MOTOROLA

UHF DUPLEXER MODULE

Model TLE9021 (403 to 435 MHz)
Model TLE9022 (435 to 470 MHz)

1 DESCRIPTION

Kits TLE9021/22 provide band-dependent duplexer modules for use with MTR2000 UHF stations. This section provides a general description, identification of adjustments and inputs/outputs, performance specifications, and typical connection. While the duplexer module is considered non-repairable, tuning screws are provided for field tuning should replacement become necessary due to module failure, or if retuning is necessary due to a change in operating channels. A single channel field tuning procedure is provided in this section.

General Description

The duplexer module (shown in Figure 1) allows a transmit and receive channel pair to share a common Tx/Rx antenna. Each duplexer module consists of six resonant cavities (three for transmit and three for receive) contained in a temperature-compensated copper enclosure designed to mount in a standard EIA 48.26 cm (19") equipment rack.

Each set of three cavities is designed and tuned to pass the respective transmit or receive channel frequency (or bandwidths) while providing maximum Tx noise suppression at the Rx frequency and maximum Rx isolation at the Tx frequency.

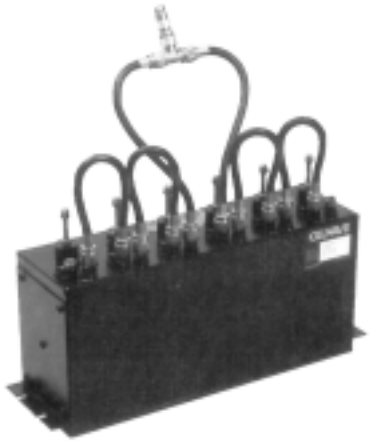


Figure 1. Typical UHF Duplexer Module

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

68P81085E17-A
07/30/97-UP

2 ADJUSTMENT SCREWS & INPUT/OUTPUT CONNECTORS

Figure 2 shows the position of the adjustment screws and input/output rf connectors for the UHF Duplexer module.

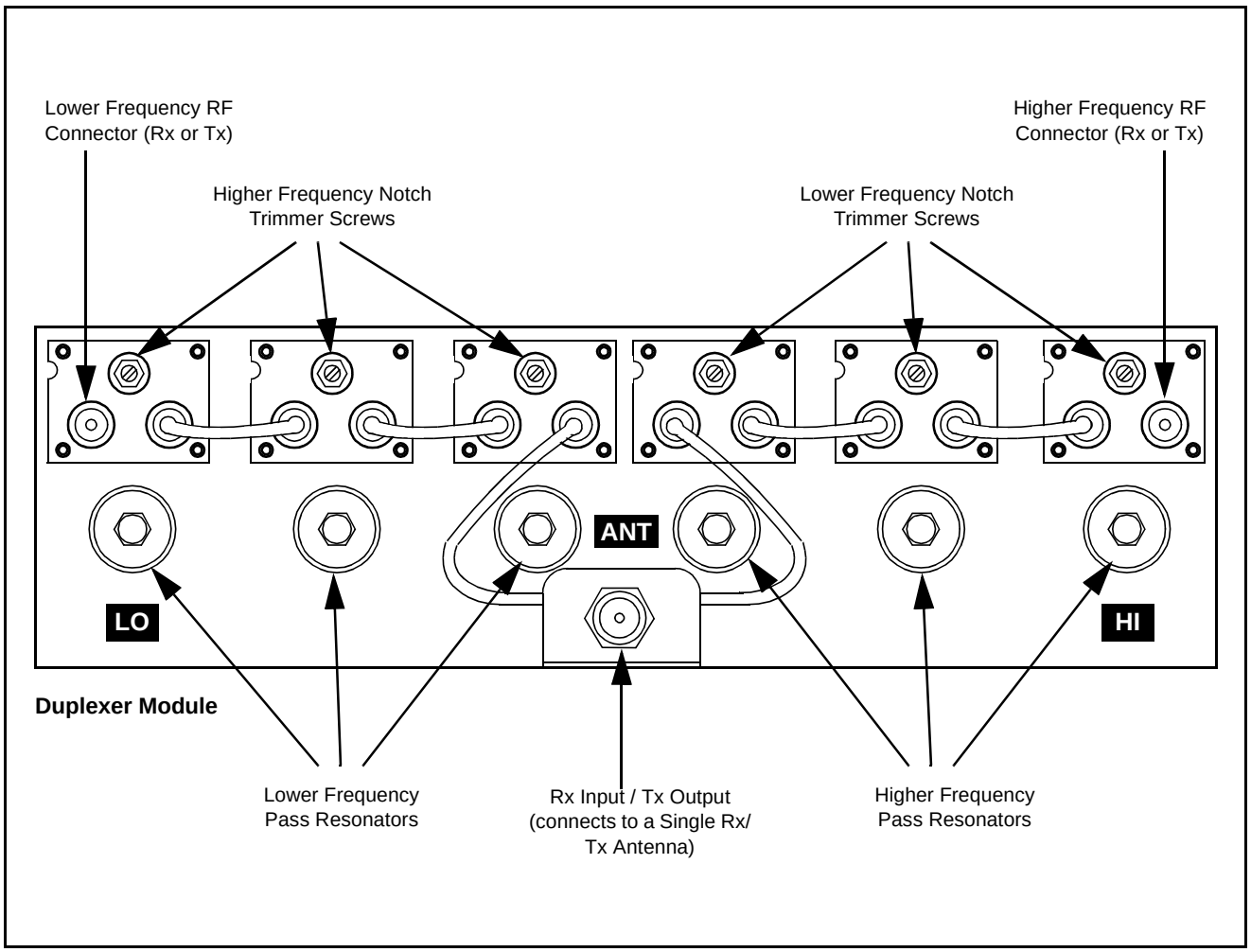


Figure 2. UHF Duplexer Module – Adjustment Screws and Input/Output Connectors

Cables

The set of cables used to connect a Duplexer to the MTR2000 station depends on what ancillary equipment is connected to the station.

