

SECTION V. MAINTENANCE

12.5.1 INTRODUCTION

This section provides the preventive and corrective maintenance procedures for the GTA radio. Preventive maintenance consists of the RF power output check, modulation level check, VSWR at transmitter output check, and frequency stability check. Corrective maintenance consists of fault isolation using the ASOS GTA radio maintenance display and removal and replacement of field replaceable units (FRU's).

12.5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of those procedures that are performed on a scheduled basis to maintain the GTA radio in an operational state. Table 12.5.1 lists the regularly required performance checks necessary to ensure operation within established tolerances and limits and provides a schedule for their performance.

12.5.2.1 **RF Power Output Check.** This check (table 12.5.2) is performed at the antenna and is designed to verify that the RF power output of the GTA radio is the required amount at the antenna. The test equipment is connected as shown on figure 12.5.1.

12.5.2.2 **Modulation Level Check.** This check (table 12.5.3 Preferred or 12.5.3 Alternative) ensures a constant level of modulation. The test equipment is connected as shown on figure 12.5.2.

12.5.2.3 **VSWR at Transmitter Output Check.** This check (table 12.5.4) ascertains that the VSWR, as measured at the GTA radio, does not exceed 1.8:1. The test equipment is connected as shown on figure 12.5.3.

12.5.2.4 **Frequency Stability Check.** This check (table 12.5.5) determines if the transmitter output frequency is within ± 0.0005 percent tolerance. The test equipment is connected as shown on figure 12.5.4.

12.5.2.5 **Antenna Cable Insulation Verification.** This check (table 12.5.6) performed annually, verifies the antenna cable insulation integrity. Test equipment is connected as shown in figure 12.5.5.

Table 12.5.1. Periodic Performance Checks

Interval	What To Do	How To Do It
90 days	RF Power Output Check	Table 12.5.2
	Modulation Level Check	Table 12.5.3
	VSWR at Transmitter Output Check	Table 12.5.4
	Frequency Stability Check	Table 12.5.5
Annually	Verify Antenna Cable Conductance and Insulation	Table 12.5.6

