SECTION 4
SERVICING

4.1 GENERAL

4.1.1 Periodic Checks

Because of the heavy duty cycles and the number of users depending on the repeater, it is especially important that regular preventive maintenance be performed. Checks should include receiver sensitivity and SINAD and transmitter frequency, deviation and power output. The repeater should be checked monthly during the first six months of operation and quarterly thereafter.

4.1.2 Visual Inspection

Always give the repeater a visual inspection before attempting to isolate a problem. Check for loose, broken or pinched wires, overheated or discolored components and cold solder joints. A defective solder joint may have excess solder, too little solder or a dull, uneven coloring. In addition, check for bent or broken pins on the card rack mother board that may not be properly contacting the card jacks.

4.1.3 Schematics and PC Board Component Layouts

Schematic diagrams and component layouts for all PC boards are located in the back of this manual. The component layouts allow quick location and identification of components and measurement points. Refer to the "Table of Contents" for the page number of a specific schematic or component layout.

4.1.4 Parts List

A replacement parts list with the part number of parts used in the repeater is located in the back of this manual. Parts are listed alphabetically according to designator starting with the lowest number and are separated into sections identified by headings in bold-face type. Refer to the "Table of Contents" for the page number of a specific section.

Semiconductor devices used in the repeater are selected to meet specific parameters and are listed with E. F. Johnson part numbers. To obtain maximum repeater performance, always replace defective semiconductors with the same type parts.

4.1.5 Test Instruments

Refer to Table 4-1 for test equipment needed to service and align the repeater. Equivalent instruments may be substituted.

4.1.6 Service and Alignment Tools

Only common service and alignment tools are required to service the repeater. Use a low power soldering iron (60 watts or less) to prevent component damage from overheating and use rosin core solder containing 60% tin and 40% lead. To remove solder when replacing a defective component, use a desoldering aid such as braided solder wick or a bulb or plunger type suction tool.

Common straight, pointed and hex tipped alignment tools are used for receiver and transmitter adjustments. A kit containing all the alignment tools needed to adjust Johnson equipment is available from the Johnson Customer Service Department. This kit (Part No. 115-0410-001) contains seven alignment tools plus two ceramic replacement tips (refer to the Replacement Parts Price Book for more information).

4.2 ISOLATION OF TROUBLE TO RECEIVER, TRANSMITTER OR CARD RACK

4.2.1 General

For troubleshooting purposes, repeater problems can be localized to the receiver, transmitter or card rack. By performing some simple tests, the section not working properly can be identified and repaired.

Before preceding with these tests, verify that the power supply is operating and that no pins on the card rack mother board are bent, preventing proper engagement with the cards.

4.2.2 Receiver Tests

a. On the control card, set the REPEAT control to "OFF" and on the level adjust card, set the SQU ADJ control fully counter-clockwise. Remove the level adjust card and reinsert with an extender card.

b. Set the RF signal generator to the receive frequency with an output of 0.5 μV, modulated with 1000 Hz at 5 kHz deviation. Connect the generator to the receiver antenna jack. By adjusting the LOCAL AUDIO control, a 1000 Hz tone should be heard at the local speaker.

c. Measure the receiver outputs on the pins of the level adjust card. Card pins are numbered starting at the bottom. If the receiver is operating properly, the signals should be as follows:

Pin 11 (receiver audio output) - 0.9 volts AC (RMS)

Pin 12 (squelch gate) - 6.2 VDC unsquelched
- 0.1 VDC squelched (adjust the SQU ADJ control clockwise with no signal input)

Change the generator modulation to a frequency from 60-250 Hz at ± 600 Hz deviation.

Pin 20 (Call Guard audio) - 0.2 volts AC (RMS)

4.2.3 Transmitter Tests

a. Connect a dummy load to the transmitter antenna jack. On the control card, set the ACCESS switch to "OPEN" and the REPEAT switch to "ON". On the level adjust card, the SQU ADJ control should be set for threshold squelch.

