THE

R-390

COOKBOOK

BY A. CARMODY, W2LE/AAR2QR

PREFACE

The R-390 COOKBOOK was intended to be used in conjunction with the R-390/URR Service Manual. However, sufficient information is provided so that each modification can be accomplished without the aid of the Service Manual.

These modifications have been incorporated into several receivers with excellent results. The Author, however, assumes no responsibility for the operation of these circuits.

A. Carmody
September, 1983

C O N T E N T S

UNITED STATES ARMY
MARS
MILITARY AFFILIATE RADIO SYSTEM
A.J. CARMODY, AAR2QR/W2LE

MODULE	REV	REF PAGE(S)	REMARKS
POWER SUPPLY SUB-CHS	A	95,96	

PURPOSE: To convert the power supply from vacuum tubes (26Z5W) to solid state diodes.

REASON:
1) Replacement tubes hard to find.
2) Eliminate heat from vacuum tube rectifiers.
3) Improve reliability with solid state diodes.

TOOLS REQUIRED:
1) Long phillips head screwdriver
2) Soldering iron and solder
3) Diagonal cutters
4) Long nose pliers

PARTS REQUIRED:
Two (2) 1N4007 diodes, 1000 PIV, 1 amp or equivalent.

PROCEDURE:
1) Disconnect main power to the receiver.
2) Remove tube shields and 26Z5W vacuum tubes from the power supply.
3) Disconnect the power plug to the POWER SUPPLY SUB-CHASSIS.
4) Using the phillips screwdriver, remove the four (4) screws that hold the transformer to the side panel of the MAIN CHASSIS.

--- NOTE ---

In the next two steps you will loosen three (3) captive screws which hold the power supply to the chassis.

5) Locate the GREEN phillips head screw adjacent to the tube socket and loosen it completely.
6) There are two (2) locating holes in the top of the POWER SUPPLY SUB-CHASSIS bracket. Below each hole is a GREEN phillips head screw. Loosen both of these screws completely.
7) Grasp the POWER SUPPLY SUB-CHASSIS and remove it from the receiver.

MODULE	REV	REF PAGE(S)	REMARKS
POWER SUPPLY SUB-CHS	A	95, 96	

8) Place the POWER SUPPLY SUB-CHASSIS on a bench with the bottom of the tube sockets facing you.

NOTE:
When installing diodes, it is important to observe their polarity. See Fig. 1.

9) Install a diode on socket XV801, the cathode lead (banded end) soldered to Pin 3.
10) Solder the anode lead to XV801 Pin 6.
11) Install a diode on socket XV802, the cathode lead (banded end) soldered to Pin 3.
12) Solder the anode lead to XV802 Pin 6.

THIS COMPLETES MODIFICATION OF THE POWER SUPPLY SUB-CHASSIS

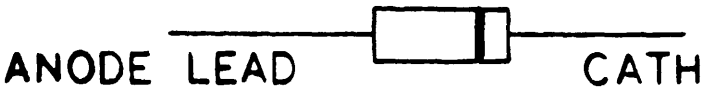


FIG. 1

MODULE	REV	REF PAGES	REMARKS
IF SUB-CHASSIS	A	99,128,129	-

PURPOSE: To replace ballast tube 3TF7 with a conventional vacuum tube.

REASON:
1) Ballast tubes are hard to find and expensive.
2) Other methods using power dropping resistors dissipate excessive heat under the chassis which is undesirable.
3) Use of voltage regulators require more parts and are more costly.
4) This method allows easy substitution of ballast tubes.... if you are lucky enough to find them.

TOOLS REQUIRED:
Wire strippers
Set of Allen wrenches
Phillips head screwdriver
Soldering iron and solder
Assortment of multi-colored fiber-tipped marking pens.

PARTS REQUIRED:
Three (3) inches #22 AWG PVC insulated hook-up wire
One (1) 12BH7 or 12BY7 vacuum tube

PROCEDURE:
1) Disconnect main power to the receiver.

--- NOTE ---

In the following step you will loosen two (2) shafts from the IF SUB-CHASSIS to the controls on the front panel. Before loosening the shafts, it is important to note the position of the BANDWIDTH knob and the BFO PITCH knob.

