MOTOROLA

TROUBLESHOOTING

For MTR2000 UHF Station and Ancillary Equipment

1 INTRODUCTION

This section provides troubleshooting recommendations and procedures for the UHF station and associated ancillary equipment.

Troubleshooting Overview

The troubleshooting procedures and supporting diagrams provided in this section allow the service technician to isolate station faults to the Field Replaceable Unit (FRU) level. Defective FRUs are then replaced with known good ones to restore the station to proper operation.

Troubleshooting information includes:

- Troubleshooting flow charts
- Interpreting front panel LED indicators
- Module replacement procedures
- Post-repair procedures for performing alignment following replacement of defective modules.

Commercial, Government, and Industrial Solutions Sector
1301 E. Algonquin Road, Schaumburg, IL 60196

68P81096E16-D
12/20/99-UP

2 RECOMMENDED TEST EQUIPMENT

The following list of test equipment is recommended to perform troubleshooting procedures on the UHF station and ancillary equipment.

List of Test Equipment

- Motorola R2001 or R2600 Communications Analyzer
- PC running Microsoft Windows™ 3.1 or Windows™ 95, and Radio Service Software (RSS)
- RSS cable; part #3082056X02
- In-Line Wattmeter (Motorola S-1350 or equivalent)
- Dummy Load (50 Ω, station wattage or higher)
- Microphone with PTT switch (GMN6147B or equivalent).
- Service speaker (HSN1000)
- Service Speaker adaptor cable; part # 0185180U01

3 TROUBLESHOOTING PROCEDURES

The troubleshooting and repair philosophy for the MTR2000 station and ancillary equipment is one of Field Replaceable Unit (FRU) substitution. The station comprises self-contained FRUs which, when determined to be faulty, may be replaced with known good FRUs to quickly bring the station back to normal operation. The faulty FRU must then be shipped to the Motorola System Support Center repair depot for further troubleshooting and repair to the component level.

Because the station is computer-controlled and employs state-of-the-art digital signal processing techniques, many of the troubleshooting procedures require the use of the Radio Service Software (RSS) application. The RSS is run on a PC (or compatible) with Microsoft Windows 3.1 or Windows™ 95, and RS-232 communication port capabilities. The RSS allows the technician to run diagnostics, and set up the equipment for various audio and RF tests. Complete details on RSS operation are provided within the RSS application via Online Help facilities. The RSS Startup Manual (68P81096E15) provides complete details on installing and starting the RSS program.

Troubleshooting Overview

Introduction

Two procedures are provided for troubleshooting the station and ancillary equipment. Each procedure is designed to quickly identify faulty modules, which may then be replaced with known good modules to restore proper station operation.

Procedure 1 – Routine Site Visit Functional Checkout

Procedure 1 consists of a quick series of non-intrusive tests performed during a routine site visit. This procedure allows the technician to verify the proper station operation without taking the station out of service. An overview of the procedure is shown in the flow chart of Figure 1.

Procedure 2 – Troubleshooting A Reported/Suspected Problem

Procedure 2 should be used when an equipment problem has been either reported or is suspected. This procedure comprises both non-intrusive (equipment not taken out of service) and intrusive (requiring the equipment be temporarily taken out of service) tests that allow the technician to troubleshoot reported or suspected equipment malfunctions. An overview of the procedure is shown in the flow chart of Figures 2.

CAUTION

Some station components can become extremely hot during station operation. Turn off all power to the station, and wait until sufficiently cool before touching the station.

How to Use These Troubleshooting Procedures

Perform the following basic steps in order to efficiently troubleshoot the station equipment.

1. Select the appropriate troubleshooting procedure flow chart (Procedure 1 or Procedure 2).
2. Perform the tasks given in the selected flow chart. Tasks requiring additional explanation are identified with an arrow (⇨) and an appropriate reference. Locate the additional information, perform the tasks (if any), and return to the flow chart.
3. Once the faulty module has been identified, proceed to Module Replacement Procedures, Section 4.

IMPORTANT

The station circuitry contains many CMOS and other static-sensitive devices. When servicing the equipment, take precautionary measures to prevent damage of station modules by static discharge. Refer to Anti-Static Precautions of Section 4 before servicing the station.

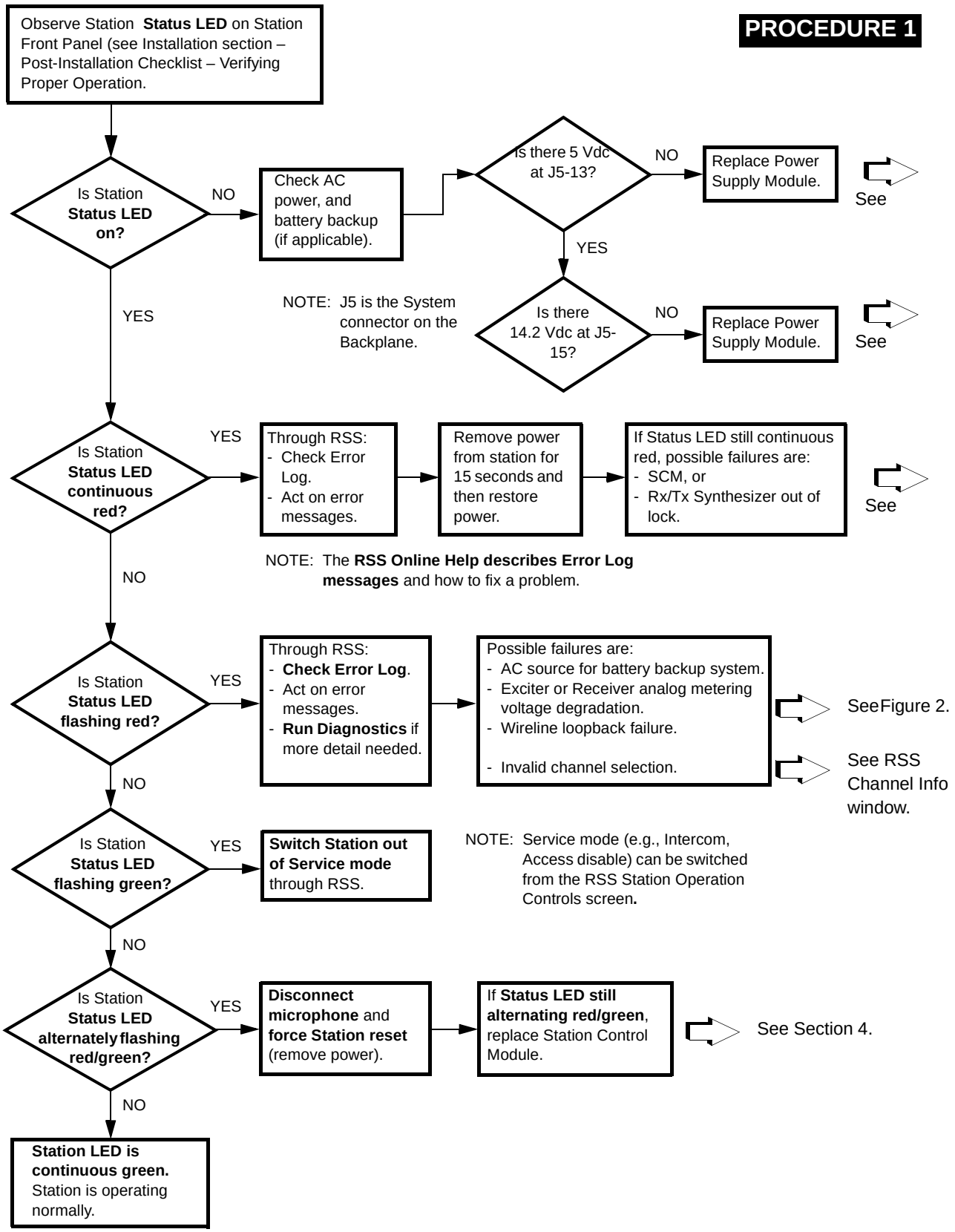


Figure 1. Procedure 1 – Routine Site Visit (Sheet 1 of 2)

