect the negative lead to Terminals 3-4 of the terminal strip. (You are measuring negative AGC voltage so the meter connections are opposite what they otherwise might be unless your vtvm has both a +dc and a ?dc mode). Now gradually open the front panel RF Gain control. There should be no action at first, then the AGC voltage as measured by the vtvm should rise to at least 12 to 15 volts.

If it doesn’t, disconnect the jumper between terminals 3 and 4. Turn off the receiver and measure the resistance from pin 3 to ground. It should be pretty close to infinite. If it isn’t, there is a leaky capacitor on the drop side of the AGC bus (the end that connects to the AGC-controlled tubes). If this checks out ok, you will have to check the source side of the AGC bus from the detector through the noise limiter.   Good luck.

Date: Sat, 05 Oct 2013 16:00:20 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Newbie needs help

You have a problem. Based on the fragmentary data you have provided, it is most likely an AGC problem.

Date: Sat, 5 Oct 2013 16:13:17 -0400
From: "quartz55" <quartz55@hughes.net>
Subject: Re: [R-390] Newbie needs help

When the filters start deteriorating, it wreaks havoc with the AGC too. Check everything else before you conclude that though. I think the only good way to test for the filters is to pull them out and check for leakage. But like I say, that will be the last thing to check. I have one I'm rebuilding the filters becasue it's messed up the AGC action, much like you are experiencing only worse.

Date: Sat, 5 Oct 2013 13:21:41 -0700 (PDT)
From: Mike Bracey <mikebracey@att.net>
Subject: Re: [R-390] Newbie needs help

You guys are great! The IF gain was about 95%. Backed it off to 50% and it's working fine. I just need to find Chuck's info on setting it correctly. Thanks......

Date: Sat, 5 Oct 2013 16:21:30 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R-390 Digest, Vol 114, Issue 7

Is your IF gain set correctly? maybe it is too high. There is a procedure on how to set it by attaching a voltmeter to the diode load connection on the back. If you are overloading on strong signals that may be a problem. Another thing to try, see if the problem is the same when you switch between the 8 kHz and 16 kHz filter positions. You should get slightly more fidelity at 16 kHz but it will not be a big difference. What I would be looking for is something radically different between the two filter positions (a filter that is leaky to ground will cause you problems).

Date: Sat, 5 Oct 2013 17:11:18 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] Newbie needs help

I love this list, he gave us a pretty good description of a problem and at least 4-5 subscribers all gave him a similar direction to go on resolving the problem. Within minutes, he is back on the air and has learned quite a bit more about the receiver. If that had happened on eHam or the `zed there would of been suggestions about pulling all of the tubes and installing transistors, some sort of political debate about the US budget situation or how a Grundig is a better
receiver (joke).

Date: Sun, 6 Oct 2013 13:23:02 -0700 (PDT)
From: Mike Bracey <mikebracey@att.net>
Subject: Re: [R-390] Newbie needs help

Thanks again for every ones help. I bought my beautiful condition 390a from a local ham. He sold it to me for $200 because it was blowing the B+ fuse and he was tired of "messing" with it. I finally traced the problem to a bad cap in the IF module. My radio is a Collins unit that at some period had a depot rebuild so it is a mix of modules. The meters had also been replaced with white faced meters. The previous owner had replaced the deadly caps, replaced the filter caps and solid stated the power supply.

Since my cap repair it has worked great except for the BC band distortion. I have set the IF gain per Chuck's method and it seems to be working fine. After using it for a while I'm going to take it to a friend who is a retired Air Force radio tech. He has agreed to do a full alignment for me.

Finding this forum has been a blessing for me. When I first bought this receiver I asked a couple of questions on the 'zed. I was answered so rudely that I erased them from my browser and have never gone back. There does seem to be a lot of ?asshats in our hobby who lurk on the forums.

Date: Mon, 7 Oct 2013 12:08:22 +0000
From: Bill Kulze <wak9@cornell.edu>
Subject: Re: [R-390] Newbie needs help

I stumbled on something interesting regarding the IF gain adjust while tinkering with feeding the IF out in to an sdr (winradio G303) tuned to 455kHz. It's best to have the sdr agc off. As I increased the IF gain on the 390a I hit a point where the noise floor jumped right up, with the SN ratio going right to crap. I set it to just under that point and it seems to have the largest delta between signal peaks and noise floor.

Date: Sun, 20 Oct 2013 23:09:48 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: Re: [R-390] R-390 progress!!

Somewhere in the dim past, I ran across a procedure for aligning an IF ending in a crystal filter that didn't use a counter. Crystals age and drift in frequency, so you switch to the tightest filter position and tune the signal generator for peak output from the filter. The frequency won't be far from 455, but it could be 100 Hz away, which would mean low output from a strip aligned by a counter. Use the frequency that peaks the crystal to align the IF strip. Worked for me. Anybody else done that?

Date: Mon, 21 Oct 2013 16:34:35 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] R-390 progress!!

You are on it. In the beginning there were no freq counters in the shops. You rocked the signal generator into the 455 crystal for max output and used that as 455 to align the If deck. We were looking at the procedure to tweak up the crystal trimmer cap and the 1Khz bandwidth slug on the IF deck. The original manual has a process but it does not read well.

Date: Mon, 21 Oct 2013 16:38:08 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: [R-390] R-390 IF adjustment of .1 1. bandwith

Now that we have counters the question becomes how to adjust the trim cap to pull the crystal onto 455 and get the 1Khz band pass also centered on the 455. As the TM came before counters, the TM does not address this adjustment process. Fellows how should we conduct this adjustment process?

Date: Mon, 21 Oct 2013 15:10:17 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] R-390 IF adjustment of .1 1. bandwidth

There isn't any trim to bend the crystal, you just have to take what you get. L503 is adjusted to resonate at the crystal frequency in order to get the widest 1kHz bandwidth. (R502 and R503 "spoil" L503/C524 by a calibrated amount to get 1kHz or 100Hz respectively.) I think C520 is adjusted to balance out stray capacitance at the crystal's parallel-resonant frequency.

Date: Mon, 21 Oct 2013 18:34:11 -0400 (EDT)
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: [R-390] R-390 IF adjustment of .1 1. bandwidth

I see what you say.

We should center the signal generator for a peak through the crystal as was done originally. Then you align the rest of the IF deck to what ever that frequency is some where near 455 and well within the mechanical filter band passes. We then work on getting L503 and the trim cap to get the best 1Khz we can. You zero the BFO to the what ever the peak frequency through the 0.1 kHz crystal happens to be. What ever the If center is we care not. You just also adjust the VFO to zero through the crystal against the BFO. So what if the IF deck is not an exact 455kc. Those receivers have worked for at least 60 years that way.If you have to use a counter, then 1 KHz bandwidth may not be zackly 1. But I will bet you can't hear the difference. I think I am diddling in the mud on this point. How do we best adjust the slug and the cap for a good 1Khz bandwidth?

Date: Mon, 21 Oct 2013 15:47:17 -0700
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] R-390 IF adjustment of .1 1. bandwidth

I don't remember if the manual has a procedure for these - I'm basing my suggestions on memories of aligning the crystal filters in HP 141T and Tektronix 1L10 Spectrum Analyzers. There, it's a sweep alignment. You select wide bandwidth on the filter, then adjust the LC tank for widest bandwidth and symmetrical skirts. I think that for the neutralizing part you select narrow and go for the deepest notch. The peak is series resonance, the notch is parallel resonance. They're slightly different frequencies. In the middle of the notch, if the caps (C520 and Cstray_xtal) are balanced, nothing gets through at all. I wouldn't be surprised if C520 and L503 interact and require a couple of cycles to optimize. Sorry to be vague, but it's been years.

Date: Thu, 13 Mar 2014 13:04:45 -0400
From: Mark Richards <mark.richards@massmicro.com>
Subject: Re: [R-390] RF subchassis separation

<snip> Question A: As I keep hearing crystal replacement as the answer to this problem, can someone here lead me to a source?

I should probably replace the pair. Test revealed that < 8MHz I have no radio.. so likely the other crystal gave up, too.

Decided not to disassemble any further, as in repairing the loose shaft that started this whole mess. It works mechanically. Why fix it.. unless I want perfect stock appearance perfection, which I am less inclined towards after all this work.

Went about removing each of the slugs to be certain I had not mixed these up and managed to snap two of them. Easy to do as they are old and seem quite brittle.

Question B: Is the best fix a dab of epoxy? Looks as if it cannot be soldered together...

Date: Thu, 13 Mar 2014 11:52:42 -0700
From: "Craig Heaton" <hamfish@efn.org>
Subject: Re: [R-390] RF subchassis separation

1: No signal below 8MHz, that is most likely the 17MHz that sits alongside the 200KHz calibration crystal. Fair Radio is one source.

2: No Crystal Calibrator signal, since you are referring to the RF section. With tube extenders check voltages. In the Y2k manual there are voltage/resistance checks listed. Try a tube replacement or two. Those crystals are getting hard to find like hen's teeth. Someone one the list might have one, make sure it is packaged well for shipping. International Crystal can make one, but very pricey. If there are harmonics but not where they should be, (use a freq counter coupled to that section of the RF) suspect one of the dozen or so silver mica caps. Shotgun time.

Date: Thu, 13 Mar 2014 15:29:03 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] RF subchassis separation

> Question A: As I keep hearing crystal replacement as the answer to this problem, can someone here lead me to a source?
> I should probably replace the pair. Test revealed that < 8MHz I have no radio.. so likely the other crystal gave up, too.

Before you order expensive crystals, make this simple test:

Hook the suspect crystal between the output of your signal generator and the RF probe on your VTVM. Set a tenth of a volt output and low voltage range on the VTVM, and tune around the crystal frequency with the generator. Slowly. You’ll see a peak if the crystal is working. You can make an RF detector with a diode, resistor and a cap if your meter doesn’t have an RF probe.

For the 200 kc crystal, you need a signal generator that goes that low. The URM-25 is ideal. *Some* audio generators go that high.

All of this is extra justification to have TWO (or more) R-390A?s, or at least spare small crystal ovens equipped with the right crystals.

Date: Thu, 13 Mar 2014 19:37:45 +0000
From: Bill Kulze <wak9@cornell.edu>
Subject: Re: [R-390] RF subchassis separation

Now, I haven't messed with my radio or looked at the manual in a while, but wouldn't a total loss of everything below 8MHz indicate a problem with the oscillator associated with the third conversion for everything from there down, or something in that neighborhood? A single crystal would only take out the one, or in this case, two 1MHz bands associated with the xtal? Like I said, it's been a while, maybe I'm remembering it wrong.

Date: Thu, 13 Mar 2014 19:43:08 +0000
From: Bill Kulze <wak9@cornell.edu>
Subject: Re: [R-390] RF subchassis separation

Of course, maybe you're talking about the xtal for that osc. If so, never mind!

Date: Thu, 13 Mar 2014 17:00:11 -0400
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] RF subchassis separation

When you lose all below 8Mc, it is indeed limited to a single crystal, or could involve the band switch contact(s). Roy's suggestion to test the crystal is by far the best way to "begin". This "could" simply be a need for cleaning the pins of the crystal, the crystal socket, or the band switch assembly contacts.

Date: Sun, 16 Mar 2014 18:33:08 -0400
From: Mark Richards <mark.richards@massmicro.com>
Subject: Re: [R-390] RF subchassis separation

Roy, Lots of good ideas, and a few comments..

> Sounds like you did well about the crystals. At $20 to$30 <snip>

I can only assume that if they pass the scope test, they are fine in circuit. Is this reasonable? Might I safely assume that crystals either work or they don't? Never heard of a weak crystal. Gosh, I remember as a novice grinding these to change frequency! Like cutting wood: you can take off, but can't put back on.

> If all you have are digital meters, <snip>

Poor timing on my part to work on R-390A in advance of finishing rebuild work on a Simpson 260 whose internal batteries were left to rot the battery contacts and unfortunately also munging one section of the rotary switch. But I have little Radio Shack handy meter that does OK.
>
> I expect to put together a test fixture <snip>

Wow! Won't that be handy. Would it be feasible (and of course, useful) if this included input for signal gen with perhaps switch to route it to IF or antenna in as needed for test? Maybe a step attenuator on the signal generator line and balanced antenna input load resistors, too?

Would your test fixture comport with extension cables for working on modules apart from main chassis? I built these form my R-390a restore, and they have already been very handy.

> Just because the crystal is acting like a crystal <snip>

I am about to do this, as the calibrator still doesn't work. I replaced v207 (5654) with a known good one and got a stronger signal from cal but it still has a 60HZ (or maybe 30HZ) rasp on it, and it drifts wildly.Noted that when peaking T207 that this part of the circuit is acting unstable. I'd peak it and get tremendous improvement and then it will suddenly drop to a lower level. Re-peaking, there seemed to be a point where tuning past the peak would cause it to drop off completely. Strange. Seems dynamic enough to be tube-related. But during tuning the 500KC and 1MHz bands went completely dark... So might have to pull the RF deck (after I change out some more tubes)... as it seems there may be flaky caps in the general area that failed as things got warmer.
>
> The URM-25 is a very versatile generator.<snip>

I love mine. I have two with one for parts as the other works better and on all bands.
>
> About the audio output meters: <snip>

It kills me to think that I owned one of these years ago.. and a bunch of other test gear (I was in broadcast engineering). Time, and life, and all my wonderful tools departed. Maybe will meet up with some at ham fests someday before I am planted.

Date: Sun, 16 Mar 2014 18:36:50 -0400
From: Mark Richards <mark.richards@massmicro.com>

Subject: Re: [R-390] RF subchassis separation

Ken, I'm glad you pointed that out. What an interesting video! Hope Gregory was aware of the line cord neutral safety issue. I cringed when he touched chassis and other items in his shop, but he didn't, so maybe it was plugged in properly or he had made the needed safety mod. I did, including a new filter, and am glad for it. C327 was replaced when I had the RF deck out. V-207 just replaced. Still issues and I posted these just now. Looks like I need to replace more tubes and then pull the deck..

Date: Tue, 29 Jul 2014 19:29:23 -0400
From: Frank Hughes <fsh396ss@gmail.com>
Subject: [R-390] R-390 alignment question

I am trying to do my first alignment on the "tailgate" R-390, so as to perk up the performance.

Using this manual:
http://i180.photobucket.com/albums/x257/fish1_07/R-390/r390TMcover_zps1455706b.jpg

R-390A alignments in the past have been no issue, but the R-390 is a little different, and I am baffled by one procedure. All was going well, peaking coils, watching the HP 410C meter increment a tiny bit more with every pass. Then I hit paragraph "K". OK, I am old, and cognitive functions are more limited - most of my brain cells are dedicated for looking for my glasses. Thus I would be MOST appreciative if anyone can explain in language I could understand what they are trying to tell me in paragraphs "K" - "N". I just don't get it.

TEXT: http://i180.photobucket.com/albums/x257/fish1_07/R-390/r390text_zps4f6aeefc.jpg

TEST SETUP http://i180.photobucket.com/albums/x257/fish1_07/R-390/r390_test_setup_zpsfeee93f8.jpg

THE DREADED Z501:
http://i180.photobucket.com/albums/x257/fish1_07/R390/Z501_zps5acd2b93.jpg

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Date: Tue, 29 Jul 2014 19:41:07 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] R-390 alignment question

Find the peak in the IF

Move off of the peak to the specified attenuation (both sides of the peak, same delta frequency from peak)

Adjust the phasing capacitor as needed to balance the rejection on both sides of the peak

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Date: Tue, 29 Jul 2014 21:50:46 -0400
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: [R-390] R-390 alignment question

Bob's response is just a clear as can be.

You are looking to set the 0.1 hertz cap to a minimum response.
But that filter is so wide you can not just dial the cap in.
You look for two skirt points that can be found.
Then you set the cap to a mid point between these two marks.

Before washing your IF deck, the Z501 can may have had six marks around the cap. You would have hoped it had three on the can and one on the cap.

When you are done you will have six marks on the Z501 can and 1 mark on the cap. Use a # 2 pencil for a marker.

Make a mark on the cap usually in line with the tool slot and only on one side of the slot.

Every cap in the R390 should have two peak points.

If the cap has only one peak point you may have a circuit problem.
The cap is reaching the max mesh or minimum mesh and you do not know it the capacitance value is sufficient (min or max) to bring the circuit to peak alignment.

So each cap should have two peak points as you rotate it through 360 degrees.

So as you do the alignment procedure you should first get two minimum points for the cap on the low frequency side. And two minimum points for the cap on the high frequency side.

Now you have four marks in two pairs. with a high side point and low side point in each pair.

This is a demonstration and witness mark that the circuit was working the last time it was performed.

Do this procedure once on your R390 and be happy for life.

Then you eye ball the mid point between the high frequency and low frequency marks and place a third line at the mid point.

Now you have six marks on the top of the can.
The two mid point marks are equal alignment points.
Align the cap mark with either of these two mid points and the cap for the Z501 filter is set to optimum setting.

Set the AN/URM25 to 455 KHz at 150 micro volts coupled into E210 on the RF deck so you can align T207 and all of the IF deck to 455. As the third mixer in the RF deck will give gain at 455 the AN/URM output should be well below 150 micro volts. dial the out put of the generator down to a level that is - 6 volts on the diode load using CW on the generator.

Pop the output level on the generator up three switch positions. (that's times 10 time 100 time 1000 [three positions])

Dial the AN/URM off 455 until the diode load drops back on to the meter scale.

Spin the cap on Z501 and find two points where the diode load read minimum.

Mark these two points as H H or L L depending on which way you went with the generator.

Dial the AN/URM back across 455 and move along until the diode load voltage drops back onto the meter scale.

Spin the cap on Z501 and find two points where the diode load read minimum.

Mark these two points as what ever you did not mark the first pair as.

Eye ball a mid point between a H and an L Make a mark.
Eye ball the mid point on the other pair and make a mark.

Set the mark on the cap to align with one of the two mid point marks.

Procedure is complete.

Find a beverage of choice and grin. Forever and ever just set the cap mark to align with the mark on the can top. The cap is aligned.

This setting is broad and the cap will be good enough for the alignment of the receiver.

If you have a frequency counter than set the generator to 455 + 8 = 463MHz and 455 - 8 = 447MHz

Increase the gain on the generator to get the diode load voltage at mid scale on the meter and spin the cap to minimum.

Mark the points up as above and eye ball the mid point to set the cap too.

A good receiver has six ticks as L C H L C H and one tick on the cap.

You set the cap tick to a C tick and go on with life.

Date: Wed, 30 Jul 2014 21:16:35 -0400
From: Frank Hughes <fsh396ss@gmail.com>
Subject: [R-390] R-390 Z501 success !!

The mysterious (to me) Z501 has been adjusted on the "tailgate" R-390, thanks to the kind advice from members here!

http://i180.photobucket.com/albums/x257/fish1_07/R390/Z501_aligned_zpsbdd94e94.jpg

<snip>

Date: Wed, 3 Sep 2014 09:20:25 +1000
From: Pete Williams <jupete@internode.on.net>
Subject: [R-390] R-390A alignment..

G'day all... I've done a few restorations but have a query on a variation not so obvious on alignment procedure. The 4 - 8 Mhz rack. when fully adjusted , ends up with the slug tops almost level with the rack .... this is at variation with all the others both past and present. The adjacent rack somewhat similar but not as bad.. I am aware of cam setting and possible trimmer/capacitor problems and even incorrect slugs, but this one seems to defy convention !. What I've done is .... checked cam settings--- even tried slightly different position,. Repositioned interrelationship of trimmer settings with core settings Changed slugs. Installed a new set of coils. RESULT.... all alignment same as before and sensitivity OK..... I don't like the slugs being inserted so far into the coils--- doesn't seem right for me. I've followed Roger R's listings over the years and maybe he might have an explanation.

Date: Tue, 2 Sep 2014 20:23:28 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] R-390A alignment..

The “magic” variable is the permeability of the core material. I’d say it’s a good guess that the radio was designed for material A and then material B was substituted .

Date: Wed, 3 Sep 2014 15:15:32 +1000
From: Pete Williams <jupete@internode.on.net>
Subject: [R-390] R-390A....align

Thanks to you all for the suggestions...... I have made a preliminary change by swapping over slugs from the adjoining rack... they are labeled Collins with
the ID 526 - 5009 13, and below is SM - C - 249245, and below that again is 6729. They OK in their original rack but unfortunately, only produced identical
setting to those installed in the 4 to 8 MHz rack which were unmarked . Anyway the data above rather academic so will pursue further.... maybe have to live with it, but even with replacement coil cans. Results identical. A WIP and any revelations to follow. Thanks for the interest.

Date: Wed, 3 Sep 2014 07:01:29 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] R-390A....align

They swap with the adjacent set. As in - we save money if we buy 2X (or 4X or ..) as many of these cores instead of buying 1X the original permeability cores.

The other variable is how tight the cores fit in the coils. The less spacing between the wire and the core the (slightly) greater the effect of the core. The thickness of the coil form essentially is the other part of this variable.

Date: Sun, 30 Nov 2014 18:42:28 -0500
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] How is this gear supposed to work?

<snip> In real life every crystal in the second oscillator and its used harmonics are not exactly on frequency. The VFO may be linear to within 200 hertz from end to end but off many cycles along the way. So you just run the receiver over to the nearest 000 cal tone spot.

Engage the zero adjust.

Dial the VFO to zero beat and release the zero adjust mechanism.

Then within about 50,000 hertz of the zero you can read the receive frequency
to 1000 hertz. from XX X00 to XX X50 plus or minus. All the megahertz from 00 to 31 should let you zero beat the receiver on every 100 KHz cal tone.
If you have a mega hertz that is so far off that it will not zero you may need to change the crystal in the second crystal oscillator.

While you try to set the zero adjust to mechanical center, release the zero adjust and adjust the counter to XX X00 by loosing a counter gear and moving the counter, and then setting the VFO to match by loosening the clamp on the Oldham coupler with a counter or to zero through the 0.1Khz crystal in the IF bandwidth as was done originally prior to the wide spread use of counters, you may find one or more of the megahertz band will not zero beat with in the range of the zero adjust.

So before you just go seeking crystals, reset the zero adjust mechanical center to not exactly center and in a spot that will let you zero every megahertz. If the range gets so wide that some thing will not zero you have to decide which end you want to start making changes on.

Some crystals are easier to find than others. You may not be going where you want to go that brings all the crystals closer to center. But you pick what you can get to get your receiver back in range.

Find the 4 or five wide ones two high and two low and go shopping. Crystals use harmonics some use two and some use three. If one harmonic is two far out then likely so will the other values of the crystal be off. Maybe only the last highest value will be two far out to get it to zero.

When setting the second crystal oscillator trimmer caps you are looking for maximum output not exact frequency.

You will find that as you change megahertz each one will have a different zero point in the zero adjust. It’s normal. If you have a fair set of crystals most will be close. Most days an operator did not go changing megahertz that much.

If an operator was swapping two megahertz to chase some ditties and the two megahertz were way apart on zero we would swap crystals around between several receivers to give the receiver some what matched crystals on the pair or three megahertz the operator needed so when he called out a frequency or was given a frequency he could read the dial with some degree of certainty.

Not that any crystal was on exact frequency but the ones of interest were all about the same zero point with in a 100 hertz or so. That close and the operator did not need to zero the receiver on the megahertz changed. The VFO from end to would only be in that range.

If the operator was working 6930 and 7041 he would have to go end to end on the VFO. Charlie know we were coping him on R390 and had this range problem and would work over a megahertz end just because. I seen a few Viet Nam rigs that were miss aligned so that the high end would be a 1000 hertz over the end of the megahertz band. The dials were just off the alignment by 1000 hertz and used that way.

Before an intercept op could spin to the end and flop over, the other end of the ditty conversation would have been completed and never copied by the intercept operator. Even if the intercept operator had his second receiver setting on the low end of the next megahertz he often could not find the second end of the exchange in time to get a copy or send it to the direction finding team to get a bearing on the transmitter.

But we never tried to get every crystal in a receiver to zero at the same point with the VFO. It just was not done. Way to much effort invested plus crystal cost.

Date: Sat, 10 Jan 2015 02:25:54 -0500
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] R390A RF deck advice

I put some other bad numbers in a post.
The IF deck needs to get us 27 or 28 to 1 for 150 uv at 455.
We will never see a receiver do those numbers end to end.
We would like to see 20 : 1 end to end.
We can get a bit over 20: 1 but you need to really pick tubes to get much over
20:1 end to end for noise.

I will admit, I seen one receiver get 30:1 end to end in 1974 with a lot of work and only on one octave............ <snip>

Date: Sat, 10 Jan 2015 04:32:50 -0500
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] R390A RF deck advice

Just checking that I understand the basics:

By: > "The IF deck needs to get us 27 28 to 1 for 150 uv at 455."

You mean:
Put 150 microvolts into the IF deck input at 455 kc
Set the right bandwidth (4 kc?)
AGC off
Turn signal generator modulation on and off (30 percent at 1 kc) and look for 27 to 28 to 1 noise voltage level change at the audio output.

and by > "We would like to see 20 : 1 end to end. ?

You mean
Put the signal into the RF input of the radio
Signal modulated 30 percent 1 kc
20 to 1 modulation on to modulation off, audio tone to noise at the audio output.

I know you've described this noise test before (and I've saved it here somewhere) but I wanted to check the basic ideas. I do have a URM-25F here, but unfortunately no R-390 of any sort to test.

Date: Sat, 10 Jan 2015 14:22:29 -0500
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] R390A RF deck advice

You need some more toys.

Use the 2KC band width on the IF and end to end we would like to be under 10 microvolts sensitivity and likely down around 4 micro volts in the 8 MHz to 32 MHz range. All the ugly long details are on the R390A.net page with more other good words than one can read in a week.

Date: Sat, 17 Jan 2015 19:05:34 -0800
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: [R-390] IF alignment questions and noise issue.

Setting out to check alignment of the variable IF stages, and the Y2K manual states to couple the generator through "Test Lead CX-1363/U" to test points E209 and E210.

I have an HP8657B, and my guess is the test lead mentioned above isolates the generator from the receiver, probably through a DC block. How to you all couple a modern generator to those test points in practice?

Noise issue: The RF deck (that some may remember had shorted B+ cap) now seems to develop a "bacon frying" sound several minutes after a cold start. I've isolated the noise to the RF deck by unplugging J208 when the noise is present and it completely goes away. I've also swapped all the tubes in the signal path with no change. Any ideas on how I might

isolate the noise to a stage in the RF deck?

Date: Sat, 17 Jan 2015 22:20:51 -0500
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

The RF deck has a three test points, labeled E-208, 209, and 210. If you short these in turn to ground (using a capacitor since at least of them is the mixer grid and has DC bias voltage on it), you will find where the noise is coming from. Or, you can simply pull the tubes one at a time beginning with the first RF amp.

Most likely you will find that you have a leaky silver mica cap. Out comes the RF deck for surgery.

Date: Sat, 17 Jan 2015 22:26:49 -0500
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

> Test Lead CX-1363/U

In the URM-25B manual, I found this:
12. TEST LEAD CX-1363/U. (See figure 2-17)

a. The Test Lead CX-1363/U should be used for making interstage receiver measurements. It consists of a 0.1 microfarad capacitor (C-601) in parallel with a 510 micromicrofarad capacitor (C-602) enclosed in an aluminum case similar to the antenna simulator and fixed attenuator units. One end of this case is terminated in a type UG-185/U connector. Two 18" long clip leads extend from the other end. The capacitor network is in series with the red lead, whereas the black lead is grounded to the case.

b. The capacitor network is inserted to protect the attenuator (E-112) of the signal generator from accidental test probing at points of B + potential and should always be used when making interstage receiver tests.

c. The reactance of the test lead capacitors should not normally affect the accuracy of the meter (M-101) voltage indication since, in most cases, the impedance at receiver interstage measurement points will be high. It must be realized, however, that when the CX-1363/U is used at test points of low impedance (below 400 ohms) the meter indication can no longer be depended upon to reflect the actual signal voltage applied.

Date: Sat, 17 Jan 2015 21:33:26 -0600
From: Barry <n4buq@knology.net>

Subject: Re: [R-390] IF alignment questions and noise issue.

Is it the sound of bacon frying or kielbasa frying? If the latter, the the radio is completely normal.

Date: Sat, 17 Jan 2015 22:36:50 -0500
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] IF alignment questions and noise issue.

Various outfits will sell you a capacitive block in an attenuator package. The ones I have are marked CC-1000 and came from a place in Florida (ELMCO?) many years ago. They look just like a coaxial 20 db pad. Mini Circuits will sell you a BLK-6 that does the same sort of thing. Rated to a whopping 50V. They also have a BLK-222 that's rated to 100V.

In both cases you have a low frequency rating on the data sheet of 10 MHz. That's not likely to be an issue feeding a signal into a high impedance grid test point.

Just about everybody who makes coaxial attenuators also do DC blocks. There are a few hundred people out there.

Date: Sun, 18 Jan 2015 18:49:40 -0500
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

Does the receiver fry bacon on all frequencies? If you are frying bacon under 7.999 as well as over then the first mixer and 17 Mhz osc are OK.

Inject 455 Mhz at 150 micro volts into the If deck at J518.
Set the band width to 2Khz
Set the BFO off
Adjust the IF gain for -7 volts on the DC load.
Set the generator modulation on at 30 %
Observe about 1/2 watt on the local output across a 600 ohm load.

Listen for your frying bacon and be certain it is not in the IF deck.
Set the generator to CW and observe a 28 - 30 DB drop in signal level at the local audio output on the back panel.

If your IF deck and audio do not pass this test start fixing problems in the IF and Audio deck.

Pull V203 the second mixer.
Set the receiver to some number over 8 Mhz.
Inject 455 Mhz into E 211.

Reduce the generator level until the DC load level is - 7 volts.

Repeat the noise test. you may only get 20 : 1 or better but not 28 - 30 DB difference. Listen for your frying bacon and be certain it is not in the third mixer and VFO.

Pull the RF tube V201
Do the math and inject a frequency into E210
Listen for your frying bacon and be certain it is not in the second mixer and crystal oscillator deck

If you fry bacon only under 7.997 you have a first mixer and 17 Mhz osc problem.

If you got this far you have an RF Amp V201 problem.

Go looking for a sliver mica cap as suggested.

Open the ground lug bolt and retighten it on any cap to ground you suspect before you just replace it.

You can turn the receiver up on end and work on the RF deck was it hangs out of the receiver.

You just can not go dialing the VFO all over.
But set the VFO to 500 KHz and you can work up and down the Mhz at the 500 KHZ point.

It's enough to trouble-shoot the problem.

Date: Sun, 18 Jan 2015 20:33:07 -0800
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

Thank you Roger. I'll work on those tests this week. A little more information after playing with it more last night. It's definitely present on all bands. Disconnecting the RF deck at J208 stops the bacon frying.

Pulling V201 stops the noise. Re installing V201, and then pulling the 1st mixer, etc on down the chain I can still hear the frying, but at a reduced level. I noted that the only silver mica in the signal path on all bands is the 33pf grid coupling cap. The others are ceramic or other types.

Another list member was puzzled by being still able to hear the noise with the mixers pulled and wondered if the AGC line was involved. At his suggestion I looked at the AGC bus with a scope and could see some noise in tandem with what I was hearing. I also grounded the AGC bus which silenced the noise, and indeed the noise is completely gone in MGC mode. By the way, its clearly a heat related problem, I turned on the receiver this afternoon about 2:15. The noise didn't show up until after 4. I almost declared is a ghost.

And finally, prior to discovering the noise, I had been working with the IF deck checking alignment and setting gain. No noise whatsoever after several hours powered on. It really seems to be narrowed to the RF deck, possibly a component on the AGC line? I'm headed back to the schematic and see what's there. And thanks to all for the DC block responses.

Date: Sun, 18 Jan 2015 23:53:15 -0500
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

> ... I also grounded the AGC bus which silenced....................

Suspect that the noise is coming from the last detector and feeding the AGC line. Look at the AGC system for the source, not in the RF deck

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Date: Mon, 19 Jan 2015 15:42:32 -0500
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

It's a mixing thing. A stage is making noise. It depends on what it has to mix with to determine if it comes out in the audio. Stop guessing. Start a proper systematic trouble shooting sequence.

Date: Tue, 20 Jan 2015 21:32:35 -0800
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] IF alignment questions and noise issue.

Thank you Roger. You are of course perfectly correct, there is no substitute for a proper analysis and diagnosis. I have no intention of going in there without knowing pretty much what I'm looking for and where it is.

Nevertheless, yesterday I let it cook for a while to see what happened. After a while listening to a local BCB station, I noticed some distortion. This sounded disturbingly familiar, so I put the HP 410C on the AGC line. It measured only about -4 volts. Backing off the RF gain got rid of the distortion. Classic low AGC. Throughout the noise was present. Wouldn't be surprised if they were connected. Probably won't post again till the weekend...busy week ahead.

Date: Sun, 17 May 2015 22:17:10 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: [R-390] Sensitivity Measurement Question

After securing another Z202 from Fair Radio and installing it into the RF deck and re-aligning that octave, I set about to measure sensitivity according to Chuck's method as published in the Pearls. The instructions specify to set the noise level on the line level meter to -10 db without the generator connected, then connecting the generator and finding the level that yields a 0 db reading on the Line Level meter for a measurement of the 10db S/N + N sensitivity. Following this method on the 0 and 1 mhz bands went well, yielding about 0.3 - 0.35 uv readings.