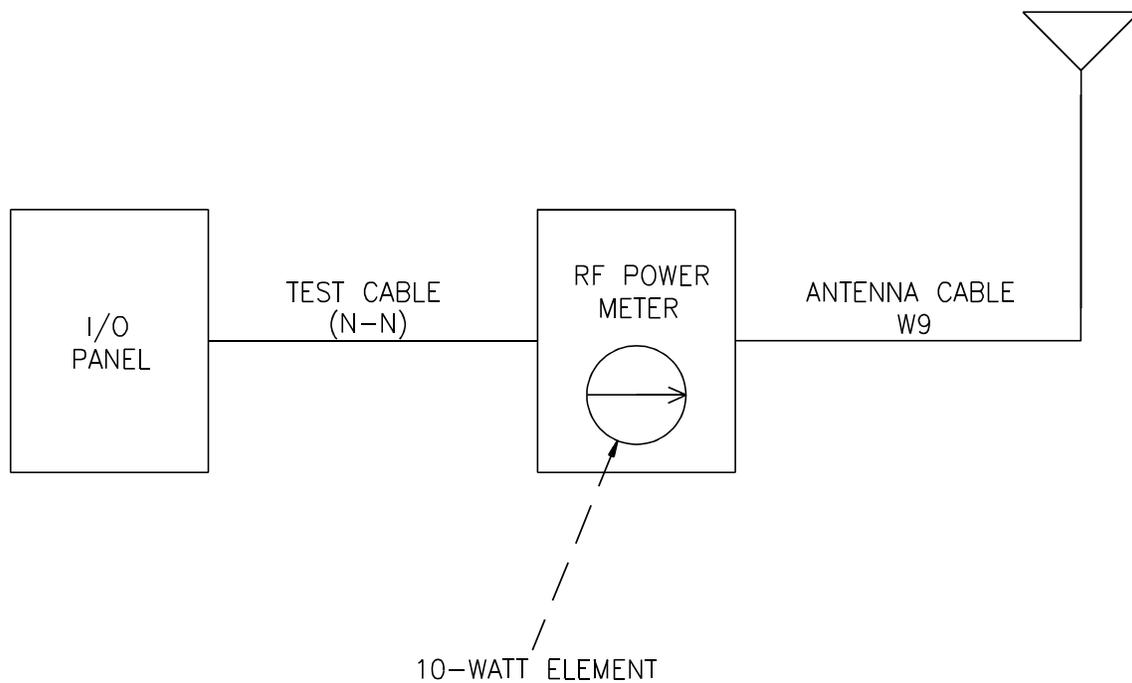
Table 12.5.2. RF Power Output Check

Step	Procedure
Tools and Materials Required: RF power meter w/10-watt, 100-250 MHz element One N-N test cable	
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At I/O panel on ACU, disconnect antenna cable W9 from connector J43.
3	Connect antenna cable W9 from ACU I/O panel to RF power meter output side.
4	Install 10-watt, 100-250 MHz element into RF power meter. Ensure that arrow points toward antenna.
5	Using N-N test cable, connect RF power meter input to I/O panel J43.

Table 12.5.2. RF Power Output Check -CONT

Step	Procedure
6	At front of GTA radio, press AC PWR switch to apply GTA radio power.
7	Observe and verify that RF power meter forward power reading is 2.5 ± 1 watt plus the insertion loss of the antenna cable. The 'maximum nominal power' required at the antenna base is 2.5 ± 1 watt however, the power output will be site specific. Insertion Loss Of The Antenna Cable = {Output Power at TXM (watts) - Output Power at Base of Antenna (watts)} Record power reading. If reading is not within tolerance, perform steps 8 through 12; if reading is correct, proceed to step 13.
8	At front of GTA radio, press ENB pushbutton twice.
9	Press MOD pushbutton four times to display XMIT power display.
10	If power reading is too low, press up arrow to increase power output, then observe RF power meter to verify that power reading is within tolerance.
11	If power reading is too high, press down arrow to decrease power output, then observe RF power meter to verify that power reading is within tolerance.
12	If power reading cannot be corrected to within specified tolerances, remove and replace GTA radio in accordance with table 12.5.11.
13	At front of GTA radio, press AC PWR switch to remove GTA radio power.
14	Remove antenna cable W9 from output side of RF power meter.
15	Remove N-N test cable from RF power meter and I/O panel.
16	Connect antenna cable W9 to I/O panel J43.
17	Remove 10-watt, 100-250 MHz element from RF power meter and return it to storage.
18	At front of GTA radio, press AC PWR switch to apply GTA radio power.

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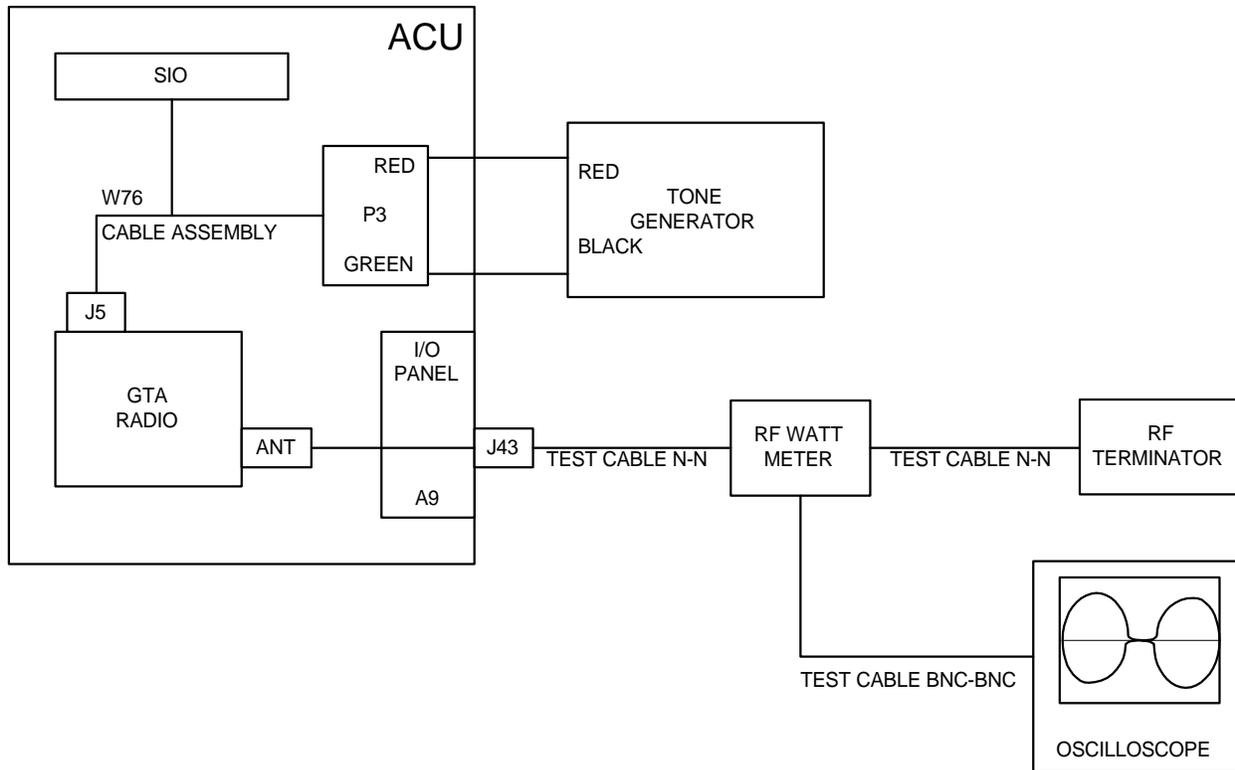