A station can be configured with the following ancillary equipment:

- a Duplexer only.
  Figure 3 shows the kits required to install this equipment on a station.
- an External Preselector and a Duplexer.
  Figure 4 shows the kits required to install this equipment on a station.
- an External Double Circulator, an External Preselector and a Duplexer.
  Figure 5 shows the kits required to install this equipment on a station.

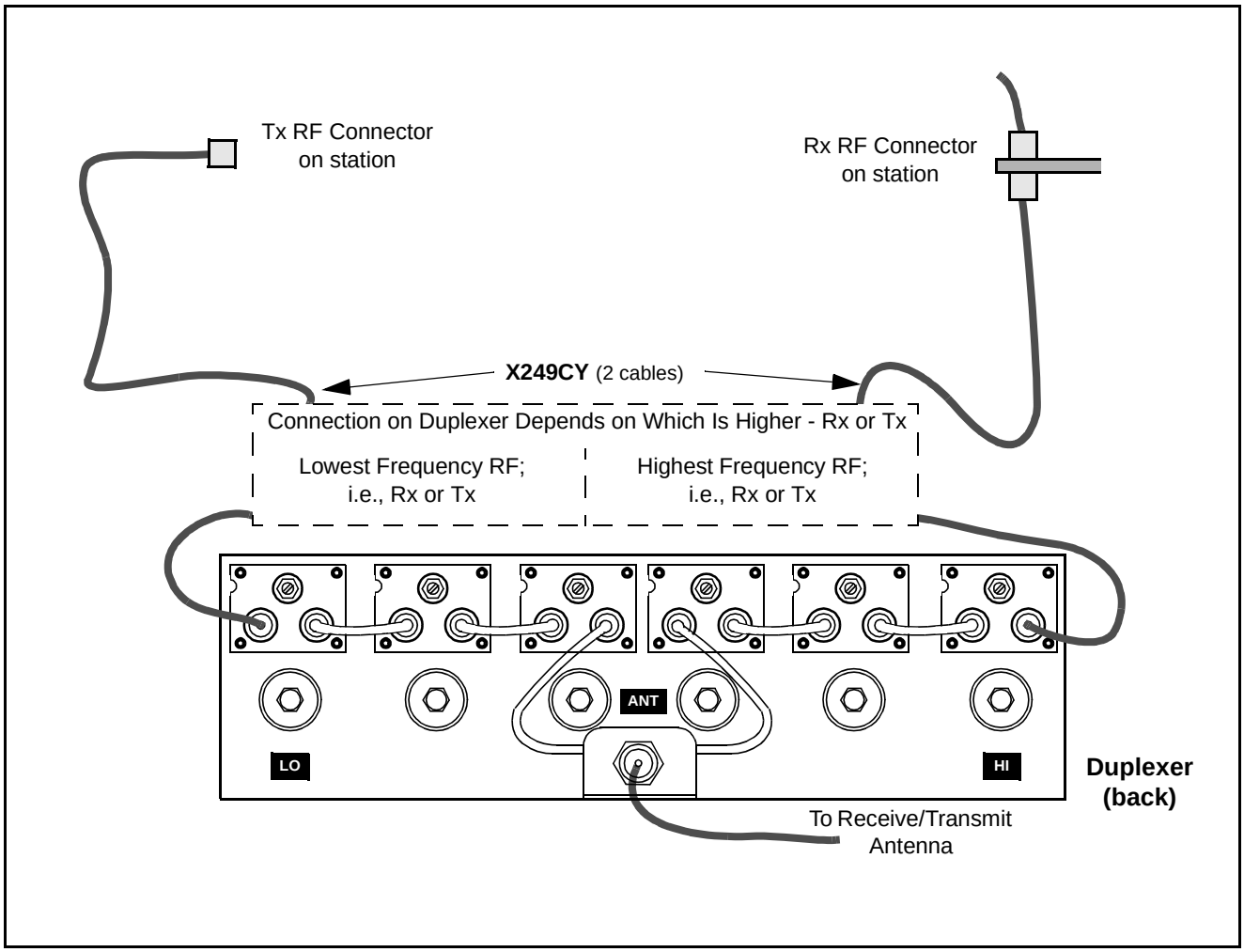


Figure 3. Duplexer Only – Cable Kits

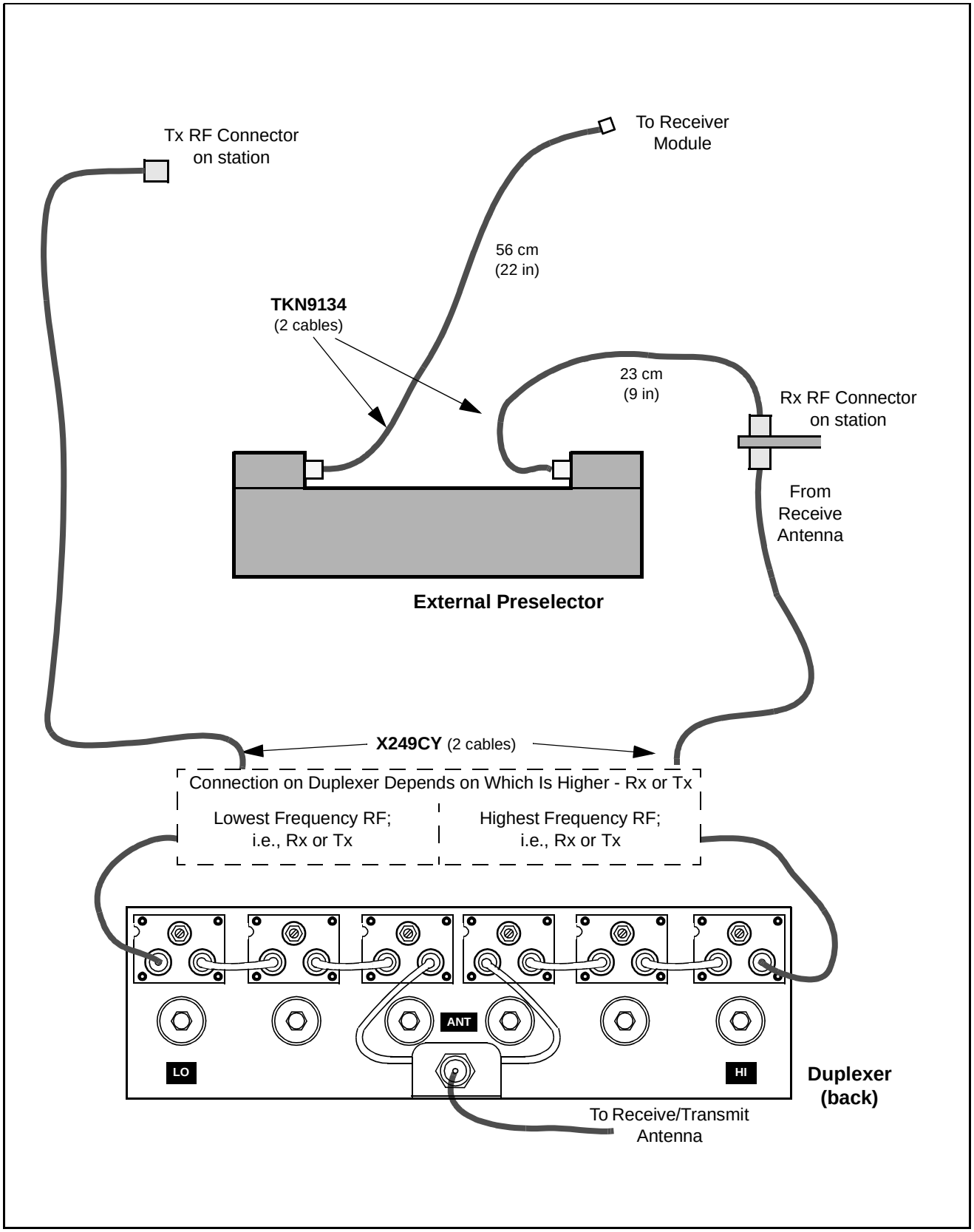


Figure 4. Duplexer and External Preselector– Cable Kits

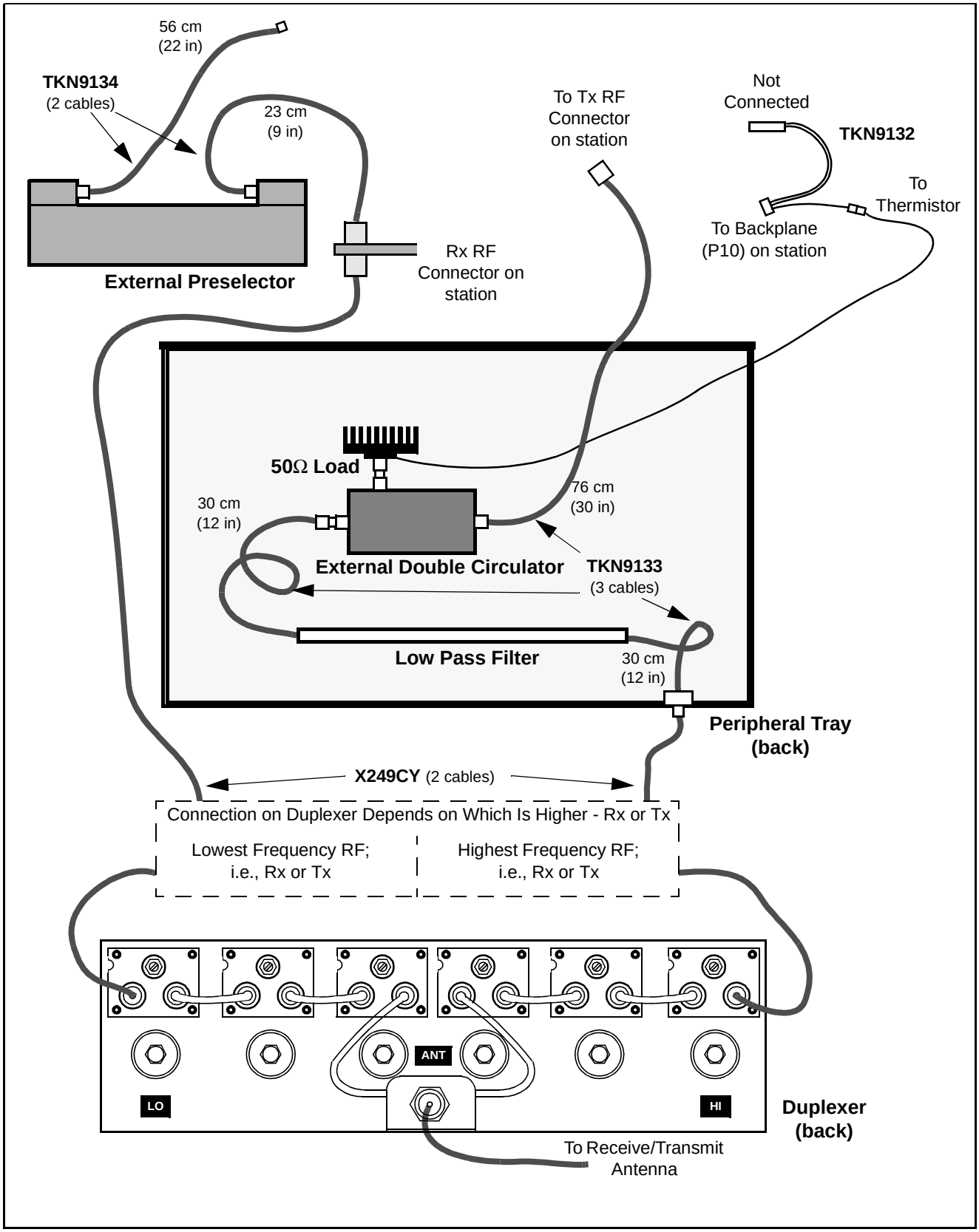


Figure 5. Duplexer, External Preselector, and External Double Circulator– Cable Kits

3 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the UHF Duplexer module.