The problem I run into on the higher bands (2 and 3 specifically) is this: I can set the -10 db level just fine, but when I attach the cable to the generator, it acts as an antenna and the noise level rises dramatically. In other words, with the cable connected, and the RF turned off, the line level is well above the 0 db mark. The generator is an HP 8657B. Feeding the output into a Tek DCA 602 scope doesn't reveal any added noise over the baseline that I can discern with just the cable connected with no RF out. What am I doing wrong?

Date: Mon, 18 May 2015 15:33:57 -0400
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] Sensitivity Measurement Question

You just are not living in a screened and well grounded noise free shack. Aggravation is going to exceed return on investment.

I have not read Chucks procedure lately. Are you using a 600 ohm load on the line output to give you proper readings for a loaded circuit?

You are right the cable acts as an antenna.
First choice is the screened and grounded shack.
Second choice is real good short grounds to the test bench.
Third choice is balanced feed to cancel as much noise as possible but not practical between the generator and receiver and knowing losses through the circuit. Plus you still have everything hanging in free space acting as an antenna.

At the line level meter you are now using the receiver as a frequency selective
meter. You can try for a quiet spot between 2.000 and 3.999.

Just align the receiver as best you can and do not worry about these absolute test values. The receiver uses the same tubes from .5 to 7.999. If you have good signal to noise any where in that range the receiver will be OK. For sure you want each octave aligned as best you can get it. But do not worry about the exact numbers.

Use the CW to modulated procedure outlined in the TM for signal to noise ratio.

Put a key in the cable between the generator and the receiver and then with the
receiver setup for CW and your head phones find the minimum discernible signal. How far can you dial the generator output level down and still get a CW
tone you can copy above the noise floor.

Connect the generator as Chuck says. Dial the receiver off the generator frequency. and set the line level to give you the -10. Dial the receiver on to the generator frequency and reduce the generator output level t get the 0 reading you seek. See how these numbers work out. You should get the same range of values on all frequencies. They will vary but it will give you the confidence the receiver is working well and every thing is well aligned.

Date: Mon, 18 May 2015 17:07:00 -0700
From: Dennis Wade <sacramento.cyclist@gmail.com>
Subject: Re: [R-390] Sensitivity Measurement Question

Thank you Roger, some great suggestions. The lead from the generator to the radio is rather long so I'm sure shortening is will help. I'll try the modified method (moving the receiver off the signal instead of disconnection). That has promise. My purpose is a relative record so I can identify bands/octaves that are beginning to deteriorate over time.

Date: Tue, 19 May 2015 01:26:22 +0000 (UTC)
From: Norman Ryan via R-390 <r-390@mailman.qth.net>
Subject: Re: [R-390] Sensitivity Measurement Question

You can increase sensitivity by repeating alignment up to three times. Each iteration yields increased sensitivity. Carefully calibrate per the manual before each signal generator frequency change. It's a lot of work even for just one complete alignment, but it has made a difference in my case.

An analog voltmeter like the TS-505/D registers the peaks best.

Date: Tue, 25 Aug 2015 15:17:10 +1000
From: Pete Williams <jupete@internode.on.net>
Subject: [R-390] Alignment R-390A... simple (?

Having an aligned R-390A (many) over the years, I've never had a sig.gen with the ability to store all the alignment frequencies to minimize the knob twirling on a URM-25 as well the rx setting to accommodate the desired frequencies. The aging process led me to make things a bit simpler.. Doing this assumes the rx s in some operating condx. I recently made myself a marker generator from a piece in a copy of Popular Electronics using a 100khz xtal and a CD4017 chip... A 2N2222 is an oscillator and another for the amplifier.

The CMOS divider produces outputs at 100, 50, 20 and 10kHz with useful
level output markers up to 30Mhz. Using the manual setup of connection to the diode load and inputting to the balanced antenna, the output level from the marker is well in excess of the input needed to get the -7V or less and having a HP switched attenuator in the line, it was easy to get the level down to or even less than -7V.

Yes knob twiddling still needed but only on the rx . With the exception of the 0-1 MHz range. all align frequencies including the 1st and 2nd IF are multiples of 100kHz . Band 1 can be accommodated using the 50kHz output.
As a rough alinement it works well and for more meaningful sensitivity tests one has to resort to a sig.gen with a calibrated attenuator. A possible side benefit is being able to check the linearity of the PTO with the 10 and 20kHz markers' Works fine for me.

Date: Tue, 25 Aug 2015 18:32:12 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Alignment R-390A... simple (?

Thanks much for your post suggesting the marker generator. I happen to have one here (and a URM-25F), and can try your method out. I notice my hamfest $5 marker generator has only an RCA-plug terminated wire for output. I plan to add some banana jacks, and a BNC jack. There is room also for a small pot that will let me adjust the output level easily (no good step attenuator is at hand). It seems to me that making the output adjustable is far more important than knowing what the signal level is in microvolts (or dBm).

> from a piece in a copy of Popular ....

Mine is on what seems to be a commerce printed circuit board - may well be the same as yours.

> The CMOS divider produces outputs at 100, 50................

Mine has a rotary switch to select the output frequency.

> ... for more meaningful sensitivity.............

My URM-25 will do that nicely (along with a fixed attenuator). Thanks for the tip.

Date: Sat, 14 Nov 2015 15:23:02 +0000 (UTC)
From: wli <wli98122@yahoo.com>
Subject: Re: [R-390] the search for 30:1

Took the time to look at *every* resistor in my Capehart audio deck. Found six that were up by over 20%, mostly cathode and grid ones. Also swapped tubes. Followed Roger's paragraph on measuring S/N of the IF-audio decks together, and saw 28:1. I am happy.

Date: Tue, 17 Nov 2015 18:28:12 +0000 (UTC)
From: wli <wli98122@yahoo.com>
Subject: [R-390] re search fro 30:1 part 2

Having satisfied myself that the IF-audio decks were OK, rechecked the end-to-end S/N as outlined by Roger. It was 12:1. Readjusted the IF gain for -10dB with the line meter at -10 and line meter gain at 10. Went thru polling all the tubes. Minimal benefit, as I had done it previously. Now 14:1.

Pulled the RF-Xtal decks, found the caps and resistors to within 10%. Accessible interior ground lugs were retightened. DeOxit'ed all tube pins. Lightly burnished all the mounting surfaces to the main chassis including the back of the front panel.

Upon recheck of the S/N it was 26:1 end-to-end!
Could it have been just bad tube or deck chassis contacts?.

Date: Tue, 12 Apr 2016 03:56:20 +0000 (UTC)
From: "R. David Eagle" <kb8nnu@yahoo.com>
Subject: [R-390] Lost receive help....

Well, I am sure glad this group exists and I am have never been happier to finally get my 390a up and running. This last week I finally powered the rig up and had one of the simapert replacement regulators fail...most likely due to a bad ground connection through the tube shield and it it wiped out half of my receiver now. I ordered the one that is on ebay as a drop in replacement to try that one and it works great...BUT I have noticed that I have lost the ability to receive below 8 mhz or 9mhz. I can hear WWV on

10mhz beautifully.
Any ideas or help would be appreciated....again!

Date: Tue, 12 Apr 2016 04:24:00 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Lost receive help....

Hi David, Glad you're back in business, almost. That typically means the first mixer and/or 17 mc 1st osc is not working. Try swapping or replacing V202 and V207. You might try wiggling them first. Then if not them, it might be the 17 mc crystal. Try wiggling it or cleaning the contacts. It's inside the heater can HR202. Also try wiggling the J221 mini bnc connector. And then there's S208 in the rf deck - it provides osc power below 8 mc. I hope its an easy one.

Date: Wed, 13 Apr 2016 01:05:41 +0000 (UTC)
From: "R. David Eagle" <kb8nnu@yahoo.com>
Subject: Re: [R-390] Lost receive help....Resolved

Larry,You nailed it! I removed and re-seated V202 and V207.....and we are back in business! I hope they all turn out to be that easy. Now, if I can only figure out what is wrong with the VU meter, I may be in good shape....for now.? I got as far as checking for audio at the meter ...nuttin there. I fear I may have a bad meter....I wonder if they can be rebuilt? On a side note- My 4 year old loves working with me on this radio....he always says "look at all those gears, Daddy"! I think he may have the bug....

Date: Wed, 13 Apr 2016 01:12:48 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Lost receive help....Resolved

I don't think you should worry about the meter until you see audio on the normal line out terms and on the meter terms. If you have audio on the output terms on the back, check the meter switch. Also, if reseating the tubes fixed it, then other sockets might have the same problem - time to deox them.

Date: Wed, 20 Apr 2016 00:16:12 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

I've been wanting to get some time for a couple years now, to work on this and finally did a few months ago. I've had very good reception with R-390A's for 37 years since I got my 1st one. About 10 years ago I added SSB capability to one and it works great except for one thing, the background noise on weak stations.

I picked up an SX-111A about 6 years ago and it had a better s/n than my two
R-390A's. I thought there must be some diffenence in the RF amps, but that was not it. They are the same. The 111A has a 6BY6 mixer with a 6C4 oscillator.

For years I've read the 390 forum posts and other online doc about lower noise tube alternatives for the R-390A, but saw no easy way to try them until recently.
I wasn't about to pull the RF deck and do surgery on it. There would be no way to switch back and forth to measure the real results. I thought about tube adapters, but was not able to find 7-pin tube bases to make adapters out of until recently. So, I read through a lot of R-390A doc that is online (thank you all that have contributed to this wonderful info) and decided to try a 6HA5 mixer. I made an adapter about an inch high that plugged right in. I used a tube socket for the 6HA5 that has the shield base on it just like those used in the R-390A.

My first try was the 2nd mixer and using the 9 mc band. With the RF gain at the same position as with the 6C4 installed, the no-antenna noise level was 9 db higher. I wasn't sure if that was a problem or not. I measured the s/n with the traditional method, but could not obtain the 10 db increase in reading. I thought: OK,what did I break. Well, it turns out that when using a 6C4, the rx noise level increases with the signal level more than enough to create the 10 db increase at a low input signal level (about 0.4 uv +/- 0.1 uv on all the bands). But, when using the 6HA5, the 'noise' level gives way to 'guieting' before the 10 db increase is achieved. This required a different way to measure any benefit that might be obtained.

What I wanted know is how much signal level would create clear audio (overcome the 'noise' level). I'm using the 10 db 'quieting' method. With signal generator and impedance matching device connected to the balanced input and no output from my URM-25D, I set the VU meter to 0 db. I then increase the generator output (with no modulation) until the VU meter goes down 10 db. At this point the 'noise' is barely audible. When I turn on the 30% modulation, the tone is loud and clear.

I measured numerous bands using this method with 6C4's installed and this is the result:.9 MC: 3.3 μv, 3.7 MC: 5.6 μv, 7.9 MC: 3.5 μv, 9.9 MC: 2.4 μv, 15.9 MC: 2.3 μv, 21.9 MC: 2.1 μv.

So, here's the same bands with a 6HA5 in the 2nd mixer position: 0.9 mc: 1.5 μv, 3.7 MC: 3.5 μv, 7.9 MC: 2.2 μv, 9.9 MC: 0.44 μv, 15.9 MC: 0.75 μv, 21.9 MC: 0.67 uv.

And, here's the bands under 8 mc with a 6HA5 in the 1st and 2nd mixer position: 0.9 MC: 0.47 μv, 3.7 MC: 1.2 μv, 7.9 MC: 1.4 μv.

As you can see, this is a marked improvement in the measurements, but the real results are in the listening. I've been listening to 40 and 80 meter SSB for a few days now, and reception is clearly improved. It's bringing in the weak stations much better and the noise between transmissions is noticeably reduced. Of course, AM reception is also much improved in bringing in weak stations. ?During testing, I did switch back and forth a few times to verify that the readings were real and repeatable. And of course, having to do the necessary alignment each time. I tried 6 different circuit scenarios for the 6HA5, settling on the simplest.

I also tried a 6GU5 as an RF amp alternative, but could never get it to work better than the 6DC6. I tried numerous different bias and hookup configurations. Sorry for the long post.   Regards, Larry

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Date: Tue, 19 Apr 2016 22:37:15 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Interesting Radio

> http://huntsville.craigslist.org/ [etc.]

Why do some of these myths persist? We have good, reliable test data on dozens to hundreds of receivers, which clearly show that many of the often-repeated claims about the 390A are ... well, let's just say ... exaggerated.

"The R390A/URR communications receiver also happens to be one of the quietest receivers if not the quietest ever built. It is capable of copying AM and CW signals all the way down to its -143db noise floor, all while maintaining the ability to operate in very strong and overloading signal environments and strong signal conditions..."

That is just not true. It's a great receiver, but the noise is (at best) 6dB worse than that (most examples give up another 5-10dB, or more, as you find them because the IF gain is set improperly), and the first mixer overloads way too early, making the overload and dynamic range performance far inferior to a great many other receivers. According to Rob Sherwood (and consistent with my measurements of properly operating 390As over nearly 4 decades), the
390A has a 20kHz (spacing) dynamic range of ~ 81dB, and a 2kHz (spacing) DR of ~ 79 dB, with a noise floor of -137dBm and 100kHz blocking of 130dB. Robust, high-DR commercial receivers have wide and narrow DRs in the 105-110dB range (that is, 25 or 30 dB better than the 390A) and blocking in the 140-155dB range (that is, 10-25dB better than

the 390A). State-of-the-art single-band receivers can do another 15dB better than these figures. <snip>

Date: Wed, 20 Apr 2016 09:20:47 -0500
From: Cecil Acuff <chacuff@cableone.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

Give a 6BZ6 a try in the RF amp....I see them used a lot.

Date: Thu, 21 Apr 2016 01:06:47 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

I noticed in my measurements that they were weak on 40 and 80 meters. That did not show up with the previous method used. The 7.9 mc problem was misalignment of Z213-1. How dumb. The fix for 3.7 mc was C237-2. So, here's my measurements before and after fix:.Before -0.9 mc: 0.47 μv, 3.7 mc: 1.2 μv, ?7.9 mc: 1.4 μv, 9.9 mc: .44 μv, 15.9 mc: 0.75 μv, 21.9 mc: 0.67 uv.After - -0.9 mc: 0.47 μv, 3.7 mc: 0.57 μv, 7.9 mc: 0.68 μv, 9.9 mc: 0.44 μv, 15.9 mc: 0.75 μv, 21.9 mc: 0.67 μv.

So, with the 6C4's, all the bands were above 2 microvolts for 10 db quieting and with the 6HA5's for the 1st and 2nd mixers, all the bands are below 0.75 uv. I think that is a significant difference. I think I'll keep 'em. SSB is now a joy to listen to.

Date: Thu, 21 Apr 2016 00:15:23 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

Thank you for having posted the results of your experiments. To my knowledge, this is the first time that someone tries to substitute the 6C4 mixer tubes of the R-390A for another type of triode. The results you report are interesting and can be explained by the higher (voltage gain) of the 6HA5's. They have a published value of 72 which is higher than the 19.5 of the 6C4.

Some may argue that this depend on the exact operating point for both tubes, but whatever, for the same operating condition, the ? of the 6HA5 will always be higher than the 6C4 one. The point here is if you increase the tube gain, it surely increases the conversion gain of the mixer at the same time, then the related increase in sensitivity you measured. I am just wondering if other frame grid triodes can behave the same (or better, who knows) like the 6GK5/6FQ5A, the 6HQ5 or the 6HM5 for example. It will be also very interesting to test the behavior of an EC91 (6AQ4) there....

Date: Thu, 21 Apr 2016 00:51:51 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

There was a series of articles quite some years ago, I think in Hollow State News, about replaced tube types in the first RF stage and mixer stages of the R-390A. In both places, the new tubes were of the frame grid types, which were not yet developed when the R-390A was designed. I don't remember if there were any measurements presented to quantify the increased performance, but I do remember claims of increased sensitivity or lower noise and increased dynamic range after the changes.

I also remember later articles with the opinion that the improvements did not warrant the work to implement them, especially considering the fine performance of the receiver as designed, and the rareness of conditions where the improvements would make any real difference in actual performance.

I'd be glad to hear if anyone has the references. Unfortunately I don't have access to the articles now.

Date: Wed, 20 Apr 2016 22:59:57 -0700
From: Renee K6FSB <k6fsb.1@gmail.com>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

There is one article in ER #26 by Ray Osterwald dealing with RF and mixers... I have the article and when I return home, scan and hopefully send to all as a pdf.

Date: Thu, 21 Apr 2016 08:05:01 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

Thanks Roy. I certainly agree about hacking up a perfectly good (or not even a perfect one) to do this kind of thing. I thought about it for 2 seconds, then threw that out the window. That's why when I found the parts that I needed to make a plug in tube adapter, I chose this route. My motivation is pretty basic - in my previous homes I could put up antennas that could pull in the weak stations quite well. I'm not so lucky here. But, this is a real step in the right direction - my reception is much better than it was last week. It's almost great.

Date: Thu, 21 Apr 2016 08:47:24 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer, 6GU5 RF amp

Hi Jacques, What I found with the 6HA5's is what you were saying about the affect of noise and gain. I intentionally reduced their gain in different amounts and different ways to determine the affect on the noise level. It's a close ratio - reduce the gain in any way and the effectiveness of noise reduction is reduced by about the same amount. I ended up using them at their normal gain and reducing the gain of the IF deck to compensate for it. So far I don't see any negative effects. Each 6HA5 increases the no antenna noise level by about ?8 db. I thought this might be a problem, but it's not so far.

The reason I chose the 6HA5 is that I had a few of them and from what I read they were a good bet to try. Unfortunately, I don't have any of the others that you mentioned.

Date: Sat, 23 Apr 2016 01:51:57 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

Hi all, Here's a link to a picture of the unit I constructed and the schematic of the adapter. http://s31.postimg.org/pywspdfgr/IMG_7165s.jpg
http://s31.postimg.org/xwkiak4nf/IMG_7168s.jpg
I have an extra one, so if someone would like to try it, I'll send it to you for postage. I only ask that you take measurements before and after and post the results here. If interested, please contact me offline.

Date: Fri, 13 May 2016 03:22:08 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

I've been playing around with this for a few months and in my original post on 4-19-16 I let you know that replacing the 1st and 2nd mixers with 6HA5's was a very noticeable improvement in weak signal and SSB reception. I knew that Ray Osterwald had written an article on this subject, but could not find a copy of it.

Renée, K6FSB, graciously offer to send me a copy of it (Part Three - 'The Competition Grade R-390A') from ER #26. Thank you very much Renée. I also thank Perry Sandeen for the schematics he sent to me on this subject. All have been very helpful.

After reading it, I realized that trying the 3rd mixer also would probably be worth while. And, I am here to tell you, at my surprise, that it was. The level required to produce 10 db of quieting is much more difficult than the usual 10 db s/n + n (this rx before using 6HA5's, the average uv level for 10 db s/n + n was 0.7 uv). The same rx with 6C4's had an average µv level required to produce 10 db of quieting was 2.4 µv. That's a huge difference in measurement methodology. Here's my results for 10 db of quieting while using a 6HA5 for the 1st & 2nd mixers and then for all 3 mixers:.

1st and 2nd mixers:
  .9mc: .64uv, 3.9mc: .95uv, 7.9mc: 1.0uv, 9.9mc: .78uv, 15.9mc: .90uv, 21.9mc: 1.0uv.
All 3 mixers:
  .9mc: .47uv, 3.9mc: .70uv, 7.9mc: .63uv, 9.9mc: .57uv, 15.9mc: .35uv, 21.9mc: .70uv.

As you can see, there is substantial improvement in the measurements using 6HA5's in all three mixers. And yes, I can tell the difference when listening to both AM and SSB. My antennas are not the quietest, but I can tell the difference.

Date: Sun, 15 May 2016 04:02:18 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

I mentioned in my original post on 4-19-16 that with 6HA5's in the 1st and 2nd mixer places, the usual sensitivity measurement (S+N/N) nolonger worked. This was only a problem in MGC mode. Well, here's what happened. The gain of the 6HA5 is considerably more than a 6C4, so when 2 or 3 6HA5's are used, the signal level at the 4th IF is way too high (even with the IF gain turned all the way down). This causes the 4th IF to go into saturation way too early and turn into a limiter (thus reducing the audio output and the ability to obtain a 10 db increase in S+N for the measurement. The solution I chose is to reduce the gain of the 2nd IF by adding an 18K ohm res in the cathode circuit unbypassed. This reduced the overall gain to where the usual sensitivity measurement (S+N/N) now works. This also makes it easy to set the overall gain to 1uv input = 7v on diode load. All is now good again. The only measurement I've made so far is on 9.9 mh and it's 0.65 uv. The measurement on 9.9 mh with the 3 - 6C4's using this method was 1.5 uv. I'll report more measurements once completed.

I tried numerous different ways to reduce the gain of the 6HA5's, but could not find a way without eliminating the gain in S/N ratio they provided.

Date: Sun, 15 May 2016 08:32:58 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

Any time you increase the gain of the front end stage(s) in a radio, you will degrade it’s overload performance. The IM2, IM3, and blocking numbers all will get worse. The real way to drop in the 6HA5’s would be to re-wind the IF coils to a lower inductance / lower impedance.

That way the gain would stay the same and the noise figure would not be impacted (much). Next step would be to take a look at issues like AGC and it's "taper". Mixers generally aren't a big deal there. RF stages (when swapped) generally are.

Date: Sun, 15 May 2016 09:14:22 -0400
From: "Jim" <Jbrannig@verizon.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

Years ago I changed the mixers in a 75A3. The results were less than satisfactory. The lesson I drew from it was that disturbing the gain distribution of the radio led to poor results. Unless one is prepared to completely redesign the signal path, they are best left alone.

Date: Wed, 18 May 2016 01:10:57 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] 6HA5 Mods.

The problem isn't in using the 6AH5 tubes.

You have an AGC problem. If you look at past postings and the Y2KR3 manual, you will find that the best solution is wholesale replacement, no matter what ohmage reading you get.

Botton Line. The AGC circuit is usually a PITA. Trying one or two caps here or there will leave you wanting to watch a Howdy Doodie re-re-run.

Date: Mon, 20 Jun 2016 23:42:50 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer

In one of my previous posts on this subject I let you know that the additional gain of the three 6HA5 mixers is too much and that the IF gain adjust could not compensate for it. The higher gain does not allow the normal S/N measurement (in MGC mode) to work correctly. The 4th IF is being swamped and turned into a limiter. I've also discovered that it could adversely affect the operation of the filters. In order to adjust for this, the gain must be reduced at the 1st IF stage. I tried a few different circuits, but nothing worked until I tried a simple cathode follower. It uses a 6C4. Here's a link to the diagram:

https://s31.postimg.org/xn1tybe8r/IMG_7219s.jpg

My 1st iteration of this circuit did not include the 18k resistor on the output. What I found is that tuning the input of the filters was not effective because of the low impedance on the output of the circuit. Now they tune well. The sensitivity measurements are still very good.

I've been using the 3 6HA5 mixers with this 'gain reducer adapter' for a few weeks now, and it's working quite well. The IF gain adjust provides very good adjustment range and the traditional S/N measurement is working correctly.

Date: Tue, 21 Jun 2016 05:31:28 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: [R-390] R-390A actual S/N measurement values

I've know for a very long time that the balanced input impedance of the R-390A is around 125 ohms and varies depending on frequency. Thus an impedance adapter is required when doing sensitivity measurements so that the meter on the signal generator will read the correct value. The adapter specified in the TM11-5820-358-35 Army tech manual is the DA-121/u that is part of the MK-288/URM maintenance kit. It is a 68 ohm resistor across the signal line to ground and a 100 ohm resistor is then in series with the signal line to the RX. This 'L' pad approach helps keep the load on the signal generator close to the required 50 ohms for reading correctness for different frequencies. Although not quite perfect, it does reduce the impedance mismatch good enough for close readings.

However, anytime a resistor is placed in series in the signal line, loss will occur. In this case it is about 55% (about 9.1 db). So, I've not seen anything about adjusting the sensitivity numbers to account for this loss. When using this adapter, if your reading is 2 uv, then the real sensitivity is less than 1 uv. Is this not important? Comments please.

As a test, I made a simpler adapter, an 82 ohm resistor across the signal to ground. 125 ohms and this also makes the impedance of 50 ohms, but with no loss. It seems to work quite well as the readings I get on it are the same as the DA-121 'L' pad after mathematical adjustment.

Date: Wed, 22 Jun 2016 03:07:16 +0000 (UTC)
From: Larry H <dinlarh@att.net>
To: R-390 Forum <r-390@mailman.qth.net>
Subject: [R-390] R-390A IF gain setting and S/N measurement reading

We have heard for a long time that the optimum setting for the IF gain is important for correct operation and good S/N measurement. The doc I've seen says that 150 uv input to the IF deck should create -7 volts on the 'diode load' point in MGC mode. And that 1 to 4 uv input to the balanced antenna connection should result in the same -7 volts. No problem for a correctly operating R-390A.

Now during my recent 6HA5 mixer testing I did a lot of S/N measuring and discovered something very interesting about the IF gain setting. With no changes to the RX, except for adjusting the IF gain, the S/N measurement readings are better with the IF gain reduced. And this is not just a trivial amount either, it varied from .4 uv to .9 uv (while keeping the IF gain in a reasonable usable point (IE: not at all close to the extremes)). This happens on both of my R-390As.

I believe that the real S/N of an RX is determined by the first 4 or 5 tubes and circuits in the RX, and those after that point really don't affect it (if they are working correctly).   Since the IF gain is in the 7th stage of the RX (3rd stage of IF), changing it should not affect the real S/N. I have no way to measure it's real affect, but I don't hear any difference.

So why does it make a difference in the measurement? And do we really need to consider S/N when setting it?

Date: Wed, 22 Jun 2016 02:28:04 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

>I believe that the real S/N of an RX is determined by the first 4 or 5 tubes...
I
t should darn well be dominated by the first stage. (Note that "dominated" does not quite mean "determined exclusively by," although in a well-designed receiver the subsequent stages should contribute only minimally.) There are two provisos:

First, radios have sections and stages with different bandwidths. If a narrow BW stage is followed by a wider BW stage, the later (wider) stage may dominate the noise in the portion of the passband outside the narrow passband of the earlier stage. This is not generally an issue in well-designed receivers, because the progression of bandwidths is like a funnel -- it should get narrower as the signal proceeds through the receiver.

Second, in recievers that apply AGC to both RF and IF stages, the gain distribution may change dramatically from weak-signal to strong-signal conditions. Again, in a well designed receiver, this should not be an issue -- but there are LOTS of receivers that do not get this right. Setting the IF gain of a 390/390A is a necessary step in ensuring this balance is right in terms of both overall S/N and overload performance (as you have found).

>   So why does it make a difference in the measurement? And do we really need to consider S/N when setting it?

Yes, for the reason noted above. It is critical to ensure that the gain distribution is correct for best overall S/N and best overload performance.

Note that you keep changing things and comparing apples to oranges. As long as there is enough gain everywhere (and there is, in a 390/390A with all original tubes -- even with thoroughly whipped tubes that test "bad," except in the case of a completely dead first RF amp), you cannot change the overall DR by any significant amount by adding gain to any RF or IF stage(s). All you can do is trade off low signal S/N against strong signal overload performance. The DR remains stubbornly the same. If you change tubes and then adjust the stage or section gains so that the overload point is where it was (in a properly operating, properly adjusted receiver), the S/N will be within experimental error of where it was with the factory setup. You're right back where you started. Any difference in S/N you can accomplish by swapping tubes (with its tradeoff in overload performance), you can also accomplish much more easily simply by tweaking the IF gain control. If you think you have a good reason for striking a different balance than the Collins engineers struck, then have at it. I have played that game, and always come back to the factory setup.

Date: Wed, 22 Jun 2016 10:18:57 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

Thank you Charles - very good information. I reread my post and I can see that I did not convey one of my questions clearly.

> Any difference in S/N you can accomplish ....

The question had to do with measuring the S/N. I tried to say that the 'measured' S/N changes depending on the setting of the IF gain, but that the IF gain control is way past the point where it could affect the 'real' S/N (as that is determined in the first few stages). So what causes the 'measured' S/N to appear to change? This happens in both of my 390As, of which one is kept vanilla. So, adjusting the IF gain a little one way or another is not really changing the 'real' S/N of the RX, but it does change the measured S/N. What I am trying to understand is what is causing the measured S/N to change? I have an idea that in MGC mode with the lower IF gain, the audio gain must be set higher to set the db starting point for getting the 10 db increase. This higher audio gain is causing the 10 db gain to be obtained with less RF signal input (therefore resulting in a lower measured S/N). I would just like to know if I'm on the right track on this question.

Date: Wed, 22 Jun 2016 12:49:53 +0000
From: Bill Kulze <wak9@cornell.edu>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

One method I have used which gives me a visual aid in setting optimal gain is that I connect the IF output to an SDR. I turn off the AGC in the SDR so I'm getting the straight IF signal. As you adjust you can see a point where the noise floor jumps right up where you don't want it. You can set it so that you can maximize the difference between the noise floor and the signal peak. You can even get a rough idea of how many db that is.

I've also used that setup doing all of the RF sections also.

Date: Wed, 22 Jun 2016 08:59:01 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

> The question had to do with measuring the S/N. ....

The S/N is only "determined" by the first stage IF THE GAIN DISTRIBUTION OF THE RECEIVER IS OPTIMIZED (see my previous post re: "determined" vs.
"dominated").

The 390/390A IF gain adjustment has sufficient range to seriously de-optimize the gain distribution of the receiver, in which case the first stage (or even the whole RF section) will NOT necessarily dominate the noise performance. You *are* measuring the real S/N of the radio in that configuration, but if the IF gain is set incorrectly the configuration isn't a useful one for other reasons (typically, because you have made the receiver's overload performance worse by several tens of dB).

Fully 50% of the 390As I've seen have had the IF gain set WAY too high by owners or techs seeking outrageous (and unnecessary) sensitivity numbers and thinking they were smarter than the Collins engineers. It should be a rule that after adjusting the IF gain, 390/390A owners and techs must take the radios to Europe and try listening to the 40/41 meter bands on a good antenna.

Date: Wed, 22 Jun 2016 18:29:54 +0000
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

It's been stated many times by Roger Ruszkowski - who ought to know - that the 150uV/7V IF gain spec in the manual is far above the gain that yields best S/N. (My radio agrees.) Were those over-hot IF's simply following the manual, or were they cranked even higher?

Date: Wed, 22 Jun 2016 16:48:16 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

> It's been stated many times by Roger Ruszkowski - who ought to know - that the 150uV/7V IF gain spec in the manual is far above the gain that yields best S/N. (My radio agrees.) Were those over-hot IF's simply following the manual, or were they cranked even higher?

I concur with Roger that 150uV/7v is too hot. However, you can't back the IF gain all the way down to the point that maximizes S/N without also compromising the overload performance of the receiver. This is because the stage that overloads first is upstream of the IF. If you set the IF gain lower, the AGC just cranks up the overall gain to compensate. This means that the RF gain runs higher and, therefore, that the mixer overloads on weaker signals than it did before the IF gain was lowered. Since the 390/390A front end is prone to overload to begin with (despite what sellers say in their ebay listings), you don't want to compromise its overload performance any more than absolutely necessary.

This is the art of balancing a radio's DR -- to get it sensitive enough that the practical limit is always atmospheric noise coming in on the antenna, never the front end's self-noise, while keeping the overload point as high as possible. This is the fallacy of pursuing maximum S/N and sensitivity -- you throw away overload performance that you desperately need, to gain sensitivity that is useless in practice because the atmospheric noise was already 10-30dB louder than the radio's own input noise.

Once some basic design choices are made -- in particular, the number and general type of active devices and the impedance levels of the plate loads and tuned circuits -- the best possible DR has been preordained. All you can do beyond that is (i) make sure you actually get the best possible DR out of the parts (i.e., make no design blunders), and (ii) slide the DR up and down the input signal range to optimize the tradeoff between weak-signal and strong-signal performance.

In the real world of antennas, QRN, and QRM, there really isn't much room for debate about what constitutes the best compromise for any particular value of DR the radio has. And to change DR, you need to change some really fundamental things about the topology you are using, such as the impedance levels and standing current at each stage. As Larry is finding, simply changing the stage gains by using different tubes doesn't buy you anything if the radio was well designed in the first place. After you adjust everything so it works again, you're right back where you started -- at the limits of the fundamental circuit elements and stage impedances the original designers chose.

I once spent a few days with several 390s and 390As, a suite of signal generators and combiners, a spectrum analyzer, and a distortion analyzer to determine the optimum IF gain. I can't find my notes right now, but I do recall it was less than the Collins spec but not by all that much.

As to the IF gain settings I've observed in radios "as found," it appears that once someone gets it into their head that more IF gain is a Good Idea, they are not bound by any sense of moderation. The ones I've found with too-high IF gain are generally 6 to 20dB higher than 150uV/7v. I'd be interested to know how a radio set up according to Roger's "alternate procedure" compares to the "by the book" 150uV/7v with respect to input level and AGC voltage -- just how much lower is the IF gain? Has anyone checked this after performing the alternate
procedure?