TABLE 4-1
TEST INSTRUMENTS

Test Instrument	Minimum Specifications	Use	Suggested Instrument*
RF Signal Generator	450-512 MHz, 0-100 μV calibrated output, 1 kHz FM modulation at 3 and 5 kHz deviation, external modulation input for Call Guard tones.	Repeater alignment and service.	Cushman CE-3A with 20 dB pad.
	10.7 MHz and 455 kHz, 0-20 mV calibrated output, 1 kHz FM modulation at 5 kHz deviation.	Receiver service.	Hewlett Packard 8640B.
Deviation Monitor	0-5 kHz deviation.	Repeater alignment and service.	Cushman CE-3A.
Frequency Meter	450-512 MHz.	Transmitter and receiver alignment.	Cushman CE-3A.
AC Voltmeter	100 mV - 4V RMS.	Repeater alignment and service.	Hewlett Packard 427A.
DC Voltmeter	100 mV - 15V.	Repeater alignment and service.	Hewlett Packard 427A.
DC Ammeter	0-30 A.	Transmitter service	Simpson
RF Voltmeter	500 mV to 15V, 500 MHz.	Receiver and transmitter service.	Boonton 92C RF Millivoltmeter with 100:1 Attenuator.
Oscilloscope	10 MHz bandwidth, 10 mV/cm vertical sensitivity, calibrated vertical input.	Repeater alignment and service.	Tektronix 561A with X10 probe.
Distortion Meter	Measure noise and distortion on a 1 kHz signal.	Measure receiver SINAD.	Heathkit IM58 Distortion Meter or SINADDER ®
Audio Signal Generator	1 kHz, 100 mV output.	Transmitter tuneup and service and receiver service.	Hewlett Packard 204D.
Speaker Load	3 ohm speaker load.	Receiver Alignment and Service	Fabricated
Wattmeter	450-512 MHz, 100 watt, 50 ohm impedance.	Transmitter tuneup and service.	Bird 43 with 100 watt UHF element
Dummy Load	100 watt, 50 ohm		
Audio Generator or Period Counter	Output frequency ± 0.5% of Call Guard tone. Count period of 60-250 Hz signals.	Set Call Guard frequency.	Wavetek 3000-216 Hewlett Packard 5302 With 5300 Measurements System

* Any equivalent instrument may be substituted.

® Registered trademark of Helper Instruments Company

b. Set the RF signal generator to the receive frequency with an output of 10 μV, modulated with 1000 Hz at ± 5 kHz deviation. Connect the generator to the receiver antenna jack.

c. The transmitter should key up and frequency, power output and deviation should be normal. If not, perform the following tests and if the transmitter inputs are correct, the transmitter is probably faulty.

Transmitter Does Not Key

Check the voltage at position 5 and 6 of the card rack test panel. The DC voltage at position 5 (Q348C) should be about 13.2 volts and at position 6 (Q348E), 13.8 volts. If the voltage at position 5 is not correct, verify that the PTT input on pin 10 of J311 at the junction of R300 and R301 is about 0.2 volts. If it is, check Q348 and if it isn't, check the level adjust card.

No Transmit Audio

Measure the transmit audio input voltage on pin 9 of J311 at the junction of R307 and C305. The AC voltage should be about 0.02 V RMS.

No Transmit Call Guard Audio

Change the generator modulation to a frequency from 60-250 Hz at ± 600 Hz deviation. Measure the Call Guard audio input on pin 22 of J311 at the (-) side of C399. The voltage should be about 0.4V RMS.

4.3 RECEIVER SERVICING

4.3.1 General

To isolate receiver troubles to a specific section, refer to the receiver troubleshooting flow chart, Figure 4-1 or refer to the following information. All voltages are measured with respect to ground and are typical readings. RF voltages are usually given as a general indication of stage gain and should not be used as absolute readings. Operational amplifiers may appear to have no signal on the input because of the large amount of feedback used to control amplification.

4.3.2 Regulated and Unregulated Supply Voltages

Measure the regulated supply voltage at the cathode of CR209. A typical reading is 9.1 VDC.

Measure the unregulated supply voltage at the (+) end of C260 which is the 1000 μF capacitor near the center of the PC board. A typical reading is 13.8 VDC.