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Figure 12.5.1. RF Power Output Check

Table 12.5.3a. Modulation Level Check (Alternative)

Step	Procedure
	Tools and Test Equipment Required: RF power meter, w/RF sampler element Oscilloscope Test cable (BNC-BNC) Two N-N test cables Dummy Load (25 watts, 50 ohms) Audio Test Tone Generator w/ Test Leads (must have pure sine wave output)
1	Inside the back of the ACU, remove the cover from the RJ11 phone jack that feeds audio to the ground to air transmitter.
2	Connect oscilloscope probe to the red and green wires inside the RJ11 phone jack.
3	Measure the peak to peak amplitude of the ASOS voice audio. Should be approximately 2.0 VPP. (If NO signal present, connect the scope ground to the other terminal reversing the connections of the scope probe.)
4	At front of GTA radio, press AC PWR switch to remove GTA radio power.
5	Refer to figure 12.5.2 and disconnect antenna cable W9 from J43 connector on I/O panel. Connect RF power meter input to connector J43 on I/O panel using N-N test cable. Connect RF power meter output to N-N test cable and dummy load. Install RF sampler element into RF power meter.
6	Disconnect ACU harness connector P67 from the RJ11 phone jack that feeds audio to the ground to air transmitter to remove audio signal from the carrier.
7	At GTA radio, press AC PWR switch to apply GTA radio power.
8	Connect the output of the audio generator to the red and green wires inside the RJ11 phone jack. Make sure the ground of the signal generator and the oscilloscope are connected to the same point.
9	Adjust the audio generator for 1000 Hz at the same Peak to Peak amplitude as measured in step 3 for the ASOS voice audio.
10	Connect BNC-BNC test cable from RF sampler element to channel 1 input on oscilloscope.
11	Turn OFF the audio signal generator.
12	Set oscilloscope time base for 200µ SEC/DIV. Manually adjust the oscilloscope so that the carrier amplitude is equal to 5 division.
13	Turn ON the audio signal generator.
14	Set oscilloscope time base for 0.5m SEC/DIV.
15	Observe and verify that modulated peaks are at an optimum of 90% ± 5%. If readings are not within tolerance, perform steps 16 and 17. If readings are within tolerance, proceed to step 18.
16	With MOD pushbutton go to MOD Index on LCD display.
17	While observing oscilloscope, use UP and DOWN arrow buttons to set modulation to 90% ± 5%. $\text{Percent (\%) Modulation} = \frac{((\text{Peak to Peak}) - (\text{Trough to Trough}))}{((\text{Peak to Peak}) + (\text{Trough to Trough}))}$ The easiest way to set modulation: Use an IFR Service Monitor and display percent of modulation, with the Second Function Meter feature, while its receiver is tuned to the GTA radio frequency.
18	At front of GTA radio, press AC PWR switch to remove GTA radio power.
19	Disconnect RF test equipment and cables and reconnect antenna cable.
20	Disconnect audio generator from the RJ11 phone jack and replace the cover to the jack.
21	Reconnect the voice audio to the RJ11 phone jack.
22	Reapply power to the GTA radio.