Date: Wed, 22 Jun 2016 21:05:12 +0000
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

Thanks, Charles. I think your post (below) should go in the next Pearls. If you ever find those notes and post them, I will read with great interest.

My own radio is adjusted for maximum S/N and I'd love to measure the IF gain, but by the time I get around to it the topic will be dead. Surely someone else has fewer projects in the pipeline. You have me thinking of resetting it to stock. With all the QRM in my area, receiver noise is the least of my worries!

Date: Wed, 22 Jun 2016 14:30:55 -0700
From: "Craig" <hamfish@comcast.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

Great reading! This is stuff worth printing and keeping inside the three ring binder with the rest of the Y2K. As David Wise commented, QRM/Part 15 RFI makes some of this discussion interesting. At this QTH the plasma TV's rule!
Many thanks on the theory of how it all works.

Date: Wed, 22 Jun 2016 23:59:00 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

When I adjust the IF gain, I initially set it for the 150uv/7v level. Then I verify that the AGC is working correctly by injecting a small signal (with no modulation) in the antenna and increasing it until the AGC voltage just starts to move the c/l meter. At this point the RX noise should have mostly diminished. If not, reduce gain and check. If the gain needs to be reduced too much, something is wrong in the AGC. I then check for signal overload by increasing the the sig gen output in steps up to 0.1v with modulation while scoping the audio output. If the c/l meter is not close to max, something is wrong.

This is all pretty straight forward in AGC mode, but we make our sensitivity checks in MGC. When reducing the IF gain in AGC mode to produce good quieting on weak signals, I noticed that the S/N measurement in MGC mode improved. I still do not know why this is happening because the IF gain adjust is way past any point where it should affect the real S/N in MGC mode.

Date: Wed, 22 Jun 2016 22:17:55 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

> When reducing the IF gain in AGC mode ....

That is exactly Roger's point about the "book" setting of the IF gain control. It is high enough that the RF stages do not clearly dominate the noise figure when the receiver gain is wide open. Thus, reducing the IF gain actually does improve the overall S/N.

HOWEVER, see below and my previous message re: atmospheric noise. For the reasons given, you DO NOT want to reduce the IF gain too much or you will lose DR on strong signals without any gain, in practice, with respect to weak signals.

This gets complex, because the 390/390A has more gain-controlled stages than many boatanchors and also has staged AGC ("delayed AGC"), where some stages get a fair amount of gain reduction before other stages get any at all. So, the stage-by-stage gain distribution changes in a complex way with both manual and automatic gain reduction, by design. Presumably, the stage that dominates the noise figure also changes in a complex way with both manual and automatic gain reduction. As ever, the goal is to keep both ends of the DR positioned for the best performance compromise, at all input signal levels.

Bottom line -- beware of setting the IF gain for "best S/N" or "maximum sensitivity," because doing so tends to sacrifice strong signal performance -- which is already a weak point with the 390/390A. As I noted before, what you gain in S/N for the weakest signals on the bench is meaningless, because in actual use the receiver noise is swamped by atmospheric noise. (If you operate exclusively above 20MHz, there may be a case for re-thinking the optimum IF gain because the band noise is much lower than at 20 meters and below.)

Date: Sat, 25 Jun 2016 22:10:00 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

It is definitely bad to set the IF gain too high to chase after the mostly irrelevant super-high sensitivity. We are talking about the HF band here, not chasing jansky's (Jy) for a radio-telescope. You will get much more bang for the buck with reducing system noise due to using too much stage gain, tube (and thermal) noises and gain balance. Put a R-390A in a Faraday cage and find out how much internal noise the radio makes all by itself.

I chased low noise in the R-390A for several years with all sorts of things like component and tube swaps, shielding and filtering. I picked up about 2 dB of S/N improvement but it was not consistent from radio to radio (I have a couple of them). For "that" type of monitoring I ended up with completely different receivers that are not nearly as much fun as an R-390A.

Now I just listen to them.

Date: Fri, 15 Jul 2016 03:40:53 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

Thanks for all your great input. It has been very helpful. This has prompted me to read through the Pearls and Y2KR3 again this past few weeks looking for an alternate and/or a more precise way to set the IF gain. I always thought that the 150uv/-7v setting was a little high, but not sure how much. And, I knew that setting it too low was not good either. And, thanks to Charles Steinmetz, I now know that too low negatively affects its Dynamic Range.

So, here's what I found:

1. A procedure by Chuck Rippel says to set it between -4 to -7 db on the line meter on RF noise (no antenna).

2. A lot folks agree that the 150uv/-7v setting was a little high.

3. A lot folks agree that keeping the gain as low as possible (bot not too low) improves the S/N.

4. A few folks agree that setting it too low negatively affects its Dynamic Range.

I found a lot of good info written by Roger Ruskowski, but it was mostly on how to measure RF and IF/audio for 30:1 and how to get there, but nothing on how to set the IF gain more accurately.

I found some very helpful info by Dallas Lankford, but there again nothing on how to set the IF gain.

Did I miss finding on how to set it?

My tech manual says that after setting it for 150uv/-7v, and if 1 to 4 uv input to the balanced input yields -7v on the diode load, that is good, leave it.

I like Chuck's setting in 1 above, as that seems to be fairly close. IE, a little less gain than the above 150uv/-7v book setting. But that's a wide range and this is affected by the quality of the RF deck.

Because the above are too granular, what I'm looking for is something like this:

'If the S/N is OK, then set the IF gain for -7v with @ 2uv average input to RF balanced connection (with the sig gen impedance matched, of course)'.

Does this sound fairly close?

What I'm 'feeling' is that 2uv might be the sweat spot - this would yield a good balance between DR and S/N.

I do not know how to tell when the DR is being negatively affected. How can I tell? I assume this is about keeping distortion to a minimum on strong signals. Can this be easily measured? Comments please. Regards, Larry

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Date: Fri, 15 Jul 2016 10:51:13 +0000 (UTC)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

The way I do it is to find a weak signal and optimize the setting for copy on the signal.? This may seem crude but it works well for me and matches the intention of the optimization, to be able to copy weak signals. For example, tune into R. Australia on 17480, and adjust the IF gain for best copy. You mileage may vary. Tom N5OFF

Date: Tue, 9 Aug 2016 04:32:47 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: R-390A s/n improvement 6HA5 mixer - CONCLUSION

While testing and measuring the results of this mixer test, I wanted to find a more precise way to adjust the IF gain for optimum performance, as it affects the S/N more than I suspected. More on this in a later post.

I spent a few days reading through the Pearls and Y2KR3 and found a couple posts by Roger Ruszkowski on how to improve the S/N by rating the noise level (merit) of tubes. I have known for a long time that tubes could be noisy and that one should swap some to find the best. Well, what I was doing was too subjective and really did not accomplish much. After I read Roger's write up on how to actually measure the noise 'merit' of a tube, and putting it into practice in one of my 390As, I was able to improve the S/N on it using 6C4 mixers from an average of 1.9 uv to an average of about 0.5 uv.

In order to accomplish this, I had to use a lot of 6C4's (14), 5 6DC6's, and 13 5749's. I started by getting the IF and AF to meet Roger's 30 db modulation on/off test described in the Y2KR3 manual. I was not able to get to 30, but did get to 29. I then went to work on the overall S/N. I started with the spare tubes I had, but that did not work well enough (I only got it down to 1.1 uv). I had to buy more and pull the ones in use in my other 390A and even my SX-111A. I had the most trouble finding quiet 6C4's, but finally did. Here's my S/N results:

MHz: 1.9, 3.9, 7.9, 9.9, 15.9, 21.9
UV: 0.36, 0.42, 0.35, 0.42, 0.54, 0.68

Because I was able to acheive a good S/N level, I wanted to see if using a 6HA5 as a mixer would improve these numbers any. I know that with this level of S/N, improving it does not improve weak signal reception, but just wanted to see. I put one in the 2nd mixer and realigned. Well, it did improve the S/N, but only very little, about 14%. I put the 6C4 (my best 1) back in.

At this point, I thought I'd see if it would meet Roger's end-to-end 30 db modulation on/off test described in the Y2KR3 manual. Well, it does not quite. I only got it to 26 db. But, the performance is good enough for me, so I'm not going to pursue it.

When I'm listening to SSB, I prefer not to hear tube noise between sentences. On my 390A, it needs to have a low S/N (about 0.5 uv) and sensitivity of 1 uv for -7 v on diode load in order to accomplish that. Now it does and my SSB reception is good (without using 6HA5s). And, when listening to AM that fades almost all the way out, I no longer get that annoying hissing noise during the fade. This low S/N is real nice in these 2 areas.

As a further test, I transplanted some of the tubes from this 390A into my other 1 and got similar results. The S/N on it went from average of 1.8 uv to 0.51 uv. Now I know it's S/N problem is also tubes.

In conclusion, I'm glad I looked at using the 6HA5 as a mixer. It forced me to determine the real problem with its poor S/N. Most, but not all of it was due to the 6C4's. Now my big problem is what to do about my other 390A and my
SX-111A, since I took the quiet tubes out of them. I think I'll put 6HA5 mixers in my other 390A until I can find some more low noise 6C4's.

Date: Tue, 9 Aug 2016 5:05:28 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] RF deck

Larry, I did inject RF [17mc] at E 209. And also varied it from 17.5 to 25 and seeing some reception of the generator signal. So I peaked some of the RF transformers. Next I put the gen on 7mc and tuned the receiver also to 7mc and heard it! Quite weak, but I did receive it. So I put the wire ant on, and I did get a strong SW signal at 7.365mc. I went to another receiver to be sure I was not getting an image or birdie. So it is working. But sensitivity is very poor. One of the cans in the 17.5 to 25mc area did not seem to peak, so we will investigate that. Russ.

Date: Tue, 9 Aug 2016 10:12:02 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] RF deck

Hi Russ, Sounds like good progress. Getting all 3 variable IF's on the 1st mixer to align correctly is very important. One not being correct will give very weak reception below 8mh. That can that did not peak is probably a big problem. I think you have found a major culprit. Good work.

Date: Tue, 9 Aug 2016 15:33:38 +0000 (UTC)
From: Norman Ryan <nnryann@yahoo.com>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer - CONCLUSION

I'm intrigued by this tube noise issue and have contemplated swapping tubes for obtaining optimal s/n as you have done. I wonder, does the tube have to be thoroughly warmed up ? Would its noise characteristic change for the better (or worse) if the tube were allowed to burn in overnight in the receiver?

Taking a bunch of tubes (32 in your case) and waiting for each to warm up to fully operational condition before measuring s/n would take an inordinate amount of time. To be sure, a fair assessment of each tube for comparison purposes can be obtained by subjecting each candidate tube to an identical brief (say, five minutes) warmup.

I still wonder if performance changes measurably when the receiver is left on overnight so as to let the tube under consideration fully optimize. The differences you note among all those tubes are striking -- I had no idea the s/n of good testing tubes could vary so much. Many thanks for all your work and for sharing your findings with the group.

Date: Tue, 9 Aug 2016 20:23:25 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A s/n improvement 6HA5 mixer - CONCLUSION

Hi Norman, That's an excellent question and one I should have addressed. I thought about it during my tests, but forgot to mention it in my post. Thanks for asking. I let all the tubes warm up for 5 minutes or more during the rating. I know that's not much, but after rating each tube and using them in an appropriate location, my S/N did not change any measurable amount after 12 hours and 24 hours. I do not know if the tubes I did not use would improve if baked in. There is certainly that chance. ?In Roger's write ups, he did mention that SOMETIMES a used tube would have a better 'merit' than a new one, but that just might have been that way even when new.

As I was rating the noise merit of each tube, I was also rating the gain of each one. I measured the diode load voltage with 1 uv input. As you would expect, I found differences there as well and recorded the merit and gain on each tube. I then went through them and selected the lowest noise with best gain, always weighting the noise as the most important. As Roger stated: low noise and low gain is not of any benefit. The tubes must have reasonable gain. I drew the line at about 90% of maximum measured with this method.   Regards, Larry

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Date: Wed, 10 Aug 2016 19:51:40 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] 390A- sn ratio- same contract

Guys, I was amazed to learn the thread on the 6HA5 was done on a 58 contract Motorola, same as mine with the RF deck problem, small world...73s Russ.

Date: Thu, 11 Aug 2016 03:51:19 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

As you know, I used Roger Ruszkowski's procedure to rate tubes for noise and gain and improve one of my 390As S/N (to an average of .5 uv) and good sensitivity. See details in my previous post subj: 'Re: [R-390] R-390A s/n improvement 6HA5 mixer - CONCLUSION' on Aug 8 at 9:35 PM. I found this procedure while on my hunt through the 'Pearls' and 'Y2KR3' manual for information on how to set the IF gain a little more precisely than commonly known (1. 'not too high and not too low' and 2. Chuck Rippel's '-4 to -7 db on RF noise' and 3. that -7 v on diode load with 150 uv IF in is too high). I didn't find my answer, but found info that helped me understand it.

We've been told that if the IF gain is turned too high the S/N is negatively affected and that if we turn it too low the Dynamic Range is negatively affected. I believe that we all understand S/N, but why is DR important. It is the ability of the rx to handle very strong signals without distortion (Intermodulation and others). This is important when you are trying to receive that very strong signal and want minimum distortion. This is where the IF gain comes in. RXs with a high DR receive weak and strong signals well. In order to receive a very strong signal, the AGC must be working correctly. I use two tests to see if it is:

1. Apply an unmodulated signal to the balanced antenna in starting at 1 uv and step it up by 10 while watching the c/l meter and measuring the AGC on terminal 3/4. At 100,000 uv in, the c/l meter should be close to max (not real important) and the agc v should be around -15 or -16 (important).

2. Turn the modulation on and scope the line out. There should be no audio distortion at any sig gen level up to and including .1 volt.

If I could test for InterModulation Distortion (IMD), I would, but don't have the equipment. However, if your rx is in good condition (no weak tubes in the RF path, resistors, caps and tuned circuits are good), then IMD should not be a problem as long as the AGC is good.

I wanted to understand the affect of adjusting the IF gain, so while I was stepping up the RF sig gen level, I recorded the AGC voltage with the gain set to min, center, and max. Here's the results:

RF in Uv:	1	10	100	1,000	10,000	100,000
min:	0	2.3	5.4	9.2	12.4	16.1
ctr:	0	3.0	6.0	9.7	12.9	16.8
max:	0	5.0	7.9	11.2	14.2	17.5

I scoped the line out while doing this and found no audio distortion on any setting. I then measured the Diode Load on min and 3/4 max for -7 v and the RF in was 1.7 uv to .11 uv, with .8 uv with the adjustment in the center. Notice I stopped at 3/4 max. This is because when I went past 3/4 max, the noise was obviously overwhelming. This is the point that is obviously too high.
Now for the affect on 'MEASURED' S/N:

min: 0.39, center: 0.54, 3/4 max: 0.68

I call it 'measured' S/N, because this does not agree with what I see on my scope. I could not hear any difference in S/N when I adjusted the IF gain from min to 3/4 max, so I thought I'd see if I could see a difference on my scope. I injected a low level modulated signal into the balance input and set it so I could see about 1/3 noise on the modulated signal. This turned out to be .7 uv. I then slowly adjusted the IF gain from min to 3/4 max while watching the scope. Well, surprise - the noise on the signal did not change any, and it would have been easy to see if it did. I proved this by turning the gain up past 3/4 and did see increased noise.

So here's my conclusion: Find the noise threshold and keep it below that. I could not tell if the DR was hampered in min or not, but I did not see any signs of it while testing or in real listening conditions. I think you should try setting the gain for 1 uv RF in = -7 v on diode load and keep it below the noise threshold in any case.   Regards, Larry

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From: Larry H <dinlarh@att.net>
To: R-390 Forum <r-390@mailman.qth.net>
Sent: Thursday, July 14, 2016 8:40 PM
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement

Thanks for all your great input. It has been very helpful. This has prompted me to read through the Pearls and Y2KR3 again this past few weeks looking for an alternate and/or a more precise way to set the IF gain. I always thought that the 150uv/-7v setting was a little high, but not sure how much. And, I knew that setting it too low was not good either. And, thanks to Charles Steinmetz, I now know that too low negatively affects its Dynamic Range.

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Date: Wed, 17 Aug 2016 00:35:45 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A IF gain setting and S/N measurement - correction

In my previous post I reported some AGC measurements as follows:

RF in Uv:	1	10	100	1,000	10,000	100,000
min:	0	2.3	5.4	9.2	12.4	16.1
ctr:	0	3.0	6.0	9.7	12.9	16.8
max:	0	5.0	7.9	11.2	14.2	17.5

The agc voltages for the 1 uv level are wrong. It should read as follows:

RF in Uv:	1	10	100	1,000	10,000	100,000
min:	.20	2.3	5.4	9.2	12.4	16.1
ctr:	.20	3.0	6.0	9.7	12.9	16.8
max:	2.7	5.0	7.9	11.2	14.2	17.5

The 0.20 v in min and ctr do not affect the way the AGC operates, but the 2.7 v in max makes a big difference. The AGC in this rx is designed to delay the application of agc voltage to the rf amp, mixers, and IF amps in order amplify weak signals as much as possible to overcome the internal noise in it. Any voltage above .5 v will degrade its ability to keep the noise as low as possible on weak stations. You can of course reduce the RF gain to compensate for this, but that too degrades its ability to bring in weak stations as best it can. The RF gain can be turned down a little without much of an issue on weak stations, to around 9.

So, this is another reason to NOT turn the IF gain up too high. Interesting enough, the IF gain setting on my 390A needs to be lower for proper AGC operation than for the S/N threshold. I set my gain at about 5/8 from min and with 1 uv in = .3 v agc. This is working very well for AGC and S/N.

Date: Wed, 24 Aug 2016 03:17:43 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: [R-390] R-390A Alternate way to set IF Gain by Chuck Rippel in 1998

The following is the 'heart' of Chuck's original post on this subject:

From: crippel@...
Date: Mon Feb 2, 1998 5:35 am
Subject: [R-390] R-390A IF gain Setting Technique

Procedure to set R390A IF Gain - Alternate
Allow the receiver to warm up for at least 1 hour then:
? Disconnect the antenna
? Set receiver for 15.2 mHz
? Set the FUNCTION control to MGC
? Select the 4kc filter with the BANDWIDTH

? Set RF GAIN control to 10 or maximum
? Peak ANTENNA TRIM for maximum noise indicated on the LINE LEVEL meter
? Set Line Meter switch to -10db scale
? Set Line Gain control to full CW or 10.
? Adjust IF gain control, R-519 to cause Line Level meter
to indicate between -4 to -7 db.

End of Chuck's procedure.

Before I went through my RF deck and IF deck tubes and installed selected low noise and high gain rated correct tubes (as outlined by Roger Ruszkowski), I used Chuck's procedure to set the IF gain. It ended up at the -4 db reading, with the IF gain set at about 1/2. I felt that this was good (and it was) at the time.

Now with the correct low noise and high gain tubes installed and setting it at the -4 db reading, the IF gain is set at about 1/4. I'm sure that the difference is due to the tubes used, and of course a realignment was done due to the tube change (this had no affect).

However, because the antenna I'm using does not have much output on some bands, and the measurements I made a few weeks ago indicate a higher gain setting is not a problem, I set it at 1/2. This equals a +3 db level (switch on -10). I'm very pleased with the performance at this level.

Thanks Chuck and Roger!

Side note - I've found that in Chuck's procedure, as long as you can peak the 'ant trim', it does not make any difference in the measurement if the antenna is shorted, terminated, or open. regards, Larry
----
Date: Wed, 31 Aug 2016 19:10:12 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] Collins 390A

On to my next repair- low sensitivity on band 2 [1 to 2 mc] only one of 3 of the
Rf cans will peak. My question is- problem in the cans or below the chassis? --
Date: Wed, 31 Aug 2016 16:24:07 -0700
From: "Craig" <hamfish@comcast.net>
Subject: Re: [R-390] Collins 390A

The issues which I've had with low sensitivity in the RF cans was because

of
bad silver mica caps in the can. Symptoms were having to turn the
inductor
adjustment almost all the way down in travel (for any peak at all);
another
turn and it would of fell free from the rack. Running the receiver a week or two after the attempt, sensitivity that it did have, went south (again).

Shotgun the silver mica caps in that RF can. Don't forget a smidgen of DeOxit on the pins of said RF can.

Date: Wed, 31 Aug 2016 23:28:35 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Collins 390A

Hi Russ, It's probably in the cans. Switch the 2 identical ones and see if it moves, unless its the antenna can that's peeking.

Date: Sun, 4 Sep 2016 9:51:33 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] ferrite slugs

So guys, heres a double fix- Don sends me a rack with green slugs, so I can fix the 390A I stole the slugs from. OK-fine. So now I go back to the Collins 390A which has a poor sensitivity problem on 1 to 2mc. I try to make the peak adjustment, and I see that 2 of the slugs are cut off and sitting at the bottom of the coils. I had just pulled the 2 red ones from the original project that were incorrect. Got myself a magnet and pulled the cutoff slugs out of the Collins, put in the 2 from the Motorola, did the alignment and now running BC band with real good sensitivity. That's what I call a double fix! Got to get lucky once in a while-hi! 73s Russ. [thanks again Don!]

Date: Thu, 6 Oct 2016 17:49:21 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] sensitivity

Folks, recently I saw an ad for a piece of gear saying it had a sensitivity of 0.07uV. I might believe 0.1uV. Is noise a real issue down at that level thanks for your realistic input-hi. Russ.

Date: Thu, 6 Oct 2016 18:10:21 -0400
From: Nick England <navy.radio@gmail.com>
Subject: Re: [R-390] sensitivity

FWIW- At VLF it may be usable. Specs for the AN/BRR-3 receiver that was

used aboard subs.
14-30 kc CW & FSK   60, 20, 170 cps bandwidth
0.2 uv sensitivity for 0 error FSK
0.02uv sensitivity for CW

Date: Thu, 6 Oct 2016 18:16:17 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] sensitivity

You *always* have to check the bandwidth being used for the sensitivity claim. The numbers for something like a 10 Hz bandwidth (easy to do with DSP) will always be very different than the numbers for 100 Hz or 500 Hz.

Date: Thu, 6 Oct 2016 16:52:20 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] sensitivity

Here is the appropriate equation:

Sensitivity (dBm) = -174 dBm + NF (dB) + 10 log (BW) + required S/N ratio for detection.

So example, the NF of the total receiver is 10 dB and the BW is 1 kHz and desired S/N is 10 dB.

-174 +10 +30 dB +10 results in -124 dBm. Knowing -107 dBm is 1 uV, you can
find the equivalent value.

Date: Fri, 7 Oct 2016 13:06:09 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] sensitivity

So OK guys, the receiver in question is a Drake TR-7 and said having been checked for sensitivity on all bands as 0.07uV. So the tightest filter in this is 300hz. So now we are talking incredible receiver... right. I have my suspicions on that. Russ.

Date: Fri, 7 Oct 2016 13:38:06 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] sensitivity

Once you know the noise bandwidth of the filter, the next question is: what is the S/N ratio used for the sensitivity measurement. This one is a bit easier.
If I use 6 db and you use 20 db, my data will be 14 db better than yours.

A more rational way to measure sensitivity is to simply come up with the noise floor of the radio. If you express that in db above the KTB noise, you get easy to understand numbers. A radio at 3 db is 7 db more sensitive than a radio at 10 db. A radio at -1 db is physically impossible.

If you are dealing with an HF radio below 10 MHz, none of this is all that big a deal. Any time or place you would ever *use* the radio, the noise into any rational antenna is well above the KTB noise floor.

Date: Fri, 7 Oct 2016 13:46:30 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] sensitivity

>... sensitivity on all bands as .07uV. So the tightest filter in this
>is 300hz. So now we are talking incredible receiver right I have my
>suspicions on that.

Claims of receiver sensitivity very much below one microvolt should be regarded with suspicion. Some of the factors in making such measurements
are:

- actual input impedance of the receiver with respect to the test signal source impedance
- method of predicting the receiver input signal level
- possibility (likelihood!) of leakage in the test signal generation system at such low levels
- bandwidth of the receiving system
- overall measurement system quality and capability
- eagerness of the operator to proclaim astounding performance for his receiver.

I know a fellow who owns a Ferrari Testarosa automobile. I think it can go
nearly 200 miles per hours. He seldom gets a chance to do that.

Bob Camps just-posted comment relates directly:
"If you are dealing with an HF radio below 10 MHz, none of this is all that big a deal. Any time or place you would ever *use* the radio, the noise into any rational antenna is well above the KTB noise floor."

Now, I'm going to go refresh my memory about the meaning of "KTB nose floor".

Date: Fri, 7 Oct 2016 13:51:09 -0400

From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] sensitivity

Not really. 0.07uV is -130.1 dBm and for 10 dB S/N, the NF of the receiver would be 8.9 dB for a 300 Hz BW. Assume my arithmetic is ok, that is a reasonable set of numbers.

Date: Fri, 7 Oct 2016 15:26:22 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] sensitivity

K = a magic constant to make it all work
T = temperature
B = bandwidth of the noise

If you are at 25C you get one number, if you are at 25K (really cold) you get another number. Once you try to convert the noise power into volts, the resistance involved matters.

Date: Fri, 7 Oct 2016 17:01:48 -0400
From: "Lester Veenstra" <m0ycm@veenstras.com>
Subject: Re: [R-390] sensitivity

And in the beginning it was: 1.3806488 10-23 joule/K

Date: Fri, 7 Oct 2016 18:34:54 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] please help

OK guys, some years back I read someone quote a noise floor of -141 DB for a "golden" R-390A. Please, if someone would, convert that to microvolts. I think it was in ER magazine. I think they also quoted -139DB for 75A4. Then someone installed a 6GM6 in the 75A4 and it was now as good as the
R-390A.   Entertainment- HF is coming back to life, I have heard beacons on 10m for 3 days now! 73s Russ.

Date: Fri, 7 Oct 2016 19:39:53 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] please help

Back to the basics: Is it -141 dbm / sqrt (Hz) In that case it compares to a 50 ohm -174 dbm / sqrt(Hz) thermal noise level. Quick math would suggest a 33 db noise figure in that case.

Date: Fri, 7 Oct 2016 20:09:01 -0500

From: <wb5uom@hughes.net>
Subject: Re: [R-390] sensitivity

May I inquire if your statement is in reference to HF only or across the board on frequency (VHF / UHF) I mentioned a long time ago (and took some flack) that my R-390A as well as the Drake R8-B and the newer WinRadio G313i all go to the bottom of my Aeroflex 3920 in lsb/usb mode which is
-138Dbm. True its MDS ... but I am lucky to be out in the Country with an almost
nonexistent noise. With 350ft of wire in the air, if I turn off all other noise making devices (TV, A/C etc) since I have spent 31 years listening to a 1Khz test tone making me half deaf, with headphones, I can copy signal down in that region.

I use the Volmet station in Hawaii (6mhz and or 8mhz or 13 Mhz)and just wait
to see at what point can I hear and understand what is being said (since they broadcast at a predictable time all the time) I know - most on here do not like the MDS method of test. Just random comments -

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Date: Sat, 8 Oct 2016 12:22:18 -0400
From: "Bill Riches" <bill.riches@verizon.net>
Subject: Re: [R-390] please help

-141 dBm = 0.2 uv

Date: Sat, 8 Oct 2016 13:10:10 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] please help

I disagree... -141dBm is 0.02V in 50 ohms. If another receiver input impedance is specified, the related voltage will change accordingly.
I hope that all agrees that 0dBm equals 1 mW. I also doubt that a R-390 (A) input impedance gives 50 ohms at all frequencies, all the time... This is why some states a receiver sensitivity as being a number of EMF volts from a specified source Impedance (like 1V EMF in series with 50 ohms for 10dB of S+N/N), because this puts the receiver input impedance variations out of the picture.

Date: Sat, 8 Oct 2016 14:25:12 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] please help

So now we are back to the noise in what bandwidth issue. Since its a floor spec (not a sensitivity) you must get the noise bandwidth of the filter used.

Note that this is only the same as the 3db bandwidth if the filter has infinitely steep sides. For a normal filter, the noise bandwidth will always be larger than the 3db bandwidth.

Taking 50 ohms as the resistance (no, thats not correct, see the message below). You could be talking about a 0.2 uV sensitivity for a 20 db S/N ratio, if 0.02 uV is the floor (or total noise). That makes sense for a narrow filter, not much sense for a wide filter.

One thing that happens with all this stuff: People are not very careful about the
details. They grab a piece of gear, do a reading and go off and yack about the
result. 20 years later we still have the yack. None of the details have survived.
A signal generator that is *capable* of a 0.2 uV sensitivity measurement is a relatively rare bird. A cabling setup and bench that will do it is even more rare. Almost all of the errors are on one side of the measurement. 0.6 uV for real will come up as 0.2 uV as tested most of the time. There are very few ways for 0.1 uV for real to test out as 0.2 uV.

If you want to be king of the hill in a standard sensitivity measurement, the drop dead simple answer is still the same. Implement a 1 Hz wide filter. Your numbers will be 20 db (10:1) better than any poor idiot who is using a 100 Hz wide filter. As long as nobody come along with a 0.01 Hz wide filter, you will reign as king. Since an audio filter is just as good as an IF filter in this regard, its a sub $10 sort of thing to implement.

Date: Sun, 16 Oct 2016 18:40:21 -0400
From: "Bill Riches" <bill.riches@verizon.net>
Subject: [R-390] C327 checks

Checking out an R390a that had low intermittent sensitivity below 8 mhz.
Replaced C327 and sensitivity came up to less than 1 uv. Checking osc output at J221 as measured with 10 db probe and Tek 465 is now 28 vpp. Before changing C327 voltage varied between 5 to 15 vpp.

Checked out cap with a Sencore Z meter. Cap would change between 35 - 70
pf. Checked for leakage - 200 volts - no leakage however capacity read 105
pf after being zapped. A day later cap was varing as before. Zapped it again and 103 pf. Then sprayed freeze-spray on it and it went bad again. I
think the cap is faulty!

Date: Thu, 20 Oct 2016 05:22:07 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Receiver dust covers

I did notice less noise on my R388 with the top cover on. All the R388's I have are missing the bottom cover as well as almost all I've seen on Ebay. I don't know how much difference it makes with it missing but I suspect it may be substantial as the sectioned modules have many screw holes for fastening one down. Does anybody have experience do a shield-no shield test.

Date: Thu, 20 Oct 2016 09:28:05 -0400
From: Al Parker <anchor@ec.rr.com>
Subject: Re: [R-390] Receiver dust covers

I've had and/or worked on 6 or 8 R-388's, many (maybe most) did have the bottom cover, few had the top. IIRC, somewhere in the manual it says to do the alignment with the bottom cover on. I remember aligning one w/o the cover, then realized the mistake and did it right. Didn't compare performance before/after, but the re-alignment did require changes. I hope you and your wife are doing well out there on the left coast.

Date: Thu, 16 Feb 2017 23:36:44 -0600
From: Chuck Collins <chuckcollins@prodigy.net>
Subject: Re: [R-390] no receive below 8mc.

I gave up on this 3 months ago and sent it to Rick Mish – Miltronix Damn good job! At this point I can't really tell which is slightly better, the Kenwood R-5000 from 1992 or the Stewart-Warner R-390a from 32 years prior.Both are nice and they both have a certain place in the home.

Date: Wed, 5 Apr 2017 00:55:35 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: [R-390] Alternative tubes for R-390A 5749/6BA6 in 1st IF V501

Because I'm receiving a lot of stations/signals that are weak and have that annoying background hiss, I've been looking at ways to improve their reception. My previous post on 3-10-17 was about my pursuit of an improved RF amp, which was successful to some degree. Previously to that, I went through the tubes that I had on hand at that time and rated the 'merit' using Roger Ruszkowski's method described in the Y2KR3 doc. That provided some improvement, also. And, previously to that, I improved my antenna for a better s/n ratio. These actions have improved my reception quite a bit, but there is one more thing I'm going to try to do, improve the audio/IF s/n to the 30 db level. As of a few weeks ago it was at

28 db, according to Roger's procedure (which I believe is an excellent test).

I obtained some more 5749's, so I'll be rating them 1st. However, on my way to this point, I read something interesting about using alternative tubes for them. They have the 7BK basing diagram, but since pins 2 and 7 are connected together in the R-390A for V501 - V503, the tubes with the 7CM basing diagram will also plug in directly and work correctly. This opens the direct alternatives up to a few more tubes, and 2 have very good characteristics for improved operation, a 6BZ6 and a 6JH6 (the 1st, 2nd and 3rd IF must be a remote cutoff in order for the agc to work correctly). I did not try the 6GM6 because the cutoff for it is -15, and that is not close enough to the -20 of the 5749. These 2 tubes will also work in the 2nd and 3rd IF positions. So, here's the list of direct plug in substitutes that I came up with for V501, 2, and 3: 5749, 6660. 6BA6, 6BZ6, and 6JH6. Did I miss anything?

So I went through my new 5749's and rated them for merit. I found 2 that were better than the one I was using in V501. I also rated the 2 6BZ6's and the 1 6JH6, and found one 6BZ6 to have an even better merit. I've been using it for a couple weeks now, and it is an improvement, and I don't see any issues, yet. This did improve the audio/IF s/n to the 31 db level. My best 5749 improved it to 30 db. Success!