4.3.3 Squelch Circuit

DC Voltages - Measure the DC voltages of U202C, U202D and Q208 and compare with those on the receiver schematic diagram on page 47.

Noise Voltages - Measure the noise voltages and compare with those in Table 4-2 (measurements taken with no signal input).

TABLE 4-2
SQUELCH VOLTAGE READINGS

Location	Volts (RMS)	Volts (P-P)
C235/R240	0.18	1.0
U202, pin 5	1.0	6.5 (peak)
U202, pin 4	0.41	1.5 (peak)

Test Conditions: No transceiver signal input. Measurements taken with Boonton 92C RF millivoltmeter and Tektronix 561A oscilloscope with X10 probe.

4.3.4 Audio Amplifiers

DC Voltage - Measure the DC voltages of U202A, U202B, Q206, Q207, Q208, Q209 and Q210 and compare with those on the receiver schematic diagram on page 47.

AC Voltages - Inject a 0.1V (RMS), 1 kHz signal at pin 6 of U201 and set the VOLUME control for an audio output of 3V (RMS) across a 3 ohm speaker load. Measure the audio voltages and compare to those listed in Table 4-3.

TABLE 4-3
AUDIO STAGE SIGNAL TRACING

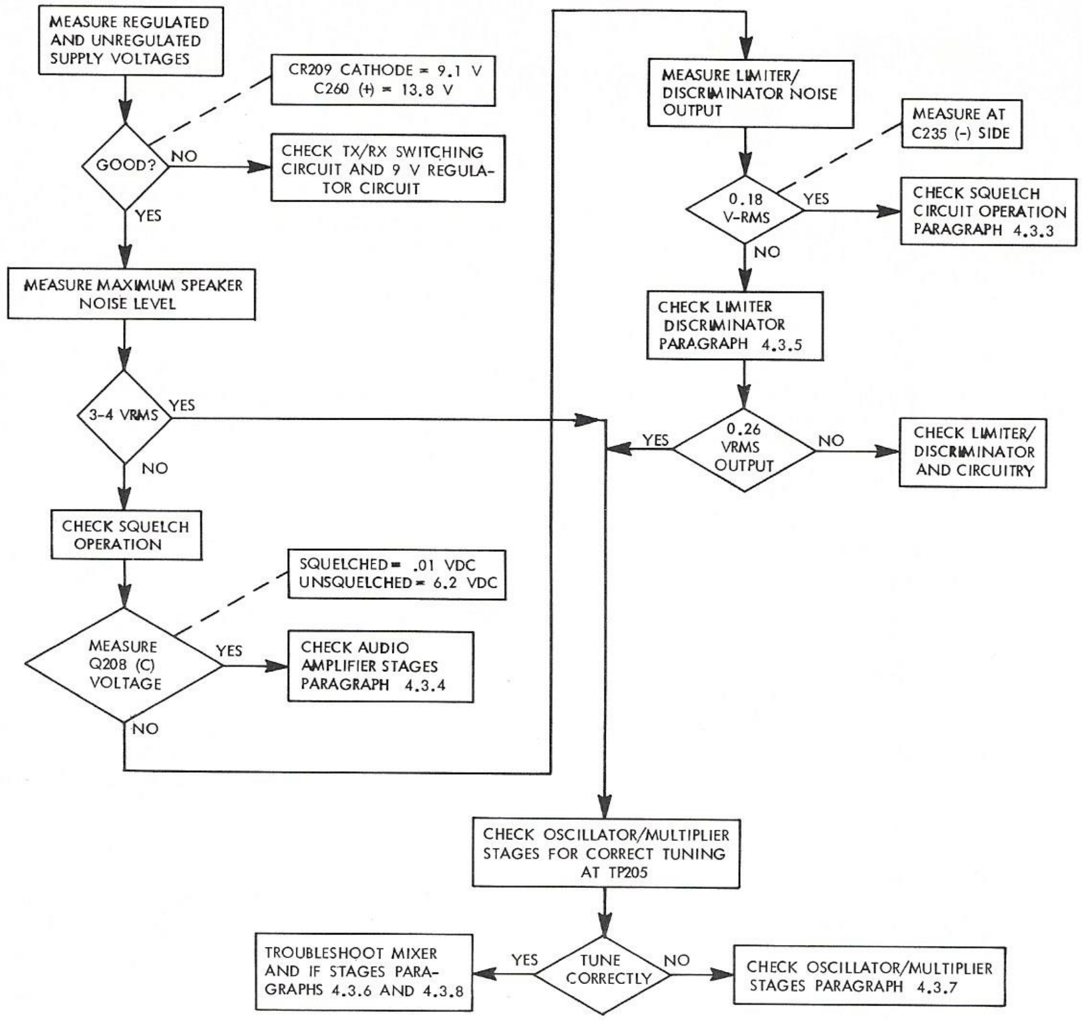
Location	Volts (RMS)	Volts (P-P)
U202, pin 9	0.30	0.90
U202, pin 10	0.35	1.1
Q206 base	0.003	0.01
Q206 collector	0.42	1.2
Q207 collector	3.3	9.3
Q209 base	0.78	2.2
Q209 collector	3.3	9.3
Q210 base	4.1	11.6
Q210 emitter	3.5	9.9