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Figure 12.5.2. Modulation Level Check

Table 12.5.4. VSWR at Transmitter Output Check

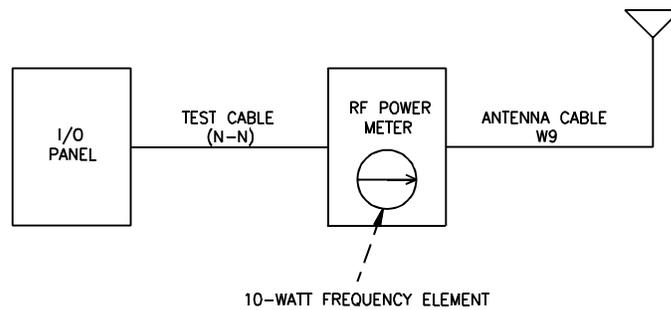
Step	Procedure
Tools and Materials Required: Laptop computer with ASOS calibration program installed RF power meter w/1-watt 110-160 Mhz element and 10-watt, 100-250 Mhz element N-N test cable	
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Install a 10-watt, 100-250 MHz element in RF power meter with arrow pointing toward the antenna.
4	Connect RF power meter output to antenna cable W9.
5	Connect RF power meter input to antenna connector J43 on I/O panel with N-N test cable.
6	At front of GTA radio, press AC PWR switch to apply GTA radio power.
7	Using laptop, type ASOS <CR> at the DOS prompt.
8	Type menu item 5 on ASOS menu calibration program and enter forward power value at prompt. Hit return.
CAUTION	
Be sure to turn the arrow (←) on the 10 watt, 100-250MHZ element toward the GTA TXM and insure there is < 1 watt of power.	
9	At front of GTA radio, press AC PWR switch to remove GTA radio power.
10	Remove 10-watt, 100-250 MHz element from RF power meter and replace with 1-watt, 110-160 MHz element.

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Table 12.5.4. VSWR at Transmitter Output Check -CONT

Step	Procedure
	CAUTION To prevent damage to 1-watt, 110-160 MHz element, ensure that arrow is in direction of GTA radio.
11	At front of GTA radio, press AC PWR switch to apply GTA radio power.
12	Observe and record reflected power.
13	Enter reflected power at ASOS calibration program prompt.
14	The program calculates VSWR, displays result, and indicates if VSWR is within tolerance.
15	If VSWR is outside of prescribed tolerance, a beep sounds and a warning message is displayed.
16	If reading is not within tolerance, press GTA radio AC PWR switch to remove GTA radio power; then, troubleshoot radio antenna cable, EMI/EFI filters, or GTA radio.
17	Disconnect N-N test cable from input side of RF power meter and connector J43 on the I/O panel.
18	Connect antenna cable W9 to J43 connector on I/O panel.
19	At front of GTA radio, press AC PWR switch to apply GTA radio power.
20	Remove N-N test cable from output side of RF power meter.
21	Remove 1-watt, 110-160 MHz element from RF power meter and secure it properly.

FORWARD POWER TEST SETUP

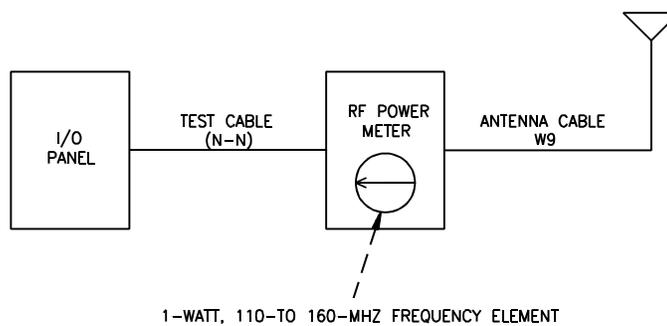


$$P = \frac{1 + \sqrt{\rho}}{1 - \sqrt{\rho}} \text{ AND } \rho = \left| \frac{P - 1}{P + 1} \right|^2$$

WHERE $\rho = \text{VSWR}$

$$\rho = \frac{W_r}{W_f}$$

REFLECTED POWER TEST SETUP



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Figure 12.5.3. VSWR at Transmitter Output Check