Roger - Thank you for documenting your procedures!
I've been working on improving my reception for more than a year now, inching my s/n down little by little. It started out at 1.2 uv as an average on most bands. The biggest improvement made was getting good 5749's in the IF strip, then the 6C4 mixers numerous months ago. These improved my average s/n to .5 uv. That brings you up to where I'm at now with the RF amp and the 1st IF improvements of the last couple weeks. My s/n is now 0.2 uv +/- 10% on most bands.

Now I know that a lot of folks are thinking - what's the point of a s/n that low, or really, I don't believe a number that low for an R-390A. Well, I've been measuring s/n for 55 years since electronics school, and I know the proper methods involved with getting it right. One thing I do is calibrate my URM-25D and 'line level meter' periodically with my HP 400FL AC RMS meter. As to the benefit of the low s/n, a lot of the usefulness deals with the s/n of the antenna and how quiet the bands are. I doubt that a very low s/n will make a difference on the bands below 23 mc where I'm located and with this antenna, but I can tell the difference on frequencies above 23 mc, as that is the point at which my antenna's noise is considerably reduced. And it is very low above 27 mc. I have no way to measure my actual improvement in reception for the last 2 weeks, but I usually listen off and on for most of the day every day, and this is the best it's been.

I know that we all know the importance of a low noise RF amp, but I did not think that the 1st IF was very important, but I guess it is. ?I've read through Rogers and others info many times, and did not get that impression. Now I know. Good listening to all.

Date: Thu, 6 Apr 2017 07:00:43 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] R-390A front end tubes

Thanks for the extensive article on tubes for the R 390A front end.
>From what I can discern, the RF section is set up for sharp cutoff pentodes. I wonder if the "A" would be any better by using a 6AK5 in the front end as Collins did on the R-388?

FWIW, Ray Osterwald (sp) ER radio editor created what he called "a competition grade" "A" using IIRC a 6HA5 triode in the front end but did have to change the bias. I have a copy of the article. If any wants one please email me off list and I send you a copy. IIRC its also in the Y2KR3 manual.

Date: Thu, 6 Apr 2017 07:42:54 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] R-390A front end tubes

I started doing this sort of thing on various radios back in the 1960's. While sensitivity is fairly easy to measure at the output of the radio, it's not always as easy to measure at the *input* of the radio. Shielding on the radio's input often is less than perfect (at least on the radios I've been able to afford). The same is true of signal generator shielding. The gotcha there is that 0.01 uv probably is 0.5uv of leakage past the shielding and 0.01 uv on the generator dial.

The next issue is overload performance. As you run up the gain on the front end of a radio, you hit the later stages a lot harder. Things like mixers don?t like that very much. Measuring that sort of thing was way beyond my abilities in the 60?s. For that matter it was way beyond my understanding. A decade or two later it was indeed all explained to me in a series of courses. It also became pretty easy to measure with the sort of gear I then had at work. The bottom line is that while it is not easy to measure, the impact is very real.

None of this says "don't do it". It's simply something to be careful of. You want to do it in a reversible fashion. It's also well worth checking the antenna system and possibly improving or repairing it. A preamp that properly matches the antenna (very high Z or very low Z) often is a reasonable alternative to modifying the radio.

Date: Thu, 6 Apr 2017 23:33:48 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A front end tubes

Hi Perry, Thanks for the offer on Ray Osterwald's article on "a competition grade" 390A. I have it and have studied it carefully and tried some of his implementations, but am not using any of them due to lack of benefit above what I accomplished with finding low noise tubes. The only non-standard tube I'm using is a 6BZ6 direct plug-in in the 1st IF. This only increased my gain by 6% in that stage, (nothing to be concerned about), but did improve my s/n.

Using a 6AK5 or 6HA5 would be a good choice for RF, but they are not direct plug-ins and I really don't need to or see any benefit to improving my 0.2 uv s/n any farther.

Date: Thu, 6 Apr 2017 23:38:31 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: Re: [R-390] R-390A front end tubes

Well there are always poor mods disasters, even from the OEM. Collins filter blocking cap and SP 600's BBOD's. The R-390A from ER magazine had proven results. In the last 50 years there hasn't been a tube radio that I couldn't make better. The simple explanation is that all these radios were built to a price point. Now with the modern components it is even easier to do.

For example:
On the SP 600's that I'm re-maning, I'm removing the two original filter chokes wired as a capacitor input configuration to a 1.5Hy Dynaco replacement followed by a 390uF/450V Nichicon rated for 10K hours at 105C. The following choke and cap are the same. The on line calculator said each cap and choke combo had 48 Db of suppression. The cost was about $60 but I wanted a bullet proof filter. One can also replace the original steel tube shields with IREC's if you can find them and are willing to pay the price. What's so good about this list is there various methods and opinions for making the BA's better. The best comment I heard was " There always better way of making anything except babies"

Date: Fri, 7 Apr 2017 00:17:51 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A front end tubes

Hi Bob, You bring up a very good point about problems one can have doing s/n testing at the RF input. That's why I like the URM-25D, they did a nice job preventing RF leakage from getting out and skewing the measurement (if it is working correctly). I had a different sig gen that was in a metal box, but it did leak RF a lot. It was not possible to get accurate readings at low levels with it.

So, just to be sure that my 25D is not leaking, I just tested it again. It's very easy to do - connect it up to your rx as for normal s/n testing with low output and center the frequency with the rx BFO. Now disconnect the coax and turn the rx volume up to where you can hear noise. Rock the rx tuning back and forth a little to determine if any signal is detected. If there is, your sig gen is leaking and if no signal is detected, it is not leaking. Now the second part - reconnect the coax and center the rx on the signal with the BFO still on. Turn the sig gen output all the way down to 0 and look for a signal as before. If one is detected, the sig gen is leaking through the sig gen output. This is a problem if the sig gen output level control is working correctly.

Luckily my 25D passes both tests perfectly. I have no detectable leakage. My s/n measurements are correct.

Your comment about overloading later stages is why I was careful trying different tubes in the front end and one reason I decided not to use them (except for the 6BZ6 in the 1st IF).

Thanks for your very good comments.

Date: Wed, 30 Aug 2017 18:13:15 -0500
From: Stan Gammons <s_gammons@charter.net>
Subject: Re: [R-390] R390A weak rf gain

On 08/30/2017 01:42 PM, Ray wrote:
> Hi everyone i have a r390A which i find could do better it,s rf gain starts at 5 to 6 on the rf gain switch.how can i bypass the rf gain switch it has 150+volts on e607

The R-390A I used to have and wished I still had was one I got from Fair Radio way back when in "used reparable" condition. It had terrible sensitivity. After some checking and a bit of head scratching, I discovered the cam that raise and lower the slug racks were all out of alignment. If memory serves, one sets the radio on 07+000 and the lobes on the cams that raise and lower the slug racks should all line up with the black lines on the front of the RF deck. Mine were nowhere near close. When I fixed that problem, she came to life. What a great old receiver. I need to find another one that the person selling it doesn't want an arm and a leg for...

Date: Wed, 30 Aug 2017 16:40:11 -0700
From: "Craig" <hamfish@comcast.net>
Subject: Re: [R-390] R390A weak rf gain

Let's see if this works: E607 is a test point, it should have +150V at that location. Drag out that Y2K and follow chapter 6, step by step. This is of course; all is correct with the entire receiver; no bad cap(s), resistors correct value, tubes are good, etc. Mechanical alignment has to be correct, then move on to the electrical alignment, etc.

Late in revision 3 there is a great step by step, how to check the sensitivity. All which is needed is a good signal generator, volt meter, and a 600 ohm resistor. (I think) A 20:1 signal plus noise to noise ratio mean you are there. If you have a ware house full of vacuum tube and feel like swapping them, 30:1 is possible. Report back,

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Date: Mon, 18 Sep 2017 17:41:52 -0500
From: Don Reaves <donreaves@gmail.com>
Subject: [R-390] MF/LF Reception

The ARRL has announced the official opening of the two new US ham bands, 630 and 2200 meters. First day of operation will be Oct 15 of this year. I expect considerable activity on the 630 meter band, which is officialy from 472 - 479 kilocycles. Currently there are dozens of experimental licenses issued by the FCC in that range, and these are active stations. But with the band becoming available to all hams of General Class or better, there should be a flurry of initial activity, including budding interest in firing up old military LF transmitters for CW operation. There will be digital modes, WSPR beacons, regular QSOs, and who knows what else. Power is limited to 5 watts Effective Radiated Power, but that is enough to work the world when propagation is favorable.

There are more challenges to getting active on 135.7 - 137.8 kilocycles, due to less equipment availability and physical limitations to erecting decent transmitting antennas for 136 Khz operation. An efficient end fed resonant quarter wave antenna will be over 1600 feet long.

Nevertheless, these two new bands add to the listening targets for our idle receivers. The easiest way to get your R-390 on these new frequencies is add a LF converter ahead of the receiver. Another easy way is to adopt the use of an external LF tuning network ahead of the receiver's first mixer stage, via a built in test point. Breck, K4CHE, has an excellent treatise as I have mentioned before. He has updated the technique with some great documentation.

http://k4che.com/R390LF/R390LFVar.htm

For my R-390A and an Icom transceiver that falls down on receive below the BCB, I use an old but serviceable Palomar Engineers VLF-A converter (the red one with an external 9V battery) which up converts the 10 to 500 KC range to 3.51 to 4.0 MC.

Having an R-389 lying about now seems prescient.

Date: Tue, 19 Sep 2017 00:06:06 -0400
From: millerke6f@aol.com
Subject: Re: [R-390] MF/LF Reception

While this is a bit off the usual list of hardware,

Tis a good time to look at the Frequency Selective Voltmeters out there gathering dust. Since most long lines communications have dumped FDM multiplex, the SVMs are available pretty cheap. Granted they lack an AGC/AVC scheme, but most are quite stable and can dig down well below the ambient noise level as well. Ones to look for at the HP 312 series which are good to well under -110dbm with selective BW from a few hundred Hz to include SSB BWs. HP 310 ok but not as good as the 312 Others are RYCOM, Siemens, Wadel Golterman {Spelling) Philco, and a host of others that don't come to mind.

Date: Tue, 19 Sep 2017 00:27:17 -0500
From: Don Reaves <donreaves@gmail.com>
Subject: Re: [R-390] MF/LF Reception

Good reminder, Bob, to repurpose unused and inexpensive test equipment.

The HP-3586B Selective Voltmeter is hard to beat, once you learn to live with no AGC and no front end filtering. I've purchased them for less than $100, fully operational. I use one as a stable frequency source. Dial up a frequency on the front panel and that signal is available on the back panel of the 3586B at a 1 volt PP level. They do make very sensitive receivers especially for NDB hunting, and the range is audio up to 32MC. You usually need at least one of those weird WECO to BNC video style adaptors to connect an antenna via BNC.

Date: Tue, 19 Sep 2017 15:44:11 -0400
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] MF/LF Reception

The challenge to the receiver is certainly NOT sensitivity. IMD is easy to solve with a decent front end and appropriate roofing selectivity. The real issue is NOISE level from sources in your surrounding area, near homes, offices and the IoT stuff. Antenna arrangements which mitigate the surrounding noise power level are key. As a simple challenge, try receiving

WWVB at 60 kHz with just any antenna. Until I solved the antenna and the local noise floor at my location, I was hard pressed to copy this large signal!

Date: Tue, 19 Sep 2017 15:41:08 -0500
From: Don Reaves <donreaves@gmail.com>
Subject: Re: [R-390] MF/LF Reception

Alan, no truer words were spoken. Noise from all the digital devices we swim around in, along with power line noise, is now almost insurmountable. Years ago, I was able to easily copy WWVB with an R-389 with a homebuilt magnetic loop, mounted with a rotator so I could null out noise. Originally at this location I benefited from living away from close neighbors, who were mostly RFI quiet but over the last few years I have noticed the ever increasing noise floor as everyone adopts home wifi, smart phones, part 15 devices, internet enabled refrigerators, TVs and home automation gadgets. I'm guilty of that, too, but at least I can track down my own RFI culprits. I banned CFI lamps for that reason.

At least those wanting some help should look at loop antennas (aka skyhooks) for HF reception. And eProbe active antennas located 50 or more feet away from your computers, the higher the better.

BTW, WWVB must be a "large signal". I wear a VLF receiver on my wrist that keeps clock time reasonably accurate. Its a Casio Wave Ceptor <https://www.casio.com/products/watches/wave-ceptor/wvm60-9a>, and I do nothing special for it to grab time signals from Colorado nightly.

Date: Tue, 19 Sep 2017 17:05:10 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] MF/LF Reception

WWVB is a particularly tough issue. The world of cheap DC/DC converters settled on 60KHz as a ideal frequency long ago..You also have sky wave from MSF that is a big issue in New England. Somehow I suspect we all now will learn just what is made cheap and dirty at 470 KHz.

Date: Tue, 19 Sep 2017 21:49:59 +0000
From: Gordon Hayward <ghayward@uoguelph.ca>
Subject: Re: [R-390] MF/LF Reception

I use a PA0RDT mini-whip which works really well for WWVB and NAA. The tiny antenna (30x40mm) cleans the noise up nicely.

Date: Fri, 1 Dec 2017 19:34:51 -0500
From: "thoyer" <thoyer1@verizon.net>

Subject: [R-390] Calibration Osc and 2nd Osc questions

After tinkering on my R-390A for a couple months, I now have it up and running, but with a few bugs I'm steadily working out. The questions for today are:

Why does the amplitude level of the calibration signal drop when I go below 8 mHz? Signals received on the AM broadcast band are nice and strong, but the cal level is very low. I'll be digging into this issue this weekend so I'm looking for some "been there, done that" advice. I have yet to probe around the cal circuit, I'll start that tonight.

Also, the voltage called out for the grid on the 2nd oscillator is -10v - I measure -.6v. Tube checks fine, a\lso swapped another in - no change. Oscillator output seems reasonable 7 to 10 Vrms on most bands. I have a couple bands with bad crystals (determined by substituting in a close in freq crystal and the circuit producing output). The resistances around the tube measure in spec. Maybe one of the caps is shot. Before I pulled the chassis out, figured I'd pose the question here. Don't want to be chasing my tail........ Overall the radio is coming back to life. Fun stuff..........

Date: Sat, 2 Dec 2017 02:48:37 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Tom, sounds like you're getting close. Good going. A little variation in the cal signal is normal, but large changes are a sign of something wrong. Since you mentioned it drops below 8mc, that is the magic number. Even though bcb sigs are strong, that doesn't mean the 1st mixer is working right. If the cal sig is real low on all bands below 8, I'd strongly suspect the 1st var IF alignment. It's easy to check - put rx on 7.9 mc cal and see if the trimmers peak correctly (ie: not at the ends of travel). If they are ok, measure the actual sensitivity on those bands.

Because the signal on the cal cathode follower output is band independent (it works the same regardless of the band the rx is on), I think you will find it's not the cal that is the problem. It could be the 1pf coupling cap, but it does not sound like it to me. When I measure E402 with my VTVM, I get any where from 4 to 11 volts, usually 7 to 8 volts.

Date: Sat, 2 Dec 2017 09:02:11 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: [R-390] R-390A 2nd xtal osc output level

What is the typical output level from the 2nd xtal osc when measured at J415 (either p-p, or rms)?

Date: Sat, 2 Dec 2017 21:50:56 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A 2nd xtal osc output level

Tom, measuring at that point can be misleading as the capacitance change in the circuit will change and be reflected back to the tuned plate circuit and detune it. I sometimes use a 200k res to decouple the capacitance of the probe which helps a little. I measure about 0.8 (8/10) volt p-p on my scope. I have not calibrated it recently, but it's probably close.

Date: Sat, 2 Dec 2017 17:23:37 -0500
From: <bill.riches@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Sensitivity below 8mhz might be down as it is a triple conversion set below 8 mhz and there are known sensitivity problems below 8 mhz. Have you checked actual RF s/n above 8 mhz and below 8 mhz. On the ones that restore the average is around 0.5 uv.

Date: Sat, 2 Dec 2017 19:55:58 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

I have not done a s/n check. A sensitivity check shows that it is not performing up to snuff though. Instead of the 3-4 uV in the spec I'm seeing closer to 10uV.

Right now I have the RF deck out chasing a 10mHz osc issue - looks like a bad mica. I'm going to do some more checking on te RF deck before putting it back in. I have a feeling there are a few more suspect caps lurking in there........

Date: Sun, 3 Dec 2017 01:37:51 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Tom, The maint manual says to connect your 50 ohm sig gen output to the R-390A using the impedance adapter DA-121. The reason I bring this up is that the adapter has a 55% signal loss, so when the book says the sig gen output reading should be less than 4 uv, the actual signal level at the rx is about 1.8 uv. Although 1.8 uv sensitivity is ok, as Bill points out, good levels of sensitivity can be achieved. The ones I've worked on usually end up at 0.6 uv above and below 8 mhz.

If the 1st var IF aligns ok, then the problem could be in the 17 mh osc or

1st mixer.

Date: Sat, 2 Dec 2017 21:28:22 -0500
From: <bill.riches@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Inside one of the cans on the RF deck there is a cap across the coil. I think it is the below 8 mhz oscillator osc plate coil. It changes value. I will look up the cap and coil numbers tomorrow when I am in the shop. I trust you have the manuals and know how to align the band switch.

Date: Sat, 2 Dec 2017 21:35:52 -0500
From: <bill.riches@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

It is the 17 mhz plate xformer - inside the coil is a mica cap - change it. You may get lucky and it is the baddie. I have had a few of them act up and one was intermittent over a several week period. Glad I have a jig to run the deck outside the frame!

Date: Sun, 3 Dec 2017 09:29:45 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Got it, thanks. Keeping this thread updated as to my progress (or lack therof....) Didn't get as much time as expected to work on it yesterday. I was able to procure another 14mc xtal which I thought would fix the no output issue from the 2nd xtal osc - nope, didn't work.

I pulled the RF deck and found that if I flip it upside down and support it on a couple wood strips above the main chassis that the two harnesses will reach and allow me to probe around on the underside easily.

Measuring all of the positions on S401 and S402 I had the following results:

All of the positions on S401 read -0.16V - All of the manuals show this should be -10v or so. I tried a couple different 5654's in V401 with no difference. The 5654's I have all test good on my Hickok.

All of the positions on S402 read approx 175v with the exception of the dead 11mc position which measures about 140v - suspect that the mica across the variable for that circuit is leaky.

The resistances and voltages around V401 all seem reasonable except for the voltage at pin 1 (E402).

I should have more time today to spend on it.

Date: Sun, 3 Dec 2017 09:33:28 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

I have so much documentation on this radio it is almost information overload! I learned how to get everything aligned upon reassembly so I'm good to go there. Will take a look at that xfmr today and report back. Thanks! Still learning - and having fun.........

Date: Mon, 4 Dec 2017 08:27:24 -0500
From: Thomas Hoyer <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions

Quick update from having a long day of "bonding time" with the radio yesterday. Cal signal issue has been corrected. After much probing / measuring and head scratching turns out the 1st IF was not aligned correctly. Once I ran through the alignment of that stage the cal level is now good.

The low voltage I was measuring in the oscillator circuit was due to the use of a DVM. When I used my VTVM (Hickok 209A) the voltage measured correctly.

I did have a bad 14mc xtal - replaced and that circuit is working.

Went through a complete alignment and the radio now receives on all bands - some better then others, but we'll dig into that later. The next issue is that I have no AGC action and the S-meter works but only under very strong signals. So I have the IF chassis out and I'm working through those circuits.   Still having fun.......

Date: Mon, 4 Dec 2017 21:22:08 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions and AGC issue

Great work Tom. Weak AGC is usually leaky caps on the AGC line. C551 is the large cap in the square can and not only does it leak like normal caps, but it also leaks to ground. Isolating the AGC line is helpful by unplugging units or removing the link on TB102. Of course, a tube or Z503 could be impairing AGC gain. Sometimes you need to remove the connection from R546 to C547 to measure correctly.

Date: Tue, 5 Dec 2017 18:58:54 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions and AGC issue

Well, it looks like my AGC issues may be due to the broken core in Z503. The coil is fine, just the iron slug is in several pieces....

Last night I connected -9v to the AGC NOR terminal and traced the voltage through various circuits. All measured voltages seem reasonable. Once I locate a new slug I should be back in business.

Date: Wed, 6 Dec 2017 00:02:44 +0000
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions and AGC issue

You may not even need a new slug. If you can glue the pieces back together, the result will have almost the same permeability as before.

Date: Tue, 5 Dec 2017 19:20:58 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] Calibration Osc and 2nd Osc questions and AGC issue

I tried that but was not very successful. There are about 10 small pieces that don't want to go back in any sort of orderly fashion.......

Date: Fri, 15 Dec 2017 07:58:01 -0500
From: Thomas Hoyer <thoyer1@verizon.net>
Subject: [R-390] R-309A T503 differences

The T503 in the 390A I'm working on measures 7 ohms on the primary and 13 ohms on the secondary.

According to the signal tracing levels in the Y2K book, with 10mV into the grid of the 6AK6 I should see the line meter at 0 min. I need to input 13mV to get the line meter to 0.

Backing up - I ran all of the level tests through the AF module and all meet or exceed the levels shown in the Y2K manual.

Back to T503, the Y2K book calls for 6 ohms on both pri and sec windings. I was able to source two other T503's - all three are constructed differently with different resistor and capacitor combinations. One of the three measures 6 ohms as specified. I installed that one into my IF unit and have the same results. 13mV gives me 0 on the level meter.

I did adjust both pri and sec coils for a peak on the line meter with 13mV at 30% modulation.

Chasing a sensitivity issue and this is the first stage I'm seeing issues.........

Date: Sat, 16 Dec 2017 01:53:01 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-309A T503 differences

Hi Tom, I don't think the problem you described here is going to make any difference on the sensitivity measurement.

If your sensitivity is low only on bands 0 to 7, then the problem is probably in the 1st mixer or var IF. If it's low on all bands, then it could be the 2nd mixer or 2nd var IF or the 3rd mixer or the main IF strip. How bad is it? Are you using the DA-121 impedance matcher between sig gen and rx bal input? You need to and account for the loss in the pad. It's 55% or 9.1 db. Have you tried measuring the IF with the 150 uv in?
Roger Ruszkowski (Flowertime01) did a writeup in the y2kr3 about measuring the IF deck snr. He says (and I agree) that you need close to 30 db snr here to get good snr in the rx. Take a look at it.

Date: Sun, 31 Dec 2017 19:44:19 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: [R-390] R-390A Operation Question

Never having operated an R-390A before, I am questioning the amount of "hissing" I get when on the 16 and 8kc bandwidth settings.

Below is a link to a video (hope it works) that shows what I'm talking about (Copy and paste the link into your browser then click on the picture to load the video). www.thdesignsinc.com/R-390A.html

The file is a .MOV file (iPhone) and 89mb so it may take a minute to download.

Also, seems like when I have the BFO on and the RF gain at max, the signals are somewhat distorted. If I back off the RF gain a bit the audio sounds much better.

I have worked through each stage, replacing the out of spec parts and aligned it per the book. The IF gain has been set per Chuck Ripples recommendation.

Overall the radio is functioning well, just this hissing is a bit annoying and making me think I'm not quite done working on this radio...........

Date: Mon, 1 Jan 2018 01:47:49 +0000 (UTC)
From: Larry H <dinlarh@att.net>
Subject: Re: [R-390] R-390A Operation Question

Hi Tom, The hissing noise that I heard from your recording sounds normal to me for a weak station (it increased when switching to 8kc and then more on 16kc).

As for the distortion with the RF gain on max - that is normally an AGC problem, especially receiving SSB. Do you have the Dr. Langford '2 diode fix' installed for this? If not, you could totally fix that with it and my correction to it. I couldn't tell which AGC speed you were using from the video, sometimes medium or fast works better. Try all 3.
Good work on the R-390A.

Date: Sun, 31 Dec 2017 21:31:07 -0500
From: Dan Martin <pitfit@comcast.net>
Subject: Re: [R-390] R-390A Operation Question

SSB signal distortion with the RF gain full on is normal and typical for a radio like the 390A with only a BFO and no product detector function.

For readable SSB, turn your BFO on, your RF gain “about” 1/2 way down, and your audio up a bit. You can turn your AGC off but if your RF gain is reduced and set right, it won’t practically matter if your AGC is on or off.

Massage the RF gain and BFO back and forth for the most readable voice.

With no product detector and sans any user mods the 390A isn’t really an SSB receiver. By interacting with those three or four controls above it can do OK.

Date: Mon, 1 Jan 2018 09:54:25 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] R-390A Operation Question

Thank you for the response. In the video I was using the med AGC setting. I have found that to be the best all around setting as I cruise the bands.

I did not install any mods (yet) as I wanted to get a feel for how the radio operated originally before making any mods. This way I can tell if the installed mod has any benefit to me or not.

The AGC diode mod is first on the list.......

But first I have an SP-600 waiting in the wings for some attention. I think I need to work on something else for a while. I spent about 2 months of evenings on this 390A and a change of scenery is in order.

Date: Wed, 3 Jan 2018 23:16:35 -0600
From: Stan Gammons <s_gammons@charter.net>
Subject: [R-390] The best

I know we all like our R-390A and it's arguably the best of the tube receivers. How do other tube receivers like the R-390, Hammarlund SP600 and Racal RA17L compare to the R-390A? I know Rob Sherwood tested the R-390A, but I haven't seen any numbers on the other receivers.

Date: Sat, 6 Jan 2018 19:35:42 +0100
From: prs@post2.tele.dk
Subject: [R-390] The best

In my opinion, you can not compare the R-390A / URR and Hammarlund SP600!

Date: Sat, 6 Jan 2018 19:27:37 -0500
From: "Todd, KA1KAQ" <ka1kaq@gmail.com>
Subject: Re: [R-390] The best

'Arguably' being the key word here, Stan. "Best" is a pretty broad definition that means different things to different people.

Best at what? Best how? As a member of this group since last century, I can assure you the discussion has been had here and elsewhere, many times. While the R-390 family of receivers definitely excels in several areas, it falls flat in others. While areas like appearance are more subjective, aspects like ease of use and fidelity are not.

I think in areas like stability, sensitivity, and selectivity, the R-390 and later, cost-reduced A models are at the front of the pack.

When it comes to ease of use, something like the SP-600 leaves it in the dust. If you're not already familiar with the term, do a google search for 'R-390 Wrist'.

Same goes for fidelity - the pre-war push-pull audio output Super Pros with their continuously-variable bandwidth are tough to beat here, and good receivers in their own right. Or the SX-28 with its P-P audio and flywheel tuning, or NC-240-D, NC-183, etc etc.

And that's where the slippery slope of 'best' takes over. I think for balance and aesthetics, the SX-28 is about the nicest looking receiver out there, for example.

But I'd never be without my R-390 and later A model - they are keepers, definitely in the top...5 keeper sets for me. And yet another reason to have a few receivers kicking around.

To your question about comparing the numbers - I'm not aware of any definitive source out there for comparison of all period sets. However, Jay Rusgrove/W1VD has done some comparisons on sets that he has gone through and brought up to spec. The R-390A and SP-600 are both in the list. It can be found at:

http://www.w1vd.com/BAreceivertest.html

I know Jay personally, he is very thorough and professional. And a decent guy as well. Happy to answer questions, give pointers, explanations, and so on. You can read a bit more about him here:

http://www.advancedreceiver.com/page11.html

>From personal experience, along with the SP-600 I've also used the RA-17.
Though not a clinical or technical review, I would certainly put it in the same class as the R-390 series. It's extremely quiet and sensitive, also quite stable if the Wadley Loop circuitry is performing correctly. Excellent build quality, but like the SP-600, it suffers from its own version of COC (Crappy Old Capacitors) syndrome. It is not easy to service, either. Takes a little getting use to with its tuning arrangement, but when it's working well, it's a truly wonderful set to use.

Hope this info helps. Happy New Year to you and the list, as well.

Date: Sat, 6 Jan 2018 19:27:27 -0600
From: Stan Gammons <s_gammons@charter.net>
Subject: Re: [R-390] The best

Yeah, I guess I could/should have been more specific. I meant best as most sensitive, best selectivity, dynamic range and so forth. I have no experience with the SP600 or the RA17. All I know about them is from what I've heard and read about them.

Yes, changing bands and tuning kilohertz on the R-390A can be brutal. While not great quality, I have listened to some decent sounding audio on local AM broadcast stations with the bandwidth set to 8 kilohertz on the R-390A. Thanks for the links.

Date: Sat, 06 Jan 2018 20:32:13 -0500
From: jbrannig <jbrannig@verizon.net>
Subject: Re: [R-390] The best

R-390A tuning is "too, Too fast for tuning in SSB or CW, Too slow for cruising the SW bands.

Date: Sat, 6 Jan 2018 20:30:09 -0600
From: Cecil Acuff <chacuff@cableone.net>
Subject: Re: [R-390] The best

Many R-390 series receiver owners also own and use an SP-600 variant. I've heard the SP-600 is great for cruising the bands and when something of interest is found, dialed up on the R-390 to listen.

Les will tell you…we just can't seem to get the job done with just one receiver and there is great joy in owning several examples of the available technology of the period.

I also own a couple high end modern receivers as well…nice for comparison and great fun to use too. I only listen to AM on my boat anchors mostly…when I want to listen to SSB or CW I have better tools for that. Boomer…great post too…

Date: Sat, 6 Jan 2018 22:09:07 -0500
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] The best

Any time you have a 'band' that goes from a bit below a 1 MHz division to a bit above a 1 MHz division (SWL band at 7 MHz comes to mind) the R-390 style radios become a bit of a chore to use.

Date: Sat, 6 Jan 2018 21:16:54 -0600
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] R-390A and the SP-600

I have had a chance to compare "a few" receivers. Presently I own;

R-390A (three of them so there is some general opinions)
R-390
R-392
SP-200
HQ-129

SP-600 (JX17)
RF-590A (Harris)
R-3030 (Cubic)
CDR-3250 (Cubic)
RA-6790 (Racal, four of them)
WJ-8718 (Watkins Johnson)
5650 (Telefunken, three of them)

- It may seem like "a bunch" of radios but that is just the premium stuff. I have a tendency to chase after perfection. (it may seem weird but I am for-real, ask Perry, he knows me personally). Here is my opinion on the Hammarlund family in comparison to the R-390A;

The SP-600 was a fantastic radio that came out when AM and CW were king around 1951. The design is reminiscent of the pinnacle of "knob turner" radios and is a pleasure to use for SWL or BCB-DX listening. The JX17 is really not the "best model" of the receiver, it was designed to support diversity pairing with another radio and some changes in the circuitry and voltages were made. If the crystal filter is close to the IF frequency it can be a decent radio but often the crystals have changed frequency or the radio was mis-tuned somewhere along the line. It also has a big problem with BBOD (black beauty of death) oil caps and the electrolytic (the cans and the bathtubs) capacitors.

I have tried a bunch of things on an SP-600. Taking B+ ripple down to the single millivolt level with filtering changes, building the "Nuvistor first RF" plug-in instead of a 6BA6 and fighting (the never ending) battle against drive slippage between the frequency disk and the knob

The SP-600 is "drifty" for the first few hours and it is definitely not frequency stabilized but if you leave it on for a long night of listening to SWL it is a pleasing radio to listen to. The sound is very full and sometimes I just listen to AM-BCB at night for the background noise while doing something else in the house. As has been said it is a pretty "intuitive" radio except for the IF bandwidth that can be a little confusing unless you read up on it first.

The R-390A is almost a generation newer than the SP-600 and is meant to get on a frequency and stay there. Probably more than a few people on this list spent their times wearing green or tan, wearing boots and eating K-rations while they maintained racks full of R-390's in RTTY service. It works great for data, is not as deaf as the SP-600 at higher frequencies and can be passably good with SSB with an external converter.

The R-390A is not a knob spinner (we all know that) and I invested significant time in to smoothing out the drive mechanisms, playing with synthetic oils and tungsten disulphide to make it less straining on the wrists. It has a better tube line-up in the RF deck and the advantages (and disadvantages) of mechanical IF filters. I have added roofing filters between the RF and the IF and rather than butchering the audio deck I just pick off the audio and feed it in to the AUX input on a Telefunken 5650 receiver (fantastic audio quality).

By itself the R-390A can be "tiring" to listen to all evening long. It has a hard to describe "robotic" sound. One receiver does not have that effect but it is a rare R-390A variant with ceramic filters in the IF.

How I wish the R-390A had an SSB mode.. it might be another reason from keeping me away from the Harris RF-590A that I have been increasingly using for dial hunting to listen to the chatter on the geritol-net on 80 meters.

In the past six months or so I have been buried in Telefunken rebuilds and while I read the postings on this list I do not contribute as much as in the past.

Date: Sat, 6 Jan 2018 21:51:55 -0600
From: Cecil Acuff <chacuff@cableone.net>
Subject: Re: [R-390] The best

Yup...agreed.