Performance Specifications

Table 1. Performance Specifications for UHF Duplexer Module

Parameter	Specifications
Operating Frequency TLE9021 TLE9022	 403 to 435 MHz 435 to 470 MHz
Insertion Loss (Transmitter to Antenna)	1.3 dB maximum
Insertion Loss (Antenna to Receiver)	1.3 dB maximum
Tx-to-Rx Frequency Separation (Minimum)	5 MHz
Tx Noise Suppression at Rx Frequency	120 dB minimum
Rx Isolation at Tx Frequency	120 dB minimum
Return Loss	17 dB minimum
Maximum Input Power	250 W
Temperature Range	–30°C (–22°F) to +60°C (140°F)
Size	48.3 cm wide (19“) x 35.5 cm deep (14“) x 13.3 cm high (5.25“) EIA Rack Mountable
Weight	10.4 kg. (23 lbs.)
Terminations	Female N-Type
Input and Output Impedance	50 Ohms

Specifications subject to change without notice.

4 TYPICAL INTERCONNECTION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 6 provides a simplified interconnect diagram showing the receiver and transmitter paths to a single Rx/Tx antenna.

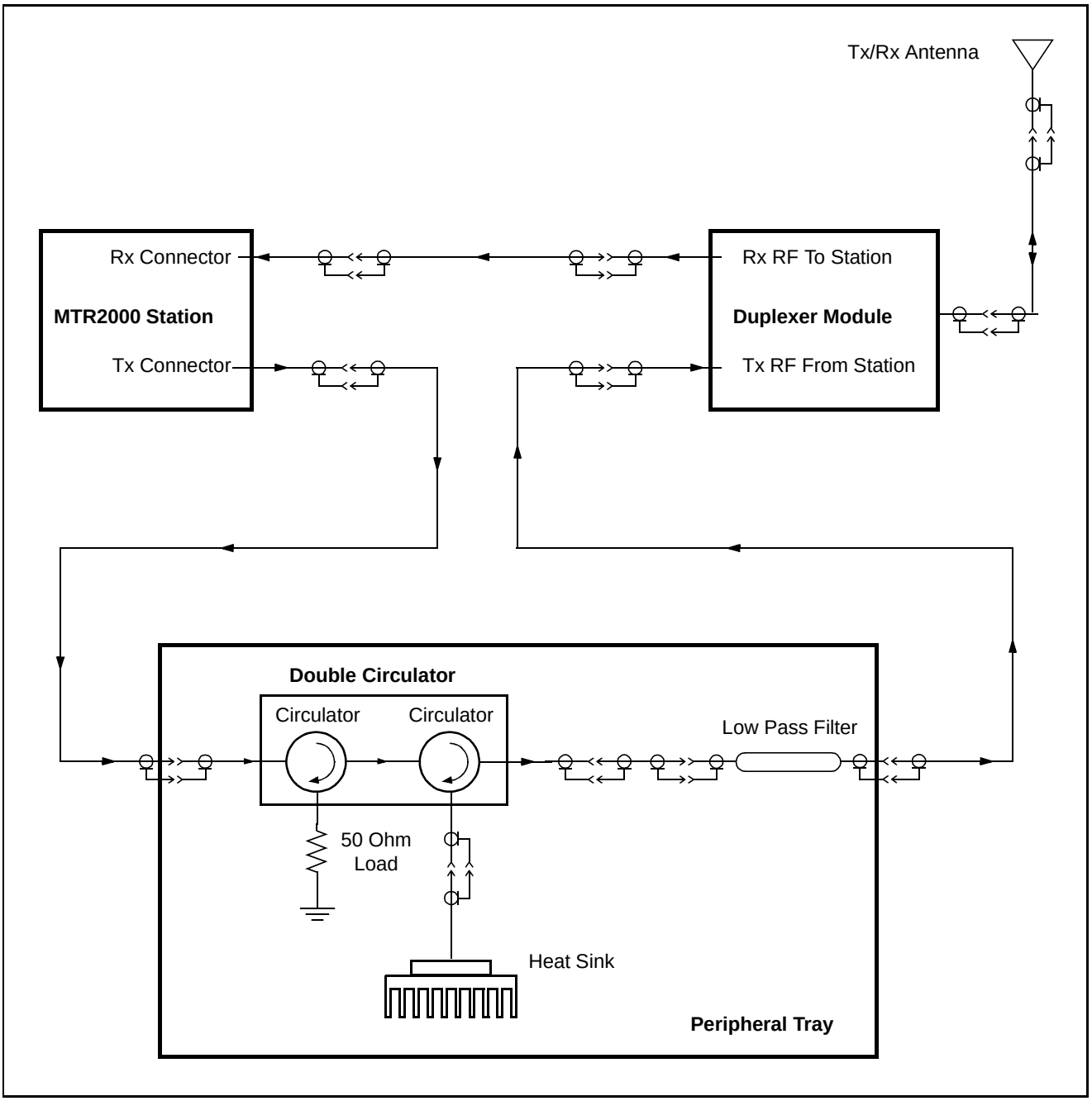


Figure 6. Typical Duplexer Interconnect Diagram

5 FIELD TUNING PROCEDURE

Duplexer modules shipped with stations are tuned at the factory. If a duplexer must be replaced in the field, the unit must be installed and tuned specifically to the transmit and receive frequency pair for the particular station.

Field Tuning Overview

The duplexer module is comprised of three low-pass / high-notch cavities and three high-pass / low-notch cavities. Each set of three cavities provides bandpass filtering for either the transmit rf signal or the receive rf signal. In general, the duplexer must be tuned so that the transmit cavity set passes the transmit signal and rejects the receive signal; concurrently, the receive cavity set must be tuned to pass the receive signal and reject the transmit signal.

CAUTION

This tuning procedure is valid for channels with a bandwidth of 200 kHz or less. If bandwidth is more than 200 kHz, the duplexer must be tuned by the service depot.