2) Using an Allen wrench, loosen the set screw on each Oldham coupler which secures each shaft from the front panel controls to the IF SUB-CHASSIS.
3) Disconnect the power plug to the IF SUB-CHASSIS.

MODULE	REV	REF PAGE(S)	REMARKS
IF SUB-CHASSIS	A	99,128, 129	-

--- NOTE ---

In the next step you will disconnect two (2) BNC connectors. It is important to identify the cables and connectors. I use colored marking pens. Other methods such as tages, tape are OK just as long as you know where the cables go.

4) Mark or somehow identify the BNC chassis connectors and the cables attached to them.
5) Disconnect the cables from the BNC chassis connectors.
6) Locate the GREEN phillips head screws on top of the IF SUB-CHASSIS and loosen them completely.
7) Grasp the IF SUB-CHASSIS and carefully remove it from the chassis. Try not to disturb the position of the protruding shafts.
8) Locate the ballast tube 3TF7 and remove it from it's socket.
9) Place the IF SUB-CHASSIS on a bench with the bottom of the tube sockets facing you.
10) Prepare two (2) lengths of hook-up wire. Each wire cut to one (1) inch.
11) Strip ¼ inch of insulation from each end of each wire.
12) Locate the ballast tube socket XRT 512.
13) Solder one of the jumper wires from Pin 2 to Pin 4 on socket XRT 512. Be careful not to disturb existing wiring.
14) Solder the remaining jumper wire from Pin 7 to Pin 5 on socket XRT 512.
15) Install either a 12BY7 or 12BH7 vacuum tube and tube shield in socket XRT 512.

THIS COMPLETES MODIFICATION OF THE IF SUB-CHASSIS

MODULE	REV	REF PAGE(S)	REMARKS
AF SUB-CHASSIS	A	97,98,99,131	

PURPOSE: To replace the 6082 (24 volt fil) regulator tubes which are expensive and hard to find with 6080 (6 volt fil) tubes.
NOTE: 6AS7G tubes are electrically similiar to the 6080 but are too large to fit into the R-390.

TOOLS REQUIRED:
Phillips head screwdriver
Soldering iron and solder
Wire strippers
Diagonal cutters
Nut driver set or small socket set

PARTS REQUIRED:
Power diode, stud mounted with mounting hardware
1N1183, 35 amp, 50 PIV or equivalent.
Three feet #20 AWG or larger PVC insulated hook-up wire.
Thermal heat sink compound - available at Radio Shack stores.

--- NOTE ---

The original filament circuit of the two (2) regulator tubes V605 and V606 is wired in parallel. In this modification, the filament circuit will be connected in series as indicated in Fig. 1.
Polarity of the diode doesn't matter. Just be sure the mounting stud is securily fastened to the sub-chassis for heat-sinking purposes.

PROCEDURE:
1) Disconnect main power to the receiver.
2) Locate the two regulator tubes V605 and V606 on the AF sub-chassis.
3) Remove the holding rings and the regulator tubes from their sockets.
4) Disconnect the two (2) power plugs from the AF sub-chassis.
5) Locate the GREEN phillips head captive screws. Loosen them completely.
6) Grasp the AF sub-chassis, gently removing the unit from the chassis.