Date: Sun, 7 Jan 2018 00:17:52 -0500
From: radiograveyard@aol.com
Subject: [R-390] The best

I have had R390's since 1992 and many other HF receivers. I have not been as pleased with any others above the 390s. others include 2nd best Harris RF590, 3rd Icom 9000 and more but why waste bandwidth. We all need to remember that the solid state radios will be door stops in twenty years (no parts no repair) and the 390s will still glow and talk. I hope my back holds out.

Date: Sun, 7 Jan 2018 17:18:56 +1100
From: "bernie nicholson" <vk2abn@bigpond.net.au>
Subject: Re: [R-390] R-390 Digest, Vol 165, Issue 3

Best is quite a Subjective term, BUT most articles talk about noise and sensitivity, I have had over a hundred R390 ,R391 , and R390A rxs go through my hands , in the 70s I used to buy them 10 to a pallet at our Gov. auctions , For their day they are unquestionably a very nice receiver, and after alignment and servicing perform really well, they do have limitations like any piece of Engineering , and the 390A was built to a Price!............ The Receiver/exciter that I found outperformed the 390A Re Sensitivity was the ARC58, This radio was developed by Collins for the B52 Bombers it's a Synthesized 28000 channel 2-30mhz remotely controlled radio, that directly evolved from the 390 series Rxs its frequency stability is 3 parts in 10^8th per day , and the slug racks are motorized and the servo s are controlled by a box of 0.01% resistors that you dial up with the 3141 digital Control box The Mhz Numbers are fast servo info and the KHZ is slow servo positioning info , [in one of my Rxs I've replaced the Mechanical switching digital readout with a couple of ten turn pots and I have a graph like a HRO for tuning which gives an analog feel to the radio] anyway you will all probably think I'm going on a bit BUT stay with me .... My ultimate test for sensitivity after full alignment , is to simply Plug in a 50 ohm termination to the unbalanced antenna terminals and measure the extra noise, I've never seen an increase in a 390, BUT the ARC58 You will see it . What you see is the spontaneous random flow of electrons in the resistor in response to the heat motion of the molecules, you wont hear it but you will see with an output meter an increase .... In the 1990 s I had a QSO with the Collins radio club at Cedar Rapids , and I talked to an Engineer who was on the team that designed The ARC58, He told me it was their BEST radio project they ever had........... literally Money was no object .... He also told me a Direct spinoff from this project was the 618 Series of radios which were the radio of Choice for most airlines for decades .... Not many Hams got this system going as it Ran on 400Hz 3 phase 208Volts , They also made a Mains 50/60Hz Versions which I also own for the ARMY and Navy the KWT6 and the URC32, these are Knob operated Slug racks like the 390 series Rx s But most modules are interchangeable between systems . The only other Tube receiver that I've tested that gives a measurable increase in noise By connecting a Termination is the National WRR2, it's a Wadley loop Rx in two boxes , Very complex and about twice the tube count of a 390A and about 4 times as heavy .... Regarding the reasons ....The Input impedance for the 390 with unbalanced input is all over the place , its NOT 50 ohms , So a mismatch might be the reason, whereas the ARC58 input impedance is pretty constant from 2-30 mhz , These radios are talked about and described in the Collins Fundamentals of SSB the system was released around 1960.................... So it's a bit more modern in design than the 390 series Rxs which were conceived in the late 40 s and produce in the 50 s .... I like reading peoples thoughts on the 390A and the fixing of various faults , it's a great resource , . Cheers Bernie

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Date: Sun, 7 Jan 2018 11:23:10 -0600
From: Bill Breeden <breedenwb@cableone.net>
Subject: Re: [R-390] The best

Yes, my favorite in the evening, the 49 meter international broadcast band, is a pain on a 390.

Date: Sun, 7 Jan 2018 15:57:40 -0500
From: "Todd, KA1KAQ" <ka1kaq@gmail.com>
Subject: Re: [R-390] The best

That's how I ran my station for many years. Had the R-390A at the top of the rack, R-390 beneath that, SP-600 beneath that. The intention was to surf around with the 600 to locate a weak signal, then use either of the other rigs to tune it in and listen long-term. Only problem was, more often than not I ended up just listening to the SP-600. Audio was as good or better than either of the other two even with the lightweight/overworked 6AQ5 audio stage. Seems I ended up being too busy to search out weak signals and would tune in a shortwave BC station and listen while working around the station.

Today the two 390 variants are in their own cabinets, with the R-390 stored under the basement stairs awaiting space. Found an original cabinet for the SP-600 at NEAR-Fest a few years back for a whopping $25, it's sitting on a shelf in the basement also awaiting a place to go here at the new location. Only the 390A is out and usable at the moment.

>Les will tell you...we just can?t seem to get the job done with just one
>receiver and there is great joy in owning several examples of the
>available technology of the period.

He's absolutely right. I suppose if you were severely limited for space, it would be hard to go wrong with just the R-390A. After all, you can pluck off the audio at the rear diode load connections to drive a small audio amp to have decent audio as well. Add a crank to the tuning knob and off you go. Not perfection, but not a bad compromise at all with the most important benefits included.

Les is a wealth of information on these old receivers, having owned most if not all types, including many newer sets. A story I've told here and elsewhere more than a few times, he's the one who clued me into the so-called 'drift' issues with the SP-600. While it's true that the earlier Super Pros (SP-10, -100, -200) took a while to stabilize (clearly stated in the manual), The postwar -400 was better and the -600, better still. My first 600 was all over the place and I remember chiming in on here about the 'notorious SP-600 drift'. Les sent me a private email and asked "Have you checked the taps on the power transformer?" to which I replied something like "Huh? Taps?". Once it was out of the rack and on the bench, I remembered seeing this before but having not owned one, never checked for myself. Sure enough - a quick check of my line voltage showed the tap is was set to (120V) was bumping up against local line voltage. When it varied, the receiver drifted. That meant, refrigerator, furnace, light switch, anything, sent it off frequency. Moved it up to the next tap (130V I think) and voila - zero noticeable drift after maybe 15-20 minutes warm up time. Even on SSB or CW, it was negligible.

> I also own a couple high end modern receivers as well...nice for
>comparison and great fun to use too. I only listen to AM on my boat
>anchors mostly...when I want to listen to SSB or CW I have better tools
>for that.

Same for me. It's tough to beat the warm sound of a tube receiver pushing an AM signal into a large speaker. I actually have a pair of RF-590s racked up with a 1 KW Harris transmitter system in a dual rack set up, about 1K pounds. Had occasion to use it in a previous life. Very versatile and stable, but sterile-sounding. When it was pulled from service a few years back and slated for the scrapper, it instead ended up being surplussed to storage by the former head of dept and a co-worker until I could work out picking it up(was down in NC at the time). It's currently living with a friend in MD awaiting a lift gate truck and warmer WX. Though it still 'works', I suspect from the codes the receivers are tossing out that the tantalum caps are rapidly approaching crap out mode. Pretty cool receivers, but apples and oranges when comparing them to something like the R-390. And as Pete said - the tube gear will still be running loooooong after the sand state stuff is recycled. Along with actual hardware problems, firmware will be a big issue. The R-390's firmware is mounted on the front panel. They're called 'handles'.

> Boomer...great post too...

TNX, Cecil. Every now and then I wake up and mumble something into the keyboard before getting distracted or falling back asleep. Les has photos of my #1 distraction, now 5 years old. She loves the old radios, especially the early regens/TRFs, pre-war shortwave receivers and battery sets from the 20s. All the big transmitters are stacked against the garage back wall since mid-2016 and 90% of the other gear is still stored in the basement. One of these days...... de Todd/'Boomer', KA1KAQ/4

Date: Fri, 12 Jan 2018 13:04:50 -0800
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] R-390A and the SP-600

I had several inquires once I fixed the misunderstanding that this is paper and not film! Anyway, I brushed the document off and started looking through it again after many years collecting dust.

I have been working on an active tuning preselector and there is an excellent treatment of broadband varactor tuned networks which is worth posting. That said, I think I will look at the cost of scanning the document or just scan it myself and send a pdf to the 390a reflector. Not sure how large a file it would be, but certainly much less than a Y2K manual!

Date: Wed, 19 Sep 2018 19:39:33 -0400
From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] Further on problem getting my R390A working

Rustle up a few spare tubes and start testing them in place. Cal Tones and the line meter will get the receiver up to best mechanical and electrical alignment. A signal generator and two meters are just more elegant. Your mission is to grade the tubes in hand, cherry pick, Easter egg hunt, test tubes. Set the receiver up and listen to some TTY. idle and active CW and modulated The world chooses your meter reading moment.

Run all the 6C4's and put your best three in the receiver. Second mixer above 8 Mhz. In the IF deck and the 6BA6's in the R390 or the 5749's in the R390A get the same treatment. First IF amp Run all the dual triodes through the audio deck and consider even grading each side if good tubes are not on hand. Ask the children to fold you some Chinese finger cuffs in a couple different sizes. Use them as tube pullers. A couple lengths of 1/4 wide ribbon from a gift package works well.

If the tube lights up and functions it passes the short test. The receiver will let you cook a shorted tube for some time for slow speed educational demonstrations After you swap a few tubes you will start to hear the difference and get an ear for judging the best of two tubes. There is a pecking order for the placement of a tube set into the receiver for the best use of the tubes in hand to yield the best sensitivity and signal yield.

Put your hand on the radio. Fifty years ago the clamber was no room for all the needs. Wait until you can get some of the audio out of your receiver and into a computer sound card. It is all there but it's different now.

Visit http://www.r-390a.net and http://www.r-390.com Different sites all of it is useful.

Date: Thu, 20 Sep 2018 10:56:58 -0500
From: Don Reaves <donreaves@gmail.com>
Subject: Re: [R-390] Further on problem getting my R390A working

I'm sending a link to the handout I used back in 2001 to conduct a short introduction workshop on the R-390A. It may be of some use to you. At a minimum, if you are to do any troubleshooting of your receiver, you need a voltmeter. Even a throwaway digital meter for $10 from Harbor Freight is better than guessing. With the ohms function of the meter you can test a tube to see if it has filament continuity, which would answer one of your questions. You can use the meter to check for basic voltages present in the receiver. Be careful - high voltage is present.

However, if you are hearing signals from your receiver, chances are most if not all of the tubes are working, at least somewhat. You can't always tell if a tube is glowing properly by looking under normal lighting conditions. Try looking at night or in a darkened room.

I would ignore any noise you hear from the radio below 500 KC, it's specified low end range. Tuning below 500 is going to reveal nothing useful. You should be able to find WWV standard time broadcasts from Ft. Collins CO at 5 MC, 10 MC, or 15MC depending on the time of day and propagation. That will help verify your receiver is working.

http://militaryradio.com/manuals/Misc/R390ABasicMaintenance.pdf
Good luck, have fun!

Date: Thu, 20 Sep 2018 15:43:04 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Further on problem getting my R390A working

The only CW you are likely to hear is on the bottom end of the ham bands and 30M ham band. Listen in the evening, on the lower bands, nothing above 18MHz. You should hear something. Lots of the tubes look like they don't light up, check it in the dark. If you're hearing stations, it most likely works to some degree. You need a calibrated sig gen to test if it's working right.

Date: Tue, 9 Oct 2018 10:15:54 -0400
From: dog <agfa@hughes.net>
Subject: [R-390] Receiver noise

When I don't have an antenna on the balanced (or unbalanced) inputs, the noise level is quite low on the RX. Using a small SS amp off the diode load to a speaker. Attaching an 80M dipole to the balanced port results in a huge amount of noise/signal increasing the output by a lot. Now on any of my other radios, I can hear the rx internal noise with no antenna, and when I attach an antenna, I hear an increase but nothing like the R390A. Is this typical? I don't remember these receivers being that much different than any others or am I having some issues with this radio? AGC works fine, signals sound fine AM mode in 8 or 16KBW if it's 30dB on the carrier meter or better. Sensitivity measures less than 2uV and passes the 10:1 S/N tests easily with a calibrated Moto 2005D. With no antenna attached I can get an increase in internal noise using the Ant Trim but attaching a dipole and listening to 10MHz WWV I really have to turn the volume down.

Date: Tue, 9 Oct 2018 14:03:46 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Receiver noise

Is this an R-390/URR (the non-A)? (That should not matter it seems to me.) Have you set the IF gain? On an R-390A, it is often found that the IF gain needs to be adjusted. The procedure is simple, though I don?t remember the details. I would put a resistor on the input (125 ohms on balanced input), no antenna, gains all the way up, and set the IF gain pot for modest noise - a low level on the line output meter. (AGC on or off should not make a difference.). Then see if most bands give the same amount of noise.

You might want to do a rough sensitivity check if you have a signal generator. Note that the calibrator signal is introduced at the very first stage of the radio, and gives a quick rough check of overall sensitivity. Also you may want to go through the set with known good spare tubes one at a time, replacing the original at each step, to see if you have a weak tube.

Date: Tue, 9 Oct 2018 16:44:17 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Receiver noise

R390A model. Yes, I don't have a load on the balanced input. I see in the manual they use a load. IF gain has been set using the book method and also the other Line Level method, but no load on the antenna port, I've been told both things, load or no load. My sig gen is a 50? output Moto service monitor 2005D. There's not a whole bunch of difference between the two methods, but it does seem like the gain is hot. I do notice the 14MHz band seems a bit lower in noise than the rest but it still meets the sensitivity test easily. Is that mostly a function of the band crystal oscillator? I only have another set of tubes for another 390A but they are all suspect as well as a few spares. I have no way to test other than substitution. Everything in these radios is pretty much original or replaced with original parts, no SSB mods and the like. Still using the tube rectifiers. Caps replaced in the PS as well as the RF and IF sections. Listening to it over the air it sounds fine. I'm actually trying to sell it. It's got all the panels, meters and all. Front panel is a bit rough is all. In the past I went through it and did a complete tune on all the circuits.

Date: Sat, 13 Oct 2018 10:28:56 -0400
From: dog <agfa@hughes.net>
Subject: [R-390] Gain drift

Not sure how to explain it except 'gain drift'. I thought it was dirty 2nd Osc. bandswitch, but don't think so now. When I turn on the 390A with no antenna on it, let it warm up so I can get some audio noise out of the diode load to a small SS amp, then let it sit for a while listening to the white noise, after about 5 minutes or less, the audio drops rather rapidly way down and I mean to the point where I have to turn up the SS amp volume a whole lot. Then if I do just about anything to interrupt the receiver, like turn to STBY, or even sometimes MGC, or rock the Bandswitch, the volume pops right back up. But none of these things are definitive to correct the attenuation, it can be any of them. It's almost like the gain through the RX had been attenuated somewhere and any interruption or change in the signal makes the attenuation go away. Tried switching tubes, RF and IF, haven't tried the PTO. Even just hooking up the antenna will do the same thing. Now if I have the antenna hooked up, it never seems to do this. I've tried poking around the different modules, tubes, etc when the volume drops and I just don't seem to be able to figure out where this attenuation is occurring or why. Any help here? I'm kinda shooting in the dark.

Date: Sat, 13 Oct 2018 10:04:38 -0500
From: chacuff <chacuff@cableone.net>
Subject: Re: [R-390] Gain drift

Does it do this if you leave it in MGC from power up. Have you replaced all paper caps? These are common issues in radios that haven't had all the paper caps replaced.

Date: Sat, 13 Oct 2018 08:21:29 -0700
From: <hamfish@comcast.net>
Subject: Re: [R-390] Gain drift

Several years ago I chased a similar ghost(s) in my "Too Loud Amelco". Never have found the audio issue, it has to be in the wiring harness. Your 'gain drift' could be in multiple IF & RF transformers. Take the metal cover off of every IF and RF transformer. Look for wire touching the cover! I found several. In Z503 a single strand of litz wire was touching, real hard to see. Make sure all the other ailments of R390/A's have been addressed, replace caps, no leaky AGC line caps, etc. Proper alignment, then chase bugs & ghost.

This receiver was almost unused, no green screws had been touched, original tubes, no mods, etc. Not impressed with the quality of Amelco, but any R390/A can be fixed given enough time, money, effort. My thought are this was a receiver to be used in a military training class. It had lots of bugs that would not have passed any inspection.

Date: Sat, 13 Oct 2018 11:45:50 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Gain drift

Two ideas:

1_ What can be seen if you monitor the AGC line when this happens ?
Say by connecting a meter to TB102, screws 3 or 4 vs GND ?
In which AGC mode this happens ? In all or only Med and Slow ?
Have you changed C551 ??

2_ Possible self-oscillation of the RF stage....
This was a trouble in the early Collins RF decks, especially when the 6DC6 is "hot" - meaning high in transconductance.
>From the Moto '56 and up this was solved by the addition of E212, E213 and C267 around the 6DC6. I do not know which vintage your RF deck is, so this one is purely a shot in the dark.... Let's us know about anything found...

Date: Sat, 13 Oct 2018 12:26:42 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Thanks for suggestions. This is an EAC 1863 from about 6-67. I got it at probably the Vienna or Gaithersburg fest maybe 20 years ago. Has all the panels, most of the EIRC shields and is in not bad shape except for the hole in the front panel and scratches. No mods. I've added a grounded plug to it since last post, I was using one of those 3-2 prong adapters from an extension cord. Now it's properly plugged in. All the usual suspect caps have been replaced in the audio, RF, IF, PS sections. Not the 5000pf bypass discs though. Been through it in the past for a major tune up and everything worked properly and was in mostly in OK tune, IF section and RF both. But I have this drop out issue. Last time the gain dropped I went through all the tubes in the RF and IF sections to shock them to no avail, didn't try the coils. Not sure if it happens in the MGC mode but probably, I've switched to MGC and it's still there sometimes. I'll monitor the AGC voltage as said. I'm monitoring the audio out of the diode load to get rid of the audio sections, so it's not in the audio sections. It's almost like even static or any signal will get rid of the attenuation where ever it's happening in an instant, but shocking things does not seem to make any difference. It seems to work fine with an antenna hooked up. AGC system works properly. Gain is fine, 10DB S/N is less than 2uV. I can't measure it when the gain drops, it always comes back. Also seems like once it warms up for an hour or so, no problems.

Date: Sat, 13 Oct 2018 09:39:17 -0700
From: <hamfish@comcast.net>
Subject: Re: [R-390] Gain drift

Another thought: The RF coil alignment, chapter 6 pg 6-16 Y2K R3. Are any of the slugs for the RF section at the bottom range adjustment, ready to fall out of the rack? If so one or more of the silver mica caps are failing. Usually this only affects sensitivity of that octive (rack). So from what I'm reading if you were to check the IF gain for the -7 volts at the diode load connections, it is changing? Craig

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Date: Sat, 13 Oct 2018 16:42:19 +0000
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] Gain drift

If the gain change is accompanied by AGC activity, which direction does the AGC line go? If it moves in the positive direction (i.e., less negative) when the gain drops, your problem is in the gain of the signal chain. (This is also the case if the gain change persists in MGC mode.) If the AGC line moves in the negative direction (i.e., more negative) when the gain drops, your problem is in the AGC system.

How's your RF GAIN pot? Keep an eye on one of the cathodes it controls.

Another suspect is the small molded mica caps that tune various inductors, and on early contracts, the mechanical filters. The foil electrodes in these caps are connected to the lead wires through pressurized mechanical contact only, and after fifty years the contact areas are prone to oxidation, which causes the capacitance to change or "spoil" with high dissipation factor. This detunes the inductor or kills the circuit "Q". Sometimes voltage transients will temporarily heal this.

My own R-390A had two bad mica caps, one inside one of the RF transformers (so this part of the problem was unique to one band), and another on a mechanical filter (so it was unique to one bandwidth). But some caps (mostly in the IF deck) are used on all bands and bandwidths, so if your problem occurs everywhere, you should still be suspicious.

Ceramic trimmer caps aren't immune, since they too rely on mechanical pressure for electrical continuity to the rotor electrode. My radio may have had dirty trimmers, but I moved them all during alignment, which usually clears them up.

A more subtle way to spoil the gain is via oscillator injection level. If one of your oscillators goes weak, the conversion gain in the associated mixer will drop. If this occurs in the 17MHz oscillator, the problem will only manifest on the 8-31MHz bands, but the crystal deck and PTO are used on all bands. You can sniff the oscillators with a second radio.

I had yet another intermittent gain shift. My IF deck had a wire supplying screen voltage to one of the 6BA6's which went tightly around the edge of a metal shield which eventually cut through the insulation. The insulation carbonized and dragged the voltage down without quite grounding it.

Date: Sat, 13 Oct 2018 13:32:31 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

I'll try some of these things, especially measuring the AGC when it happens. It takes a while because it's not always happening. I'm still not sure if it happens below 9MHz but I'm thinking it does. It's not just on one band and the BW on the IF appears irrelivant except for more or less noise out which is normal. This is one of those buggars to find, it takes so long to happen. I thought about cleaning the bandswitch but haven't gotten it out yet. I see the 2 green screws on the front of the 2nd Osc module to the RF module are missing. I'll replace them next time the front panel is off.

Date: Sat, 13 Oct 2018 17:28:28 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Hi Dave, This sounds like a tough one. It could be most any contact: tube, switch, or wiring socket. RF deck switch would be my 1st choice. Do you have any subchassis you can switch out? You might need to narrow it down. And yes, it could certainly be one of those SILVER MICAs acting up. You might try some cold spray on them one at a time. Since it happens on more than one band, you can eliminate the 'band' section of the RF deck (but not the switch or tube contacts), but it could be the 2 variable IFs. If it happens above 8mh, then it should not be the 1st var IF.

Date: Sat, 13 Oct 2018 21:13:29 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

OK, new data. I socked 50uV into the antenna balanced input right at cold start up. After a few minutes and things settle down, the agc is at -5VDC. Carrier meter is 48. Let it run for a while and soon the Carrier drops to 25-30 and the AGC goes to -2.4VDC. I've got AM mod going into it and the AC output of the diode load is holding steady at about .5VAC no matter which carrier reading. Then after a while the Carrier meter goes back to 48 with the corresponding AGC of -5VDC. Does this several times and I get tired of watching it so one time while it's on the 25 carrier, I switch it to STBY and back to AGC. Goes right back to Carrier of 48 and corresponding AGC. Something is drifting but it's hard to hear on the audio, the AGC seems to be working but something is changing the gain during warm up.

After letting it sit for over an hour it seems to stabilize on Carrier level of 48 and AGC of 4.3. I have a list of uV vs. AGC voltage, I'll check all the agc vs uV voltages out after it warms up good.

I'm thinking with no antenna the AGC is down (.6VDC) where it's not working so a small change in gain produces a large output on the diode load audio output. That's why I'm hearing the difference with no antenna. Not so much output difference when there's a fairly large signal present and the AGC is working. I'm really not sure how to find this other than a shotgun approach. It's very difficult to get to the components to shoot freeze spray on them while in operation.

I do have another RF and IF section, but the other RF section doesn't appear to work, I tried it once, but I may try it again. The other IF section,? the 2KHz mechanical filter has a shorted output and I've got it apart for repair so it's disabled at the moment. I may have to fix it first before I can proceed.

Date: Sat, 13 Oct 2018 20:55:12 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, When the gain drops and goes back to normal during the 1 hr warm up, are the transitions from good to bad gradual or quick? About how long does it take? About how long does it stay in each state? Is there any unusual noise in either state or during the transition? Do you need to let the 390A cool down for some length before it will happen again? About how long? Are you using a 3tf7 osc current regulator? Have you checked all the mini BNC connectors?

Date: Sun, 14 Oct 2018 10:06:07 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

I have to let the rx cool off before it acts like this again. Upon startup, it has what I would call normal gain. Then after about 5 mins it drops, not all of a sudden but a gradual, but over maybe 5 seconds to the low gain point. Then after about another 5 minutes it drifts back to normal the same way. It seems to go through this cycle until after about an hour or so it stops and the gain is very near what it was at startup. I have seen the gain drop all of a sudden, but that was just once. When the rx is interrupted if it's on low gain cycle, the gain jumps back to normal, usually but not always. Yes, using the 3TF7. I have played with the mini BNC's when the gain is low to no avail.

I was thinking about pumping in a signal to the balanced input from my transceiver, it puts out a +7dBm port that I can pad down if necessary, and watching various spots through the RF/IF signal path with the spectrum analyzer. But first I need to get some baseline measurements. Was thinking about doing this also in MGC mode to stop the AGC effect. Maybe I could isolate at least a stage that's causing it that way instead of having to shotgun it?

I also have a Fluke 189 recording voltmeter that I can use if necessary but I'm thinking the SA will be the easiest method.

I should check it below 9MHz first.

Date: Sun, 14 Oct 2018 07:58:29 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] Gain drift

You might want to monitor your local oscillator injection levels into all mixers depending on the band chosen. Sounds like it is not band related so just check those. I have seen LO injection levels drop off with increased temperature rise over time.

Date: Sun, 14 Oct 2018 14:58:17 +0000 (UTC)
From: <shelly199@aol.com>
Subject: Re: [R-390] R-390 Digest, Vol 174, Issue 11

Hi Dave,Sounds like you have to isolate the problem. I think I would start by putting a 455 KHz signal with some modulation into the IF unit at about 75 uv, monitoring the diode load voltage and listening to the audio out at startup. If you're good there then start putting a signal into the various test points in the rf deck.? Put signals in starting at E208 then E209, E210, E 211 and T208 output. Do this in MGC only.

I've had similar problems and have found that mica caps with B+ on them are the most failure prone components in the radio and the toughest to pinpoint. That's what I would suspect and probably in the rf deck. Good luck!

Date: Sun, 14 Oct 2018 13:20:39 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] R-390 Digest, Vol 174, Issue 11

Well, today it wouldn't do it. That's after I left it off all night. What I do notice though (noticed this for a long time) is turning the bandswitch produces a lot of noise (static), especially just before it's going to lock into a band. It's fairly consistent as to which bands I go into, especially 14 and 27.? I think I'm going to have to pull that RF section again and clean the bandswitches. But I get the feeling that's it's something else, related. Sometimes when I go to a band, it doesn't produce full output, like in the past when it's on low gain, but changing to another band and back makes it full volume again. I can't always do it just rocking on a particular band that is low. Sometimes I'll go to a couple bands with low gain in a row but once I hit one with regular gain, it all goes back. Fair amount of static involved too.

There may be several things going on. I still get the feeling that the 'static or noise' shock may do something to a component that makes it erratic. Maybe doing the gain checks at the test points like suggested may tell me something. Actually most of the time the RX sounds fine, once I get to a place I want. Lots of good suggestions. Dave

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Date: Sun, 14 Oct 2018 19:21:43 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

I think I may have found the erratica. Renee, K6FSB, told me to check the Xtal osc bandswitch, she had an EAC that had a problem with that switch. So I am digging around looking at the RF deck and I press on the circular thing that shows the band numbers on it and lo and behold, it get very erratic, just like when I'm changing bands. I can make the gain go away or stay there depending on how I mess with it. Anyone got ideas on what to check for with that section? Looks like I need to pull this RF section out and inspect that area. There always were a few erratic issues with tuning each 2nd osc band, and it was not consistent.

Date: Sun, 14 Oct 2018 18:35:06 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Hi Dave, Great tip from Renee. This is very probably it. So it could be alignment (try this 1st), but is probably the contacts need cleaning. It's made of phenolic, so be careful to not get cleaning solvent on it, just the contacts. Here's hoping.

Date: Mon, 15 Oct 2018 21:45:47 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Today I took out the RF section. Used some alcohol to clean the switches with an acid brush bristles cut short, there was some grease on the wipers I cleaned off. Checked the operation of each contact, seems normal, spring action seems good nothing is messed up. Used alcohol to take the wiper around the whole circle both switches to try to clean the contacts. The alignment seems OK, but there is an amount of backlash in the wiper, it centers the wiper better turning one way opposed to the other way, exactly like the other one I have. Pulled all the xtals and hit the contacts with a copper brush, new de-ox on the xtals and a bit on the switch wipers and a few places around the contacts, not much. Pulled and inspected every solder joint in the osc section, contemplated replacing the 5000pf bypasses but didn't. Solder joints all seem good. Back together, there seems to be somewhat less noise, but still the drifting gain on startup. Cooled it off for a while and pulled the input RF amp. Turned it back on and didn't see the gain drift issue but much less ACV on the diode load. I'll try it once more without the RF amp. And then maybe another RF amp tube.

I notice that with no inputs on the ant inputs, the RX is very sensitive to movement around the input ports. Like there's a lot of common mode currents making noise in the input. If I put a load on the balanced port it's much quieter. Of course if I sock a 50uV signal into the balanced input I get Carrier reading with AGC.

Did I read somewhere that if I use the balanced port I should short the unbalanced ports to gnd?

Do all these RXs make noise when changing the bands? I almost always get a big crackle when I change bands. But now as I rock the bandswitch on a particular band there's lots less to no noise. The 27M and the other one that seemed noisy before seem more like the rest now, stable. No issues tuning the output caps unlike yesterday.

Almost lost the Oldham coupler spring putting it back together today.

Date: Mon, 15 Oct 2018 20:45:46 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, the inputs should not be sensitive to movement - sounds like it might have a shield grounding problem on the input coaxes. And, the unbalanced input should not need to be grounded. There should be very little noise while turning the MC between bands. Noise indicates poor contact in the band switch. Tube shields are needed on all the sensitive tubes in the RF and IF sections. Sounds like you're making progress.

Date: Tue, 16 Oct 2018 14:54:05 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

What I mean about the sensitivity around the antenna inputs is that when I wave my hands, fingers or an antenna near the antenna input ports, there is activity in the noise level. I find nothing wrong with the cables from the relay and there's no sensitivity there.

I did notice the gain drift again last night with the AGC mode. Today I'm trying it in MGC mode and so far the gain drift is much more noticeable in that mode. I'm going to start from the input to the IF and work backwards to the input. I've got some tube extensions so I can put signals into each stage as I go along, much as what Renee and others have suggested. I've been thinking about this for a while. My sig gen has a 50? output so I'm going to have to be sure I put the signal either through some small capacitor or find a good place in the circuits to do it. I tried some of the E ports casually, but that didn't seem very effective.

Sometimes I wonder about the AGC circuit. But this MGC drift is much more noticeable. I'm sure the AGC is trying to compensate for that.

I've been putting a fan on the rx to try to get it cooled down a bit quicker between sessions. It's a slow process when it's not just a basic fault.

The bandswitch is quieter especially on a single band, but I still get clicks switching between bands.

Date: Tue, 16 Oct 2018 22:22:15 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Well, actually tonight it seems a lot better. I think today I've been chasing warm up blues. I'm going to let it cool off tonight and start over tomorrow. I think the clean up on the RF section did a lot of good.

I even got my TS2000 working again, the ACC2 port was distorting audio and I hard reset it several times and it seems to have cleared up.

Date: Thu, 18 Oct 2018 18:27:40 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

I'm beginning to wonder if it isn't the AGC circuit that's messing up. I put 455KHz into J513, IF strip, and in AGC mode I get gain drifting around. In MGC it seems solid as a rock. Put an extension on V502 and with 3mV going into J513 I sometimes get 40 Carrier in AGC, but then it drifts down to 10 or so after a while, back and forth. But if I switch to MGC I get solid RF readings on the grid and plate of V502. In AGC mode the grid and plate of 502 is all over the place with the Carrier. Gain of V502 seems to be somewhat less than 30dB on the Boonton mVmeter in MGC. Switching in 10/20dB on the sig gen also registers the same on V502 plate and grid so that seems real.

I haven't seen anything on checking out the AGC rectifier and amp. Any ideas on that? Guess it could be something on the AGC line later that's pulling things down too but that's hard to check with the RX off, other than the static checks and the -7VDC on the diode load which seem OK. I suppose I could pull the RF module to eliminate that much.

Date: Thu, 18 Oct 2018 21:10:57 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, you might be on to something there with the AGC. One test you can make is to disconnect the AGC jumper on TB102 3&4, thus disabling the AGC. With the mode switch in AGC, ground 4 and measure AGC volts on 3. If it fluctuates, trace it back tube by tube to where it's stable.

Date: Fri, 19 Oct 2018 10:20:01 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain Drift

If I disconnect tb102 3,4, the AGC rectifier still works but doesn't send AGC to the RF/IF tubes. What does grounding TB102-4 do? I know it grounds the AGC line, but I guess that puts full gain on all the AGC tubes? And measuring pin 3 tells me if the AGC voltage is varying with constant gain tubes in the RF/IF? Seems to me if I have varying voltage on TB102-3 with no AGC action there's something wrong in the AGC circuit. I'll try it.

Date: Fri, 19 Oct 2018 10:27:39 -0400
From: <wb3fau55@neo.rr.com>

Subject: [R-390] gain drift

By what you say, i think you may have bad caps in the RF deck. I did not follow all of this, but as I was taught years ago, remember how old these things are. All of the different contractors had different problematic faults. Caps are a very common problem, especially the ones that don't usually go bad. Stay at it, give it a break when frustrated, process of elimination. We have some real good techs here, keep giving details and we will find it. 73 Russ wb3fau- [been there]

Date: Fri, 19 Oct 2018 10:33:50 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Gain drift

> ... I've got some tube extensions so I can put signals into each stage as I go along,

The RF deck has a number of test points - often at the grid of a stage. Little test prod jacks on the chassis among the tubes.