Table 12.5.5. Frequency Stability Check

Step	Procedure
	<p>Tools and Materials Required:</p> <ul style="list-style-type: none"> RF power meter w\RF sampler element Two N-N test cables BNC-BNC test cable Frequency counter Laptop computer w/ASOS program installed
1	At front of GTA radio, press AC PWR switch to remove GTA radio power. Disconnect audio input at cable W76 connector P67 from connector P3.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Install RF sampler element into RF power meter.
4	Using N-N test cable, connect RF power meter input to antenna connector J43 on I/O panel.
5	Using N-N test cable, connect RF terminator to output side of RF power meter.
6	Connect BNC-BNC test cable to RF sampler element.
7	Connect frequency counter, input C, to BNC-BNC test cable.
8	At front of GTA radio, press AC PWR switch to apply GTA radio power.
9	<p>Observe and verify that frequency count is within 0.0005 percent of assigned frequency using example provided below. If frequency is not within tolerance, perform steps 10 through 15. If frequency is within tolerance, proceed to step 16.</p> <p style="text-align: center;">NOTE</p> <p style="text-align: center;">Press the Function Key on the Frequency Counter until “Freq C” has been selected.</p> <p style="text-align: center;">Example: 118.025 MHz x 0.000005 = ±590.125 Hz Carrier frequency x percentage = tolerance level</p> <p>Alternate Method:</p> <ol style="list-style-type: none"> a. To initialize ASOS calibration program, use laptop PC as follows. At DOS prompt, enter: ASOS, <ENTER> b. Choose menu item number 6 to execute GTA frequency tolerance program. c. Note frequency indicated on frequency counter and enter this value at prompt. d. The program calculates frequency tolerance and displays upper and lower frequency limits.
10	At GTA radio front panel, press ENB pushbutton twice.
11	Verify that frequency is set to correct setting.
12	Press MOD pushbutton three times to display warp setting.
13	If frequency setting is too high/low, press up/down arrow, respectively, to change warp setting.
14	Verify that frequency level has either increased or decreased to within tolerance.
15	If frequency level cannot be corrected, remove and replace GTA radio in accordance with table 12.5.11.
16	At front of GTA radio, press AC PWR switch to remove GTA radio power.
17	Remove N-N test cable from connector J43 on I/O panel.
18	Connect antenna cable W9 to connector J43 on I/O panel.
19	Remove N-N test cable from input side of RF power meter.
20	Remove BNC-BNC test cable from RF sampler element.
21	Remove RF sampler element from RF power meter and return it to storage.
22	Remove BNC-BNC test cable from frequency counter.
23	At front of GTA radio, press AC PWR switch to apply GTA radio power.

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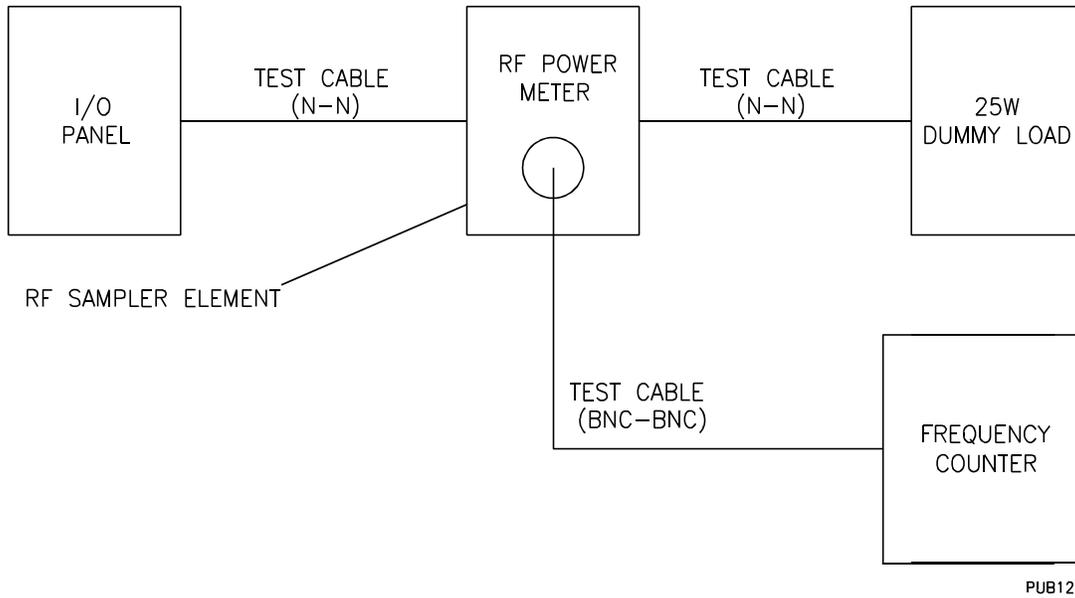
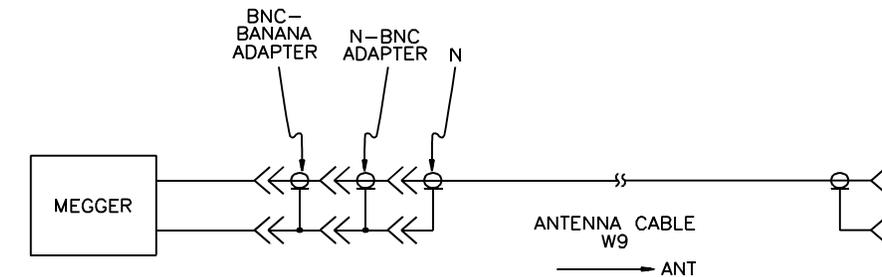