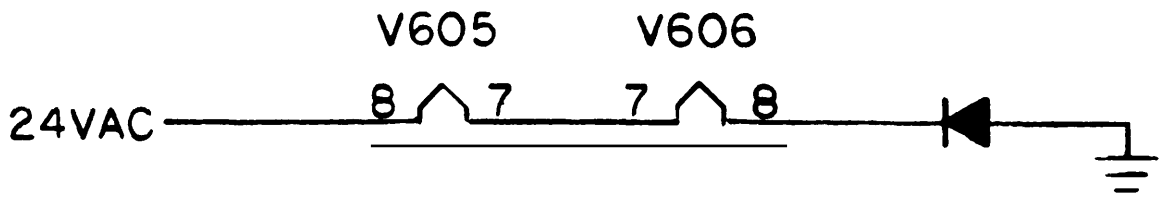


FIG. 1

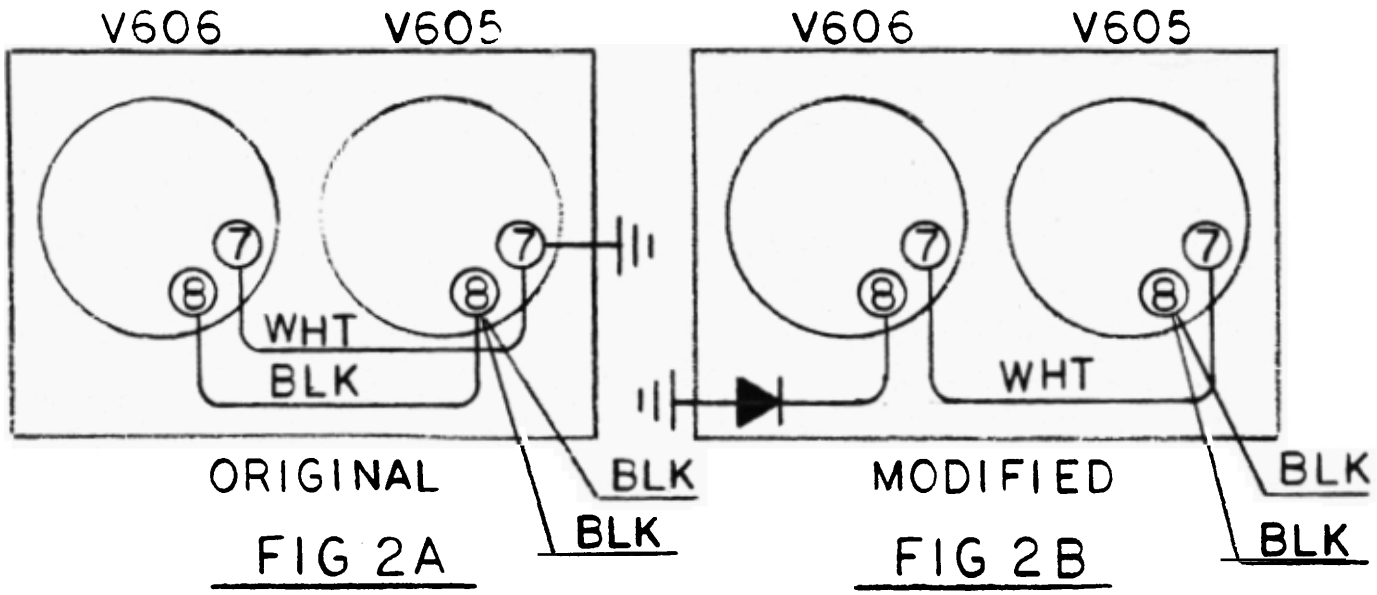
MODULE	REV	REF PAGE(S)	REMARKS
AF SUB-CHASSIS	A	97,98,99,131	-

7) Set the AF subchassis on a bench with the bottom of the tube sockets facing you.

NOTE: There are several large holes in the chassis around the base of the octal tube sockets to provide air circulation. We will use one of these holes to mount the stud diode.

8) Mount the stud diode in one of the chassis holes. Select a hole between the octal tube sockets. If the hole is larger than the stud, use flat washers from your junk box. Be sure to coat the flat base of the stud diode with heat-sink compound. Also apply a thin coat of compound to the flat washers.

9) Wire the circuit, refering to Fig. 2A and 2B.



ORIGINAL
FIG 2A

MODIFIED
FIG 2B

MODULE	REV	REF PAGE(S)	REMARKS
NONE	--	20,81,82,85	LOW IMPEDANCE SPKR CONNECTION

The R-390 receiver has two (2) audio channels, LOCAL AUDIO and LINE AUDIO with seperate gain controls for each channel. The output impedance of each channel is 600 ohms. The LINE AUDIO channel is intended to be used as a balanced audio line. The LOCAL AUDIO channel is to be used for speaker and headphones.

The R-390 receiver does not have a self-contained speaker. Therefore, it is necessary to provide an external speaker. Most speaker impedances are low, typically 4 to 16 ohms. Since the LOCAL AUDIO output impedance of the receiver is 500 ohms, if we wish to connect a low impedance speaker to the receiver, an audio impedance matching transformer must be used. A filament transformer from the junk box will work but has poor high frequency response.