> ... I'm going to have to be sure I put the signal either through some small capacitor

Yes do that - there may well be AGC voltage at those test points. The capacitor (100 PF maybe ?) will keep the signal generator output from ?shorting? the AGC voltage. There are tables of expected RF voltage at these different test points for ?standard output? from the audio stage. (Gains all the way up, I would assume.) If you are fussy about it, arrange a load on the generator output (likely 50 ohms) so as to give more or less correct indication of output voltage from the signal generator.

> ... I tried some of the E ports casually, but that didn't seem very effective.

Not sure what you mean by E ports - maybe these test points I am referring to.

Date: Fri, 19 Oct 2018 10:58:50 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Gain Drift

That is the link that sends the AGC voltage from the rectifier off to all the controlled stages. It may reveal something to hook up a couple or three flashlight batteries in series, and put negative 3-5 volts on the terminal that is the AGC bus (not the rectifier output) with the two terminals not connected. (Positive side of batteries to ground.) The radio should show steady fixed gain, steady output level with steady RF input level.

A variable resistor hooked up to a 9 volt battery gives you the chance to vary the voltage applied to the AGC bus at will. This can tell you a lot about how the whole radio is working. Was there an AGC voltage vs. RF signal input voltage for standard output table included in the recently posted document: R390A CRYPTOLOGIC TECHNICIAN CLASS A CRYPTOLOGIC MAINTENANCE COURSE.pdf

> What does grounding TB102-4 do? I know it grounds the AGC line, but I guess that puts full gain on all the AGC tubes?

Yes, with the GC bus at zero voltage, the radio is at full gain. Testing voltages (VTVM) at the test points may reveal a leaky coupling capacitor feeding that point.

(Note: most Digital meters have high input resistances on DC, but the test leads have capacitance to ground, so the test lead applied to an RF test point may 'suck the signal out'. Put a 100K or 1 meg resistor at the test lead tip, and don't expect accurate DC voltage measurements. Most old time VTVM's have a one meg resistor IN THE DC PROBE and that solves this problem. The AC-DC switch on some probes switches this resistor out for AC measurements, if I remember right.)

The Y2K manual has diagrams that show just the AGC system. A bit of time studying those diagrams may help any of us understand the AGC system.

> And measuring pin 3 tells me if the AGC voltage is varying with constant gain tubes in the RF/IF ? Seems to me if I have varying voltage on tb102-3 with no AGC action there's something wrong in the AGC circuit. I'll try it.

I don't remember the nature of the two terminals: one is the AGC rectifier (is there an AGC amplifier? Can't remember) output, the other is the line that feeds all the controlled stages in the radio. With them disconnected, one should vary (AGC ON) with the radio RF signal level, and the other one should not change at all. Varying or occasionally changing voltage on the AGC buss with those terminals not connected indicates intermittent or leaky capacitors some where (likely signal coupling caps).

Date: Fri, 19 Oct 2018 11:15:08 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Interesting. I disconnect TB102, 3-4, ground 4 and 3mV into J513 is way too much RF for the carrier meter in AGC mode. Reduce the input to about

250uV and that gives me 50 on the carrier. 0V on TB102-3. About 5 minutes later the carrier drops to 0. I have to increase the RF input to 1.3mV to get 50 on the carrier again. It seems to be holding there, but there's 0V on pin 3 no matter what I do. Carrier has been holding steady for half hour now with 1.3mV in. Oh, wait the voltmeter is not plugged in. Let's start over.

I need to get that other IF module working which means repairing the 2KC filter. That will take a few hours if I can fix it. It was working but all of a sudden showed a short on one side. Hopefully it's just a wire that I can push around, otherwise I need a 2KC filter or do without it.

Date: Fri, 19 Oct 2018 11:21:35 -0400 (EDT)
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Gain Drift

If you happen to have a variable-output DC power supply, that might be handier (and allow you to advance the AGC voltage further as well).

Date: Fri, 19 Oct 2018 11:24:42 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Gain drift

> Interesting. I disconnect TB102, 3-4, ground 4 and 3mV into J513 is way too much RF for the carrier meter in AGC mode. Reduce the input to about 250uV and that gives me 50 on the carrier. 0V on TB102-3. About 5 minutes later the carrier drops to 0. I have to increase the RF input to 1.3mV to get 50 on the carrier again.

I suspect you have an intermittent capacitor or coil in the RF system. Insert the RF signal into the various test points in the RF deck. Look for the table of voltages (they will be APPROXIMATE) for the various stages (and appropriate frequencies). I assume you have ruled out the IF deck with an IF signal at it's input - and perhaps set the IF gain while doing that.

Date: Fri, 19 Oct 2018 16:46:31 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

At the moment, I'm just feeding 455 RF into the IF module. That appears to be where I'm getting the gain drift. It's even doing it with the AGC jumper disconnected. Need to fix this before I get into the RF section which actually may be OK. Thinking about measuring along the 455 RF line through the 4 tubes with the Boonton to see if I can find the area it's changing. Slow process since I have to let the RX cool off between sessions. I may start at V502 which breaks the IF section in half.

I did replace the recommended caps in the RF section, 3 of them. The IF has all the recommended ones replaced, but not C551, it seems OK at least measuring, I don't have a ESR tester.

The test equipment I have is a Moto 2005D sig gen/calibrated rx/spectrum analyzer/scope. All purpose monitor, it will put out +13dBm into 50ohms and a step attenuator with adjust pot down to -120dBm. Also a Boonton milivoltmeter and a Fluke 198 along with an old HP427A, and a Tec 545A that's still working.

Date: Fri, 19 Oct 2018 17:06:21 -0700
From: <hamfish@comcast.net>
Subject: Re: [R-390] Gain drift

On C551: I've never found a good one. Test equipment is a Sprague TO-6A. C551 is a paper oil filled cap, value 2uF @ 500VDC. Sometimes the value is close to 2uF, but at rated voltage it is a dead short. Insulation resistance is a big fat zero. This is one of the caps I no longer test, it gets replaced with all the other shotgun caps. A good replacement is a NTE MLR205K630. This NTE will fit inside the old metal can or fit on the bottom side of the IF module.

Date: Fri, 19 Oct 2018 17:16:59 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, The idea for disconnecting the 3/4 link is to allow the AGC circuitry to work but not affect the IF gain. This will provide for a constant gain (if all is working correctly) for easier testing. Although grounding # 4 creates max gain in the IF, if less gain is desired, the RF gain controls the gain of the 1st 2 IF tubes. The 3rd IF gain is controlled by the internal IF gain adjust. If C551, C547 and C548 are original, I'd look very closely at them. C551 can leak like a normal cap, but it can also leak to it's case, which is gnd.

While testing, I suggest using the lowest level of input as possible, as it is possible to overdrive the 4th IF and obscure your results,. Although the IF should handle input creating a diode load of 15 vdc, 7vdc is safer. The issue is driving the 4th IF or the agc amp into clipping. This can happen in mgc mode, but in agc mode the agc helps prevent this from happening. Since the agc is disabled for testing, you need to be careful of this.

Date: Fri, 19 Oct 2018 21:59:15 -0400

From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

I think I'm getting somewhere now. Put the Boonton on pin 5 of V504 4th IF amp. Input 54uV into the IF module because that was all it took to get ~600mV out of V540 which is near the top range on the Boonton. Checked with a 10dB smaller input and same 10dB on V504 plate. So it's not compressing. After a few minutes the RF volts start dropping off, I'm going to step back to the grid of 504 and see what's going on there next. AGC is disconnected. I was getting a few volts on TB102-3 and it didn't change when the plate of V504 dropped. Not sure what that means. But I see the AGC is coming from the grid of V504 to a cathode follower and the AGC IF amp comes off that. AGC rectifier comes off the plate of AGC amp. Looks like the 4th IF amp V504 is not controlled by AGC.

C547 and C548 are replaced.

Reason I didn't change C551 is I read that it wasn't usually a problem, but looks like maybe could be. I've got a 2MFD NTE film I think, it looks like a large orange drop but it's burgundy colored. I'll have to look back in my Mouser order to see what it is. That will fit in that C551 can, but I'm going on with the gain in V504 for now.

The 2.7M is R544. I haven't replaced it. Yet. It's in the plate circuit of the AGC time constant.

Date: Fri, 19 Oct 2018 20:34:54 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

It sounds like you're getting close, Dave. I'd double check by measuring the diode load -vDC and the AGC out -vDC. From what you have seen, the diode load should go down while the AGC holds steady. If it does, then the suspect area is the 4th IF. If both go down, then it's before the 4th IF.

Date: Sat, 20 Oct 2018 09:10:26 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

OK, this morning, checked the grid of V504. After a few minutes RF is dropping along with TB102-3 -DCV so I'm going to let it cool off. Since the plate of V504 didn't show any dropping, it looks like it could be in T502. I don't really see any other stuff in that path. I don't think I replaced C523 and I have a bunch of 4700pf I got for those. I doubt it's that or R551 since that plate circuit is good. Could be something inside the T502. Sure acts like a tube though as quick as it happens and fast as it drops. But it does eventually come back to 'normal' after a while. It's a bugger. I should try another V504 tube just for drill, but I've tried all the tubes before. It could be in that cathode follower V509B, I could just pull it and see what happens to the RF through V504. I'd loose the AGC voltage but so what.

I'm writing this to help me understand what I'm doing. Otherwise I loose track.

Date: Sat, 20 Oct 2018 13:31:10 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Well, maybe I've found the problem. Took shield off T502 and found some funky solder joints. Re-did them and now I don't seem to have that drifting problem. But now I've got a loud white noise that comes and goes. I'm feeding signal into the IF and listening on the diode load, and there is no indication on the carrier meter or the milivoltmeter that anything is changing, I tried all the IF amp tubes to no avail, but it's probably in the detector or maybe limiter, don't know where else it could be. Getting closer. Gotta go mow now.   Dave

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Date: Sat, 20 Oct 2018 14:11:00 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Gain drift

Dave, speaking about the "funky solder joints" in T502... Does someone previously removed the internal damping resistors within ? Meaning R553 and R554 that can be seen in the schematic. Both are 47k ohms, 5%, 1/2W. R511 and R512 in T501 are the same (and should be present also !).

Removal of those resistors was a "modification" recommended by some people 30 years ago ! But the end effect was - in some cases- self-oscillation of the IF stages. Like having a regenerative receiver within the IF strip... No wonder then if the gain is very high at turn-on and the global operation unstable. Have a check !

Date: Sat, 20 Oct 2018 16:58:27 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Yes, those T502 resistors are still in there. So far I haven't heard the gain drift since I resoldered the joints but I need to give it some hours. I also replaced the detector tube for the noise and it didn't do anything, tried the Limiter V507 and that may have done it. I need to give it some time now.

T502 can looked from the top like it had been messed with. Inside it appeared that the input circuit had been tampered with, but what looks like original parts. I took a big iron, heated it up good, used a little rosin solder paste and re-tinned the joints. That's all I did. They did look a little cold. I doubt the joints were original.

I notice the tuning on T502 changes with different tubes? I was looking in my Navships book for the tuning of the transformers in the IF stage but can't find it. Anyone know where that is? I thought I'd been through that years ago. I know I did the first variable IF and I seem to remember going through the IF.

Date: Sat, 20 Oct 2018 14:13:31 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, Great work! The IF alignment procedure is in the Y2K-R3 tech ref chapter 6, here's the link: http://www.r-390a.net/Y2K-R3/06_Chapt_06.pdf

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Date: Sat, 20 Oct 2018 21:41:47 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Gain drift

There was a BAD modification published a long time ago - folks were advised to clip those Q-spoiling resistors. This increased the gain of the set, making it 'much hotter'. This of course was a big mistake. Don't do it. If you find a radio with that mod applied, put the resistors back into the circuit. Then do an alignment on the affected stages, and set the IF gain.

By the way, I recall discussions about the use of modern carbon film resistor (some with spiral tracks of resistance material on ceramic tubes), and how they exhibit unwanted inductance in RF circuits. I have long held that many uses of these resistors do NOT involve RF voltages on the resistor, such as in bypassed screen dropping or bypassed cathode use. And blindly assuming that these modern resistors will act badly in all situations is a mistake. BUT, these resistors in the IF (or RF?) cans of the R-390A really do experience RF voltages. (If I remember correctly, the R-390/URR - the 'non-A' - may use such resistors in different stages than the R-390A.) HOWEVER, it is another matter whether or not the actual inductance that may be present if you use modern carbon film resistors matters much if at all. If anyone can point us to measured data on the inductance of such resistors, please do. I remember that in the past, such data was posted or referenced on the R-390 list. (I may have it but can't locate it now.)

A final note: the technology involved in 30 megacycle IF amplifiers used in WW-II era radar systems involves the use of resistances to set the Q and stagger tuning the various stages to achieve much desired bandpass and phase characteristics. This is covered in Valley and Walman 'Vacuum Tube Amplifiers' of the MIT Radiation Laboratory Series. (The math involved is not for the faint of heart.)

Date: Sun, 21 Oct 2018 10:21:32 -0400 (EDT)
From: ROSS HOCHSTRASSER <bavarianradio@comcast.net>
Subject: Re: [R-390] Gain drift

It probably wouldn't be a bad idea to replace these resistors with either more modern carbon or maybe even metal film resistors. It is possible that these resistors have drifted far enough out of value that their effectiveness has been compromised. The audiophile world has realized that carbon comp resistors do contribute noise of their own , especially if excessive heat was used when "modifying" the circuit.It may also be advisable to re-tune the coils after replacing the resistors. Very interesting thread!!
W1EKG

Date: Sun, 21 Oct 2018 17:32:55 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Gain drift

As the internals of the R-390A IF transformers have been MFP coated (at least in the ones I have) I do not believe that the ambient oxygen had a chance to go thru the carbon composition resistors cases used within. If the MFP coating is still intact, the resistors should still have the same value than when they were manufactured. And they are Allen-Bradley parts, known to resist "aging" better than similar parts from other manufacturers. But... in case of doubt, CAREFULLY remove the original resistors and replace those by the variant of your choice.

Audiophiles pretend that the carbon composition resistors are more noisy than other types of construction, and it is true to a point. When DC current passes thru those, the path followed by the electrons within is not always the same, causing a type of "partition noise" at the microvolt level. The carbon film and metal film variants, on which less "mass" of resistive material is involved, creates less of this "partition noise" for the same current value going thru.

For the "inductive effect" of the spiraling of the carbon/metal film resistors tracks, some testing is in order, especially at very high frequencies. However, the tests I already performed on low-value 1W parts proved that the dominant factor is the inductance of the connecting wires, and way much than the resistive element within. I do not believe that bad behavior can be created by using replacement carbon/metal film resistors within a R-390A.

Date: Sun, 21 Oct 2018 17:46:06 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Gain drift

MFP is not a magic material. It will slow down moisture (and air) it will by no means totally block either one. There are plenty of examples of carbon comp resistors heading off for who knows where value wise in military / MFP coated gear.

They *do* have odd properties at HF which make replacing them with other resistors a bit tricky. Rather that going capacitive as frequency goes up, they stay resistive. Their value drops, but the device stays resistive (as opposed to an R parallel C combo ?). When used as a Q lowering device this subtle difference does come into play.

Date: Sun, 21 Oct 2018 18:41:00 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Well I had it on for about 6 hours today and no sign of the gain changing all that much. With the AGC jumper disconnected the Carrier meter is very sensitive over a small delta RF and with the same input it changed from 50 at startup to 25 later on and finally back to about 65. Changing the sig gen just a few uV will bring it back to 50. Once the AGC is in play that will change. I saw no difference on the plate of V504 nor the -9VDC diode load output nor the audible noise from the diode load. Tomorrow I'll hook up the RF section and put the RX back in order and see what it does from the balanced ant input.

Date: Mon, 22 Oct 2018 13:52:57 +1100
From: "bernie nicholson" <vk2abn@bigpond.net.au>
Subject: [R-390] Re Gain drift

Hi everybody, regarding gain drift and bursts of noise all the symptoms describe a fault, that I've come across on multiple occasions. In my case it was caused by the foam dematerializing in one or other of the mechanical filters becoming slightly conductive as the set warmed up. If you look at the circuit the outputs from all the filters are commoned at the AGC Line .... I found the FAULT By disconnecting all at the common point and Meggar testing each with an insulation tester; the most common Culprit was the AM filter, but I've also found the 2KHZ filter to have this problem too. I used to buy these radios at our gov. surplus auctions and after

selling to people I've had many come back for repairs
over the years, and yes, I remember one receiver had so much gain AGC lost control, and was very noisy too........... somebody had cut the resistors in the IF can. The man who owned it was a 6meter fanatic using it with a converter. It took a bit of finding Regards Bernie VK2ABN

Date: Sun, 21 Oct 2018 20:31:50 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Hi Dave, Although you've made very good progress, unfortunately, I'm thinking you still have a gain problem. I just tested the stability of gain on my daily driver and it's what I'd expect. I set the carrier level at 40 on a cal signal 3 hours ago and it held very stable for a long time, and has drifted slowly down to 39. This is with the AGC hooked up and in normal cal operation with 8kc bandwidth. The set had been off for 16 hours. Wish I had better news.

Date: Mon, 22 Oct 2018 12:52:12 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Those carrier meter numbers were with the AGC disconnected. The meter is very sensitive to slight gain changes that way I notice. I'm going to hook up the AGC and the RF section today and see what it does. I expect it may be much more stable, the AGC action should make the meter act more as a log mode. I'm hoping.

Date: Sat, 27 Oct 2018 11:55:13 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

It's not over yet. I just turned on the rx after being off overnight and fed 150uV into the IF section, and after a few minutes got -1.5V on the diode load, measured the RF on grid and plate of V504 and it seemed pretty low. I touched the plate with the mV meter, there's a snap and the gain jumps up about 10dB and the DL goes to -7V, where I'd set it last night. Then right away it starts drifting back down to where it was while I had the mVmeter on the plate, I watched it go down. Still something not right in that circuit. I did take off the cans to the other two IF interstage transformers and they look normal with the proper resistors and caps.

How does one know if a rx is supposed to be stagger-tuned or not in the IF strip. Apparently there are 2 kinds. I tried stagger tuning T501 and T502, but it seems like 467 and 448KC is barely available at the DL where 455 is. I need to get the 2KC filter in my other IF module fixed and put that one back together. I may work on that today.

Date: Sat, 27 Oct 2018 18:20:22 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

Thinking about it today it seems like maybe I should just replace what I can in the plate circuit of V504, even in the transformer. Don't know what else to do.

In the meantime I repaired the 2KC filter from the other module, put it back in the other IF module so now I need to do some checks on it and try it in the RX. As I remember it too had some issues. All the pertinent caps are replaced in it too. Took me all day to get the filter back in with all the wires I had disconnected to get the filter out and also to find the issue with that filter. The filter is one that I replaced the innards with a plastic Collins 2KC filter of the same general specs. It's made the same way, just a plastic box. Not sure where the short was, but it seems OK now. I'm sure one of those #40 wires from the coil to the contacts inside shorted to ground. I replaced them with #30 enameled wire. 40 is just too small for me to work with anymore.

Date: Sat, 27 Oct 2018 21:15:21 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, good deal on getting your 2kc filter working and installed.

When you said that the level jumped 10db, did you mean on the carrrier level meter? If yes, then the 4th IF does not normally affect that reading.

The 'snap' when touching the mV meter probe on the plate is interesting, do you normally get that? Not sure why that would cause it to temporarily work. Do you have vtvm dc readings for the plate, screen, CG, and cathode, when it's not working?

About the IF's that need stagger tuning, I believe they were only used for the 1st couple years and did not have the Q reducing resistors in them.

Date: Sun, 28 Oct 2018 04:10:59 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Gain drift

Dave, I should have elaborated a little more when I said: 'If yes, then the

4th IF does not normally affect that reading.' That's true under normal operation where the current would not change much in the 4th IF tube. But in your case there is something unusual going on, so maybe the current is changing considerably causing the CL meter to read abnormally.

Date: Tue, 9 Oct 2018 10:15:54 -0400
From: dog <agfa@hughes.net>
Subject: [R-390] Receiver noise

When I don't have an antenna on the balanced (or unbalanced) inputs, the noise level is quite low on the RX. Using a small SS amp off the diode load to a speaker. Attaching an 80M dipole to the balanced port results in a huge amount of noise/signal increasing the output by a lot. Now on any of my other radios, I can hear the rx internal noise with no antenna, and when I attach an antenna, I hear an increase but nothing like the R390A. Is this typical I don't remember these receivers being that much different than any others or am I having some issues with this radio AGC works fine, signals sound fine AM mode in 8 or 16KBW if it's 30dB on the carrier meter or better. Sensitivity measures less than 2uV and passes the 10:1 S/N tests easily with a calibrated Moto 2005D. With no antenna attached I can get an increase in internal noise using the Ant Trim but attaching a dipole and listening to 10MHz WWV I really have to turn the volume down.

Date: Tue, 9 Oct 2018 14:03:46 -0400
From: Roy Morgan <k1lky68@gmail.com>
Subject: Re: [R-390] Receiver noise

Is this an R-390/URR (the non-A) (That should not matter it seems to me.) Have you set the IF gain On an R-390A, it is often found that the IF gain needs to be adjusted. The procedure is simple, though I don t remember the details. I would put a resistor on the input (125 ohms on balanced input), no antenna, gains all the way up, and set the IF gain pot for modest noise - a low level on the line output meter. (AGC on or off should not make a difference.). Then see if most bands give the same amount of noise.

You might want to do a rough sensitivity check if you have a signal generator. Note that the calibrator signal is introduced at the very first stage of the radio, and gives a quick rough check of overall sensitivity. Also you may want to go through the set with known good spare tubes one at a time, replacing the original at each step, to see if you have a weak tube.

Date: Tue, 9 Oct 2018 16:44:17 -0400

From: dog <agfa@hughes.net>
Subject: Re: [R-390] Receiver noise

R390A model. Yes, I don't have a load on the balanced input. I see in the manual they use a load. IF gain has been set using the book method and also the other Line Level method, but no load on the antenna port, I've been told both things, load or no load. My sig gen is a 50 output Moto service monitor 2005D. There's not a whole bunch of difference between the two methods, but it does seem like the gain is hot. I do notice the 14MHz band seems a bit lower in noise than the rest but it still meets the sensitivity test easily. Is that mostly a function of the band crystal oscillator I only have another set of tubes for another 390A but they are all suspect as well as a few spares. I have no way to test other than substitution. Everything in these radios is pretty much original or replaced with original parts, no SSB mods and the like. Still using the tube rectifiers. Caps replaced in the PS as well as the RF and IF sections. Listening to it over the air it sounds fine. I'm actually trying to sell it. It's got all the panels, meters and all. Front panel is a bit rough is all. In the past I went through it and did a complete tune on all the circuits.

Date: Sun, 28 Oct 2018 10:51:58 -0400
From: dog <agfa@hughes.net>
Subject: Re: [R-390] Gain drift

The 10dB jump measurement is on the plate of V504 on the mVmeter. I'm pretty sure the grid doesn't do that. A snap is typical when touching either the grid or plate with the probe. I've notice before when the gain jumps it's usually accompanied with a snap, but usually it's because of an interruption it the RX like switching from MGC to AGC or turning on the noise limiter or the like. No, I haven't been monitoring the voltage on the plate of V504. I was thinking about doing that very thing.

And yes, I'm still getting a bit of drifting around in the CL meter with constant input in AGC mode, but not like when the AGC line was disconnected.

Another thing I've noticed is sometimes when I switch the BFO on it's like the AGC has been whacked out and it takes a second or more to recover. I don't remember this happening before.

Although I've got the 2KC filter back in I notice I have a lot of loose connections in that module that I unhooked searching for the short in the AGC line (the filter). So I've got a bit of work and checking to do yet to get that module working. Might get it done today.

Wife helped me pull that filter apart, I used a small butane torch and she pulled on the cap. I had to wrap a wet cloth around the label to keep from melting it. It finally came out. It's easy enough to solder it back on with a decent iron.

Date: Mon, 4 Mar 2019 01:18:35 +0000 (UTC)
From: "Tom M." <courir26@yahoo.com>
Subject: Re: [R-390] Newbie looking for Calibration Instrument(s) feedback...

David, one more thing. While operating the receiver, slightly move the MHz change knob while watching the S meter. If the signal improves while you rock the knob back and forth, it could benefit from alignment (on that set of bands). Check each band. If there is no improvement when you rock the Mhz knob, then it's probably pretty good already. This doesn't mean the tubes are good naturally, but points to good mechanical alignment.

Date: Wed, 10 Apr 2019 15:19:40 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] IF Transformer, alignment and performance

I have been lurking for quite a while, I continue to travel extensively and rarely get to fire up my radios; but on to sensitivity:

We know what S/N (signal to noise ratio) and receiver selectivity has probably even more to do with receiver performance than just sensitivity, expressed as either RSL in dBm, uV or S-units. Once you get to the point where you are between 3 and 0.5 uV sensitivity and you are still wanting more you find yourself chasing after ways to improve selectivity. I did a few things to improve selectivity; since I was not worried about ESSB or wideband audio quality for BCB or SWL listening (I primarily listen to SSB or CW) I went after the stagger-tuning on the IF, going with a conventional alignment of the stages instead of an offset made the radio more selective. Building a 12 KHz wide roofing filter between the RF and IF decks helped as well. Fortunately I live in a radio-quiet area where across most bands the background noise levels are -110 to -115 dBm (S2-S3) when there aren't thunderstorm crashes I can dig out some good ones off of the tail end of a 1600' beverage.

Trying to do better than -110 to -112 dBm RSSI required the use of a Faraday cage and constantly swapping good tubes for good tubes to find the quietest one. It reverted to black-magic and I wanted to do blood sacrifices and scatter chicken bones for better results. That is when I put a stop to that fools-pursuit.

Date: Wed, 17 Apr 2019 05:20:48 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: Re: [R-390] IF Transformer, alignment and performance

>Fortunately I live in a radio-quiet area where across most bands the
>background noise levels are -110 to -115 dBm (S2-S3) when there aren't
>thunderstorm crashes I can dig out some good ones off of the tail end of a
>1600' beverage.

First: OK, I admit lust for such a receiver site.
Second:? With a 1600 foot beverage antenna I'd think you could pick up a Flea Fart From Figi with a crystal set!

>Trying to do better than -110 to -112 dBm RSSI required the use of a
>Faraday cage and constantly swapping good tubes for good tubes to find
>the quietest one.

It reverted to black-magic and I wanted to do blood sacrifices and scatter chicken bones for better results. That is when I put a stop to that fools-pursuit. Gee, where's a good on-call witch doctor when you need one.<G>
Now we enter the Twilight Zone of performance enhancement. Was this with the stock OEM tubes? If so lots of blood, sweat, and tears. Chuck Felton reported a 6dB S/N improvement by the direct plug in of a 6BZ6 for the 6DC6.the BZ is a true semi-remote cut-off while the DC is a sharp cut-off tube. Going for maximum performance is the *Competition R390A* mod done by Ray Osterwald N0DMS editor of ER magazine. Which is in the Y2KR3 manual. Between the to mods there is a lot of middle ground that one can try. The saga continues, but that's our hobby.

Date: Thu, 18 Apr 2019 23:55:42 +0100
From: jm <josemic@gmail.com>
Subject: [R-390] r390a and SDR (software-defined-radio)

Taking advantage of the IF external connection of the receiver, I have been using it with my SDR dongle. It is a Funcube pro+ and the sdr software is Gqrx running under Linux. I have to thank my son the program settings and his willingness to help me with the obscure world of Linux. The combination of both new and old technology runs smoothly. Obviously, the program is tuned to 455 kcs and the bandwith used in the 390 is its maximum capability, 16 kcs. I am impressed by the technical level of the people in the list and hope not to be an annoying beginner that makes silly questions. In spite of the above, here are my questions:

1. I was surprised about the floor level in the sdr sofware. The floor is -100 db which is very low, in my opinion, according to what I have read

about the 390. I don't aspire to have a receiver whith a 'galactic level' as Mr. Rippel says, but this is far from expected. Does that level correspond to the r390 or is it the sdr receiver level (funcube)?

2. I read somewhere that it is possible to feed the sdr receiver through some point of the 390 with the result of obtaining a much widest bandwidth. I remember that could be extended to 1 mhz. The current 16khz is appropriate for amateurs chunks of bands but in broadcasting the reception is limited to only one station.

Date: Thu, 18 Apr 2019 18:58:35 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] r390a and SDR

Can you clarify? Not sure what you mean "the floor is -100 dB." Do you mean -100 dBm or -100 dB relative to WHAT? If the noise figure of the receiver is known up to the point of the IF output port and the S/N ratio for the SDR software is specified for proper decode or display, you should be able to determine a noise floor value. That is typically specified as xxx dBm.

Date: Thu, 18 Apr 2019 21:53:21 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] r390a and SDR

Hi Jose, In reference to increasing the bandwidth, it might be possible to increase it to 50 or 60 kh, but I doubt any more than that. In order to do that, you would need to bypass the 16 kh filter in the IF deck. You would also need to put a custom filter in it's place to increase the gain of the skirts, so the result would be some what flat. The R390s were designed to not have a panoramic bandwidth.

Date: Fri, 19 Apr 2019 09:00:09 +0100
From: jm <josemic@gmail.com>
Subject: Re: [R-390] r390a and SDR

Many thanks for your answer. Sorry that I'm not very familiar with the terms. I think thas it's called the noise floor. In my layman words the place where the signal begins. I have checked different sdr receivers and the point (I suppose the noise floor?) where the signal appears is different. For example in the sdrplay the figure is -90 db. In the case of the combination Funcube/r390 is -100db. My doubt is whether that figure of -100db corresponds to the sdr receiver of to the 390. I am not sure if my explanation now is clear enough.

Date: Fri, 19 Apr 2019 09:02:15 +0100

From: jm <josemic@gmail.com>
Subject: Re: [R-390] r390a and SDR

Thanks Larry. 50-60 khz would be a good improvement.

Date: Fri, 19 Apr 2019 07:21:40 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] r390a and SDR

If the R390A is set to 16 kHz BW that is a noise power 40 dB above kTB or -100 dBm. If the NF of the 390A is say 10 dB that would at least place the noise floor at -90 dBm. Perhaps additional gain would be required to improve the S/N ratio at the display. What am I missing? Is the noise floor of the pan adapter much higher? Hence we require a wider BW prior to applying signal to the adapter.

Date: Fri, 19 Apr 2019 19:36:29 +0100
From: jm <josemic@gmail.com>
Subject: Re: [R-390] r390a and SDR

I thought that the noise floor could be better than -100 db . My mistake.

Date: Mon, 22 Apr 2019 11:08:58 +0100
From: jm <josemic@gmail.com>
Subject: [R-390] r390a and SDR

The noise floor that I can see in the sdr software (-100 dbm) belongs to the sdr device or to the r390a receiver?

Your explanation is about a noise floor of -100 dbm. This level could be considered as low if the comments of Chuck Rippel are taken into account (up to -143 db in exceptional cases). Is my receiver performance below its possibilities?

Date: Mon, 22 Apr 2019 19:16:38 +0800
From: Martin Sole <hs0zed@gmail.com>
Subject: Re: [R-390] r390a and SDR

It belongs to the sdr most likely, and can be made to show whatever you like by adjustment of some sdr controls, depending on the software and driver. Quite often you can adjust the gain of the sdr device which esentially moves the "grass" that which shows as random noise in the spectrum display. This is purely a relative figure, unless calibrated, and most likely bears no relationship to the performance of the receiver to which it is attached as a detector at the receivers IF. Much will also depend on the gain in the receiver between the antenna port and the

IF output. I don't know the R390 that well but I doubt the noise level present at the IF output is much lower than -100dBm possibly it is even higher than that. I expect there is significant amplification between the antenna connector and the IF output.

Date: Mon, 22 Apr 2019 06:18:03 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] r390a and SDR

I was trying to clarify the original query posted by Jose. In any case, I suspect that the SDR could be treated no different than a spectrum analyzer or a swept receiver with a noise floor. The question is, does the R390A have a selected bandwidth (BW) which could provide sufficient noise power output to display on the SDR? If not, either the SDR noise floor must be lowered, add a low noise preamplifier, or the bandwidth of the R390A must be increased. I took the example of its widest bandwidth, 16 kHz, that is 10 log BW or 40 dB above kTB; -174 dBm. Hence, the 390A at zero dB noise figure would generate a -100 dBm noise power floor. Well, the NF is not zero in the 390A, so that would further raise the floor. Furthermore, 16kHz BW may not be wide enough to be of much value for a SDR display. So it seems like addressing the construction of an outboard IF strip taken directly from the 390A and bypassing its internal module may make sense. I believe that was Larry's point.

In any case doing both, decreasing the SDR noise floor, and adding a high IP3 low noise preamp to the SDR and an independent wide band IF to the 390A would make a nice listening post. My 2 cents. Alan

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Date: Mon, 22 Apr 2019 22:02:42 +0100
From: jm <josemic@gmail.com>
Subject: [R-390] sdr and r390

One of the sdr programs that I use is SDRuno. When you move down the "grass" the dbm scale moves accordingly. So if the noise floor is at -100dbm, it is maintained at the same level in the new position.

Date: Mon, 22 Apr 2019 22:14:32 +0100
From: jm <josemic@gmail.com>
Subject: [R-390] r390a noise floor

Anyone has had some experiences about a noise floor better than -100 dBm? " the R390A is capable of copying signals down to its -143db noise floor, close to the galactic limit " (C. Rippel). Is there something I am missing?