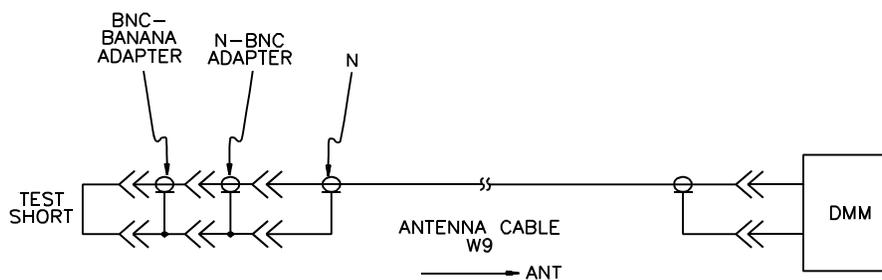
Figure 12.5.4. Frequency Stability Check

Table 12.5.6. Coax Cable Conductance and Insulation Check

Step	Procedure
Tools and Materials Required: DMM Megger Adapter, N-BNC Adapter, BNC-Banana	
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Connect N-BNC adapter to W9 RF antenna connector as shown figure 12.5.5.
4	Connect BNC-banana adapter to the N-BNC connector.
5	Connect megger to antenna cable W9 with Banana adapter.
6	Disconnect RF coax connector from the antenna.
7	At the megger, press the trigger button and verify that reading is >50 megohms.
8	Observe and record the reading.
9	Remove megger.
10	Short the shield to the center conductor at the banana adapter.
11	Using the DMM, verify that the center conductor to outer shield, loop resistance at the antenna side of the cable is ≤ 5 ohms.



INSULATION TEST



CONDUCTANCE TEST

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Figure 12.5.5. Coaxial Cable Insulation and Conductance, Test Setup

12.5.3 CORRECTIVE MAINTENANCE

Corrective maintenance consists of three major tasks: troubleshooting, voice card adjustment, and removal and replacement of the GTA radio and other FRU's.

12.5.3.1 Troubleshooting. Troubleshooting involves the isolation and removal and replacement of faulty FRU's. ASOS is equipped with a continuous self-test (CST) program that isolates the majority of faults to a single FRU. However, due to the system hardware configuration, there will be instances when the diagnostics can isolate a problem only to the GTA radio. Table 12.5.7 provides corrective maintenance symptom analysis information for the GTA radio.

12.5.3.1.1 Troubleshoot the GTA Radio RF (Table 12.5.8). When there is a deterioration of the broadcast signal, it is not normally picked up until an aircraft reports that there is no message or a deteriorated message on the defined frequency. The technician must first confirm that the radio is powered on; when that is ascertained, he must verify that the cables are properly connected and the antenna is not damaged. If the problem is not the antenna or loose cabling, the technician must then perform the RF power output, frequency, and modulation checks at test points designated by the troubleshooting procedures to determine the FRU.

12.5.3.1.2 **Troubleshoot the GTA Radio RS-232 Data Link (Table 12.5.9).** This type of failure is normally observed as a no-response failure on the GTA radio page of the OID. When there is a communications problem between the ACU and the radio, the configuration of the radio to the ACU is checked first on the COMMS page on the OID. If the radio is configured to the ACU incorrectly, the ACU does not receive data back from the GTA radio. The technician must install the RS-232 tester next to verify that the data link between the ACU and the SIO board is functioning correctly. If the SIO board is not operating correctly, it must be removed; if the SIO board is operating correctly, the radio must be removed and replaced.

12.5.3.1.3 **GTA Radio BERT Program.** The RS-232 data link can also be tested using the Bit Error Rate Tester (BERT) program located on the technician's laptop PC in the ASOS directory. Access the BERT program by typing the phrase ASOS at the command line prompt and selecting item number 2 from the menu. The technician then follows the Bit Error Rate Tester instructions in Chapter 13, section V.