Test Conditions: 0.1V RMS, 1 kHz signal injected at U201, pin 6. VOLUME control set for 3V RMS across a 3 ohm speaker load. Readings taken with Fluke 8000A Digital Voltmeter and Tektronix 561A oscilloscope with X10 probe.

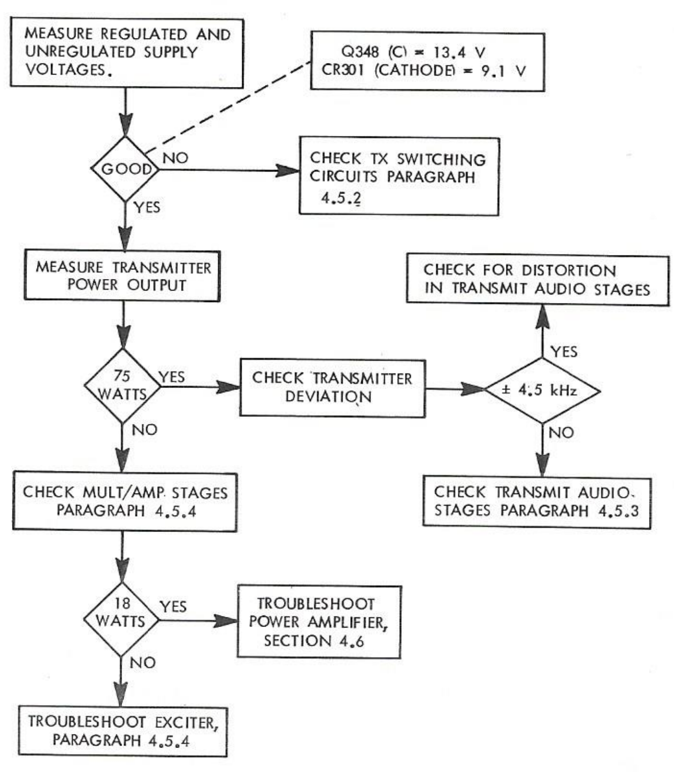
4.3.5 Limiter/Discriminator

DC Voltages - Measure the DC voltages of U201 and compare with those on the receiver schematic diagram on page 47.

U201 AC Output - Inject a 100 μV 455 kHz signal modulated with 1000 Hz at ± 5 kHz deviation at TP202 through a 0.01 μF capacitor. This signal should produce a 0.26V RMS, 1000 Hz signal on pin 6 of U201.



RECEIVER TROUBLESHOOTING FLOW CHART
FIGURE 4-1



TRANSMITTER TROUBLESHOOTING FLOW CHART
FIGURE 4-2

4.3.6 Second Oscillator, Second Mixer and 455 kHz IF Amplifiers

DC Voltages - Measure the DC voltages of Q214, Q202, Q203 and Q204 and compare with those on the receiver schematic on page 47.

Q214 RF Output - Measure the RF voltage on the emitter of second oscillator Q214. A typical reading is 0.43V RMS.