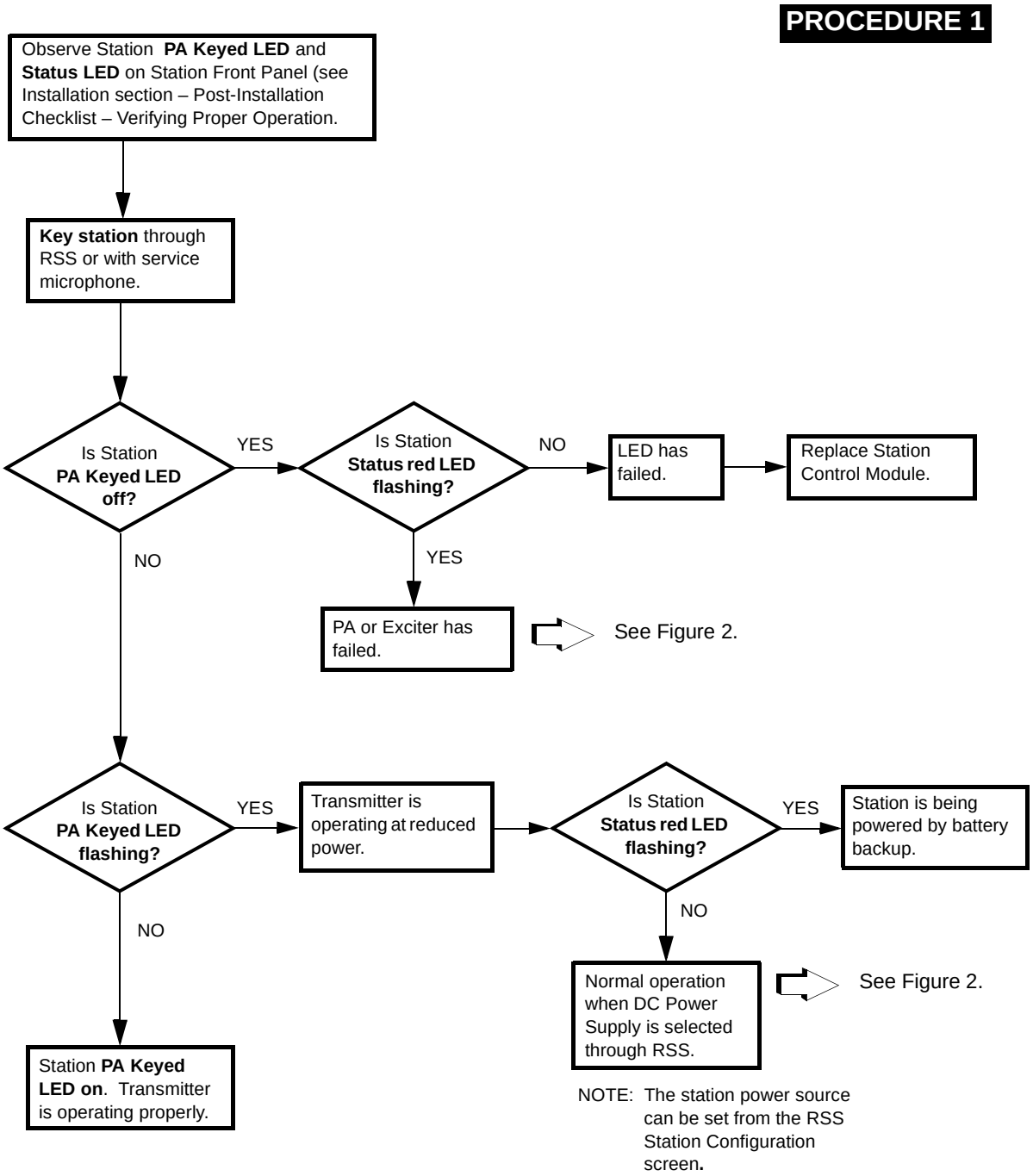


Figure 1. Procedure 1 – Routine Site Visit (Sheet 2 of 2)

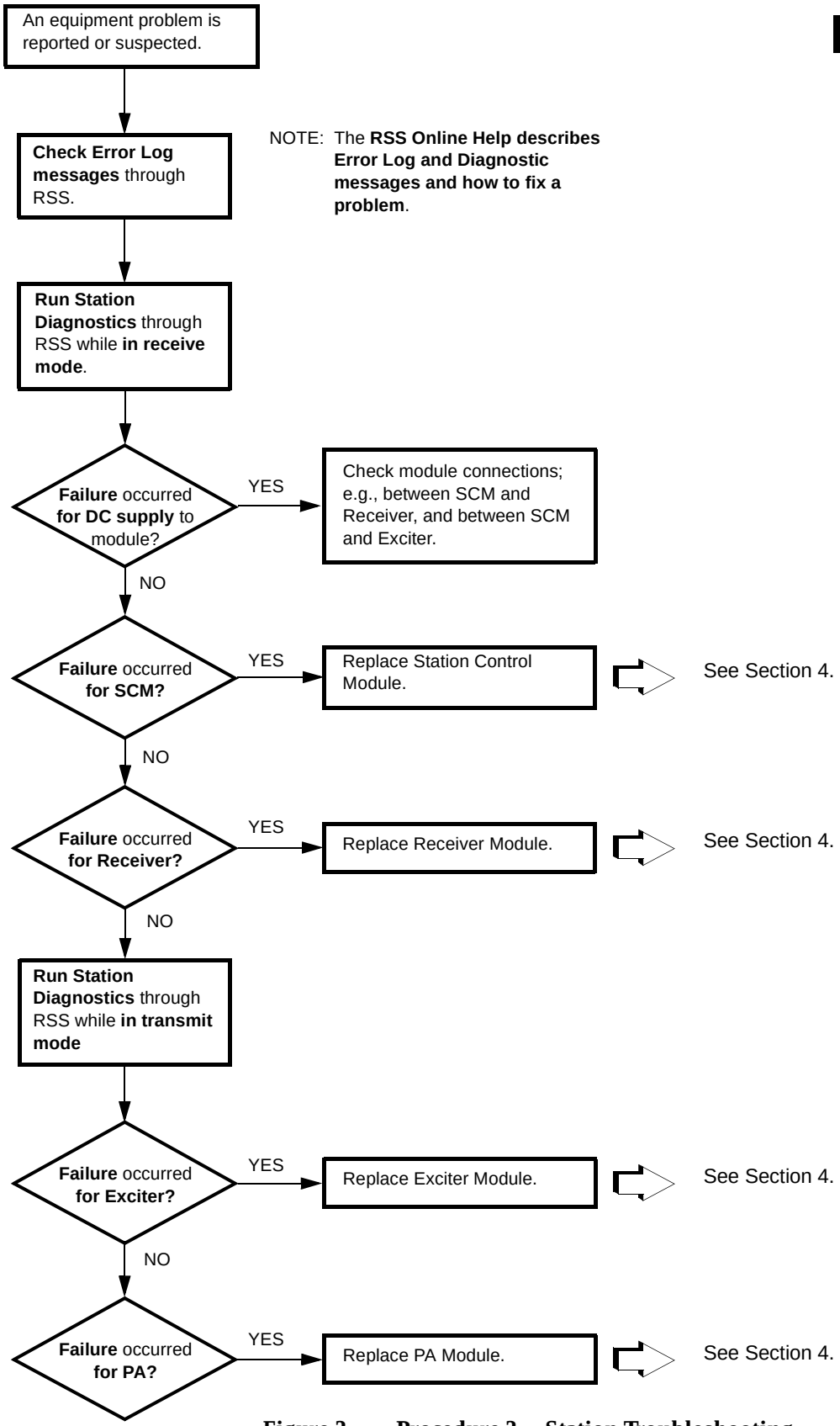


Figure 2. Procedure 2 – Station Troubleshooting

Interpreting LED Indicators

Four LED indicators are provided on the front of the Station Control Module (viewable on the front panel) that indicate specific operating conditions. The service technician may observe these LEDs to obtain a quick status indication of the station equipment.

For information on the operating conditions indicated by these LEDs, refer to the INSTALLATION section, Post-Installation Checklist, Verifying Proper Operation.

Removing/Replacing Station Front Panel

Connection of service aids (mic, speaker, etc.) or removal of any of the station modules or option cards necessitates first removing the front panel.

Removal Procedure

Remove station front panel by inserting a small flat-blade screwdriver into one of two access holes at either end of the panel and, by carefully moving the handle of the screwdriver away from the center, release the front panel locking clip from the chassis and pull away the panel (refer to Figure 3).

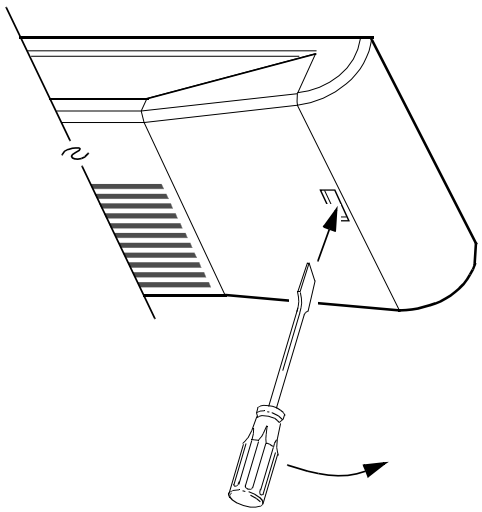
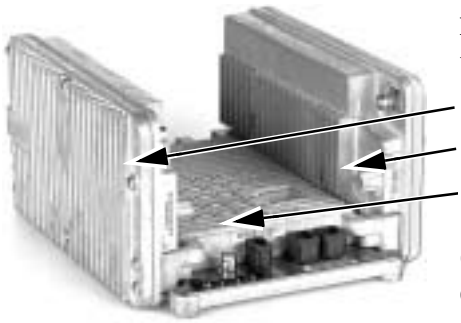


Figure 3. Front Panel Removal

Replacement Procedure

Replace station front panel by inserting one of the front panel locking clips into corresponding latch on the station housing, and carefully pressing the panel on the opposite side until the second locking clip snaps into place.

Accessing Station Control Cluster



By removing the front panel, the station control cluster is accessible (refer to Figure 4). The station control cluster consists of the:

- Exciter Module
- Receiver Module
- Station Control Module (SCM)

Connectors on the Exciter and Receiver modules mate with connectors on either side of the SCM to form the control cluster. Service connectors are provided on the front of the SCM, including connectors for:

- RS-232 port (P5600),
  8-contact modular jack, provides connection to Serial Communications port on a PC running Radio Service Software (RSS)
- external speaker / amplifier (P5601),
  4-contact modular jack
- microphone (P5602),
  8-contact modular jack, and
- 5 / 10 MHz external reference input (J5603),
  BNC connector

Front of station with Front Panel removed.