Date: Mon, 22 Apr 2019 18:11:13 -0400

From: <jgedde@optonline.net>
Subject: Re: [R-390] r390a noise floor

When mine is restored, (soon) I'll check it. I have equipment capable of measuring that low... But, the following caution is made: -143 dB compared to what? dB is always a ratio... Without knowing what Chuck used, we can't speculate... All that said, I wouldn't lose any sleep over the noise floor. Suffice it to say, the r390a's noise floor - especially if you optimize the tube locations - is more than sufficient for our modern day, noise filled environment. Disconnect your antenna, put the receiver in MGC mode, then short the antenna balanced inputs together. Compare that to what you hear to what you hear with the antenna connected on a dead frequency. If it's dramatically different - which I'm sure it will be - you needn't worry about the R390a's noise floor. -143 dB is crazy low (even compared to a thunderclap) and will almost certainly never be achievable in real life except in a screened lab.

Date: Mon, 22 Apr 2019 18:38:50 -0400
From: <jgedde@optonline.net>
Subject: Re: [R-390] sdr and r390

It's not a fair test to use the SDRPlay as a spectrum analyzer. Without going crazy into the math, noise and bandwidth are closely related. Firstly noise floor over several MHz is a far cry from the noise floor over 16 kHz (max). Secondly, I would guesstimate the R390a's noise floor bests that of the SDRplay by 20 dB or more from the get go. My opinion is, and take it for what you wish, that noise floor is just bragging rights. Outside of a laboratory environment, it's academic. Don't get me wrong, I want my R390A to hit -143 dB too, but I'll never see any benefit apart from bragging rights.

Since you posted, I've hooked up my R390A to my SDRPLay2 and it yielded similar results (using SDRUno). Also keep in mind the SDRPlay uses AGC which will have the effect of raising its gain its noise floor to support its dynamic range... -100 dB is quite respectable - not quite CD quality but better than a cassette tape with dbx or Dolby C back in the day. In short, you're not missing any signals in all likelihood.

A real measurement might consist of shorting the balanced antenna inputs on the R390A and seeing what the SDRPLay says the noise floor is then. Then try turning off all AGC in the SDRPLay and setting the IF gain to say mid span. Again, SDRPlay is not a spectrum analyzer and it reports dB – but relative to what? It's an uncalibrated measurement unless you reference it to something... Think of dB as a comparison between two numbers... Without knowing one, the other is meaningless.

I hooked my R390A to a 2 uV source with 30% modulation using high grade shielded cabling. I clearly heard the signal. Then I ran it in MGC mode, disconnected the sig gen, connected the antenna and was rewarded with deafening noise. Lesson learned? Even 2 uV sensitivity is academic with real world noise nowadays.

Date: Mon, 22 Apr 2019 23:44:41 +0100
From: jm <josemic@gmail.com>
Subject: [R-390] R390a and SDR

Very clear and educational. Many thanks

Date: Mon, 22 Apr 2019 16:54:00 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] R390a and SDR

I did not imply that the R390A was limited to -100 dbm at its INPUT. I indicated that its noise power at its output might be as high as -100 dBm. Most likely higher, let's consider the sensitivity equation. It's pretty straight forward. Sens (dBm) = -174 + 10 log (BW) + NF (dB) + S+N/N ratio in dB for desired intelligibility.

Lets plug in some typical numbers. BW: 3 kHz, NF: 10 dB, S+N/N: 10 dB Then SENS is -174+30+10+10 = -124 dBm. Obviously if we reduce the BW by another order of magnitude then we could achieve -134 dBm and so on. The noise power OUT would be dictated by the input sensitivity or the NF multiplied by the total forward gain of the receiver. Additional gain could be added as required as long as we don't compromise distortion, IMD, etc...

Date: Mon, 22 Apr 2019 20:06:44 -0500
From: <wb5uom@hughes.net>
Subject: Re: [R-390] R390a and SDR

Well, I decided to chime in here, hopefully I will not offend anyone. I have 3 R-390A's as well as a gathering of other "classic" Hf receivers, and I have several SDR's as well. I have played with the R-390 as the 'front end' to the SDR and it is fun to play with. But I really do not see how you can use the SDR to state the sensitivity of the 390, UNLESS you have calibrated it (the SDR) with a accurate signal generator.

I am lucky enough (on some days) to work in the commercial communications field, and happen to own a AEROFLEX 3920 service monitor that does SSB (and AM too). Now I have gotten frowns from others on various lists, but the 3920's generate function is calibrated down to -138Dbm. IF I say IF I use the MDS method (minimum discernable signal) on SSB - using a 1000khz test tone, I can hear that

test tone all the way to the bottom on the 390's and the Winradio 313i Does that mean I could copy a SSB station that weak, nope, because the tone is a steady signal and a voice ssb as we know is not. (And I am part deaf after all these years of listening to a 1khx test tone, so I have to wear headphones when I do this) I have never been a fan of the 12db sinad test, since in the 2way communications business we use the 20db sinad.
At 20db sinad, my 390's will do around -109Dbm as will my Winradio 313i on SSB

Now that you all have my mind going on this, I guess I need to bring the 3920 home and see what the SDRplay RSPduo will really do. Just my 2 cents worth.   David WB5UOM

Date: Mon, 22 Apr 2019 20:10:31 -0500
From: Robert Nickels <ranickel@comcast.net>
Subject: Re: [R-390] r390a noise floor

> I wouldn't lose any sleep over the noise floor.

Very true.? The ITU, RSGB, and others have made extensive studies, in part because of the horrific RFI from VDSL in the UK which elevates the HF noise floor to the level of unsuitability despite notching the ham bands.??? (VDSL uses overhead copper wiring to distribute internet/tv signals to homes using the HF spectrum - it's the bullet we in the US dodged when BPL was stillborn). But the easiest way to cut thru the technical jargon and data is to just look at this one chart that the ARRL put together which shows typical noise levels vs. frequency in various listening environments: https://i.imgur.com/BxWpZ3j.png

This makes it clear that unless you're in a quiet rural location and are tuning above 20 meters, you won't hear much below -122dbM, and unless you enjoy insanely optimal conditions -136dBm is the practical limit.
This summary from RSGB provides an easy-to-read overview and discusses measurement techniques:

http://rsgb.org/main/files/2017/12/221216-Noise-leaflet-issue-2.pdf
73, Bob W9RAN

Date: Mon, 22 Apr 2019 21:08:02 -0500
From: <wb5uom@hughes.net>
Subject: Re: [R-390] r390a noise floor

This is a very true comment below. I do live in a rural area that has been VERY quiet for years. I have about 400 feet of wire strung up in a rough configuration of a diamond. Somewhere I have pictures I took on the lower freq ranges of -130Dbm noise floor on the antenna. My new neighbor

likes electric fences...

Date: Mon, 22 Apr 2019 20:04:43 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] R390a and SDR

Hi David, thanks for the input.

>But I really do not see how you can use the SDR to state the sensitivity
>of the 390, UNLESS you Have calibrated it (the SDR) with a accurate
>signal generator.*

I agree and certainly did not make that inference, I hope. I believe all of this discussion is based on bench measurements from nice sources and NO ANTENNA. Just box to box calculations. An R390A to a panadapter and what is possible was my understanding. It would be useful to look at some bench measurements and then correlate those numbers to the performance of the panadapter. In the end, without modification of the 390A at 16 kHz BW what is the minimum BENCH discernible signal level?

Date: Mon, 22 Apr 2019 22:10:35 -0500
From: <wb5uom@hughes.net>
Subject: Re: [R-390] R390a and SDR

Never have played with 16Khz Bw. If I can remember this weekend, I may bring the equipment home and do some playing and see. Also, here is an interesting article that you might take a look at:
http://w1vd.com/R-390ASoftRockdetails.html

Date: Mon, 22 Apr 2019 21:45:52 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] R390a and SDR

Since you might be using Bandwidth in a formula, keep in mind that the R-390A bandwidths are not necessarily dead on. The specs for 4 kc and below are usually pretty good, but 8 kc is 7.5 khz and higher, and 16 kc is 12 khz and higher (measured at the 50 % signal output level). The last ones I measured were pretty good, but the 16 kc bandwidth can be affected by the stagger-tuning of the IFs. It could be wider or narrower. So, if your calculation is important, you may want to measure it (see chapter 4 of the Y2K tech ref).

Date: Mon, 22 Apr 2019 23:49:52 -0700
From: Alan Victor <amvictor@ncsu.edu>
Subject: Re: [R-390] R390a and SDR

Jay's document is an excellent read. Thanks for sharing.

Date: Wed, 24 Apr 2019 18:00:37 -0400
From: <jgedde@optonline.net>
Subject: Re: [R-390] Frankenradio gets its Front Panel Restored

Thank you! I'm still learning, tweaking and finding issues but so far the radio is working great with all the mismatched modules. I had a sensitivity issue that wasn't evident in use, but showed up in stage gain tests. I found a weak 6AK6 in the IF bank, replaced it and now the stage gain checks show proper diode load voltage at the low end of sig gen injection which is a good thing. Right now I'm listening to Radio Guinea on 9650 kHz loud and clear.

When all is ironed out: a line out oscillation, ovens blowing a fuse, etc. I'll do the full sensitivity check. I don't expect to be disappointed as I was seeing 3 uV for 10 dB (S/N + N)/N before the tube change. Diode load went from -3.7 to -7 just with that and I haven't tweaked the IF stage to match the new tube (not that I expect much from that since I already aligned it.)

Date: Sun, 5 May 2019 16:24:53 -0400
From: <jgedde@optonline.net>
Subject: [R-390] R390A sensitivity and noise floor measurements

After weeks of fiddling, tube swap optimizations, fixes, etc. I've got my R390A performing extremely well. I have an HP 8644A signal generator I bought from the local scrap dealer for scrap value (it works fine) and was able to make the following measurements:

Sensitivity: 0.55 uV for 10 dB S+N/N with a 30% modulated input. It'll do better with 100% modulation..

Noise floor: better than -137 dBm. I can't go any lower with the 8644A without additional attenuators (they appear to add noise of their own) and my noise environment isn't great. A screen room would be needed to go any lower. I fiddled a bit with the IF gain and got an improvement from -132dBm with the standard IF gain setting at -7V at the diode load to -137 dBm. The judging factor was whether the signal could be detected. At -137 dBm you could just make out that the sig gen was on or off. My spectrum analyzer can go much lower in noise floor and confirms I wasn't just measuring RF leakage in the sig gen: it can see -137 dBm no problem if I set up the BW just right.

While I am not able to repeat Chuck Rippel's -143 dBm and Sherwood engineering's 0.2 uV, I consider this quite good and I am very pleased. But to be fair, Sherwood doesn't state what they used as a source. If it was

100% modulation, then I was able to get there. I used the 30% modulation standard. I tend to doubt -143 dBm noise floor to begin with as I have stated before. I wonder if his sig gen is leaky? Sherwood got -137 dBm as did I. Another good R390A day! John

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Date: Wed, 26 Jun 2019 08:05:27 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Thrifty Tubes II

If you are only concerned about sensitivity then more gain may be better. If you are concerned about front end overload or adjacent channel selectivity, it generally is a bad thing. If you are concerned about your front end going into random oscillations at various times, it can be a bad thing. The normal design algorithm has (and had back in the 1950?s) you put minimum gain in front of your mixers.

Since tubes are far from uniform (even in the same type designation) in terms of gain, you can go overboard fretting about this. Anybody who owns a tube tester that does measure gain knows that a radio (or other piece of gear) can do pretty well with some “dead” tubes in it. Equally, putting in all brand new tubes into a working radio rarely makes a difference. There is a range that works ok and making sure of that was part of the design process.

Finally, not all tubes are in some hyper critical part of the circuit. There are always going to be stages where gain could be just about anything and the radio is going to work ok. That often gets you into “I this new tube and it worked” sort of conversations. The key question is always which location did it work in. Lots of fun !!! Bob

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Date: Fri, 20 Sep 2019 08:35:43 -0400
From: "John Gedde" <jgedde@optonline.net>
Subject: [R-390] 31 and 25 meter bands are HOT right now...

Fire up your boat anchors guys... 25 and 31 meter bands are HOT right now. Logging DX like crazy. Right now hearing a 1 kW station in Taiwan on 9180 here on the East coast of the US. Also heard VOA out of Philippines like it's local on 12180. Voice of Hope from Korea on 9100 (10 kW). Virtually everything https://www.short-wave.info/index.php says is on the air right now, I can hear!

Date: Sat, 30 Nov 2019 13:41:27 +0000
From: David Olean <k1whs@metrocast.net>
Subject: [R-390] Got my R-390A working great.

I have been slowly working on getting an R-390A running. I was side tracked for a short time with some carpentry, but had everything working except the carrier meter. The meter was pegged to the left at all times. Funny thing because when I first started work on the R-390A, that meter worked. (?) Well I finally got some time to work on it again, and found the problem with the meter, a bad bypass cap in the cathode circuit of the 4th IF amplifier. I did not suspect it as this was a 1967 EAC contract unit and it had modern poly caps in it. Of course I assumed those new looking parts were fine and so I looked everywhere else at first. The shorted cap looked like a 3 ohm resistor.

After getting everything running, I decided to tweak up the IF transformers. Just about every slug was badly stuck. I managed to get them sorta loose, but there must be something that can be put on them to make them turn more freely. Any ideas? Tuning the 455 kHz IF strip improved things a bit. Going on the higher bands, at 26.5 MHz, I was seeing -125 dBm at 1 kHz BW, and -123 dBm at 2 kHz bandwidth for a 10 dB S/N ratio. This is better than 0.3 uV.

I listened on the BC band and with an 8 kHz filter, that carrier meter was always up near 100! It hardly ever moved. I had a good beverage antenna on it and could not believe the signal strength. So now I have an R-1051B, an R-390 and a 390A finished. The next step is to work on a couple of R-392s. When I get those running I have to choose which one I will keep as I don't have much room for all of them. What a quandary! I am leaning towards keeping the R-390 from the first Collins contract.

Date: Sun, 1 Dec 2019 22:08:10 +0000
From: David Olean <k1whs@metrocast.net>
Subject: Re: [R-390] Got my R-390A working great.

Well, I did some more testing today and played with the IF gain internal pot. Turning the gain down definitely improves the S/N ratio, but not by a huge amount. Still it is very significant. Someone asked about 7 MHz and I saw much worse sensitivity on 7 MHz vs the other bands. I tried a 4 kHz band width and saw about -121 dBm in 4 kHz on most bands. (-121 dBm = 0.2 microvolts.) 8 MHz was -121 as was 26 MHz. 7.5 MHz (middle of the band) showed only -117 dBm at 4 kHz. (-117 dBm = 0.32 microvolts). The same crystal is used on 27 MHz and my sensitivity there at 4 kHz was a bit worse than other bands, but not too bad at -120 or maybe -119 dBm. (-119 dBm = 0.25 microvolts). Then I remembered that my 15 MHz crystal for 7 & 27 MHz was NG., and I had dropped in a 7.500 MHz crystal and it worked, but not so well. I scrounged around my junk box and asked my brother and he does not have a 15 MHz crystal either. Someone on this list had one and offered it at $8, (He said it was a tad off frequency) so I definitely need it.

Looking at the RF output of the crystal oscillator module, 7 and 27 MHz have very low output with the wrong crystal installed. It looks like 7 MHz does worse than 27 MHz. I need the proper 15 MHz crystal!

If I use a wider bandwidth or a narrower one, those sensitivity numbers change and I get better sensitivity at 2 kHz and 1 kHz. Sensitivity drops a bit if I measure in an 8 or 16 kHz bw.? That all looks OK.

I ended up turning the IF gain way back and an S9 signal (-73 dBm) reads about 54 dB on the carrier meter. The linearity of the carrier meter is not perfect, but at least S-9 is good at 54 dB when you figure 6 dB per S- unit. This R-390A is just about ready to go!

Date: Sun, 16 Feb 2020 22:26:08 -0800
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] decreasing signal touching kilocycle knob

Hi Jose, Yes, that would be bothersome to me also. Two things, is your rx grounded correctly? The 2nd could be the external grounding finger on the VFO shaft - they can get to where the slightest movement will change the contact and thus the grounding of the shaft and therefore the vfo frequency. Also check the end play on the vfo shaft - there should be none.

Date: Mon, 17 Feb 2020 14:24:53 -0800
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] decreasing signal touching kilocycle knob

Jose, To check the end play, grab the VFO shaft with your fingers and try to move it in and out with a little pressure. Not too much, though (just a few pounds). The VFO shaft ground is a 90 degree metal stock that is mounted on the VFO shaft collar by the manufacturer and contacts the shaft. Verify that it is in contact with the shaft with a little bit of pressure and the contact is clean. Just apply a drop of deoxit to the contact point.

Date: Tue, 24 Mar 2020 00:06:25 +0000 (UTC)
From: "R. David Eagle" <kb8nnu@yahoo.com>
Subject: [R-390] R-390A Best Cal. Procedure

Hello all. I am getting back in to finishing out my Motorola 390a now that I am at home for a few weeks. I was curious what the best calibration procedure is to use? How critical is it to have the line voltage at 115 Volts

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Date: Mon, 23 Mar 2020 17:41:25 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] R-390A Best Cal. Procedure

Hi Dave, The input vac is not critical, but a good range is 110vac to 117vac, with the best at about 113vac. This range will keep the calibration right on and keep the stress within reason.

Check the VFO EP adjustment and correct if necessary. It should be within 500 hz, less is better. Follow the WWV calibration procedure in the tech ref after it's warmed up for at least an hour or when the VFO becomes stable. Monitor a stable station looking for very little drift with the BFO on. Use the highest WWV you can receive well.

Date: Tue, 24 Mar 2020 13:46:13 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] R-390A Best Cal. Procedure

I am seeing 125.22 VAC right now; It seldom deviates more than a half a volt. Sometimes I can hear the tap-changers down at the substation as they move a few times each day (33 position switch; 16 positive, 1 neutral, 16 negative). Each step on the tap changer can move my line voltage up or down 0.75 volts (changers are +/-10%). The utility sets the line voltage higher because they have some long distance runs that go up north of here, along the crest of the mountain with no intervening tap changers to compensate for line losses. Being close to the substation it means that I will always be on the higher edges of what ANSI C84.1 has as service voltage limits (114-126 VAC).

Running on the high side of mains voltage has not hurt any radios. We need to remember that many of these were intended for some pretty lousy mains voltages being supplied by a 10-50 KW generator that was burning fuel of questionable quality; Maybe adjusted by an E-3 who was listening for the right sounds from the generator and not any particular line voltage or frequency.

Once a radio warms up and the crystal oscillators find their happy place they are pretty stable on frequency.

Date: Wed, 25 Mar 2020 19:05:29 +0000 (UTC)
From: Steve Toth <stoth47@yahoo.com>
Subject: Re: [R-390] R-390A Best Cal. Procedure

TishaAlways enjoy your posts - and your sense of humor (something sorely needed these days). The reference to the R390A crystal oscillators stabilizing when they find their "happy place" brought a big smile to my face.

Date: Fri, 27 Mar 2020 01:54:28 +0000 (UTC)
From: "R. David Eagle" <kb8nnu@yahoo.com>

Subject: Re: [R-390] R-390A Best Cal. Procedure

Thanks for the info Larry! I am going to start the process this weekend of getting all aligned.

Date: Wed, 24 Jun 2020 19:19:39 +0000
From: "FISCH, MICHAEL" <mfisch@kent.edu>
Subject: Re: [R-390] PING!

Well, I have a problem. I turned the calibrator on my 390 on and it sounds like it is ill, unstable, etc when I tune through the signal. The BFO and PTO are fine on a signal generator so they are not the problem. The frequency of the calibrator varies and it is at 0078, .182, ... So it's the crystal or the tube or maybe the multivibrator. Or is it something else? It’s in a rack so I'm reluctant to pull the beast without a plan. Any thoughts? Mike AC8PD PS Ohio is still here.

Date: Mon, 22 Feb 2021 16:30:42 +0000 (UTC)
From: Thomas Hoyer <thoyer1@verizon.net>
Subject: [R-390] R-390 Mechanical Alignment

Working my first R-390 (Been through a few 390A's) and I have a question about the cam alignment statement in the manual (different sections and fig numbers depending on version you are looking at).
I'm looking at the TM 357-35, 1962 version and in section 73 a.1 it states that the image in figure 44 shows the cam position of the 1-2mc cam bisecting the alignment line and states this is for the "low" end of the band. I can agree with this as the slugs are fully engaged in the RF modules for low end adjustment. It then goes on to say that the second IF cam shown in that image is shown at the high end of the band (indicator reading 999). When I tune to the high end of the band, my second IF cam is not in this position. It is almost in the opposite position where the slugs are fully engaged in the RF modules. I would expect the slugs to be out of the modules at the high end of the band so the trimmers could be adjusted.? Is the text wrong and the image of the cam position for the second IF is really at the low end of the band - not the high?
There is another section in the manual where it references the same image and says that it shows the cam positions at 0200 - which all my cams seem very close to aligning with.

Date: Mon, 22 Feb 2021 12:41:28 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] R-390 Mechanical Alignment

I've been thru this recently...
1_ The Collins manual for the R-390, dated 23 October 1953 is OK: the

position of the cams HAVE TO BE looking like in the "figure 44" when the tuning is at 2.000. The corresponding figure is 91 in the 1953 manual.

2_ The Army manual TM11-856 is COMPLETELY WRONG when it states the position of the of the second IF cam in the Chapter 110 1) (P.116): "The position of the second if cam shown in figure 90 represents the correct position for high end of the band (the last three digits of the frequency indicator should read 999)". The figure # is 90 there. I do not know who was responsible, but the preceding text between quotes makes absolutely no sense (As you doubted of...) and should be disregarded.

3_ Surprisingly enough, this nonsense was perpetuated in the TM11-5820-357-35 of 9 March 1962 Chapter 73 1) (p. 88) (same text....).
I admit to have scratched my head for a few hours when I began the alignment of my Collins sn 2074. But I finally figured out that this paragraph made no sense and aligned the cams at the 2.000 position, then all the rest of the alignment went on beautifully.

So the proof is in the pudding, should I say.
My set is now running as new, but with some modifications:
_ 12BW4 rectifiers
_ 6080 regulator tubes
_ W7DI "improved" product detector with Larry Haney?s AGC modifications.
_ Modified squelch circuit (original one being incompatible with the W7DI product detector scheme).

Good luck with your own R-390 !

Date: Mon, 22 Feb 2021 18:33:27 +0000 (UTC)
From: Thomas Hoyer <thoyer1@verizon.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

Thank you for confirming my suspicions, for once I'm not going crazy......?
I'll dig around for the Oct 53 manual. The ones I have are 55 and up.
I do have the solid state regulator kit for this beast. I originally bought it for my 389 but since that radio is working perfectly I decided to save it for use in the 390. This radio has been in my "que" for about a year now.
Looking forward to getting it back alive again.

Date: Mon, 22 Feb 2021 14:21:59 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] R-390 Mechanical Alignment

If ever you can find the Collins R-390 1953 manual (on line or in paper) please tell me. I once searched it on the web, but never been able to found

it. However, I had an original copy in hand in 1983 and "photocopied" it. I found my R-390 in a local "army surplus" store in 1982. I used it as-is at the time, but it was left is storage from 1985 to 2018 ! I then began to restore it. Final alignment and modifications were performed last December. For the "proof-in-the-pudding": when the KC display shows "000" the PTO runs at 3.455 MHz, so the 2nd IF have to be tuned at 3.000 MHz to provide a 455 kHz IF. So the tuning slugs have to be OUT of the coils. At "999" the PTO runs at 2.454 MHz and the 2nd IF at 2.001 MHz so the slugs have to be IN the coils. This matches the position of the 2nd IF cams in the pictures for the "000" position, contradicting the text.

Date: Mon, 22 Feb 2021 14:56:59 -0500
From: "Robert P. Meadows" <rpmeadow@bellsouth.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

I probably have an original manual around here somewhere, plus three or four R390 in various states. One is my first one that went away and came back, over a period of about 35 years.

Date: Mon, 22 Feb 2021 15:15:21 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: [R-390] TR: R-390 Mechanical Alignment

My 1953 manual copy is spiral bounded, so not that easy to scan...
I made a photo (attached) of the related page, however.
No mention of the 2nd IF cam into.
The more recent TM11-856 and TM11-5820-357-35 are OK only if the following text is blanked out (or disregarded, whatever you like):

"The position of the second if cam shown in figure 90 (or 44) represents the correct position for high end of the band (the last three digits of the frequency indicator should read 999)"

Again, I do not understand where this sentence came from, as it just makes no sense.

Date: Mon, 22 Feb 2021 19:24:52 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

Silly me, I thought there would be a pdf of one out there in cyberspace - none that I could find. That's ok, now that I know the pic is correct for 0200 I'm good to go.

Date: Mon, 22 Feb 2021 19:07:40 -0600
From: Cecil <chacuff@cableone.net>

Subject: Re: [R-390] R-390 Mechanical Alignment

It’s 02 000
2mhz not 200khz.

Date: Mon, 22 Feb 2021 20:21:40 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] R-390 Mechanical Alignment

The "23 October 1953" R-390 original manual which I once had in hands was coming from the Canadian Army, Kingston Museum of Communications. It seems to be a pre-issue of the TM11-856.
This is the only R-390 manual I have seen that identifies the ballast tube as being a 2HTF11B instead of a 3TF7. The number of copies still available could be very small. This manual applies only to the first production Collins units, before any of the Engineering Changes (1,2 and 4) were issued. It also contains some information that are not found in the later manuals, like a complete table of parts with their Signal Corps Stock Numbers. Also, if any of you experience problems during the restoration of your R-390, do not hesitate to ask for help. I've been thru a couple of issues with mine, so maybe I will be able to give more advice.

Date: Mon, 22 Feb 2021 20:26:56 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

Thanks for the offer Jacques.

Date: Mon, 22 Feb 2021 20:29:31 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

You are correct, it is my typing that is bad - not enough zeros (same could be said for my paycheck!). Just finished going through the mech alignment at 02 000. Someone was in there before as two of the Bristol head screws were fairly stripped. I was able to get them out and found some replacements in one of my spare parts boxes. Onward and upward!

Date: Tue, 23 Feb 2021 15:29:00 -0600
From: comcents <comcents@bellsouth.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

is the original question / issue resolved?

I believe my manual is R390 A/ 391(A) is from 1953 and may have the

answer(s). I rebuilt my 391 in early to mid 70's from that manual, but I don't claim to remember much about it now. I had an advantage we do not have anymore (Randy was handy if I had a question)

Date: Tue, 23 Feb 2021 19:25:22 -0500
From: "thoyer" <thoyer1@verizon.net>
Subject: Re: [R-390] R-390 Mechanical Alignment

Yes, I Jacques and Cecil confirmed my questioning of the alignment text. Thank you for asking
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Date: Wed, 24 Feb 2021 13:39:11 -0600
From: Paul Staupe <staupe@gmail.com>
Subject: [R-390] Diversity with an A and a non-A?

I read through the Pearls just now and didn't see any references to diversity reception with a R-390A and a R-390. I have one of each, so I'd like to try it out. Both receivers are capable of diversity reception and I imagine it's possible to do. I'm wondering if the phase delay in the mechanically filtered A model would be significantly different enough than the L/C filtering in the non-A to make a noticible difference in this configuration vs. a set up with identical models?

Date: Wed, 24 Feb 2021 20:56:45 -0000
From: "Fred Moore" <fred_moore@usa.net>
Subject: Re: [R-390] Diversity with an A and a non-A?

I don't think you need to worry about any difference in propagation deleay between the two receivers. gain matching is important. check schematics to confirm that the diode connection is done the same way (almost certainly is compatible). Then it can be tried.

Date: Fri, 19 Nov 2021 14:11:54 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: [R-390] R-390A 2nd Oscillator alignment...?

I'm wondering if there has been a consensus as to a reliable way to set T401 in order to perform the alignment of the 2nd Osc. and the variable capacitor bank...? I've read and tried a number of various methods published by users and what can be found in the various manuals including the R-390 non-A manual, which is the procedure I have finally resorted to in order that the oscillations in this '60 S-W deck remain stable, which thus far appears to have worked. Thoughts, opinions etc. much appreciated....73..Jordan VE6ZT

Date: Fri, 19 Nov 2021 23:08:08 -0800

From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] R-390A 2nd Oscillator alignment...?

Hi Jordan, None of the tech refs do this subject justice, especially the 1956 Army version (it's totally missing). This is very noticeable because of the frequent discussion on our forum.

Although I haven't tried it, I like the R-390/URR tech refs process, but it too does not discuss the very common situation where some components like the crystals and SM caps may have drifted value and this requires a little more finesse. What you will most likely end up with today is some of the trimmers are at or close to the end of adjustment, some in one direction and others in the other. When the situation is at hand where a trimmer is at end of adjustment, the T401 needs to be adjusted slightly so that all the trimmers can be adjusted where they are not at the end of travel. If this is not possible, then replacement of a crystal that has drifted too far off frequency needs to be replaced or the trimmer or its parallel SM cap needs to be repaired or replaced.

As far as instability goes, I've only seen that when the trimmer involved needs to be cleaned or an SM cap is going bad or some connection is bad.

Date: Sat, 20 Nov 2021 07:04:23 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] R-390A 2nd Oscillator alignment...?

Some background and some clarification may be in order. Sorry if this a bit of a long post... When I first pulled the RF deck with the 2nd osc. module attached, I found that R406 and R407 had been badly cooked and both were disintegrating and the board underneath them badly discolored. As a result, I searched thoroughly to see if anything else appeared to have been overheated, including the coil and connections within T401, and all the B+ leads to the tube socket and the crystal bank fed off the plate of the 5654 oscillator tube. There were no signs of insulation melt or discoloration, or wires having been overheated, so while replacing Rs 406 and 407, I checked the ceramic bypass caps C411, C412 and C413 for leakage and found none at all.

Since both resistors were cooked, it appeared that the B+ "short" had to be after R406 in the plate circuit, which leaves only the primary of T401, the plate of the tube, and the capacitor bank connected to the plate circuit. There was no tube present, so I couldn't check that for a short, so I inserted a vector socket into the tube socket, disconnected J410, and connected my TO-6 from pin 5, the plate pin of the tube socket, to ground. Again, I could not detect any leakage while cycling through each of the 31 positions of switch S402 even with 600Vdc applied from the TO-6, so I reinstalled the RF and Osc. assembly and began work on the RF deck circuitry which is not quite complete yet. What I then noticed while setting T401 and the caps was that I could set all the caps for good strong peaks, but on the 2 lowest bands the peak would randomly shift and lower the sensitivity on those bands by 10-20 dB, so I adjusted T401 slightly and reset all the caps, but the bottom 2 bands would still "drift" off the peak, which I when I started searching for a proper method of setting T401.

So far, this is by far the most finicky 2nd Osc. I've ever worked on, but I think I've solved the problem by using a very slightly modified version of the method described in the R-390 non-A manual for setting T401. That manual says to adjust T401 in the 31MC position so that only 1 peak can be found by rotating the cap, and then adjust T401 slightly away from that position. What I ended up doing was setting T401 until a single peak could be found while adjusting the 31MC cap, and then adjusting T401 roughly 1/2 turn farther into the coil where 2 peaks appeared within a few degress of rotation of the cap. I then went through the remaining bands and set the caps for peak noise on the Line Level meter with the AGC off, and the issue with the bottom two bands has been resolved. I can't figure out what caused the burned resistors, but I do recall finding a 3/8" machine screw rolling around under the oscillator deck when I first pulled the rig apart to clean the chassis. Whether it caused a short, or the tube itself developed a short, I can't say, but it appears the damage was limited to those 2 resistors...   73...Jordan VE6ZT

Date: Sat, 20 Nov 2021 07:07:36 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] R-390A 2nd Oscillator alignment...?

P.S....

The third sentence should read: "...B+ leads to the tube socket and the capacitor bank fed off the plate...."

Date: Sun, 28 Nov 2021 07:40:37 -0600
From: Paul Staupe <staupe@gmail.com>
Subject: [R-390] R-390A deaf below 600 KC?

<clip>   Secondly, and more concerning is that below 600kc there literally is no signal. I primarily use my EAC for BCB DXing and I need to figure this out for sure. Thirdly, although the 10 turn pot is installed, the carrier level meter is very insensitive and only moves 1/8 of the scale between the loudest and lowest signals. So I've got a pretty looking radio but there is some work to be done. Any suggestions?

Date: Sun, 28 Nov 2021 09:29:24 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] R-390A deaf below 600 KC?

<clip> As far as a lack of sensitivity below 600khz, are you sure the cam and slug rack for that band is in alignment according to the manual. The cam for that band should be very near the peak of the cam when tuned to 00.999.99+, and continue past the peak of the cam as you pass 1.000.00+ on the bottom band... I hope some of this helps....

Date: Mon, 6 Dec 2021 05:43:26 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: [R-390] Collins trim cap settings..?

