MOTOROLA

DUPLEXER MODULE

Options X182AA (132–146 MHz)
X182AB (144–160 MHz)
X182AJ (158–174 MHz)

1 DESCRIPTION

Options 182AA/AB/AJ provide band–dependent duplexer modules for use with *Quantar* VHF stations. This section provides a general description, identification of adjustments and inputs/outputs, performance specifications, and a typical mounting location detail. 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 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.

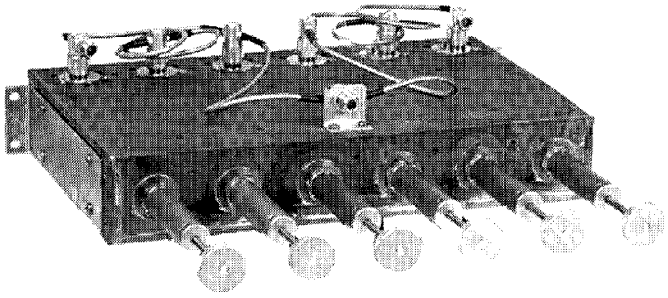

Figure 1. Typical Duplexer Module

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2 ADJUSTMENTS AND INPUTS/OUTPUTS

Figure 2 shows the location of the adjustment screws and input and output rf connectors for the duplexer module.