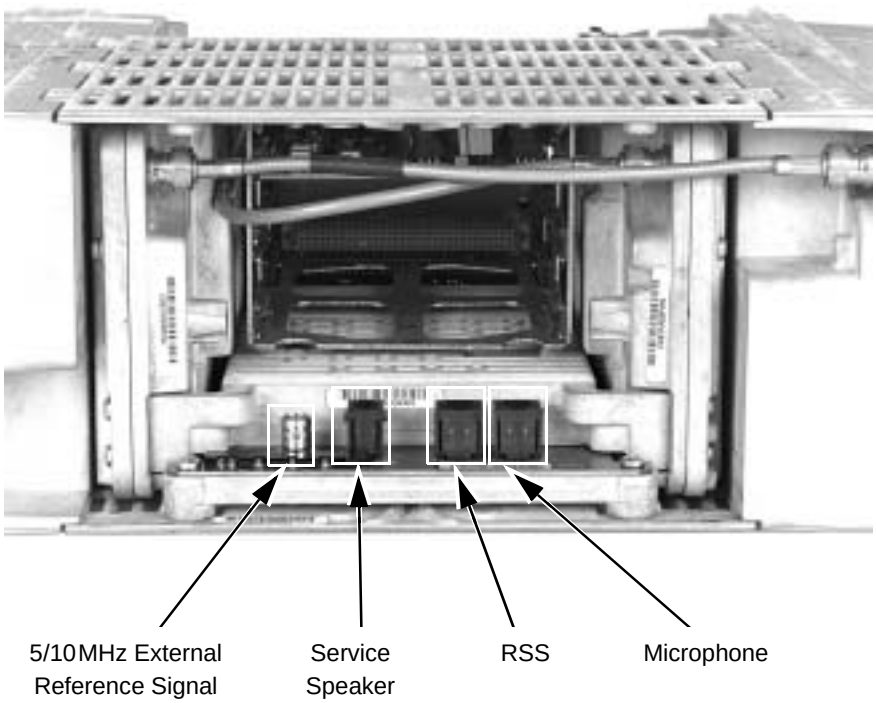


Figure 4. SCM Service Connectors

Using the Service Mic

The Service mic buttons (see Figure 5) provide local control of station operation. All of these operating functions can also be controlled through the RSS (through the Station Control area of the Station Operation Controls window).

Speaker Volume Control

To increase the speaker volume, press this button. Each button press increases the volume by one step (approximately 2dB). There are 16 steps from the lowest volume level.

To set the speaker to the lowest volume, press and hold this button longer than 2 seconds.

The speaker volume cannot be decreased in steps. To lower the volume, reset the volume to the lowest setting and then increase it to the desired level.

Monitor Button

To step through the sequence of station audio monitor modes, press this button. The selectable modes are:

- **Off** (no carrier squelch and no PL/DPL)
  Listen to the channel with the station unsquelched and PL/DPL disabled; that is, hear everything on the channel.
- **CSQ** (carrier squelch and no PL/DPL)
  If the station is already unsquelched (as determined by station codeplug value) then no change is heard when the CSQ mode is selected. This mode enables the station to operate in carrier squelch mode; that is, with PL/DPL disabled.
- **Normal** (carrier squelch and PL/DPL set by codeplug)
  Listen to normal radio audio operation for the channel, which is determined by the station codeplug.

Intercom On/Off Button

To toggle the Intercom mode, press this button. Intercom mode provides communication between the station and a Remote Controller (over a wireline connection).

When in Intercom mode (indicated by the Station Status LED flashing green), press the PTT button to communicate over the wireline without keying the transmitter

PTT / Intercom Button

The function controlled by this button depends on whether or not Intercom mode has been selected (see above button).

- When Intercom mode is not selected (i.e., off), key and dekey the station by pressing the PTT/Intercom button. To key the station transmitter, press this button. To dekey the station transmitter, release this button.

  OR

- When Intercom mode is selected (i.e., on), press the PTT/Intercom button to talk over the wireline connection; the transmitter is not keyed.

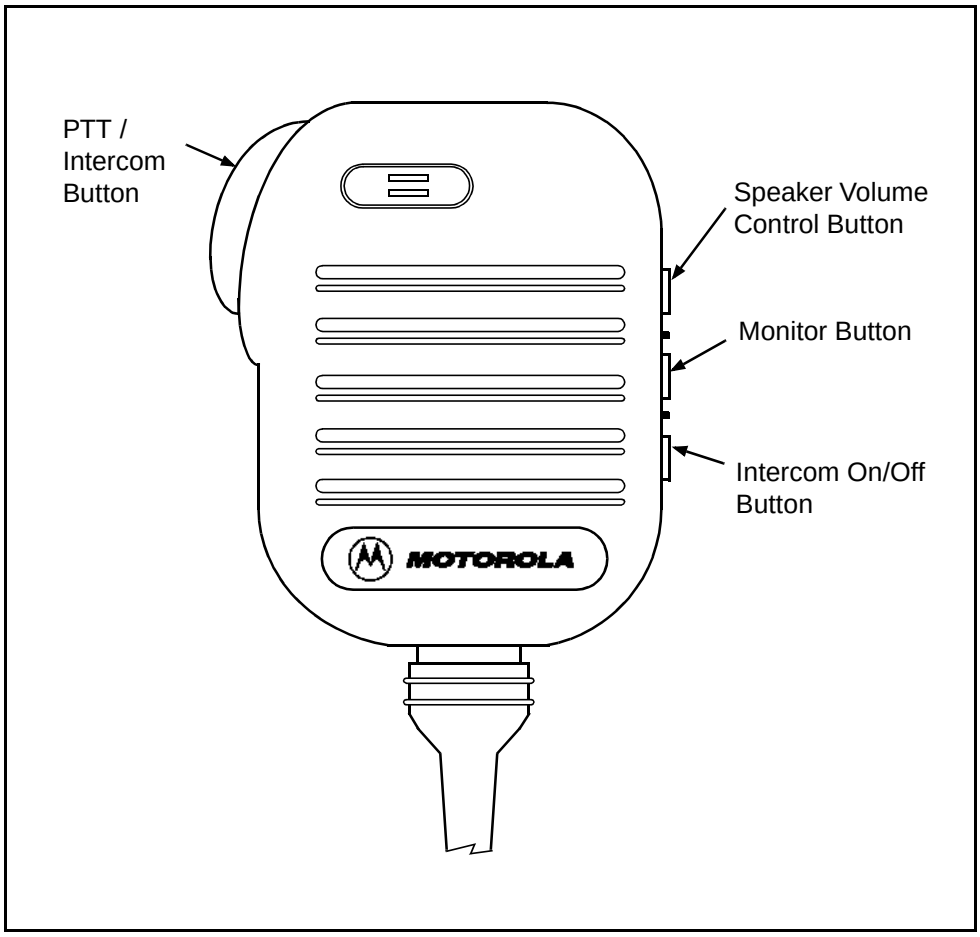


Figure 5. Service Mic Buttons

Verifying Transmitter Circuitry

CAUTION

Performing this procedure requires that the station be taken out of service. It is recommended that, unless the station is already out of service due to an equipment malfunction, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers.

Introduction

While most module faults can be detected by running the station diagnostics provided by the RSS, the following procedure provides a more traditional method of troubleshooting the transmitter circuitry. This procedure is useful in the event that the RSS is not at hand or for some reason cannot be utilized (PC malfunction, etc.).

This procedure allows the service technician to make minor adjustments and verify proper operation of the station transmit circuitry, including:

- Exciter Module
- Power Amplifier Module
- Power Supply Module
- Transmitter-related circuitry in the SCM
- Wireline Board

In general, the transmitter circuitry is exercised by injecting and measuring signals using a Motorola R2001 or R2600 Communications Analyzer (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

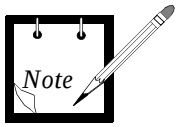
Required Test Equipment

The following test equipment is required to perform the procedure:

- Motorola R2001 or R2600 Communications Analyzer (or equivalent)
- Microphone with PTT switch and 3 special function switches (GMN6147B or equivalent)
- In-Line Wattmeter (Motorola Model S-1350 or equivalent)
- Dummy Load (50Ω, station wattage or higher)

Verifying Transmitter Circuitry Procedure

1. Connect test equipment by performing Steps 1 to 5 shown in Figure 6.



In the following steps, suspected faulty modules are ranked in order of most to least likelihood.

2. Press the PTT button of the microphone and observe the **PA Keyed** LED indicator (DSG5602) on the Station Control Module.

- If **PA Keyed** fails to light, suspect the following:

  Faulty Power Amplifier Module

  Faulty Exciter Module

  Loose or bad Exciter-to-PA RF cable

  Loose or bad PA-to-antenna RF output cable

  Improperly terminated PA RF output cable

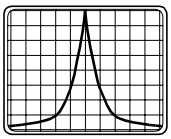
  Faulty Station Control Module

  Faulty Backplane

  Faulty Antenna Relay

3. Measure output power by pressing the PTT button and observing reading on in-line wattmeter.

- If PA output not at proper power (as set for particular site), adjust the output power as described in the RSS online help.



4. If PA output power OK, set up R2001 or R2600 for spectrum analyzer display. Press the PTT button and observe the display. The display should show a single frequency carrier:

- If the display shows multiple carriers evenly spaced about the carrier, suspect a faulty Exciter module or PA module.
- If the display shows a solid carrier but off frequency, suspect the following:

  Faulty Exciter or Station Control Module

  Faulty external 5/10 MHz reference source (if used)

- If the display shows a single carrier moving erratically, suspect:

  Faulty Station Control Module

  Faulty Exciter Module

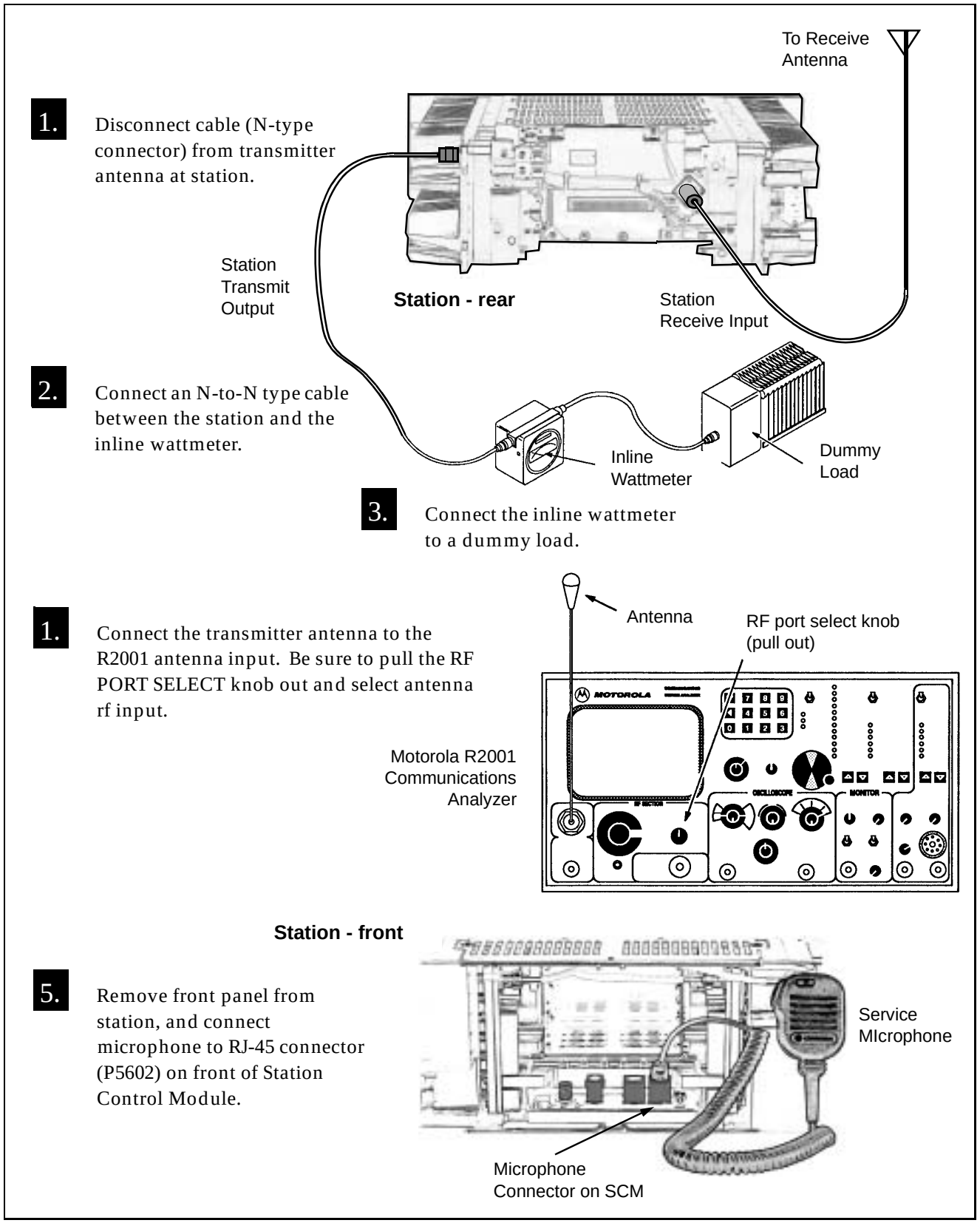
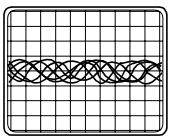


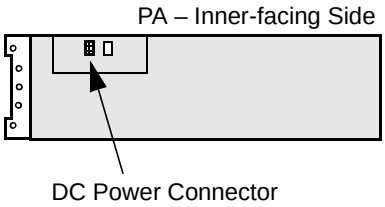
Figure 6. Test Equipment Setup for Verifying Transmitter Circuitry



5. If display OK, set up R2001 or R2600 to display modulation. Using the microphone, push the PTT button and speak into the microphone. Verify that the display shows an audio signal.
   - If proper display is not obtained, suspect faulty SCM or Exciter Module.
6. Set the R2001 or R2600 for GEN / MON MTR. Press the PTT button and speak loudly into the microphone to cause maximum deviation. Display should read:
   - ±5 kHz maximum for a 25 kHz system.
   - ±4 kHz maximum for a 20 kHz system.
   - ±2.5 kHz maximum for a 12.5 kHz system.
   - If proper display is not obtained, suspect faulty SCM or Exciter Module.
7. This completes the Verifying Transmitter Circuitry test procedure. If all displays and measurements are correct, the transmitter circuitry may be considered to be operating properly. Remove test equipment, restore the station to normal service, and return to the troubleshooting flow chart to resume troubleshooting sequence.

Station Reset

In the event that the station repeatedly resets:



1. Disconnect dc power to PA and connect a load to the PA Module.
2. Power on the station.
3. If the station is not resetting, there is a problem with the PA.

   If the station is resetting, there is a problem with another module in the station.
4. Reconnect dc power to PA.
5. If the station is resetting, there is a problem with the PA.
6. If the station does not reset, key the station.
7. If the station is resetting, there is problem with the PA.

   If the station is not resetting, there is a problem with the antenna, feed line, or peripherals.

Verifying Receiver Circuitry

CAUTION

Performing this procedure requires that the station be taken out of service. It is recommended that, unless the station is already out of service due to an equipment malfunction, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers.

CAUTION

If the station operates as a repeater, the transmit output from the station must be connected to a dummy load to prevent over-the-air broadcast during receiver testing.

Introduction

While most module faults can be detected by running the station diagnostics provided by the RSS, the following procedure provides a more traditional method of troubleshooting the receiver circuitry. This procedure is useful in the event that the RSS is not at hand or for some reason cannot be utilized (PC malfunction, etc.).

This procedure allows the service technician to make minor adjustments and verify proper operation of the station receive circuitry, including:

- Receiver Module
- Power Supply Module
- Station Control Module

In general, the receiver circuitry is exercised by injecting and measuring signals using a Motorola R2001 or R2600 Communications Analyzer (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

Required Test Equipment

The following test equipment is required to perform the procedure:

- Motorola R2001 or R2600 Communications Analyzer (or equivalent)
- Male N-type to Male N-type coaxial cable
- RJ-45 to BNC 15cm (6 inch) cable; part # 3083191X02
- Service Speaker; part # HSN1000
- Service Speaker adaptor cable; part # 0185180U01
- Dummy Load (50Ω, station wattage or higher) required for repeater stations only

Verifying Receiver Circuitry Procedure

1. Connect test equipment by performing Steps 1 to 3 shown in Figure 7.
2. Using the RSS or the Service mic, disable PL and unsquelch the Receiver such that noise is heard through the external speaker. If no audio is heard, suspect the following:
   - Faulty Receiver Module
   - Faulty Station Control Module
   - R2001 or R2600 is outputting a carrier signal without modulation
3. Set R2001 or R2600 to generate a 1.0 µV (-107 dBm) FM signal at the receiver frequency, modulated by a 1 kHz tone at 3 kHz deviation for 25 /30 kHz channel spacing, or 1.5 kHz deviation for 12.5 kHz channel spacing. The 1 kHz / 1,5kHz tone should be audible through the external speaker. If no audio is heard, suspect the following:
   - Faulty Receiver Module
   - Faulty antenna-to-Receiver preselector RF cable (for station with external metal preselector)
   - Faulty R2001- or R2600 -to-station RF cable
   - Faulty Antenna Relay
4. If audio is heard, connect the external speaker RJ-45 jack to the Oscilloscope input BNC connector, as shown in step 4 of Figure 7.
5. Using the RSS or the service mic, increase the audio volume to maximum. Measure the audio level using the R2001or R2600 .
   - Audio level should measure approximately 0.75 to 1.5 Vpp. If not, suspect faulty SCM.
6. Change R2001 or R2600 injection signal level to 0.25 µV (-119 dBm).
7. Measure the receiver 12 dB SINAD sensitivity. Set the signal strength of the communications analyser to the rated sensitivity of –116 dBm (0.35 µV).
   - If the SINAD level is less than 12 dB, suspect faulty Receiver Module or SCM.
8. This completes the Verifying Receiver Circuitry test procedure. If all displays and measurements are correct, the receiver circuitry may be considered to be operating properly. Remove test equipment, restore the station to normal service, and return to the troubleshooting flow chart to resume troubleshooting sequence.