Tuning is performed by injecting rf signals and making tuning adjustments (using the tuning rods and trimmer screws) while monitoring for maximum or minimum readings on the rf millivoltmeter. Field tuning the duplexer module requires the following general adjustments:

- Tune high-pass / low-notch cavities for maximum pass and reject response
- Tune low-pass / high-notch cavities for maximum pass and reject response
- Check high-pass / low-notch and low-pass / high-notch cavities for insertion loss
- Check high-pass / low-notch and low-pass / high-notch cavities for isolation

Required Test Equipment

Field tuning of the duplexer module requires the following test equipment:

- Motorola R2001/R2600 Communications Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8565B or equivalent)
- 50Ω N-type terminator
- Tuning tool; 4mm x 10.1cm (5/32" x 4") screwdriver
- N-to-N bullet connector (UG29A/U or equivalent)
- 11mm (7/16") Nutdriver
- 11mm (7/16") Open End Wrench
- N-to-BNC Adapter (UG349A/U)
- N-to-N Connector (UG57B/U)

Setting Up for Tuning Duplexer

Perform the preliminary tasks shown in Figure 7 to prepare the duplexer module for tuning.

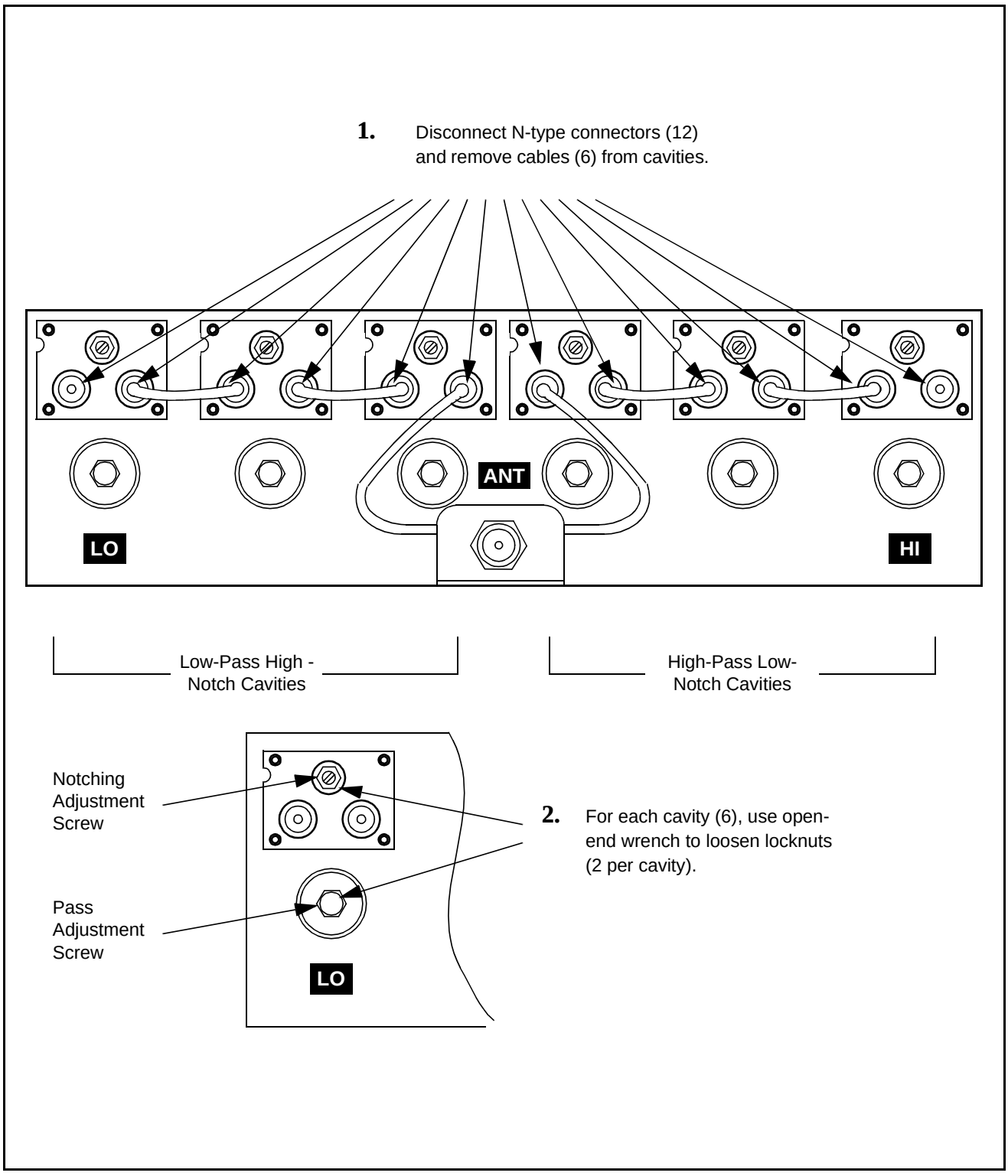


Figure 7. Preliminary Tasks Prior to Tuning Duplexer

Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in Figure 8. The procedures are most easily performed with the duplexer module removed from the station rack or cabinet. Be sure to make note of the transmit and receive frequencies for the particular station before beginning.

If the duplexer module is tuned according to instructions and does not meet specifications for return loss, insertion loss, and / or isolation, you must return the duplexer for repair.

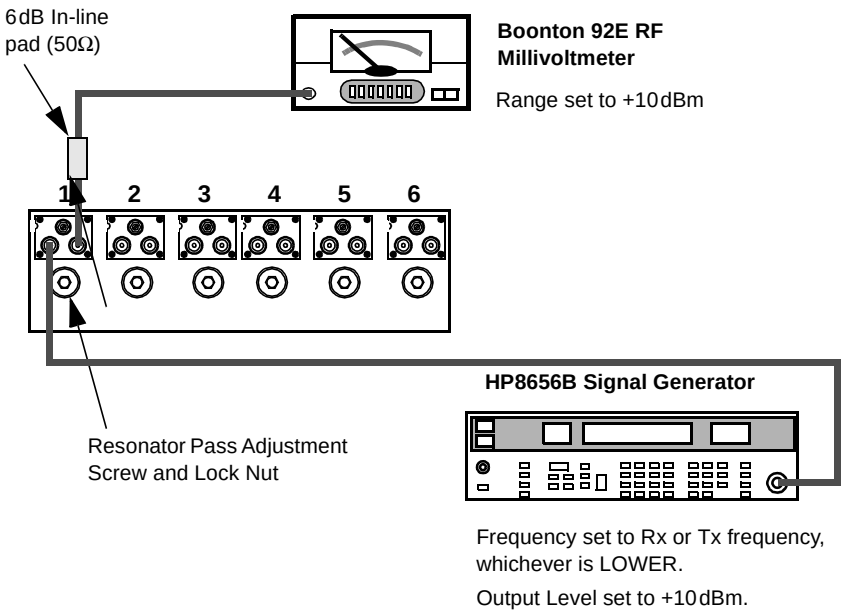
The notch (reject) frequency will maintain its spacing to the pass frequency when the pass adjustment of a cavity is moved several MHz. For example, a system operating at 455 and 460 MHz, which is moved to 460 and 465 MHz will require a minimum of readjustment if the pass adjustment is made first. It is therefore recommended that the pass adjustments be made first and that the procedure provided in Figure 8 be followed.