12.5.3.2 **Voice Recorder/Playback Board Check.** This check, which adjusts the voice board output, is performed when the GTA radio has been replaced, when the voice board(s) have been replaced, or when called out as a part of a troubleshooting procedure.

12.5.3.3 **Removal and Installation Procedure.** Table 12.5.11 provides the procedure for removing and installing the GTA radio. Removal and replacement procedures for the CPU, audio, and SIO boards are provided in Chapter 2, Section V.

Table 12.5.7. Corrective Maintenance Symptom Analysis

Symptom	What To Do	How To Do It
Loss of broadcast weather voice	Troubleshoot GTA radio RF.	Paragraph 12.5.3.1.1 and table 12.5.8
GTA radio does not respond to ACU data test	Troubleshoot GTA RS-232 data link.	Paragraph 12.5.3.1.2 and table 12.5.9
Failure of GTA self-test	Remove and replace the GTA radio.	Table 12.5.11

Table 12.5.8. Loss of Broadcast Weather Voice

Step	Test	Corrective Action
1	Check that GTA radio has power.	If power is turned off, press AC PWR switch to apply power to the GTA radio.
2	Check cable connections associated with GTA radio.	
3	Connect RF power meter to output connector between connector J43 and cable W9 on I/O panel and measure RF output power. Verify that output power is ≥ 5 watts.	If power is approximately 0 watt or if it is evident that the radio is not transmitting, proceed to step 4. If power is less than 5 watts, use ENB, MOD, and arrow pushbuttons to adjust power. After adjusting power at I/O panel, perform RF power output check in accordance with paragraph 12.5.2.1. If power is within tolerance, proceed to step 6.

Table 12.5.8. Loss of Broadcast Weather Voice -CONT

Step	Test	Corrective Action
4	<p>Disconnect power meter from connector J43 and reconnect antenna cable W9.</p> <p>Connect RF power meter to connector J4 of GTA Radio 1A10.</p> <p>Verify that output power is ≥ 5 watts.</p>	<p>If power is present, replace the following components in sequence and retest system:</p> <ul style="list-style-type: none"> a. Connector J43 filters b. Antenna cable W51 <p>If power is still not present, proceed to step 5.</p>
5	<p>Turn off GTA radio.</p> <p>Disconnect adapter cable W076 connector P1 from GTA radio connector J5.</p> <p>Verify continuity between pins A and H of cable W76 connector P1.</p>	<p>If continuity is present, remove and replace GTA Radio 1A10.</p> <p>If there is no continuity, remove and replace adapter cable W076.</p>
6	<p>Perform frequency stability checks in accordance with table 12.5.5.</p> <p>Verify that carrier frequency is identical to assigned frequency.</p>	<p>If carrier frequency is not identical to assigned frequency, remove and replace GTA radio.</p>
7	<p>Perform modulation level check in accordance with table 12.5.3. Adjust level as necessary.</p> <p>Verify that modulation level is within tolerance.</p>	<p>If the modulation level is not within tolerance, proceed to step 10.</p>
8	Check cable connections at antenna.	
9	At antenna, perform RF power output check in accordance with table 12.5.2.	<p>If power output is correct, remove and replace antenna.</p> <p>If power output is incorrect, remove and replace antenna cable W9.</p>
10	Perform voice recorder/playback board check in accordance with table 12.5.10.	<p>If the voice is OK, perform the following steps in sequence:</p> <ul style="list-style-type: none"> a. Check cable W076 for continuity. b. Remove and replace GTA radio. <p>If the voice is not OK, perform the following steps in sequence:</p> <ul style="list-style-type: none"> a. Reseat Voice Recorder/Playback Board A21. b. Remove and replace the Voice Recorder/Playback Board A21.

Table 12.5.9. GTA Radio Does Not Respond to ACU Data Test

Step	Test	Corrective Action
1	Check SIO configuration on OID display.	If not configured correctly, correct configuration at OID.
2	If configured correctly, check SIO board self-test page at the OID; verify that self- test is passing.	If SIO board does not pass self-test, remove and replace SIO board.
3	Perform RS-232 test. Connect input side of RS-232 tester to ACU harness connector DB-25 corresponding to assigned SIO port. Connect output side of RS-232 tester to connector P2 of cable W076.	If transmit line from SIO board is not active, remove and replace SIO board. If receive line is not active, check condition of cable W076. If cable checks out, remove and replace GTA radio.