I hope this request will make sense to some of you all... I recall that there is a way to determine how to set the trim caps for mid-range by the position of the capacitors value printed on the rotor, but I don't recall how exactly. It has something to do with the position of the printed value on the cap in relation to the "band" printed next to the adjustment opening for each cap. Does anyone know how to make that determination...?
I'm hoping so..!!

Date: Mon, 6 Dec 2021 05:04:58 -0800
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Collins trim cap settings..?

Hi Jordan, If you are looking at the 2nd osc unit with the trimmers closest to you (normal installed position) and the tuning tool slot is running left and right (parallel to the front of the unit), the trimmer is adjusted in the minimum or maximum position. So, if the tuning tool slot is parallel to the sides of the unit (running front to back), it is set at half value.

Date: Mon, 6 Dec 2021 06:17:21 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Collins trim cap settings..?

For further clarity, if the adjustment slot is at 90 degrees to the front panel, the cap should be at mid-range... The reason I'm asking is that I've read of a number of different ways to set T401 and then the trimmer caps, and I'm hoping to find a standardized method. Even the method I've used for years doesn't work on the S-W I'm working on now, so I'm trying to find if there is an actual fault in it or simply a mis-adjustment...

Date: Mon, 6 Dec 2021 05:20:07 -0800
From: Larry H <larry41gm@gmail.com>

Subject: Re: [R-390] Collins trim cap settings..?

I believe that is correct, Jordan.

Date: Mon, 6 Dec 2021 06:23:10 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Collins trim cap settings..?

Thanks again Larry....Jordan..

Date: Thu, 27 Jan 2022 11:57:54 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: [R-390] 1st IF tracking problem solved

Hi again group...

In going through this '60 SW, I had noticed a 1st IF tracking problem, causing a serious roll-off in the gain as I tuned upward through the 7 mhz band. During alignment, the core in L213-1 ended up having to be adjusted almost to the end of the threading above the 1st IF rack at the 1.250 mhz alignment point, far above the other 2 1st IF slugs.

While I could peak the variable cap in that transformer at 7.250 Mhz, I could still increase the gain by pulling that end of the slug even higher.

Since I had to replace a number of fixed SM caps in the xtal oscillator, and attend to some other concerns, when I last pulled the RF deck, I replaced the SM caps across the 1st IF cores which are under the deck, while I had access to the underside components.

While the rest of the work was highly successful, I still found a problem with the 1st IF tracking, in particular the same slug in L213-1. In fact, the farther I pulled the rack upwards the stronger the signal would get when on the 7 mhz band, while it peaked properly at the 1.250 alignment setting.

This morning, I swapped out that entire rack with one from a working 390a, and not only did it restore proper tracking, after alignment the sensitivity on all the lower bands improved, especially above 6 Mhz. The slugs are now very close in ajdustment height.

It had to be that slug, which had always appeared to be fine, and had the appropriate green dot.

However, I put it under some magnification and found a hairline crack around the entire circumference of the slug about 1/4 ich from the bottom of the slug, which upon even closer inspection, turned out to be a very well done repair of a broken slug.

I myself have repaired broken slugs before using "crazy glue" or similar, and never had a problem with those repaired slugs. Then I realized that all the those repairs were on slugs in the RF racks, never the IF racks.

Another lesson learned in bringing this thing back from the dead...!

Date: Thu, 27 Jan 2022 19:19:04 +0000
From: David Wise <David_Wise@Phoenix.com>
Subject: Re: [R-390] 1st IF tracking problem solved

It can't have been the repair. Glue joints don't matter - as long as the usual amount of iron is in the usual place, all is well. I predict the slug is the wrong material, dot notwithstanding. If you have an LCR meter or a grid dip meter you can check this by winding wire around two slugs and comparing their L.

Date: Thu, 27 Jan 2022 12:39:32 -0700
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] 1st IF tracking problem solved

I hadn't thought about the possibility of it being incorrectly marked...I have a GDO around here somewhere, so I might just take a look at that when I get a chance...

Date: Thu, 27 Jan 2022 14:59:53 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] 1st IF tracking problem solved

I agree with Dave. Having a green dot on an IF slug is not a proof that it have the proper relative permeability. The relative permeability of the IF slugs (AKA the "green" slugs) HAVE TO BE 4.   I checked this by winding a layer of 26 AWG, Teflon covered solid wire around a "good" slug, and measuring the resultant inductance, then, by removing the core carefully (so keeping only the self-supporting winding) the measured inductance dropped by a factor of 4. Same kind of test applied to the RF slugs gives a relative permeability of 10. I also found some slugs in a '56 Motorola RF deck (which came from Fair Radio) that measured a relative permeability of 7 and were bronze in color No idea from where they came from, but they surely caused alignment troubles.

Date: Thu, 27 Jan 2022 15:13:24 -0500
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] 390 RF Deck Replacing After Removal

Do you have the "GREEN" gear ? If the green gear is put in place, it will be less of a headache to re-assemble / re-align the RF deck. Not meaning that it will be easy either.... I had to preform it about 7 times on my R-390 before everything went correct after reassembly. BTW, what is the Contract # + Serial of your own ? Mine is 14214-PH-51-93 #2074.

Date: Sun, 30 Jan 2022 19:03:28 -0800
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] computer swtiched source

Hi Jose, Unfortunately, some laptop power supplies generate very bad EMI. And, it's not just laptop supplies, it's a lot of 'wall warts' that are major offenders. And the bad thing is that with most 390s and other rx's with good power line filters built in, the emi from the wall warts enters the rx through the antenna, and not the power line. You can test this fairly easily by tuning in the emi and then disconnecting your antenna. When you do this, make sure you have tube shields on for the sensitive tubes, all covers on the 390, and it is correctly grounded.

So, the answer to your question is: no, an additional EMI filter in the power line of a 390 will not help. If you are not using coax or twisted pair to feed the 390, then that makes it much easier for noise to get into the rx.

Date: Mon, 31 Jan 2022 21:16:14 -0500 (EST)
From: GENE BALINSKI <g.balinski@comcast.net>
Subject: Re: [R-390] computer swtiched source

RE: Laptop PS. I had to purchase a replacement PS for my HP laptop as the original died. I bought a unit from ePay.   It charges the battery just fine. It is also a MILITARY GRADE JAMMER! It is so bad, that I cannot listen to the local 50 kW AM news station (I am 35 miles away) on my clock radio upstairs when the charger is plugged in downstairs! It also clobbers 160 - 15 and even up to 10m. Yes it was made in China. However least you think that it is only the cheap Chinese gear that is the culprits, the switching PS INSIDE my HP printer exhibits similar characteristics, and must be completely unplugged (not just turned-off) for the RFI to stop. It may be from China as well. That cannot be easily determined.   I have used a Radio Shack in-line AC noise filter. It actually **did** make some difference, but not enough to reduce the 40 noise level much below ~ S-7. Perhaps the filter just reduced the power line conducted emissions while leaving the radiated emissions.

Date: Mon, 31 Jan 2022 21:01:19 -0600
From: Robert Nickels <ranickels@gmail.com>
Subject: Re: [R-390] computer swtiched source

> I have used a Radio Shack in-line AC noise filter....................

Roger all, Gene, good to hear you've at least identified the culprit. Some years back the power supply in my Dell desktop failed so I bought an eBay replacement and had the same experience.? It took me part of a day to realize that no, the bands weren't all dead, but the noise floor was so high it sounded that way. I took the p/s out and found that the IEC AC entry was not the line filter I thought it was, but just a connector for an IEC cordset. Filtering was probably the first thing they took out to reduce cost, after all the OEM was the one who had to worry about FCC, etc. I scrounged up a line filter from my junk and with it inline the noise floor was back where it previously was. You can find them online and it's not a big job to mount one in a metal box with suitable cords or connectors. I found it a handy thing to have around when trying to identify noise sources. Corcom and Schaffner are good brands to look for.

Date: Sat, 26 Feb 2022 21:49:43 -0800
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] Capehart/Clavier R-390A noise issue 6DC6 tube

Tom Marcotte made a very interesting find on Google Books in the 'Board of Contract Appeals Decisions' section. Unfortunately, the source is out of focus, lengthy and full of legal ease. See my brief summary of it and a link to a copy of it in the History section on our website, r-390a.net.

Date: Sat, 7 Jan 2023 22:13:02 -0800
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] R-390A Improving Sensitivity by Tube Optimizing

Many years ago, Roger Ruszkowski posted a procedure on our R-390 List Forum that identified an important noise level criteria for the IF and AF system. This 30 db criteria is necessary in order to be able to get your R-390A overall noise figure to a good point (< 1 uv sensitivity). It is not documented in any official documentation, but is elsewhere. This is important because if your rx does not meet the overall sensitivity requirement, this is a very good place to start. This test will help you determine if the problem is in the IF/AF section or the RF section. And, if it is in either, how to optimize tube selection to obtain improved noise levels.

I have used it many times over the years and appreciate having it very much. Thank you Roger. It's in the r-390 list forum archives, his 'R-390A Checklists' on our website in the 'Tutorials' section (first entry, newly highlighted), in the 'Pearls' 'Sensitivity Alignment' section, and in the

Y2K R3 Tech Ref. Unfortunately, it's not easy to find. Here's where it's at:

1. Y2K R3 Tech Ref: Chapter 9 ? Supplemental Repair Info - part 1, p. 9-15. The 'Tube Optimization' follows through p. 9-19.
2. Roger's 'R-390A Checklists' in the 'Tutorials' section in paragraph Q on PP. 16 - 18. RF Optimization is on PP. 25 & 26.
3. The 'Pearls' 'Sensitivity Alignment' section has it on PP. 472 - 476.

I hope this makes it easier to use Roger's valuable procedure.

Date: Tue, 24 Jan 2023 05:40:34 -0800
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] DA-121 adapter in MK288 for R-390A, URM-25

When connecting an R-390A balanced antenna to an AN/URM-25 Signal Generator for testing, most of the documentation says to use the DA-121 impedance adapter. But, only very little documentation says that you can find it in the MK288/URM Electronic Equipment Maintenance Kit, or where the documentation can be found for the kit. Well, a few years ago, David Hallam asked about the documentation and Manfred Antar provided it through the R-390 List forum. Thank you Manfred.

Then, a few weeks ago, I realized that it would be beneficial to have a link to the online version of it on our website for easy access to it. Since the documentation is an Army document, the link to it (TB SIG 319) is at the bottom of the Army section of our 'Reference' page. The MK?288/URM (TB SIG 319) doc is on 'radionerds.com' at: nfe82b2.tmp (radionerds.com)
<https://radionerds.com/images/b/bd/TB_SIG_319.pdf>.

Because the DA-121 impedance adapter is a resistance 'L' pad and as such the output voltage is a percentage of the input voltage (45% of input, 9.1 db loss, or 4/9 of the input) for this adapter (each adapter is different). EG: if the sig gen reads 1 uV out, the voltage seen at the rx will be 0.45 uV. Of course, this is only true when the actual input impedance of the R-390A balanced antenna connection is 125 ohms. Well, as you probably know, the impedance varies from about 50 ohms to about 200 ohms, depending on the received frequency. Although I have not calculated it, I believe the variance is small enough to not make much difference.   Regards, Larry
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Date: Sat, 11 Mar 2023 01:35:13 -0800
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] R-390A Article in Short Wave Magazine, 5-2002

Terry Harvey sent me an article in Short Wave Magazine from May of 2002 about how good the R-390A performs. The importance of it is that the author, John Wilson, did his own testing and analysis of it. I put it on our website with a link to it at the bottom of the new 'Other Tutorials' section. Thank you Terry. Here's a link to it: Short Wave Magazine Article **<https://www.r-390a.net/R390A%20Artcl%20Short%20Wave%20Mag%205-2002.pdf>**

This magazine was published in the UK for a very long time, is very interesting and this website THE SHORT WAVE MAGAZINE - UK from 1930's to 2005
<https://worldradiohistory.com/Short_Wave_UK.htm>
has most of the magazines on it for free viewing. Should I put a link to it in our 'Magazines' section? Please let me know.

Date: Sat, 11 Mar 2023 07:45:33 -0600
From: Don Cunningham <donc@martineer.net>
Subject: Re: [R-390] R-390A Article in Short Wave Magazine, 5-2002

Yes, please put the UK magazine articles link in the section.

Date: Mon, 13 Mar 2023 22:52:20 -0700
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] Added link to 'Short Wave' magazines to website

I added a link to the 'Short Wave' magazines to our website at the top of the 'Magazines' section of the 'References' page. Here's a link to the 'Magazines' section: The R-390A 'Magazines' section
<https://www.r-390a.net/faq-refs.htm#Magazines>.

I also added a link to an improved copy of the EAC Ad for an R-390A in the 73 Magazine in the 'Other Tutorials' section of the 'References' page. Here's a link to the Ad: R-390A 73 Magazine Ad 12-1968 p70
<https://www.r-390a.net/R390A%2073%20Mag%20Ad%2012-1968%20p70.png>.

Date: Fri, 17 Nov 2023 18:41:02 -0700
From: <gary.biasini@shaw.ca>
Subject: [R-390] R-390a not receiving below 8 MHz

I have an R-390a that will not receive below 8Mhz. I have replaced the 17 MHz crystal with a known good crystal. The filament on the 1st mixer tube, V202 seemed to not be lighting up so I replaced it with a 6C4WA and still no reception. Any thoughts of what I might check next?

Date: Fri, 17 Nov 2023 18:48:28 -0800
From: Larry H <larry41gm@gmail.com>

Subject: Re: [R-390] R-390a not receiving below 8 MHz

Hi Gary, Try v207, also. And, the mini coax connector (MB) at j221 makes bad contact sometimes. And then there's the band switch section S208 rear. If it's out of alignment or making bad contact, can do it. Has it worked correctly recently?

Date: Sun, 26 Nov 2023 22:25:22 -0800
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] R-390a not receiving below 8 MHz

On Sun, Nov 26, 2023 at 12:36?PM <gary.biasini@shaw.ca> wrote:
> After pulling the RF module and tracing the wiring on V201, I am not
>sure how this radio ever worked. Pin 7 has a wire that goes through the
>hollow metal center of the tube socket and across the bottom tube and is
>hooked up to pin 3 on the other side of the tube socket which is the
>ground side of the filament on the tube. Of course it reads 0 ohms!
>Unfortunately, everything is so tight in there, I am not sure I have the
>skills to unsolder and re-solder. Before I move forward with trying, can
>anyone confirm that the schematic is correct and that I won?t bugger
>everything up if I rewire as per the schematic?
> To continue the story, I used tube extenders and measured the voltages
>and resistances of V201 to V206 (I couldn?t get both the tube extender
>and tube on V207). The most interesting readings come from V201 as
>follows:------<clip>----- From a review of the schematic, pins 2 and 7 are
>supposed to be connected together so they should both have the same
>voltage and resistance. However, you can see that it not the case. When I
>pulled the tube and checked the resistance between pins 2 and 7, it was
>infinite so, whatever connection the schematic says should be there, is
>not. So, time to pull the RF module but I may have to wait until later to
>do that.
> Thanks for reading.
> The saga continues (but so does the fun!). I think I have narrowed the
> problem down to either the VFO Oscillator or the RF module. I have put
> known working IF, audio and Power Supply modules in the radio and no
> difference.
> I did find out why I couldn?t get a calibrate signal below 6 MHz.
> Apparently, Z213, the middle one, had some sort of obstruction in the
>coil form that prevented the ferrite slug from going in more than about
>half way. If I had some sort of boring tool that was exactly the right size,
>I might be able to bore out the obstruction. Instead, I replaced the coil
> with one from a parts RF chassis and now I get the calibrate signal
>below 6 Mhz. But, still very low audio (and noise) ? both almost non-
>existent. I can receive WWV at 10 MHz and 15 MHz (I will try 5 MHz
>tonight, now that I appear to have some reception below 6 Mhz) but I
>still cannot receive strong BCB stations in the area.

>
> Time to figure out how to troubleshoot the RF module and the VFO Module.

Hi Gary, Pin 7 on V201 was changed to go directly to ground, so that is good that change is on your RF deck.

Regards, Larry

Date: Tue, 2 Jan 2024 22:42:47 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Some trouble shooting thoughts

There have been several posts asking for help with trouble shooting so here are a few tips of mine.

1. The modern digital VOM's have a high enough impedance for trouble shooting.? The requirement for a VTVM came at a time when they were analog causing a noticeable voltage drop on high impedance circuits.

2. R390's are not a tinker toy receiver. They require some investment in test equipment to be able to service them.

A. Everyone should have a spare set of good new or used spare tubes. This because tube tester are usually a fortune if one can find the. Tubes are a high failure rate item

B. I find the most helpful tool is a O'scope. I have a Tek 2445 that I bought at a hamfest for $180 ten or so years ago. There are a gizzilion scope models available. Tek scopes seem to be the best quality and are often found at hamfests for reasonable prices. All one needs is a 2 channel 50Mhz bandwidth. Usually more common are the 100MHz bandwidth units. Looking on Epay one can find Tek 22XX series for $200 delivered. Large choices of used probes are available as well.

C. Get large (2 ft by 3 ft) print out of "The almost ultimate R390A upgrade schematic" parts one and 2. There is a ton of practical advice from a number of Guru's to help you. It is large enough for one to take notes (in pencil) of your various reading. Some people just print out a specific section on there home printers. This works well. Some have used a laptop to go through the ski's. I personally don't think this is a good idea. You can't annotate your readings.

D. Good RF signal generators are big, heavy and still fairly expensive. It's hard to invest in one if you have only one or two radios. BUT there is a $30 signal source that's usually advertised in QST magazine that plugs

into the antenna input and provides some calibrated signals. (I couldn't find the ad in my QST - maybe a list member can help)

Date: Thu, 11 Jan 2024 20:42:31 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] New small test equipment

Here are a few of the new small pieces of test equipment that may be helpful. Most are from China and are offered at different prices. I don't know if the more expensive of those offered are real deal and the cheaper ones are knock offs.

LCD Handheld DigitalOscilloscope Kit - 2 Channel 3.2" TFT Multi-meter OscilloscopeSignal Generator Mini Automotive Oscilloscope Bandwidth 120MhzDigital Oscilloscopes Portable 250MSa/s Sampling Rate $139.99to $210.

Calibrated S9 RF signal generator - Battery Powered & Portable US $35 eBayitem number: 304986375765(Legit)

Precisesignal generator for DIY projects Adjustable frequency up to 1MHz US$12.19 eBay item number: 404674467488

Si5351-2VFO-150Signal Generator 2Channel VFO-5351A V1.03 Square Wave 10K-150MHz US$26 eBay item number: 295930022178
2023

Upgraded TinySA UltraSpectrum Analyzer, SeeSii 4.0 Inch 100kHz to 5.3GHz Handheld TinyFrequency Analyzer with 32Gb Card, 2-in-1 Signal Generator 100kHz to800MHz MF/HF/VHF UHF Input,V0.4.5.1 Amazon This is a copy. YOYO$259.99+ The real one is sold out.

Date: Sat, 30 Mar 2024 12:24:04 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

After a long break from working on 390As, I'm back into a 390A I bought at least 25 years ago. It's the most mongrel 390A I've ever seen, with a modules and assemblies from S-W, Teledyne, Capehart in an early single fuse chassis of unknown mfgr. The front panel is a re-paint and re-letter and the ID tag is a generic after-market type. The RF deck front plate and gear assembly is Teledyne with the deck chassis being a S-W and with a Capehart xtal oscillator module refurbed at Tobyhanna(sp?).

I've gotten a good deal of the required rejuvenation work done, but I found an issue where the 1st xtal osc. voltage is rather low when measured as rectified at E-209. I cannot get more than 2v DC measured at E-209, while T207 peaks smoothly. What I've done so far regarding this problem:

Replaced the 17Mc xtal, and then the entire oven ass'y including xtals from a working radio to no avail. I then swapped out the 6AK5 osc tube with several good 6AK5/5654 tubes, then did the same with the 6C4 1st mixer tube. Again, all to no effect. Since it has been 25+ years since I originally worked on this radio, I suspected component problems in the RF deck, so I pulled the deck. I pulled C275 and C268 as the originals had been replaced with disk ceramics (what I had on-hand at the time) but both test just fine at 99 and 105pF respectively. I'll replace them with S.M. caps. I then checked every resistor in the RF deck and aside from R203, which had drifted up to 90K from 82K, they all are within spec and show no signs of overheating. Aside from checking feedback caps C324 and C325 to see if one or both have issues, is there anything else I should look at...? Any suggestions or advice would be much appreciated...!

73...Jordan VE6ZT

Date: Sat, 30 Mar 2024 16:19:11 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Some questions:
1_ What is the value fitted for R210 ?? 56K or 220K ?
Have to be a 56K for proper 17MHz output to V202.
2_ Did you replaced C327 ? That cap was flagged as failing in some R-390A. Just put a new SM there, re-peak T207 and retry.
3_ What is the pp voltage measured with J221 directly routed to a 'scope input (with T207 peaked) ?

73, Jacques, VE2JFE in Montreal

Date: Sat, 30 Mar 2024 15:26:00 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

R210 is 56K and measures well within spec. I had removed the original C327 mica cap years and years ago for that very reason. I replaced it with a 1kV 100pF ceramic disk cap. I had also replaced C268 with the same type of cap. I'll be replacing them with SM caps anyway while I'm in there. I'll have to check the RF level at J221, what should it be in either p-p or RMS...?

Date: Sat, 30 Mar 2024 15:37:02 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>

Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

I found the expected RF levels In Larry's R-390A oscillator output paper...

Date: Sat, 30 Mar 2024 22:58:48 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Ok Jordan, let us know what you found.
If ever you doubt about the T207, I still have some spares...

Date: Sat, 30 Mar 2024 21:55:56 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Hi Jordan, Are you using a high impedance VTVM to measure it at E209? It must be and the 390 must be in standby. Also, if you measure it at J221, what you connect to it will probably detune T207 and change the output, sometimes quite a bit. And, what are the dc voltages on the mixer plate and cathode in AGC mode? You can use a tube test extender to measure them. You might want to scope the cathode while it's in there and see what it shows. In the past, I've found that the mini coax to J221 can be bad or the connection from J221 to P221 is bad (try exercising the connection a few times). Or C277 could be bad. And, what are the DC voltages on the osc plate and screen? Have fun.

Date: Sun, 31 Mar 2024 10:55:35 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

I'm re-sending this msg because the original response seems to have drifted off into the ether somewhere...

Hi Larry and the group... I normally use a DVM with a 10Mohm input impedance for DC measurements and a 50 MOhm VTVM for RF/AC voltages. I've used both on all types of tube gear. Normally, I measure over 7Vdc at E209 on my other 390As, but this one won't peak higher than 2.02Vdc at E209. I'd use the VTVM to measure that, but the probe won't fit into the space around E209. There is a tube in the probe head so it's a little too large to get in there. I'll do some more checking and testing today and see what I can find out. Is there any concern using disk ceramics in place of C327 and C268, rather than the original mica caps...? The ceramic caps I removed both test fine for value and insulation resistance, and I was advised that replacing those mica caps with ceramics was fine and a normal procedure back 25 or so years ago.

Date: Sun, 31 Mar 2024 16:25:12 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Using a 10Meg input DVM is good, but if there is not an isolation resistor direct in the probe, connecting the + wire of the DVM directly to E209 can detune the circuit. Remember how the old Heathkit VTVM probe is made ? In DC mode there is a 1M ohms resistor directly inserted just after the tip and this was basically to prevent RF sensitive circuits to turn crazy with the direct connection of a wire of unknown impedance. And also because with the VTVM probe, the wire going to the meter is a coax, making the situation worse. Too long to explain why, but I made a DVM probe with a 10Meg inserted in the tip. The displayed voltage is half of the real value, right, but the insertion of the 10Meg isolation resistor in any sensitive circuit is inconsequential. Meaning, I just have to double the value read on DVM, and this is the real DC value present in the circuit.

Your 17MHz oscillator problem now:
The V207 stage behave as there is not enough gain in it. That could came from many places, the most unusual being an open or otherwise defective decoupling capacitor. Usual suspects: C328, C326, C275 (which is supposed to be a .033?F, btw). Is L201 of the correct value and have a proper DC continuity? Could it be that T207 is damaged in some way ? If there is a resistive leakage across either the primary or the secondary, you cannot get the proper signal amplitude at the plate.

Replacing SM caps by ceramic ones in resonant circuits is OK, but only if the ceramic caps are of the NPO variety. Unknown ceramic grade (Z5U, for ex.) cap can be OK for decoupling but not for a parallel resonant circuit, as the losses in the dielectric could be to high. Or, in some cases, the dielectric constant changes with the voltage excursions, and this kills the Q factor of the resonant circuit. Result: loss of gain... And you mentioned that T207 "peaks smoothly". Well... As far as I remember, the T207 tuning I experienced with my R-390As was quite sharp.

73, Jacques, VE2JFE in Montreal

Date: Sun, 31 Mar 2024 18:43:39 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Hi Jordan, I don't think you need to get out your VTVM, as your DMV should be fine for E209 in standby. Since C275 is a bypass in this circuit and nothing special going on there, a little higher value will be fine. No lower, though.

Date: Wed, 3 Apr 2024 13:53:21 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Ok..I'm now able to adjust T207 to produce -7.6 VDC at E209, so the effort has been rewarded. I wish I could say for certain what the cause for the prior low output has been, but I did not find a faulty component including coil resistances, a bad cable or connector, or anything else. Even C227, the .047uF PIO cap tested fine after I replaced it with a film cap. I replaced C268 and C327 with Mica caps, an 82K resistor and thoroughly checked wiring and switches. The one thing I did find was that C275 had been replaced with a .0033uF cap rather than the .033 called for. I'm not exactly sure what effect that might have had, but there was a reason for the published corrections. I'm going to do some contact cleaning and a little lubrication before I re-intall the deck and move closer to the finish...

Date: Wed, 3 Apr 2024 16:04:45 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Happy to know that it works fine now. When you mention C268 below, would you really mean C328 ?? A mica cap is mandatory for C327, I guess, what was fitted there before you replaced it ?

Date: Wed, 3 Apr 2024 16:19:57 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

AH ! I warned you about the ceramic caps before. This is not a value or insulation problem. It's a DIELECTRIC LOSSES problem ! I'm 100% sure that your original trouble came from that "ceramic" C327 fitted there.

Date: Thu, 4 Apr 2024 01:40:34 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Hi Gary, C327 should be a 100 pf SM cap. The SM cap gives the tuned circuit a higher Q.

Date: Fri, 5 Apr 2024 14:50:58 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

For the ceramic caps: this is the grade of ceramic used within that counts. As I wrote few days ago, if it is NPO grade ceramic, the capacitor is most probably OK to use, despite that only a real-life test can confirm. But,

being just curious: can you send me a picture of the 100pF ceramic capacitor that was installed at the C327 position? With some grades of ceramics, the dielectric losses (measured as the ESR) are so high that they kill the Q factor of the resonant circuit, then the gain of the oscillator stage. And this one is running at 17MHz in the R-390A. We know that silver mica caps are OK there, and probably polystyrene or polypropylene ones. But not Mylar (polyester) however. The polyester loss factor at HF is about ten times higher than the mica or polypropylene, so using those in a resonant circuit is excluded. For the previously published advice you mention, about changing the mica caps for ceramic ones, well, not sure that this was fully validated at the time. Like many other "recommended" modifications of the R-390A that works more or less well...

Date: Fri, 5 Apr 2024 15:46:38 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

There is another issue with replacing a ?resonant circuit? cap with just any random type of ceramic cap: the types typically used for bypass (X5R, X7R, Z5U ?.) don?t just have loss issues. They also change value with applied DC voltage. If the cap is right across a coil (so no net DC) this might not be a big deal. If the circuit is a bit more exotic and you have 150V DC on the cap, it is a big deal. The value of the part will be quite a ways away from that labeled value. In a bypass application, you look at the curves, work out the impact, and select a part that still has enough ?C? to do the job. The part is much smaller and likely much cheaper than the alternatives. Away you go.....

Date: Fri, 5 Apr 2024 17:21:52 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Bob, I 100% agree !

Date: Fri, 5 Apr 2024 16:29:42 -0500
From: Tom Frobase <tfrobase@gmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

I have had the 100pf mica go bad in the 17 mhz drive circuit. nterestingly it did not check bad, but greatly limited the amplitude of the mixer drive.

Date: Fri, 5 Apr 2024 23:22:35 +0000
From: David Wise <d44617665@hotmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

There's a straightforward failure mechanism in mica caps. If the end

contacts are crimped and moisture gets in, corrosion degrades the contact of one or more sheets, changing the value and causing loss. I don't know if any models use a contact method that can't do this. I've had both molded and dipped parts fail. Not many, but enough that nowadays I give all of them the side-eye if something's wrong.

Date: Sat, 6 Apr 2024 08:33:50 -0700
From: Larry H <larry41gm@gmail.com>
Subject: [R-390] R-390 Q of Caps and tuned circuits (was: Tracking down low sensitivity 0 to 8 mhz)

We all know that the R-390 and many other rx's rely on high 'Q' tuned circuits to operate correctly. Silver Mica (SM) caps have been used a lot in these circuits because of their high 'Q'. The resultant high 'Q' of a tuned circuit is normally the result of the design of the inductor used in them (for the most part), but the Q of the cap is also important. If the Q of either is not high, the overall Q of the tuned circuit will not be high.

For many years, the high 'Q' of SM caps was unequalled, but a few years ago better dielectrics in ceramic caps were developed and the Q was considerably improved. These caps are in the 'class 1' category and are usually NPO's or COG's. Some datasheets for 'class 1' caps specify the Q of the dielectric, and some specify the inverse factor, DF (dissipation factor). The formula to convert one to the other is: Q = 1/DF, but this rating is usually done at 1 MH. Some include graphs that help in determining the Q at higher frequencies, like 17 MH.

The dissipation factor of Vishay's series 561R 'class 1' COG is 0.1 % max at 1 MH, so according to the formula Q = 1/DF, the Q for this cap would be 1000.

The PAN OVERSEAS (GUANGZHOU) ELECTRONIC CO.,LTD.
TEMPERATURE COMPENSATING
CERAMIC DISC CAPACITOR (POE-D01-00-E-16) for values of 30 PF & ABOVE, have a specified Q of 1000+ at 1 MH.

CDE's SM caps of type CMR meets requirement of MIL-PRF-39001, in the capacitance range of 100-1000 pF, have a dissipation factor of 0.00075 max at 1 MHz. That's a Q of 1333.3333. Lower pF value caps have a higher Q.

I'm not sure what the Q is of the SM caps used in the R-390, but suspect it is above 1000 at 1 MH, so I'm not sure that ceramic caps are ready to replace SM's in sensitive tuned circuits, yet.

Date: Sat, 6 Apr 2024 23:49:53 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Well, that confirms my initial suspicion. An Y5F ceramic class capacitor is a "Class II" capacitor designed for coupling and decoupling purposes, but not for use in a resonant circuit. This is described in length here :
https://en.wikipedia.org/wiki/Ceramic_capacitor
And in the attached AVX datasheet.

And yes, you can post your .pdf(s) here. I have also run some tests with my HP 4192A Impedance Analyser. The best 100pF ceramic cap I have in my bins scores a Q of 220 at 1MHz. A 100pF EL-MENCO from a R-390A RF deck scores a Q of ~1800 at 1Mhz A 100pF EM dipped silver mica pushes the instrument to it's maximum reading: Q of 2000 at 1MHz !
-------------- next part --------------
A non-text attachment was scrubbed...
Name: Disc_Ceramic_Caps_Rev_Oct_1999.pdf
Type: application/pdf
Size: 169835 bytes
Desc: not available
URL: <http://mailman.qth.net/pipermail/r-390/attachments/20240406/c60aacf5/attachment-0001.pdf>

Date: Sat, 13 Apr 2024 07:58:23 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

While replacing C327 with a mica cap did bring the 1st Xtal Osc output up to snuff, I still find problems below 8Mhz, so I have a few questions for those in the know. The service manual states that E402 should show from -4 to -11V when measured with a USM-116 VTVM which has a 100 Megohm input impedance on DC. What do you guys use to measure this voltage.? What type of tip/connector etc. do you guys use to insert into E402, E209 etc..?   Is there a standard "pin" that fits snugly in those connections...? I do have and use the specified CX-1363/U Test Lead, but I cut the alligator clip off the positive lead due to it's size and the tightness of the available space around the test points. Lastly, for now at least, Do you all follow the manual instructions for aligning the 1st and 2nd IF, or do you use your own methodology...? Thanks for your time and any possible responses...

Date: Sat, 13 Apr 2024 08:21:56 -0700
From: Larry H <larry41gm@gmail.com>
Subject: Re: [R-390] Tracking down low sensitivity 0 to 8 mhz problem

Good questions, Jordan. I use a vtvm that has 11 Meg Ohms input resistance, but 10 M Ohms should be good enough. For a probe that fits snugly into E208 - E211 and E402, I use a piece of solid copper wire #16 gauge about 4.5 " long that has about 1/2 " of insulation removed on both ends.

For the 1st and 2nd IF alignment, I assume you are referring to the IF deck. See my post that follows that is also at the end of the 'IF Deck' section in the Pearls. It is important to not straight tune an IF deck that was designed to be stagger tuned, as the gain may be too high to correctly adjust the IF gain R519 for correct operation of the AGC and carrier level meter.