1. To Start

Remove cables from the duplexer, noting the position of each cable. Each cable is unique and must be returned to the original position when tuning is complete.

2. Tuning Low Pass Resonators

1. Set up test equipment as shown, connecting to cavity #1.
2. Use nut driver to adjust pass adjustment screw for cavity #1 to obtain a PEAK reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut carefully, making sure pass adjustment screw does not shift position.
4. Repeat steps 1 to 3 for cavities #2 and #3.



3. Tuning High Pass Resonators

1. Set up test equipment as shown, connecting to cavity #4.
2. Use nut driver to adjust pass adjustment screw for cavity #4 to obtain a PEAK reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut carefully, making sure pass adjustment screw does not shift position.
4. Repeat steps 1 to 3 for cavities #5 and #6.

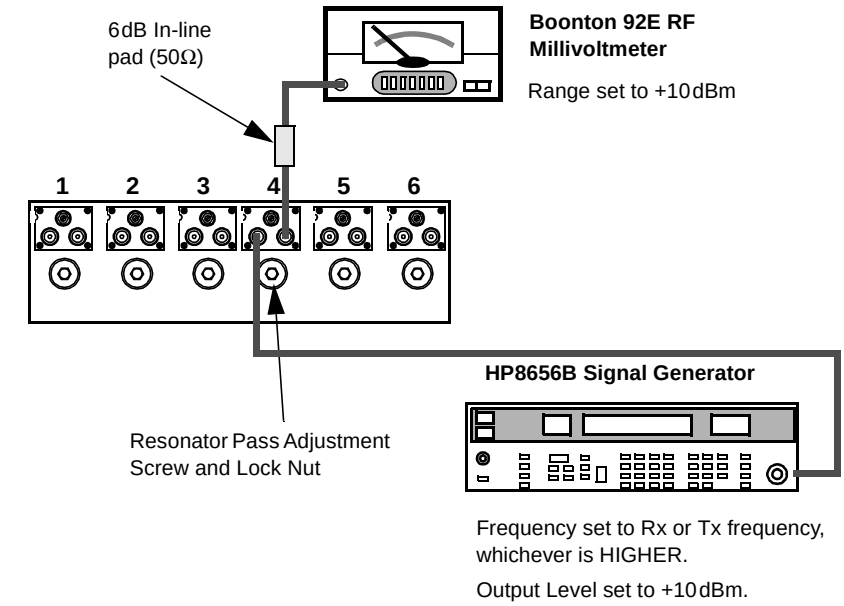
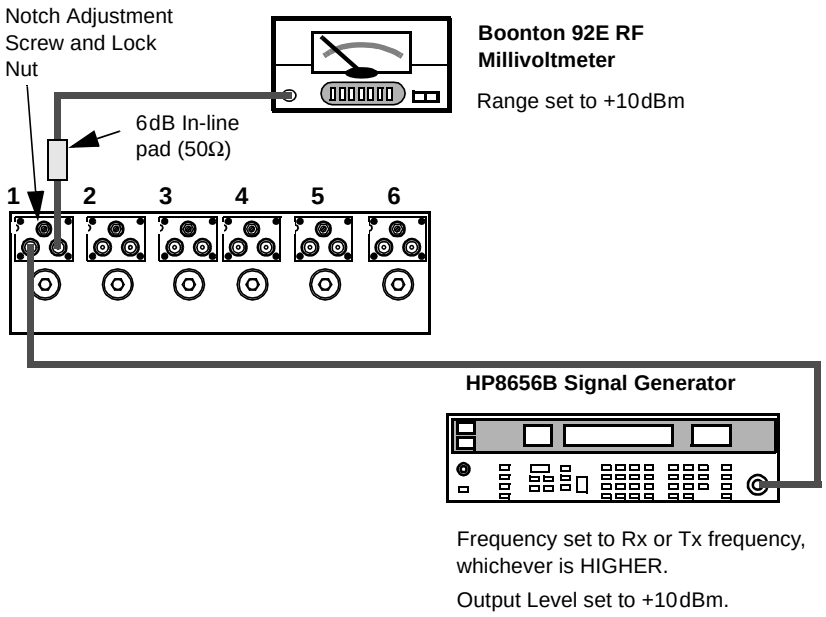


Figure 8. UHF Duplexer Field Tuning Procedure

4. Tuning High Notch Loop Assemblies

1. Set up test equipment as shown, connecting to cavity #1.
2. Use screwdriver to adjust notch adjustment screw for cavity #1 to obtain a minimum reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut carefully, making sure notch adjustment screw does not shift position.
4. Repeat steps 1 to 3 for cavities #2 and #3.