Table 12.5.10. Voice Recorder/Playback Board Check

Step	Procedure
Tools and Materials Required: 600-ohm resistor Oscilloscope Terminal block, telephone, screw terminal VME extender board	
1	Power off ACU.
2	Attach 600-ohm load resistor between terminals on telephone jack as shown in figure 12.5.6.
3	Disconnect connector P67 from connector P3.
4	Connect connector P67 to 600-ohm load assembly female jack (42A block).
5	Connect oscilloscope probe across 600-ohm load assembly terminals. Set oscilloscope input to AC at 1V/DIV and set sweep to 5MS/DIV.
6	Power on ACU and wait for system to initialize.
7	Observe audio on oscilloscope. Verify that amplitude is 2 ± 0.2 V p-p. If amplitude is not in tolerance, resistor R22 on audio board 1A2A21 may be adjusted for 2.0 ± 0.2 V p-p. If amplitude cannot be reached, remove and replace Voice Board 1A2A20.
8	Power off ACU.
9	Disconnect oscilloscope from 600-ohm load assembly terminals.
10	Disconnect 600-ohm load assembly from connector P67.
11	Connect connector P3 to connector P67.
12	Power on ACU.

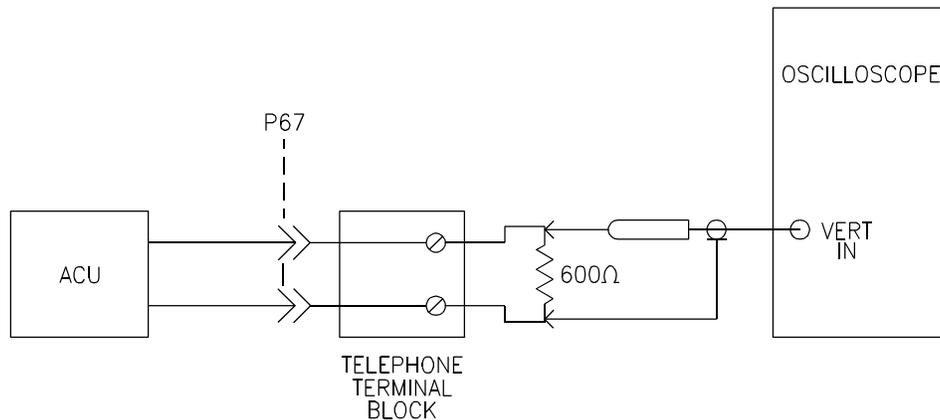


Figure 12.5.6. Voice Recorder/Playback Board, Test Setup

Table 12.5.11. GTA Radio Removal and Installation

Step	Procedure
REMOVAL	
Tools required: Small flat-tipped screwdriver	
CAUTION Damage to equipment may result if power is not removed prior to removal or installation. Ensure that the power switch on the GTA radio is set to the off (0) position.	
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	Open ACU rear cabinet door.
3	Disconnect ground lug E1.
4	Disconnect antenna connector J4.
5	Disconnect ac power connector J1.
6	Disconnect remote connector J5.
7	Remove four screws located on front of GTA radio that secure GTA radio to cabinet.
8	Slide GTA radio from cabinet until catches are secured.
9	Reaching around both sides of GTA radio, release levers that secure GTA radio to permanent slides mounted to cabinet.
10	Slowly slide GTA radio from cabinet using both hands and place GTA radio onto suitable work surface.
INSTALLATION	
Tools required: Small flat-tipped screwdriver	
CAUTION Damage to equipment may result if power is not removed prior to removal or installation. Ensure that the power switch on the GTA radio is set to the off (0) position.	
1	Carefully place GTA radio into slide slots.
2	Slide GTA radio completely back into cabinet so that slide locks engage. (This prevents the GTA radio from sliding completely out of the ACU cabinet.)
3	Locate and secure four screws that secure GTA radio to ACU cabinet.
4	Open ACU rear cabinet door.
5	Connect ground lug E1.
6	Connect antenna connector J4.
7	Connect ac power connector J1.
8	Connect remote connector J5.
9	Close ACU rear cabinet door.
10	At front of GTA radio, press AC PWR switch to apply GTA radio power.
11	Verify that AC PWR indicator is illuminated.
12	Perform voice recorder/playback board check in accordance with table 12.5.10.
13	Perform RF power output check in accordance with table 12.5.2.
14	Perform modulation level check in accordance with table 12.5.3.
15	Perform VSWR at transmitter output check in accordance with table 12.5.4.
16	Perform frequency stability check in accordance with table 12.5.5.