Checking Stage Gain - Inject a 455 kHz signal at various points as indicated on the schematic diagram. When the indicated level is injected, approximately 20 dB quieting of the speaker audio should be produced. This indicates that the receiver circuitry following the injection point is probably operating normally.

4.3.7 Oscillator/Multiplier Stages

DC Voltages - Measure the DC voltages of Q211, Q213, Q101, TP204 and TP205 and compare with those on the receiver schematic diagram on page 47.

RF Voltages - Measure the RF voltages and compare with those on the schematic diagram.

4.3.8 First Mixer and 10.7 MHz Amplifier

DC Voltages - Measure the DC voltages of Q103 and Q215 and compare with those on the schematic diagram.

Checking Stage Gain - Inject a 10.7 MHz signal at various points as indicated on the schematic diagram. When the indicated level is injected, approximately 20 dB quieting of the speaker audio should be produced. This indicates that the receiver circuitry following the injection point is probably operating normally.

4.4 RECEIVER FRONT END STRIP REMOVAL

NOTE

Loosening front end strip screws or removal of the front end strip will detune the helical coils making front end realignment necessary. Do not remove the front end strip unless a test point measurement cannot be made from the exposed side or a component replacement is required.

a. From the component side of the receiver board, remove one end of the bare wire to C110 on the Q101 mounting bracket.

b. On the front end strip, remove the orange wire to R107 and the wire from C109 to J200, pin 26.

c. Remove the 18 screws attaching the front end strip to the casting. With a screwdriver, carefully pry upward on the front end strip in the area of the transistor recess hole to slide the Q101 mounting bracket out of the mounting slots. The front end strip can now be hinged on the coaxial cables to gain access to components.

d. Install the front end strip in the reverse order. Start all 18 mounting screws and tighten from the middle outward.

4.5 EXCITER SERVICING

4.5.1 General

To isolate transmitter troubles to a specific section, refer to the transmitter troubleshooting flow chart, Figure 4-2 or refer to the following information. All voltages are measured with respect to ground and are typical readings. RF voltages are usually given as a general indication of stage gain and should not be used as absolute readings. Operational amplifiers may appear to have no signal on the input because of the large amount of feedback used to control amplification.

4.5.2 Regulated and Unregulated Supply Voltages and Transmitter Current

Voltage Measurements - With the transmitter keyed, measure the 9 volt regulated voltage and the voltages of Q348. The voltage on the cathode of CR301 should be about 9.1 volts. Compare the voltages of Q348 with those listed on the schematic diagram on page 48.

Current Measurements - Connect a 30 ampere ammeter in series with the red cable from the power supply. Measure the transmitter current with an RF power output of 75 watts. Typical transmitter current should be 22 amperes.

4.5.3 Transmit Audio Stages (U301)

DC Voltages - Measure the DC voltages of U301 with the transmitter keyed. Compare the voltages to those on the schematic diagram on page 48.

AC Voltages - Inject a 0.1 volt, 1 kHz signal at pin 1 of the local microphone jack or at the junction of R307 and C305 on the transmitter board. With the transmitter keyed, compare the voltages and waveforms to those shown on the schematic diagram.

4.5.4 Oscillator, Multipler and Amplifier Stages

Test Point Voltages - Key the transmitter and measure the DC voltages at TP301, TP302 and TP303 and compare to those on the schematic diagram on page 48.

RF Voltages - Measure the RF voltages and compare to those on the schematic diagram.

DC Voltages - Disable the TCXO by removing the jumper from MP4 to MP2 on the TCXO board. Measure the DC voltages with the transmitter keyed and compare to those on the schematic diagram.

Transistor Current - Measure the current flow through each transistor by performing the measurements indicated in Table 4-5.

Transistor Resistance Measurements - Check Q376, Q377 and Q378 for opens or shorts with an ohmmeter. Refer to Table 4-4 for typical resistance measurements.