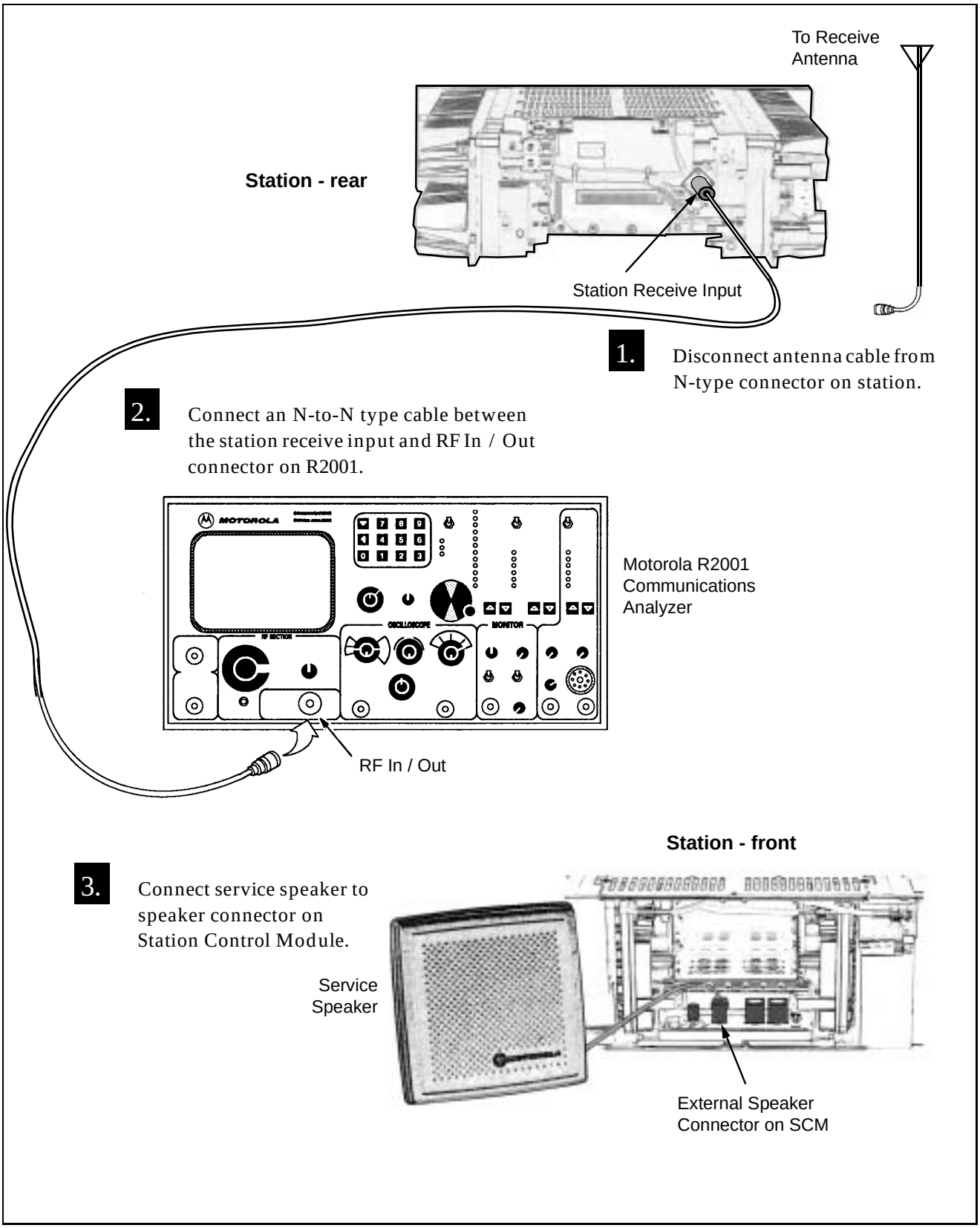


Figure 7. Test Equipment Setup for Verifying Receiver Circuit

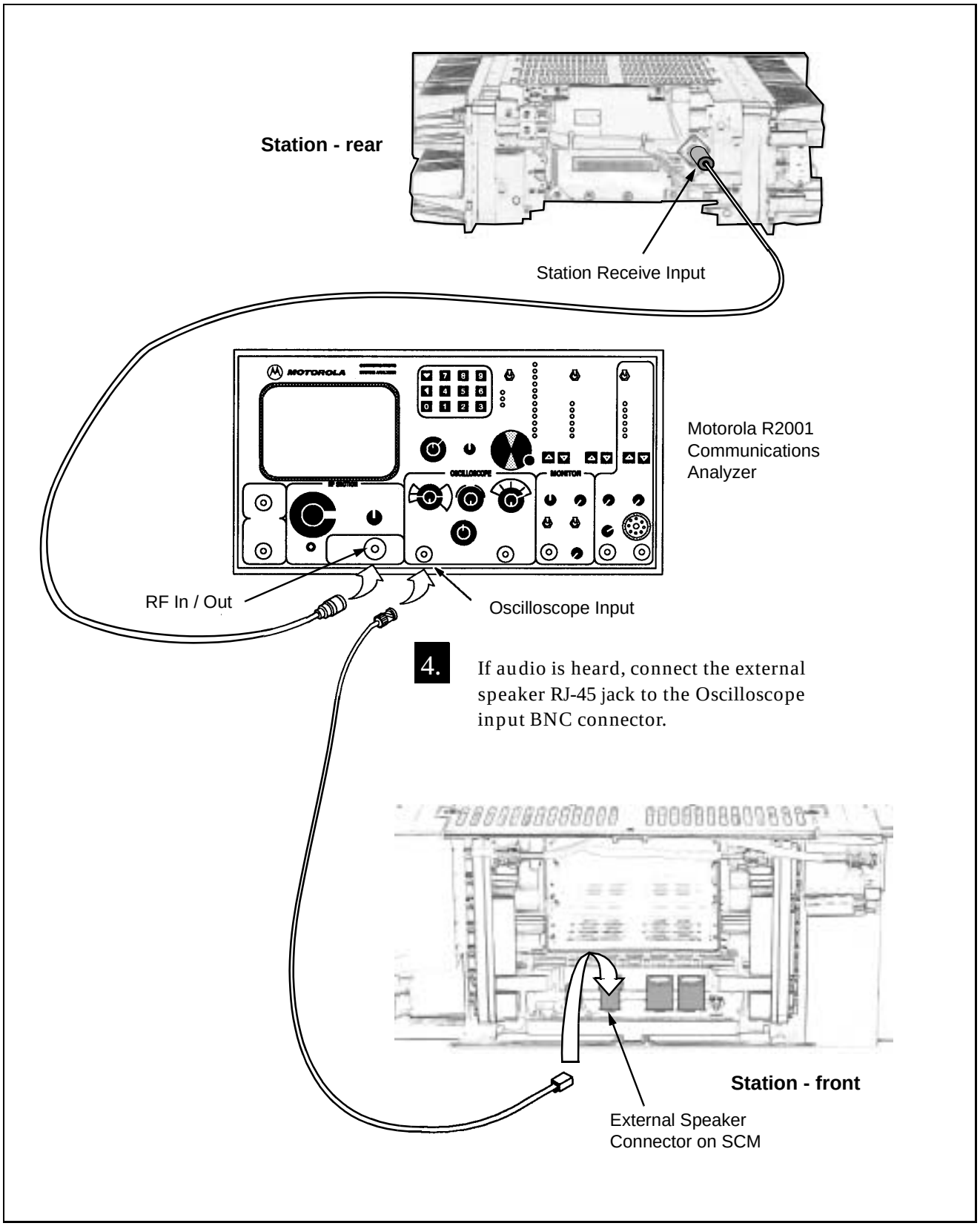


Figure 7. Test Equipment Setup for Verifying Receiver Circuit (Continued)

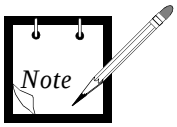
4 MODULE REPLACEMENT PROCEDURES

Station modules suspected of being faulty must be replaced with known good modules to restore the station to proper operation. The following procedures provide instructions for replacing each of the station modules and performing any required post-replacement adjustments or programming.

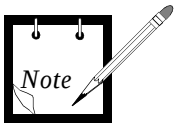
General Replacement Procedures

IMPORTANT

DO NOT insert or remove station modules with power applied. This may result in damage to the modules. Always turn off the station by removing the source of ac power (and battery backup power, if used) before inserting or removing modules.



MTR2000 modules are not field-repairable. Contact the System Support Center at the phone number listed in the first section of this manual for information on obtaining replacement modules.



All screws used in the station **are T-20 Torx-head** screws, **unless otherwise noted**.

Anti-Static Precaution

The station circuitry contains many CMOS and other static-sensitive devices. When servicing the equipment, you must take precautionary steps to prevent damage to the modules from static discharge. Complete information on prevention of static protection is provided in Motorola publication 68P81106E84, available through Motorola Americas Parts Division (APD) or a local support Motorola facility (see the list of Motorola facilities in the front matter of this manual, under Service and Replacement Modules). Some additional precautions are as follows:

- Always wear a static-grounding wrist strap (Motorola Part No. RSX-4015A, or equivalent) while handling any station board or module to minimize static buildup. The static-grounding wrist strap is connected to the front-right handle of the station.
- Avoid touching conductive parts of any module with your hands.
- Avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) during service to minimize static buildup.
- Be sure to ground all electrically-powered test equipment. Connect a ground lead (–) from the test equipment to the module or board before connecting the test probe (+). When testing is complete, remove the test probe first, then remove the ground lead.

- All spare modules should be kept in a conductive bag for storage and transporting.
- When shipping modules to the repair depot, always pack in conductive material.

WARNING

When wearing a Conductive Wrist Strap, be careful near sources of high voltage. The low impedance provided by the wrist strap also increases the danger of lethal shock from accidentally touching high voltage sources.

Care of Gold-Plated Connector Contacts

The connections between the modules and the station backplane board are made with gold-plated connector contacts to provide maximum reliability. Gold-plated materials do not form a non-conductive oxide layer, and therefore should not require cleaning under normal conditions.

When the modules have been subjected to many extraction / insertion cycles, or if the station is operated in a dusty environment, the contacts may require cleaning. Do not use an eraser or any type of abrasive substance to clean either the module or backplane connector contacts. Any type of abrasive cleaning (typically employed for cleaning non gold-plated contacts) can result in the removal of the gold plating or bending of the connector contacts.

If cleaning of the gold-plated contacts is required, use a soft cloth dampened with alcohol to lightly wipe the contacts. Be sure not to touch the contact surfaces with your fingers, as finger oils and salts can contaminate the contact surfaces.

IMPORTANT

Power Down Station Before Removing/Inserting Modules

Before removing or inserting the station cluster or an option module into the station to engage the backplane connector, be sure to turn off the station power by turning off the breaker at the ac source, or disconnecting the station ac line cord.

IMPORTANT

If the station is equipped with battery backup, disconnecting the station ac line cord will not turn the station off. You must also disconnect the battery backup cable from the station power supply module. Remember to reconnect the battery cable before restoring the station to operation.

Front Panel Removal

Removal of any of the station modules or option cards necessitates first removing the front panel, as detailed, Removing / Replacing Station Front Panel of Section 3.

Validating Repairs

After replacing a faulty module with a known good module, perform one of the following tests to validate the repair before leaving the site.

- If the faulty module was detected as the result of running station diagnostics via the RSS, run the diagnostics again after the repair is made to ensure that the replacement module passes all diagnostic tests.
- If the faulty module was detected by an operational failure, perform the operation to ensure that the repair corrected the reported / detected failure.

Replacing Fans

If a fan on a 500 W Power Supply Module or on a high power Power Amplifier fails, it can be replaced without having to exchange the entire module. The fan can be ordered through the Americas Parts Division or another appropriate facility (see Service and Replacement Modules in front of this manual) with part number 59-83663R09.