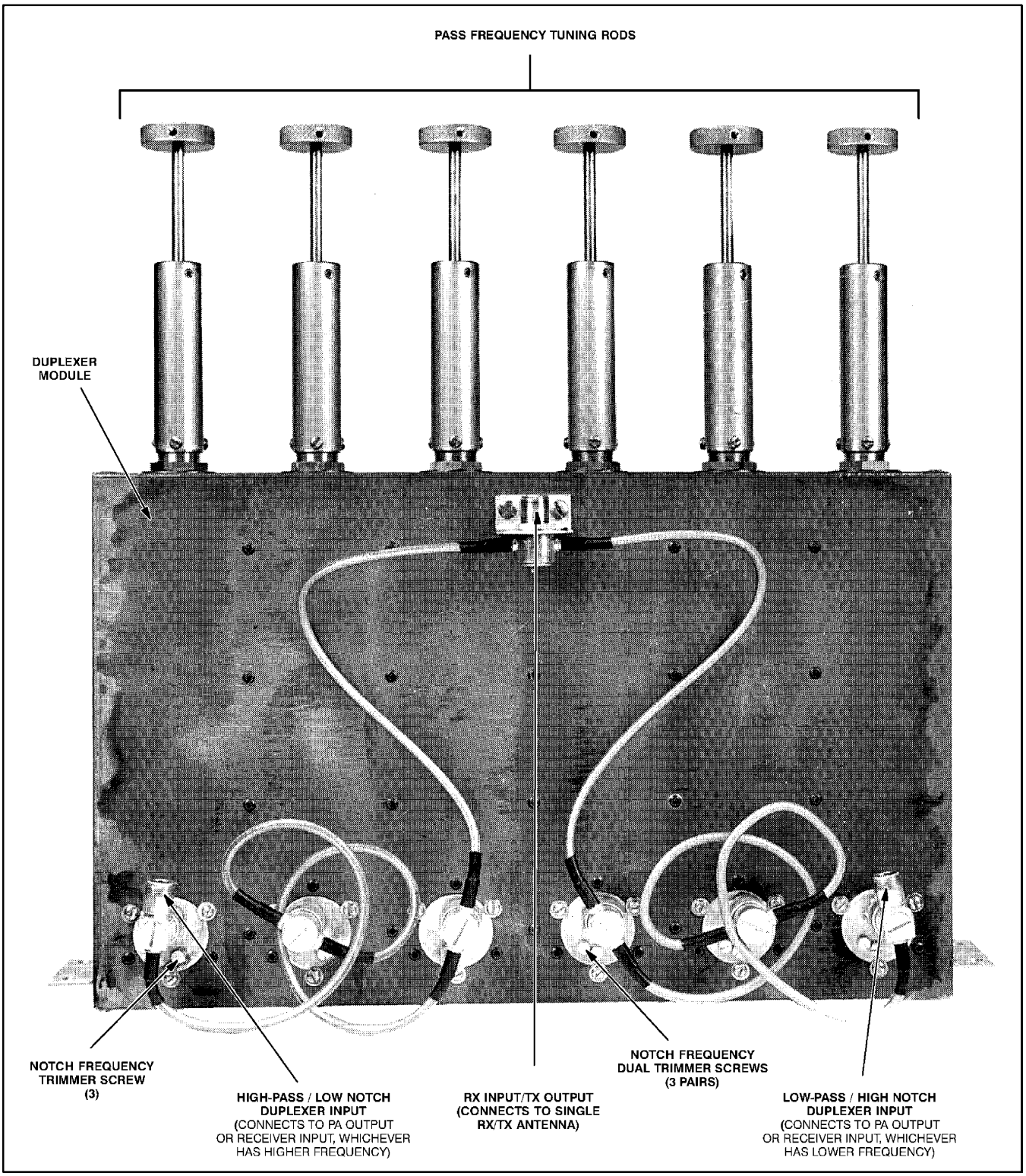


Figure 2. *Quantar* VHF Duplexer Module Adjustment Screws and Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the duplexer module.

Performance Specifications

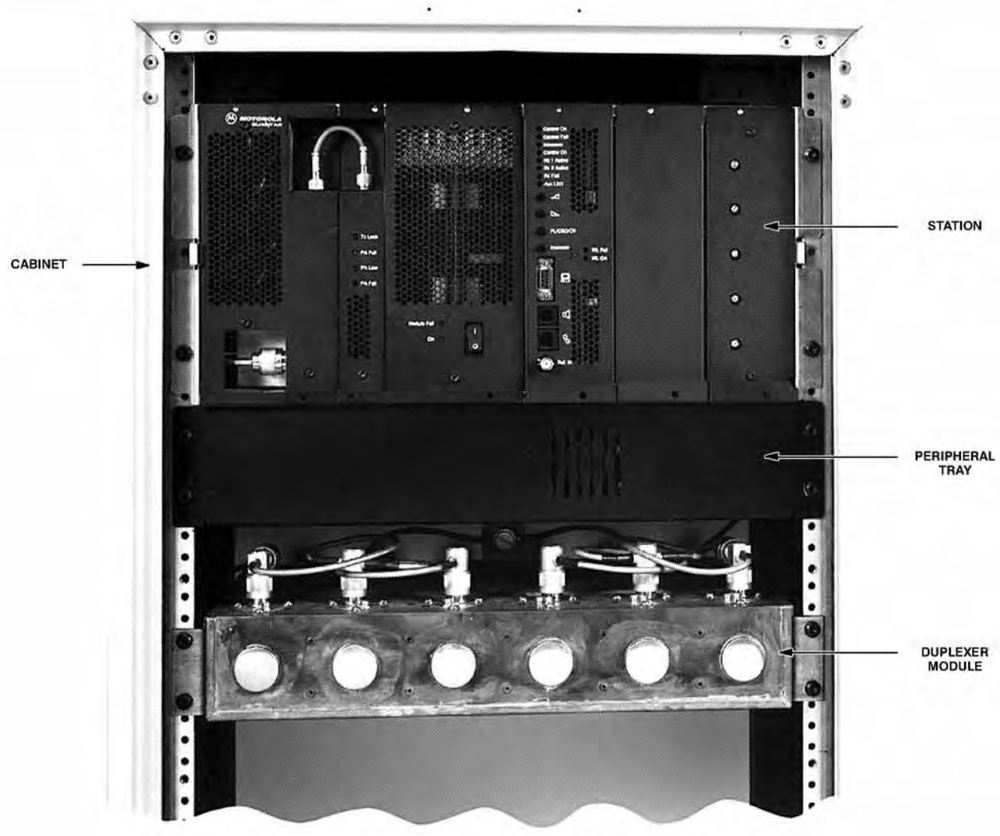
Table 1. Duplexer Performance Specifications (Options X182AA/AB/AJ)