Radio Shack (TM) stores offer a 70V Line Transformer stock number 32-1031 for under $5.00 which works very well. It's secondary is tapped for 4/8/16 ohms and has solder lug terminals. Connect the high impedance primary of the transformer to TB2-6 and TB2-7 located on the rear panel of the receiver. Refer to Fig. 1 for proper connections.

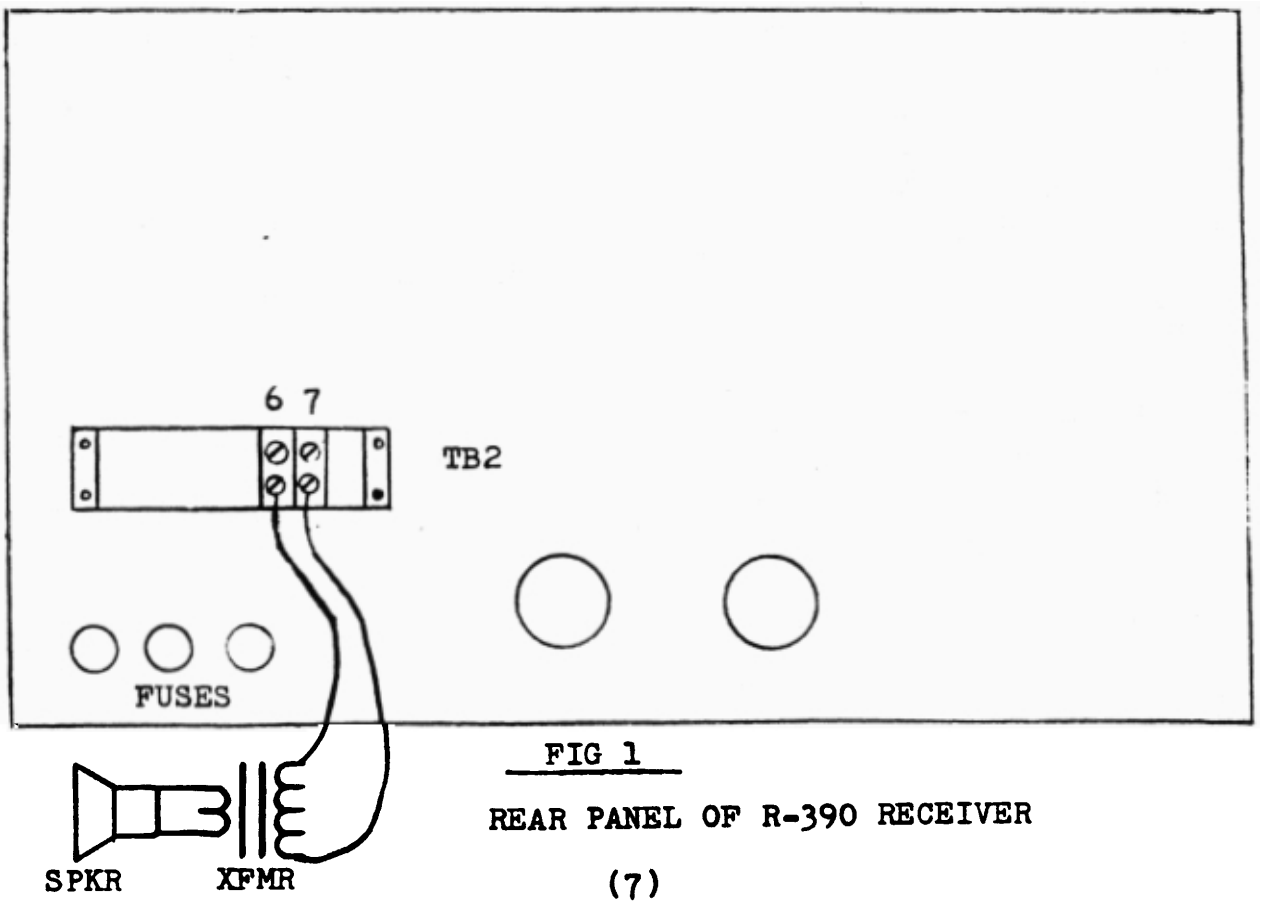


FIG 1

REAR PANEL OF R-390 RECEIVER

MODULE	REV	REF PAGE(S)	REMARKS
NONE	- -	20,47,48	ANTENNA INPUT CONV TO 50 OHMS

PURPOSE: To replace antenna input connectors with SO-239 connectors that mate with standard ham equipment.