TABLE 4-4
TRANSISTOR RESISTANCE MEASUREMENTS

Measurement			Resistance (ohms)					
-		+	Q376	Q377	Q378	Q901	Q902	Q903
B	to	E	∞	∞	∞	∞	∞	∞
B	to	C	∞	∞	∞	∞	∞	∞
C	to	B	350	350	300	300	300	300
E	to	B	350	350	300	300	300	300
E	to	C	∞	∞	∞	3,000	∞	∞
C	to	E	350	350	300	4,000	300	300

Test Conditions: Base and collector electrically isolated by removing one end of attached chokes and resistors or lifting base and collector tabs. Measurements taken with Triplett 630 NS VOM on X100 scale.

Exciter Power Output Measurement - Connect a wattmeter and dummy load to the exciter antenna jack. The exciter power output should be about 18 watts.

NOTE

When power output is measured at the exciter antenna jack, no RF is sensed by the power control circuit and maximum power to be produced by Q377 and Q378.

TABLE 4-5
TRANSISTOR CURRENT MEASUREMENTS

Transistor	Measurement Point	⚠1 Voltage Drop (VDC) Crystal Out	Crystal In	⚠2 Current (Amps) Crystal Out	Crystal In
Q320/Q321	R338	0.45	0.47	----	----
Q345	R355	0.03	0.14	----	----
Q346	R360	0.15	0.60	----	----
Q347	R364/R365	0.10	5.4	----	----
Q375	R371	0.25	2.3	----	----
Q376	L357/C377	----	----	0.018	0.30
Q377	L359/C91	----	----	0	0.80
Q378	L361/C387	----	----	0	1.3
Q901	L903/C908	----	----	0	5.0
Q902	L908/C939	----	----	0	6.0
Q903	L909/C939	----	----	0	6.0

⚠1 Voltage drops are measured across resistor specified in "Measurement Point" column.

⚠2 Current measurements taken by unsoldering DC end of the specified RF choke and connecting a DC ammeter between the choke and the removal point.

Test Conditions: Current measurements taken with Triplett 630 NS VOM with crystal removed (microphone keyed) and with crystal in with 75 watts RF output.

4.6 POWER AMPLIFIER SERVICING

4.6.1 General

Component Replacement

When replacing components on certain areas of the power amplifier board, care must be taken to prevent leads from touching the heat sink under the PC board. There is no insulator under the board from the base area of Q902 and Q903 outward to the area of the low-pass filter to achieve better heat dissipation. If the components in this area are installed with the leads too far through the PC board, they may become grounded to the heat sink.

PC Board Removal

Remove the six mounting screws from Q901, Q902 and Q903. Remove the three PC board mounting screws and the PC board is free from the heat sink.

When reinstalling, check that there is adequate heat sink compound on the transistor bases and that proper seating occurs. Be sure the insulator is installed between the PC board and heat sink.

4.6.2 Power Input Measurement

Connect a wattmeter and dummy load to the exciter antenna jack and measure the power output. Typical power output should be 18 watts.

4.6.3 DC and RF Voltages

With the transmitter unkeyed, measure the DC voltage on the collectors of Q901, Q902 and Q903. Then key the transmitter and compare the RF voltages to those on the schematic diagram on page 48.

4.6.4 Q901 Current and Power Measurement

a. Measure Q901 current by unsoldering the supply side of L903 and attaching an ammeter between L903 and the removal point. DC current should be about 5 amperes with 75 watts RF output.

b. To measure Q901 power output, remove the coaxial cable attached to C907. Attach in the same location a coaxial cable connected to a wattmeter and dummy load. Power output should be about 50 watts.

4.6.5 Q902 and Q903 Current and Power Measurement

a. Measure Q902 current by unsoldering the supply side of L908 and attaching an ammeter between L908 and the removal point. DC current should be about 6 amperes with 75 watts RF output.

b. Measure Q903 current by removing the supply end of L909 and attaching an ammeter between L909 and the removal point. Current should be about 6 amperes with 75 watts RF output.

c. Measure the power input to the low-pass filter. Remove the coaxial cable at C941 and connect in the same location a coaxial cable connected to a wattmeter and 50 ohm dummy load. Power output should be 85 to 100 watts.

NOTE

When power output is measured at points preceding the power sensing microstrip, no RF is sensed by the power control circuit. This causes maximum power output to be produced by Q377 and succeeding stages.