Parameter	Specification
Operating Frequency Model X182AA Model X182AB Model X182AJ	 132–146 MHz 144–160 MHz 158–174 MHz
Insertion Loss (Transmitter to Antenna)	1.3 dB max
Insertion Loss (Antenna to Receiver)	1.3 dB max
Frequency Bandwidth vs Frequency Separation	**Tx–to–RX Spacing** / **Bandwidth (maximum)** 1.5 MHz / 200 kHz 2.5 MHz / 600 kHz 3.5 MHz / 800 kHz 4.5 MHz and above / 1000 kHz
TX Noise Suppression at RX Freq.	75 dB min
RX Isolation at TX Freq.	75 dB min
Frequency Separation (Min.)	1.5 MHz
Return Loss	14 dB minimum
Maximum Input Power	150 W
Temperature Range	–30°C to +60°C
Size	3" (H) x 21.5" (D) x 17" (W) EIA Rack Mountable
Weight	22 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

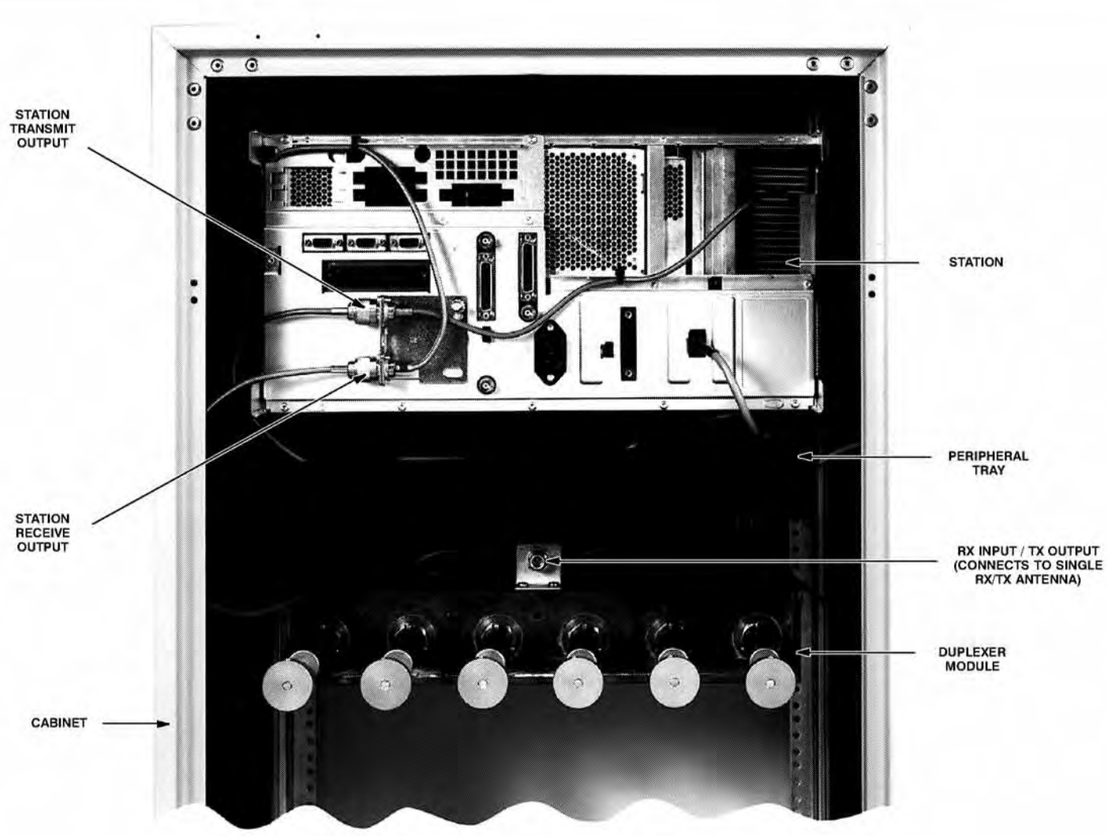
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.