The procedure is:

1. Turn off station power by turning off breaker at ac source.
2. Remove screws (4) securing fan to PA or Power Supply casting.
3. Unplug fan electrical power connector.
4. Lift the fan away from the casting (the electrical power plug will detach when the fan is lifted).
5. Ensure that the correct fan is being installed.
6. Position the fan on the casting.
7. Push the power connector into the plug in the casting.
8. Secure the fan to the casting with the 4 screws.
9. Restore power to the station.

Replacing Fuses

The procedure is:

1. Turn off station power from source (e.g., ac breaker).
2. Remove fuse cover plate located on the backplane shield by unscrewing one M4 screw.
3. Pull defective fuse carefully with small needle nose pliers.
4. Replace new fuse (part # 6583049X16) carefully with small needle nose pliers.

IMPORTANT

For continued protection of the station against risk of fire, replace the fuse only with the same type and rating of fuse.

5. Restore power to the station.

Ordering Replacement Modules

All FRU Modules are ordered through the Americas Parts Division or another appropriate facility (see Service and Replacement Modules in front of this manual)

Replacing Power Amplifier Module

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. If station is equipped with an external preselector, label and disconnect corresponding RF coax cables to preselector and remove screws securing preselector to station.
3. Label and disconnect all cables, as follows:
   - RF output coax cable to antenna port
   - RF input coax cable from Exciter Module
   - Control Cable (10-conductor ribbon cable which connects to J03)
   - PA Power Cable (6-conductor cable which connects to J02)
4. Remove screws securing battery backup connector to PA casting.
5. Remove the station from the rack, cabinet, or wallmount bracket (if so mounted).
6. Remove six screws securing top and bottom plates to PA casting and remove PA Module.
7. Ensure that the correct PA Module is being installed.
8. Install replacement PA Module.
   1. Line up holes in the PA casting with corresponding holes in the top and bottom plates.
   2. Replace the screws according to the order indicated by the label numbers on the top and bottom plates; that is start with screw #1, positioned toward the front of the station.
   3. Reconnect all cables.
   4. Secure battery backup connector to PA casting.
9. If required, reinstall external preselector and reconnect all cables.
10. Restore power to the station.

11. Integrate the PA Module into the station.

    1. Access the appropriate RSS application screen through path: Service –> Station Alignmentt –> Transmitter –> Power Amplifier.
    2. Enter the PA Module Calibration number into the appropriate data field. The Calibration number is printed on the label located on the front of the PA Module.

Post-Replacement Optimization Procedure

Perform the Power Output alignment procedure located in the RSS Service menu online help facility.

Replacing Power Supply Module

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. If station is equipped with an external preselector, label and disconnect corresponding RF coax cables to preselector and remove screws securing preselector to station.
3. If station is equipped with an antenna relay, disconnect control cable and remove screws securing relay to station.
4. Remove screws (2) securing battery backup connector to PA casting.
5. Label and disconnect all wires / cables, as follows:
   - PA Power Cable (6-conductor cable which routes power to PA)
   - Station Power Cable (8-conductor cable which routes power to backplane)
6. Remove six screws securing top and bottom plates to Power Supply casting and remove Power Supply Module.
7. Remove the station from the rack, cabinet, or wallmount bracket (if so mounted).
8. Ensure that the correct Power Supply Module is being installed.
9. Install replacement Power Supply Module.
   1. Line up holes in the PA casting with corresponding holes in the top and bottom plates.
   2. Replace the screws according to the order indicated by the label numbers on the top and bottom plates; that is start with screw #1, positioned toward the front of the station.
   3. Reconnect all cables.
   4. Secure battery backup connector to PA casting.
10. If required, reinstall external preselector and antenna relay, and reconnect all cables.
11. Restore power to the station.

Post-Replacement Optimization Procedure

Replacement Power Supply Modules are factory aligned. Therefore, no post-replacement optimization is required for this module.

Replacing Exciter Module

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Remove the station control cluster:
    1. Remove module lock screws (2) from front of station control cluster.
    2. Disconnect BNC connectors on RF cables connecting PA Module to Exciter Module, and Receiver Module to Receive antenna port.
    3. By pulling forward on cluster pull tabs, carefully slide station control cluster out of station.
3. Remove screws (4) securing Exciter Module to cluster and disconnect Exciter Module from Station Control Module (SCM).
4. Ensure that the correct Exciter Module is being installed.
5. Install replacement Exciter Module by plugging module into connector on SCM, replacing screws (4), and sliding the cluster back into the station (along the guide rails) to mate with the connector on the backplane. (Do not slam the station control cluster against the backplane or push any harder than necessary to seat the connector.)
6. Install module lock screws (2) to front of station control cluster and reconnect the RF cables from the PA Module and the Receive antenna port to their respective modules.
7. Restore power to the station.

Post-Replacement Optimization Procedure

1. Perform the TX Deviation Gain Adjust alignment procedure, located in the RSS Service menu online help facility. Access the RSS application screen through path Service –> Station Alignment –> Transmitter –> Tx Deviation.
2. Perform the Reference Modulation alignment procedure, located in the RSS Service menu online help facility. Access the RSS application screen through path Service –> Station Alignment –> Transmitter –> Ref. Modulation.

Replacing Station Control Module

Replacement Procedure

1. If the Station Control Module (SCM) is capable of communicating with the RSS, connect the PC to the RSS port, start the RSS program, and save the codeplug from the station to a file on the PC hard disk. This will allow the codeplug information to be downloaded to the codeplug located on the replacement SCM. If the module cannot communicate with the RSS, an archive file (if present on hard disk) of the particular codeplug may be downloaded. If no archive codeplug file exists, you must program the codeplug as described in the RSS online help facility.
2. Turn off station power by turning off breaker at ac source.
3. Remove the station control cluster:
    1. Remove module lock screws (2) from front of station control cluster.
    2. Disconnect BNC connectors on RF cables connecting PA Module to Exciter Module, and Receiver Module to Receive antenna port.
    3. By pulling forward on cluster pull tabs, carefully slide station control cluster out of station.
4. Remove screws (4) securing Exciter Module, and screws (4) securing Receiver Module to the SCM, and disconnect both modules from the SCM.
5. Ensure that the correct Station Control Module is being installed.
6. Install replacement Station Control Module by plugging Exciter Module and Receiver Module into respective connectors on new SCM, replacing screws, and sliding the cluster back into the station (along the guide rails) to mate with the connector on the backplane. (Do not slam the station control cluster against the backplane or push any harder than necessary to seat the connector.)
7. Install module lock screws (2) to front of station control cluster and reconnect the RF cables from the PA Module and the Receive antenna port to their respective modules.
8. Restore power to the station.

Post-Replacement Optimization Procedure

1. Replacement Station Control Modules are shipped with default data programmed into the codeplug (Flash EPROM located on board). After replacing a Station Control Module, you must download codeplug data (unique to the particular station) to the replacement mod-

ule codeplug. Simply retrieve the file from your archive and follow the instructions in the RSS online help facility for saving data to the codeplug.

2. Calibrate the reference oscillator (station reference) by performing the procedure in the Routine Maintenance section of this manual.
3. Perform the TX Deviation Gain Adjust alignment procedure located in the RSS Service menu online help facility.
4. Perform the Reference Modulation alignment procedure located in the RSS Service menu online help facility.

Replacing Receiver Module

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Remove the station control cluster:
    1. Remove module lock screws (2) from front of station control cluster.
    2. Disconnect BNC connectors on RF cables connecting PA Module to Exciter Module, and Receiver Module to Receive antenna port.
    3. By pulling forward on cluster pull tabs, carefully slide station control cluster out of station.
3. Remove screws (4) securing Receiver Module to cluster and disconnect Receiver Module from Station Control Module (SCM).
4. Ensure that the correct Receiver Module is being installed.
5. Install replacement Receiver Module by plugging module into connector on SCM, replacing screws, and sliding the cluster back into the station (along the guide rails) to mate with the connector on the backplane. (Do not slam the station control cluster against the backplane or push any harder than necessary to seat the connector.)
6. Install module lock screws (2) to front of station control cluster and reconnect the RF cables from the PA Module and the Receive antenna port to their respective modules.
7. Restore power to the station.

Post-Replacement Optimization Procedure

1. Perform the Squelch Adjust procedure and the RSSI alignment procedure (if applicable) located in the RSS Service menu online help facility.
2. If the station includes an external Preselector, perform the Preselector Field Tuning Procedure, of this section.
3. Perform the Preselector Field Tuning Procedure for the internal varactor-tuned preselector, of this section.

Replacing External Preselector

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Disconnect cable to Receive antenna connection and cable to Receiver Module.
3. Remove screws (2) securing External Preselector to back of station.
4. Ensure that the correct External Preselector is being installed.
5. Install replacement External Preselector by reconnecting the 2 cables and securing the External Preselector to the station with the 2 screws.
6. Restore power to the station.

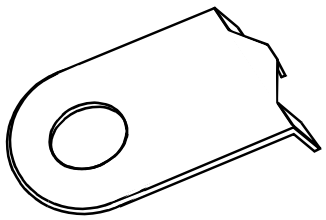
Post-Replacement Optimization Procedure

1. Perform the Preselector Field Tuning Procedure, of this section.

Replacing Wireline Interface Board

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Ensure that an ESD cable is connected to the station.
3. Remove Wireline Interface Board from top option card slot by carefully pulling straight out from the station. Use the Option Card tool (part # 6683334X01) to pull the card out. Make sure that the board is placed on properly grounded anti-static surface.