Change antenna input from a balanced line to an unbalanced line.

REASON: Adapters or "C" type connectors are difficult to locate and are non-standard ham equipment.

Most ham stations use 50 ohm unbalanced coaxial line.

TOOLS REQUIRED:

1) Phillips head screwdriver
2) Colored marking pens
3) Soldering iron and solder
4) Long nose pliers
5) Wire strippers
6) #6-32 tap

PARTS REQUIRED:

1) Two (2) SO-239 coax sockets
2) Eight (8) #6-32 pan head screws
3) One (1) foot of hook-up wire

PROCEDURE:

1) Disconnect main power to the receiver
2) Place the receiver on a bench with the top removed and the rear panel facing you.

--- NOTE ---

In the next step you will remove the module containing the antenna connectors. It is important to clearly mark the BNC connectors J109, J110, J111 with tape or colored marking pens before removing the cables from the module.

3) Locate the three (3) BNC connectors J109, J110 and J111 on the module.
4) Using a different color pen or tape, mark each BNC connector and it's associated cable.

MODULE	REV	REF PAGE(S)	REMARKS
NONE	- -	20,47,48	ANTENNA INPUT CONV TO 50 OHMS

5) Disconnect the three (3) cables from the BNC connectors.
6) Locate the three (3) screws that hold the antenna module to the rear panel. Remove and save the screws.
7) The module should now be free to remove from the rear panel.
8) Remove and save the two (2) screws that hold the cover on the antenna module.
9) Solder a small jumper wire from the center of J110 to ground.

--- NOTE ---

In the next step you will remove the BREAK-IN RELAY and it's associated hardware. This feature has no effect on the performance of the receiver.

10) Remove the two insulated wires going to the relay coil and tape the ends of the wires.
11) Remove the relay from the antenna module.
12) Unsolder all wires going to the antenna connectors J107,J108.
13) Using a screwdriver, remove both antenna connectors J107,J108.
14) Remove any wires going to the center of J109 and J111.

--- NOTE ---

In the next step you will put threads in the four mounting holes of each SO-239 connectors.

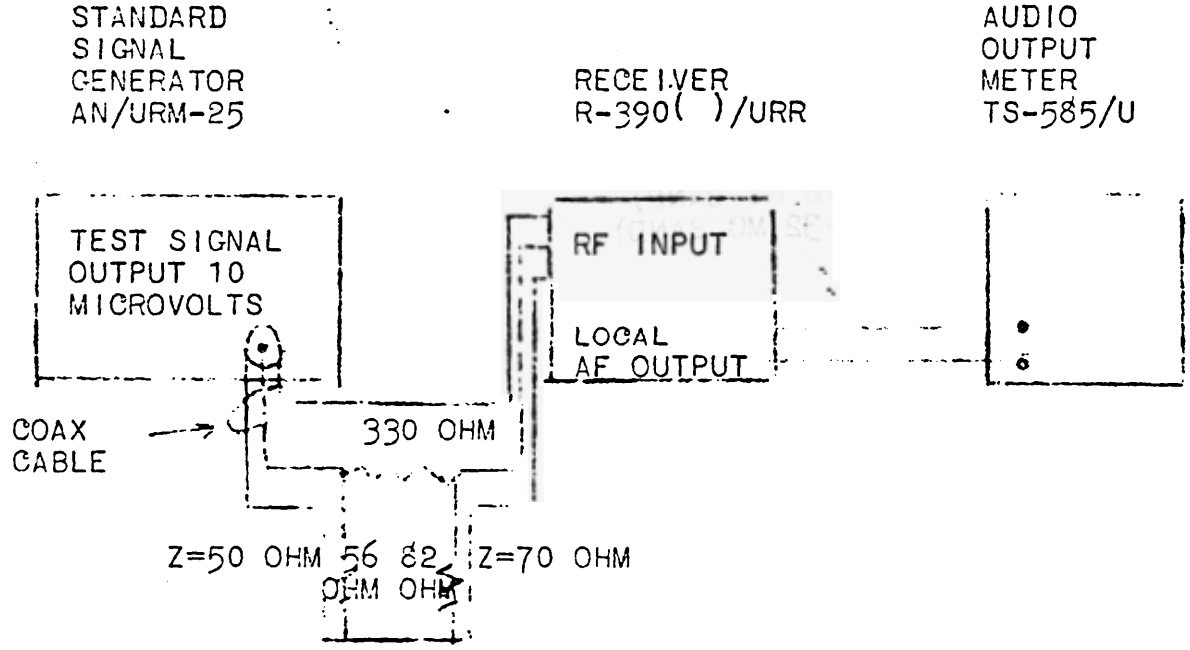
15) Locate the SO-239 antenna connectors and thread the four (4) mounting holes of each connector using the #6-32 tap.
16) Install one of the SO-239 connectors at J107 (UNBALANCED WHIP) such that the connector is inside the antenna module.
17) Solder a small piece of hook-up wire from the center of J107 to the center of J109.
18) Similiar to STEP 16, install the remaining SO-239 connector at J108.
19) Solder a small piece of hook-up wire from the center of J108 to the center of J111.
20) Replace the cover on the antenna module.
21) Install the antenna module in the receiver.
22) Reconnect the three (3) cables to the BNC connectors.