5. Tuning Low Notch Loop Assemblies

1. Set up test equipment as shown, connecting to cavity #4.
2. Use screwdriver to adjust notch adjustment screw for cavity #4 to obtain a minimum reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut carefully, making sure notch adjustment screw does not shift position.
4. Repeat steps 1 to 3 for cavities #5 and #6.
5. **Reconnect the cables on the duplexer. Make sure that the cables are returned to their original position on the Duplexer.**

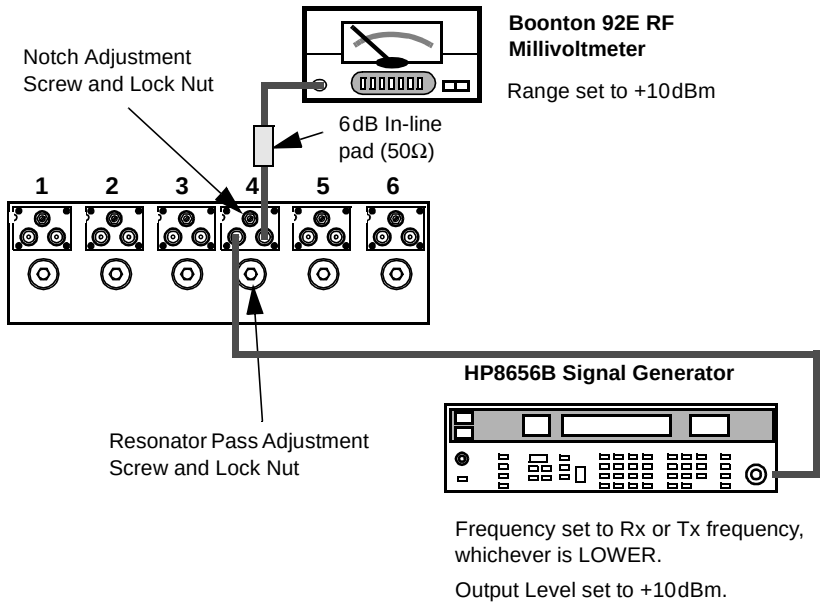
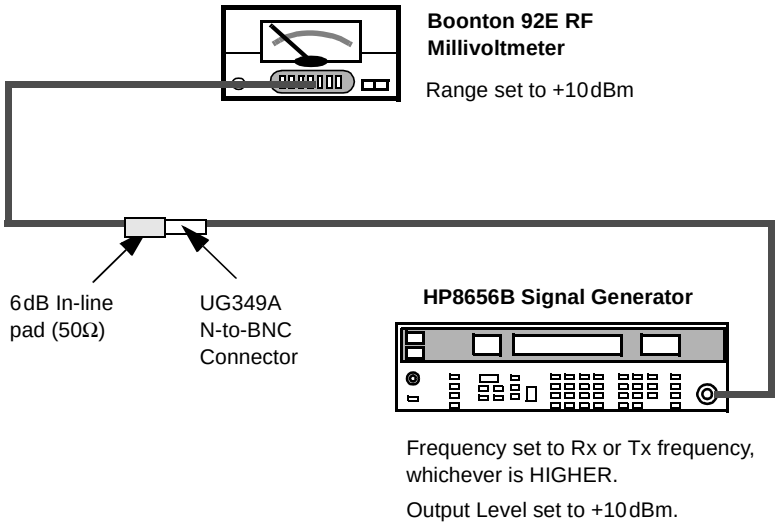


Figure 9. UHF Duplexer Field Tuning Procedure (Continued)

6. Verifying Insertion Loss

1. Connect test equipment as shown.

2. Observe and note the level in dBm as shown on the millivoltmeter.



3. Connect the duplexer cables and test equipment to the duplexer as shown.

4. Observe and note the level in dBm as shown on the millivoltmeter.

5. Subtract the absolute number noted in Step 2 from the number noted in Step 4. The difference should be less than 1.3 dB to meet specification for Insertion Loss.

6. Repeat Steps 1 to 5 for Low-Pass/High Notch cavities with the following exceptions:

- **a)** Set Frequency Generator for Rx or Tx frequency, whichever is LOWER
- **b)** Connect Signal Generator to Low Pass duplexer input (cavity #1)
- **c)** Connect terminator to cavity #6.

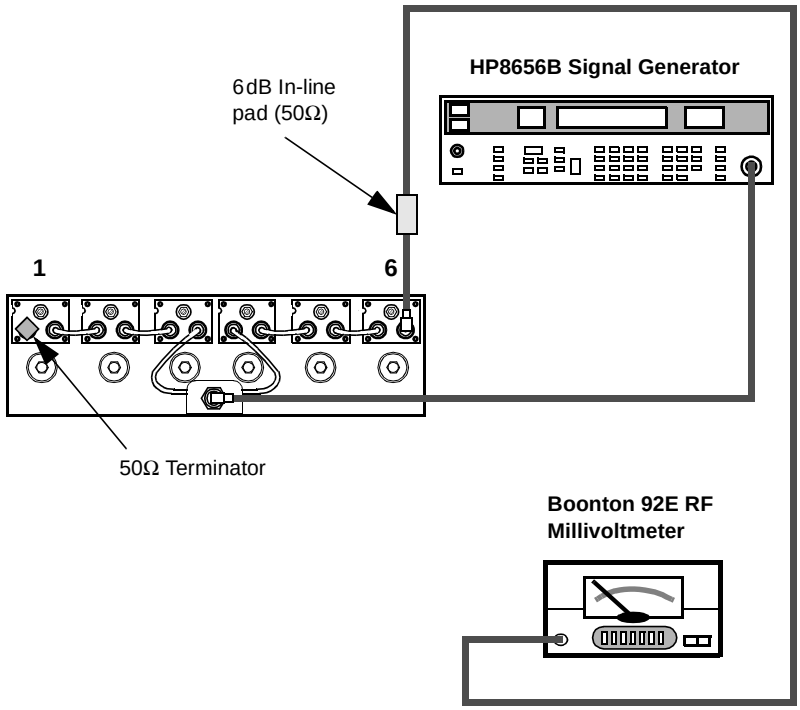
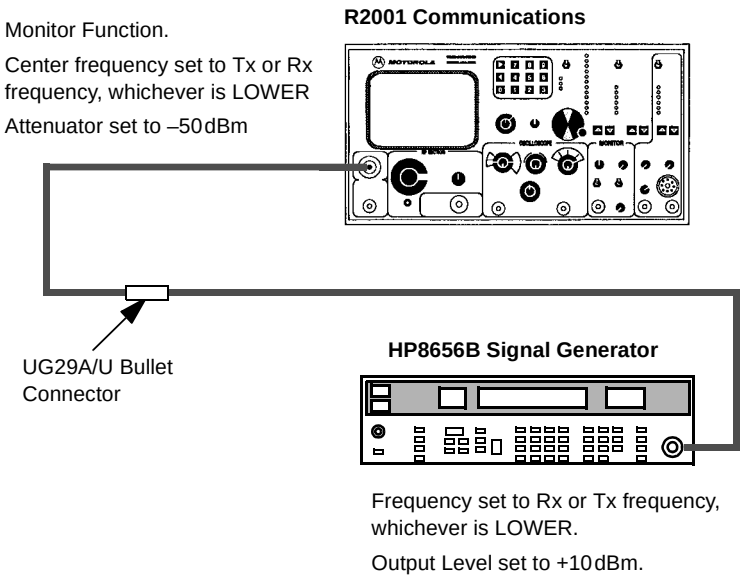