4. Ensure that the correct Wireline Board is being installed.
5. Set all jumpers on replacement board to match those on the faulty board. These include input/output impedance matching jumpers (refer to Wireline Interface Board section of this manual for more information).
6. Install replacement Wireline Interface Board by sliding board into top option card slot, and firmly seating the board Euro-card connector into the mating backplane connector. (Do not slam the board against the backplane or push any harder than necessary to seat the connectors.)
7. Restore power to the station.

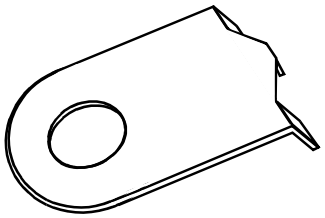
Post-Replacement Optimization Procedure

1. Perform the Rx Wireline and Tx Wireline adjustment procedures located in the RSS Service menu online help facility. This includes selecting the 2-wire or 4-wire configuration. Ensure that the wireline board is aligned according to relevant leased line specifications.

Replacing Auxiliary I/O Board

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Ensure that an ESD cable is connected to the station.
3. Remove Auxiliary I/O Board from middle (Option Cart #1) or bottom (Option Card #2) card slot by carefully pulling straight out from the station. Use the Option Card tool (part # 6683334X01) to pull the card out. Make sure that the board is placed on properly grounded anti-static surface.



4. Ensure that the correct Auxiliary I/O Board is being installed.
5. Set all jumpers on replacement board to match those on the faulty board. Refer to Auxiliary I/O Board section of this manual for more information.
6. Install replacement Auxiliary I/O Board by sliding board into middle or bottom option card slot, and firmly seating the board Eurocard connector into the mating backplane connector. (Do not slam the board against the backplane or push any harder than necessary to seat the connectors.)
7. Restore power to the station.

Post-Replacement Optimization Procedure

1. Perform the Auxiliary I/O adjustment procedures located in the RSS Service menu online help facility. Ensure that the Auxiliary I/O Board is aligned according to auxiliary equipment specifications.

Replacing Backplane Board

Replacement Procedure

1. Turn off station power by turning off breaker at ac source.
2. Remove all option boards from the option card slots as described in Replacing Wireline Interface Board. Make sure that all boards are placed on properly grounded anti-static surface.
3. Remove the station control cluster:
    1. Remove module lock screws (2) from front of station control cluster.
    2. Disconnect BNC connectors on RF cables connecting PA Module to Exciter Module, and Receiver Module to Receive antenna port.
    3. By pulling forward on cluster pull tabs, carefully slide station control cluster out of station.
4. If station is equipped with an external preselector, label and disconnect corresponding RF coax cables to preselector and remove screws securing preselector to station.
5. If station is equipped with an antenna relay, disconnect control cable and remove screws securing relay to station.
6. Remove ty-wraps securing battery backup cable and Power Supply-to-PA cable.
7. Label all cables / wirelines connected to the rear of the Backplane Board and disconnect all cables / wirelines.
8. Remove screws which secure the metal shield and backplane board to the top and bottom plates.
9. Remove the metal shield and backplane.
10. Ensure that the correct Backplane Board is being installed.
11. Install the replacement Backplane Board and metal shield using the screws removed previously, reconnect all cables, and reinstall all modules, boards and assemblies.

Post-Replacement Optimization Procedure

Using the RSS, run a complete set of diagnostics to exercise all boards and modules.

5 PRESELECTOR FIELD TUNING PROCEDURES

Depending on the configuration, the station may have an external preselector assembly, an internal preselector, or both. The external preselector assembly is a 3-pole bandpass filter equipped with tuning slugs to adjust the passband corresponding to the operating frequency(s) of the station. For the internal preselector, circuitry in the Receiver Module provides a varactor-tuned bandpass filter which adapts to the required frequency range under the control of the Station Control Module.

The external preselector must be retuned if the preselector assembly or Receiver Module are replaced in the field, or if the station operating frequency(s) are modified. The internal varactor-tuned preselector is factory-tuned to cover the relevant frequency band in its entirety, and is retuned only if the Receiver Module is replaced in the field or if there is a suspected problem with the Receiver alignment. The tuning procedures follows.

IMPORTANT

If the station has both an external preselector assembly and an internal varactor-tuned preselector which must be retuned, you must bypass the external preselector and retune the varactor-tuned preselector first, then reconnect the external preselector and retune it. Also, since this is a non-standard configuration, you can expect a slight degradation in the receiver sensitivity (approximately 1.5 dB) due to preselector insertion losses.

External Preselector Tuning Procedure

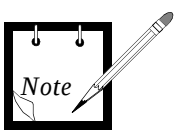
IMPORTANT

Tuning for best SINAD response DOES NOT result in optimum tuning of the preselector assembly. You must use this field tuning procedure to obtain optimum preselector performance.

Required Test Equipment

The following test equipment is required to properly tune the external preselector assembly:

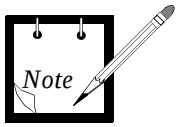
- RF signal generator – Motorola R2600 or R2001 Communications Analyzer (see note below), or HP8656A signal generator (or equivalent)
- Dip / Peak Monitor – HP435B Power Meter (or equivalent) with HP8484A sensitive power head, Boonton Model 92E with BNC input, or R2001 / R2600 using the spectrum analyzer function
- Torque driver capable of delivering 1.36 Nm (12 in-lb) of torque and 10 mm deep well socket
- Tuning probe – Motorola Part No. 0180763D22, p / o TRN7799A
- Flat-blade screwdriver



The R2600 Communications Analyzer can both generate and measure simultaneously. The R2001 may be used for either the generator or the monitor function, but not both simultaneously. When using R2001 as the signal generator, the RF signal **must** be taken from the Antenna port.

Calculating Proper Alignment Frequency

Use one of the following two methods to calculate the alignment frequency to be generated by the signal generator.



For stations which are equipped with both an external preselector and an internal varactor-tuned preselector, always tune the external preselector to an **actual receive frequency** after first tuning the varactor-tuned preselector (if required).

For stations with a **single receive frequency**, calculate the alignment frequency as follows:

1. From the site documentation or the RSS, determine the station receive frequency. **Add 200 kHz**.
2. If the receive frequency is in the range of 403 to 435 MHz, determine the alignment frequency as follows:
   - If frequency (from Step 1) is > 433 MHz, then alignment frequency = 433 MHz
   - If frequency (from Step 1) is < 405 MHz, then alignment frequency = 405 MHz
   - Otherwise, use actual frequency from Step 1 (see above note).
3. If the receive frequency is in the range of 435 to 470 MHz, determine the alignment frequency as follows:
   - If frequency (from Step 1) is > 468 MHz, then alignment frequency = 468 MHz
   - If frequency (from Step 1) is < 437 MHz, then alignment frequency = 437 MHz
   - Otherwise, use actual frequency from Step 1 (see above note).

For stations with **multiple receive frequencies**, calculate the alignment frequency as follows:

1. From the site documentation or the RSS, note the receive frequency for each channel supported by the station.
2. Calculate a midpoint frequency as follows:

   $$F_{mid} = (F_{highest} + F_{lowest}) \div 2$$

3. Using F_{mid} in place of the station receive frequency, perform Step 1 through Step 3 from previous procedure (i.e., calculation of alignment for single receive frequency).

Preparing Equipment

1. Make sure the preselector assembly is connected to a functional Receiver Module.
2. Using the torque driver and deep well socket, loosen the three tension nuts on the adjustment screws.
3. Detune the preselector by turning tuning screws (see Figure 9) 3 and 4 clockwise until they bottom out. Be careful not to apply more than 0.34 Nm (3 in-lb) of torque to prevent warping preselector cover and housing.
4. Tighten the tension nuts to 0.68 Nm (6 in-lb).
5. Connect the test equipment as shown in Figure 8.