4.6.6 Checking Q901, Q902 and Q903 for Opens or Shorts With an Ohmmeter

Refer to Table 4-4 for typical resistance measurements.

4.6.7 Checking Low Pass Filter Power Losses

Adjust R420 on the power control board maximum clockwise. Measure the power output at the antenna jack and compare to the reading obtained in paragraph 4.6.5 c. Typical power loss through the low pass filter is 0.3 - 0.5 dB. This equals about 7 to 9 watts with a 100 watt input.

4.6.8 Additional Troubleshooting Hints

a. If the power output is low and a defective Q902 or Q903 is suspected, one of the following methods may indicate the defective stage:

CAUTION

Do not touch the transistors while transmitting since high levels of RF are present.

1. Transmit for a short time to allow the transistor to warm. Discontinue transmitting and briefly touch the transistor cases. If one is cold, it probably is not conducting and may be defective.

2. Briefly short the transistor base to the emitter with the blade of a screwdriver. If a large power decrease occurs, the transistor is probably operating properly and the other transistor may be defective.

b. If a transistor is shorted in the power amplifier, the 30 ampere fuse in the power cable will open. This fuse provides short circuit protection for the power amplifier and must not be defeated since severe component or microstrip damage could result.

4.7 INTEGRATED CIRCUIT AND TRANSISTOR SERVICING

4.7.1 Integrated Circuit Servicing

Troubleshooting - Before removing the integrated circuit, determine that it is defective by measuring and comparing the DC voltages to those on the schematic. Then measure and compare the AC voltages to those in the servicing tables. There normally may appear to be no signal on the input pin of operational amplifiers because negative feedback circuit drops the input signal to a very low level.

Removal - One of the three following methods can be used to remove the integrated circuit:

1. If the integrated circuit is definitely defective, it can be removed by cutting the package from the leads and then unsoldering and removing each lead separately.
2. A special integrated circuit desoldering tip can be used on the soldering iron. This large tip simultaneously melts the solder on all the leads so the integrated circuit can be removed intact.
3. A suction type desoldering tool or a braided desoldering wick can be used to remove the solder around the IC pins. The solder should be thoroughly removed so the IC can be withdrawn without resistance since damage may occur if the IC is flexed to break residual solder.

Replacement - Solder the new IC in place using a low power soldering iron with a small tip. Check for solder bridges before applying power to the circuit.

4.7.2 Replacing Transistors Soldered to Microstrip

Removal - Remove the defective transistor along with all excess solder from the microstrip where the transistor was attached. Thoroughly clean the mounting surfaces with alcohol or another solvent which leaves no residue. Do not apply cleaning fluid to Underwood capacitors since the value may be affected.

Tinning - Lightly tin the underside of each transistor lead with solder. Do not allow a thick buildup of solder since this may cause case separation when the transistor is tightened.

Mounting - Check that no solder, flux or dirt is on the transistor mounting base and then apply a thin coat of silicon heat sink compound to the transistor mounting base. Install the transistor and tighten it securely before proceeding with soldering.

Soldering - Solder the transistor using a generous amount of solder to provide good contact between the entire transistor tab and the microstrip. Check that no solder bridges or shorts are present. Underwood capacitors attached between the base and emitter or collector and emitter should be installed as close as possible to the transistor case.

4.8 CARD RACK SERVICING

To isolate a problem to a specific stage on one of these cards, refer to the card rack block diagram on page 51 and the appropriate schematic diagram. Determine the signal path from the block diagram and then measure the DC and AC voltages as shown on the schematic diagrams.

NOR Gate U601 Operation

U602 on the control card contains two, four-input NOR gates. The output from these NOR gates is a high signal only when all four inputs are low. When one or all inputs are high, a low output is produced.