FRONT VIEW



REAR VIEW

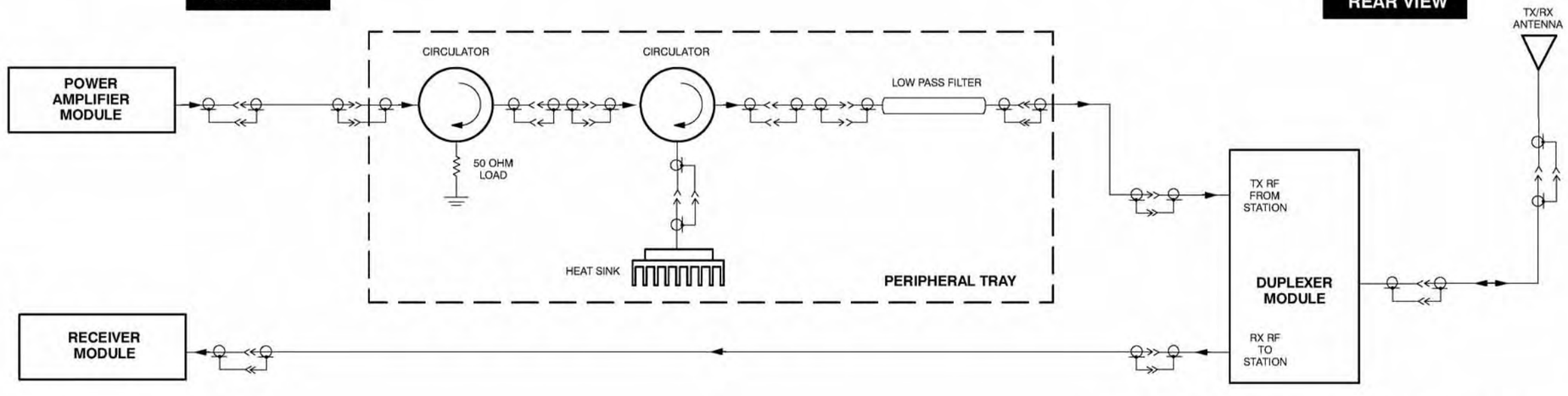


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

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

Note: *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.*

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.

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 Communications Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8565 or equivalent)
- 50Ω N–type terminator
- Male–to–Females N–Type "T" connector (UG–107B/U or equiv.)
- Slotted screwdriver
- 3/32" allen wrench
- Tuning tool (thin blade)
- N–to–N bullet connector (UG29A/U or equivalent)
- N–to–BNC Adapter (UG349A/U)
- N–to–N Connector (UG57B/U)

Setting Up for Tuning Duplexer

Perform the preliminary tasks shown in Figure 4 to prepare for tuning the duplexer module.