Figure 9. UHF Duplexer Field Tuning Procedure (Continued)

7. Verifying Isolation

1. Connect test equipment as shown.

2. Observe and note the level in dBm as shown on the R2001 display.



3. Connect the test equipment to the duplexer as shown.

4. Observe and note the level in dBm as shown on the R2001 display. (If no number is displayed, consider isolation to be greater than 105 dB, which exceeds the specification.)

5. Subtract the absolute number noted in Step 4 from the number noted in Step 2. The difference should be higher than 100 dB to meet specification for Isolation.

6. Repeat Steps 1-5 for Low- Pass/ High Notch cavities with the following exceptions:

- **a)** Set Frequency Generator and R2001 for Rx or Tx frequency, whichever is HIGHER
- **b)** Connect Signal Generator to Low Pass duplexer input (cavity #1)
- **c)** Connect terminator to cavity #6.

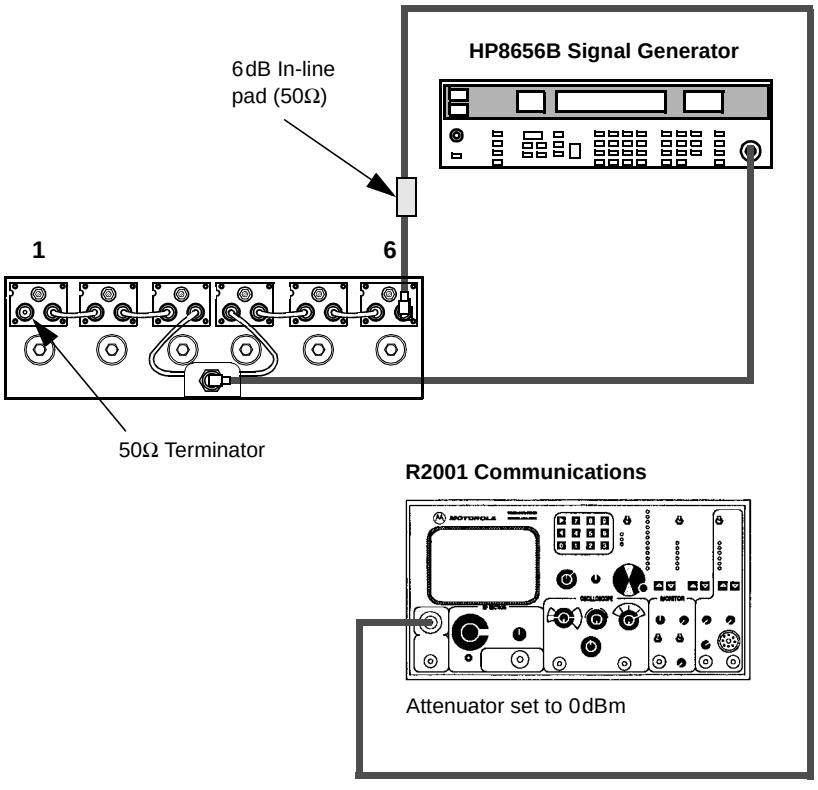
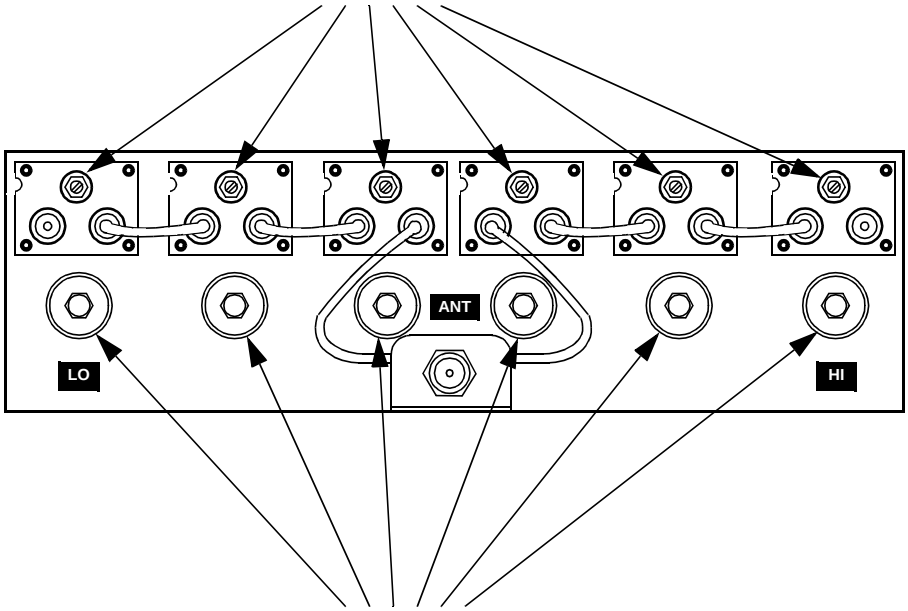


Figure 9. UHF Duplexer Field Tuning Procedure (Continued)

8. Post-Tuning Checks

1. Make sure all notch adjustment lock nuts (6) are tight.



2. Make sure all pass adjustment lock nuts (6) are tight.

Figure 9. UHF Duplexer Field Tuning Procedure (Continued)