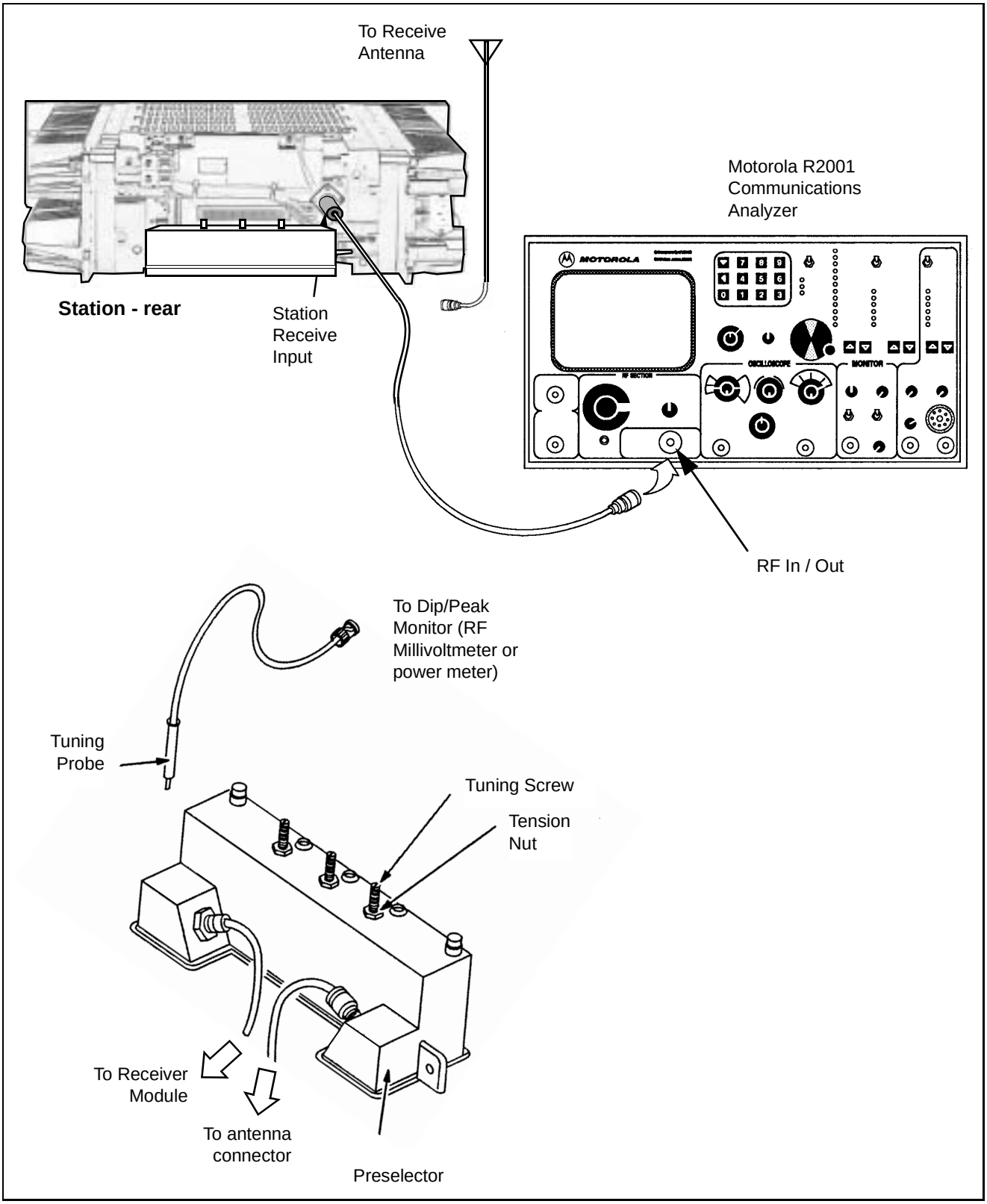


Figure 8. Test Equipment Setup for External Preselector Field Tuning

Tuning Procedure

1. Apply ac power to the station power supply (to provide an active 50 Ω termination).
2. Adjust the signal generator to the frequency calculated in the previous steps. Set the level to +5 dBm.
3. Insert tuning probe into cavity U2 (refer to Figure 9) and adjust tuning screw 2 for a **PEAK**.
4. Tighten tension nut on tuning screw 2 to at least 1.36 Nm (12 in-lb) and fine tune tuning screw 2 for a **PEAK**.
5. Keep tuning probe in cavity U2 and adjust tuning screw 3 for a **DIP**.
6. Tighten tension nut on tuning screw 3 to at least 1.36 Nm (12 in-lb) and fine tune tuning screw 3 for a **DIP**.
7. Insert tuning probe into cavity U3. Decrease output from signal generator to –5 dBm.
8. Adjust tuning screw 4 for a **DIP**.
9. Tighten tension nut on tuning screw 4 to at least 1.36 Nm (12 in-lb) and fine tune tuning screw 4 for a **DIP**.

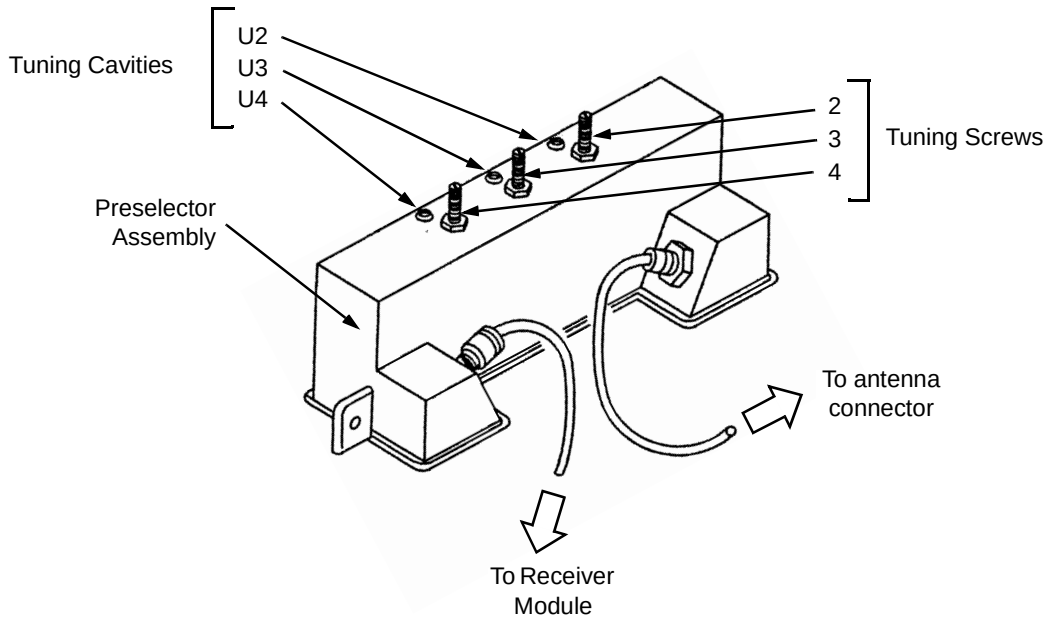
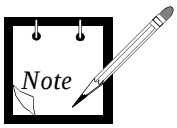


Figure 9. Location of Tuning Screws and Cavity Probe Holes

Varactor-Tuned Preselector Tuning Procedure

The Receiver Module may contain a varactor-tuned preselector which must be retuned whenever the Receiver Module is replaced in the field. The tuning procedure requires application of an RF signal into the receiver and use of the RSS Service menu to set the high and low alignment values of the varactor-tuned preselector. Either the Received Signal Strength Indicator (RSSI) value (if available) or SINAD is read and peaked by changing the preselector alignment values via the RSS. The alignment values are determined for 403 to 435 MHz and 433 to 470 MHz and stored in memory (within the Station Control Module).

These two alignment values are the only information required to interpolate the tuning voltage of the preselector to any frequency within the 403 to 470 MHz band. To retune this preselector, perform the Varactor-Tuned Preselector alignment procedure located in the RSS Service menu Online Help facility.



The RSSI can be monitored at pin C11 of the Systems connector (J5) on the station backplane (refer to Figure 10 for the location).

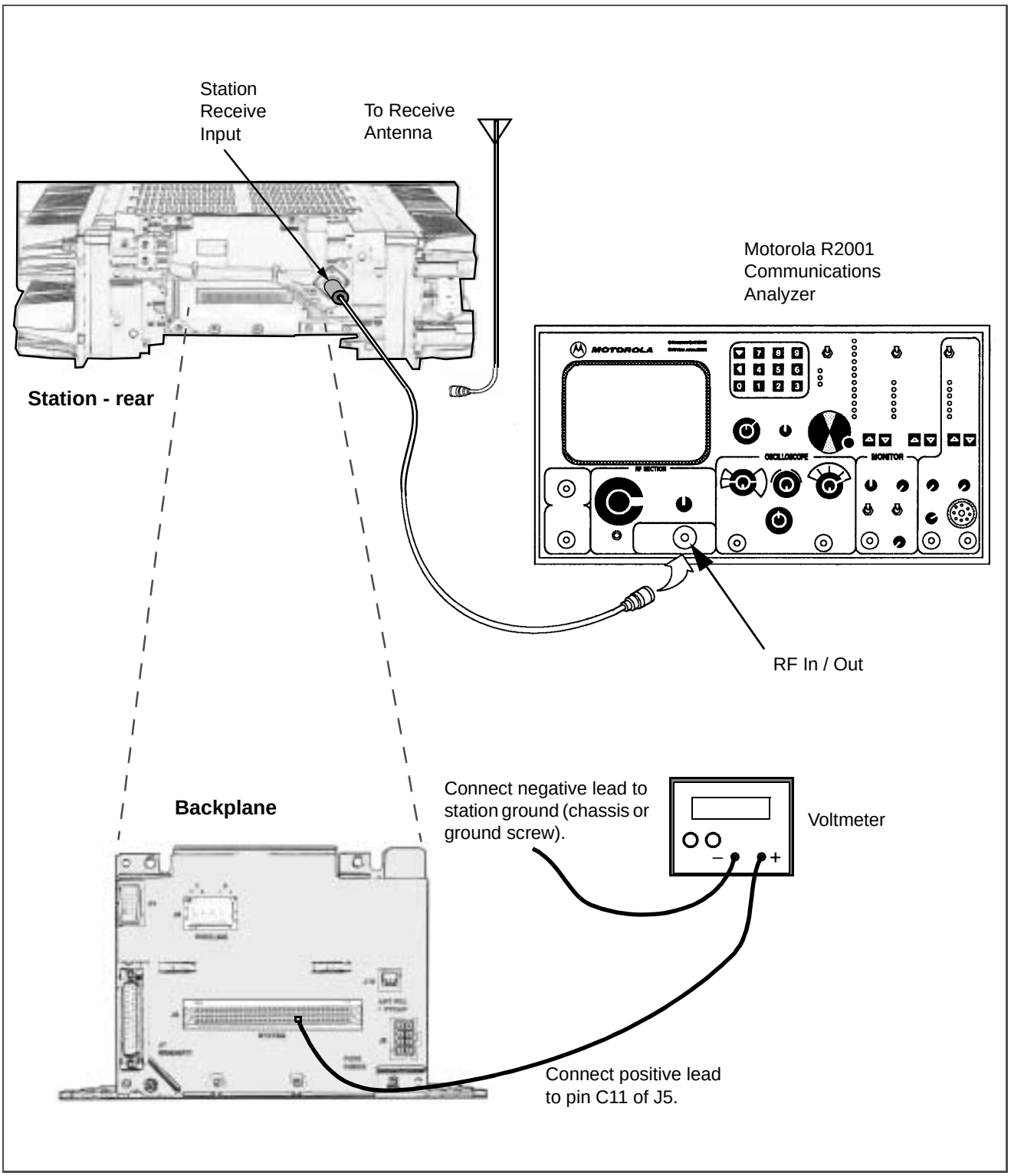


Figure 10. Location of RSSI Monitoring Point (Trunking Stations Only)