I've found it convenient to connect a second receiver's antenna input to J107 using a short cable and connect my main antenna to J108 so that the two receivers share the same antenna.

TESTING R-390( )/URR RECEIVERS

DESCRIPTION OF TEST:

1. APPLY ONE MICROVOLT CW TEST SIGNAL TO RECEIVER INPUT.
2. TUNE RECEIVER FOR ZERO-BEAT BETWEEN TEST SIGNAL AND BFO AT CENTER OF 2KC IF BANDPASS.
3. ADJUST RECEIVER GAIN FOR AN AUDIO OUTPUT OF PLUS 10DB OR OTHER CONVENIENT LEVER, (SIGNAL PLUS RCVR NOISE).
4. DE-TUNE RECEIVER FROM TEST SIGNAL AND MEASURE RECEIVER NOISE.
5. A DIFFERENCE OF 20DB BETWEEN SIGNAL PLUS RECEIVER NOISE AND RECEIVER NOISE INDICATES A GOOD R-390 RECEIVER.



CU-408/URM-25F
(IMPEDANCE MATCHING NETWORD AND 10:1 VOLTAGE DIVIDER).
NOTE: CU-408/URM-25F IS SUPPLIED W/URM-25F MODEL ONLY. FOR URM-25D AND OTHER MODELS CHANGE RESISTORS AND CIRCUIT IN EITHER 5;1 OR 10:1 ATTENTUATORS TO AGREE W/CU-408 CIRCUIT AS SHOWN ABOVE.

PROCEDURE:

1. SET RECEIVER CONTROLS FOR CW RECEPTION:
   A. BANDWIDTH--2KC
   B. AUDIO RESPONSE--WIDE
   C. BFO PITCH--ZERO
   D. LIMITER--OFF

E. FUNCTION--MGC
F. RF GAIN--MAX

2. TUNE RECEIVER TO ZERO BEAT WITH TEST SIGNAL.
3. TURN BFO PITCH TO MINUS 1 OR PLUS 1.
4. PEAK ANTENNA TRIMMER FOR MAXIMUM INDICATION ON TS-585.
5. ADJUST RF GAIN FOR PLUS 10DB ~~[illegible]~~.
6. DE-TUNE RECEIVER AT LEAST 10KC FROM TEST SIGNAL FREQUENCY.
7. TS-585 NOW INDICATES RECEIVER NOISE OUTPUT RESULTING FROM STANDARD GAIN SETTING ESTABLISHED BY STEP FIVE ABOVE. RECEIVER PASSES TEST IF NOISE INDICATION ON TS-585 IS MINUS 10DB OR LESS.

TEST FREQUENCIES:

1.5MC; (1-2 MC BAND)
3.0MC; (2-4 MC BAND)
6.0MC, (4-8 MC BAND)
12.0MC, (8-16 MC BAND)
24.0MC, (16-32 MC BAND)