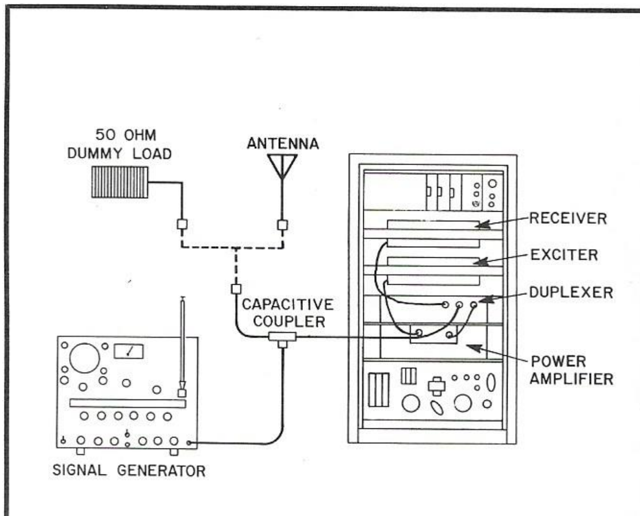
U602(A) causes the transmitter to key if all four inputs are low. The output goes high only if the squelch, time-out timer, Call Guard (if used) and repeater disable switch signals are all low.

U602(B) acts like an inverter since all four inputs are connected together. With all the inputs high, a low output is produced and with all inputs low, a high output is produced.

4.9 CHECKING RECEIVER DESENSITIZATION

4.9.1 General

Receiver desensitization is the loss of receiver sensitivity caused by high level, off-frequency signals getting into the receiver. Some possible causes of desensitization are an improperly tuned duplexer or a transmitter emitting spurious radiation.



DESENSITIZATION TEST SETUP
FIGURE 4-3

4.9.2 Test Setup

Connect the test setup as shown in Figure 4-3. A capacitive coupler is used to isolate the signal generator from the transmit RF. To adequately protect the generator, the coupler should provide 50-60 dB isolation.

Use a capacitive coupler such as Bird Model 4275 or fabricate one from a coaxial "T" connector. Remove the pin from the side terminal of the connector and shorten until the desired isolation is obtained.

4.9.3 Test Procedure

a. Switch the REPEAT switch to "OFF". Set the RF signal generator to the receive frequency with an unmodulated output. Connect the generator and the antenna to the capacitive coupler.

b. Set the generator output for 15 dB audio quieting. Switch the REPEAT switch to "ON" and less than 2 dB quieting degradation should result.

4.9.4 Localizing Cause of Desensitization

Antenna - If desensitization is produced with the antenna attached, substitute a 50 ohm dummy load for the antenna and repeat the test. If the result is normal, the antenna or feedline may be defective.

Duplexer - Connect the signal generator to the receiver antenna jack and connect a 50 ohm dummy load to the transmitter antenna jack. Repeat the test and if the result is normal, the duplexer is probably improperly tuned or defective.

Transmitter - If the duplexer test still resulted in abnormal desensitization, the transmitter is probably emitting spurious radiation.

4.10 DETERMINING EFFECTIVE SENSITIVITY

4.10.1 General

If the repeater is operating in a congested area where many high level RF signals are present, the effective sensitivity may be less than that obtained using the standard bench check procedure. To determine the effective sensitivity of the repeater, perform the following test.

4.10.2 Test Procedure

a. Check the quieting sensitivity of the receiver using the standard bench check procedure as detailed on page 31. Perform the test with the duplexer (if used) and record the results.

b. Connect the test setup as shown in Figure 4-3 using a capacitive coupler as described in paragraph 4.9.2 Check the quieting sensitivity using a 50 ohm dummy load connected to the capacitive coupler. Record the results.

c. Check the quieting sensitivity with the antenna connected to the capacitive coupler. Record the results with no on-channel signal present.

d. Determine the effectivity sensitivity using the following formula:

Effective Sensitivity =

$$\text{Bench Check Sensitivity} \times \frac{\text{Sensitivity With Antenna}}{\text{Sensitivity With 50 Ohm Load}}$$

Example: Bench Check Sensitivity = 0.4 μV (20 dB quieting)

50 Ohm Load Sensitivity = 400 μV (20 dB quieting)

Antenna Sensivitity = 4000 μV (20 dB quieting)

$$\text{Effective Sensitivity} = 0.4 \times \frac{4000}{400} = 4\ \mu V$$