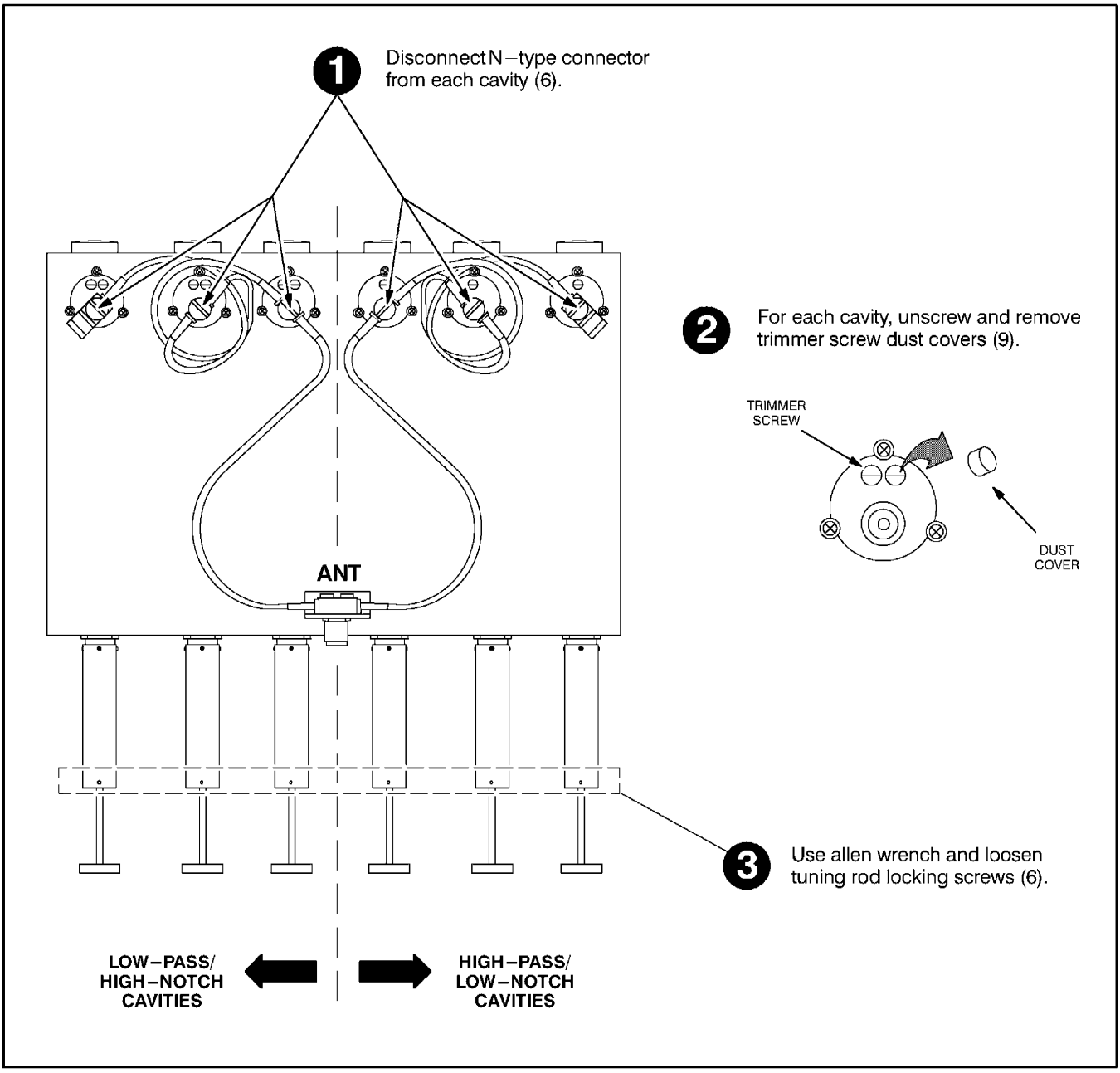


Figure 4. Preliminary Tasks Prior to Tuning Duplexer

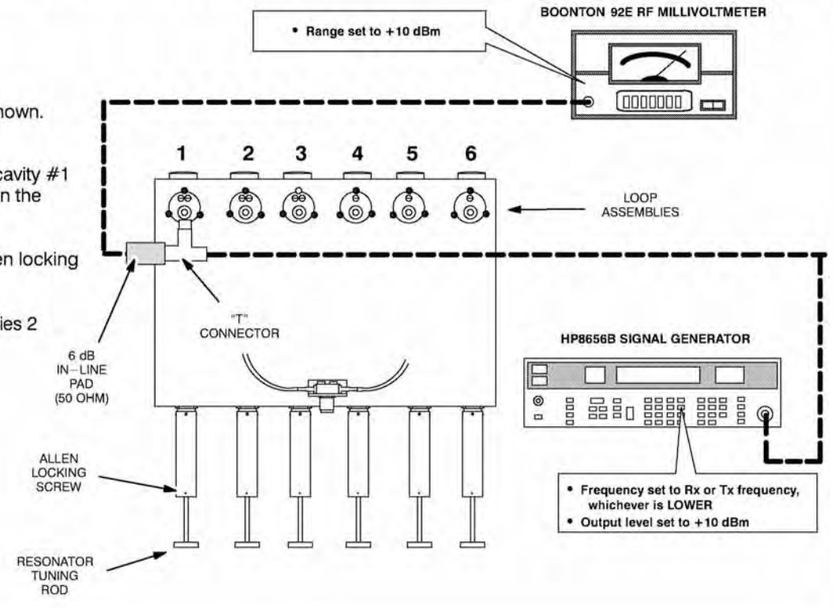
Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in Figure 5. 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.

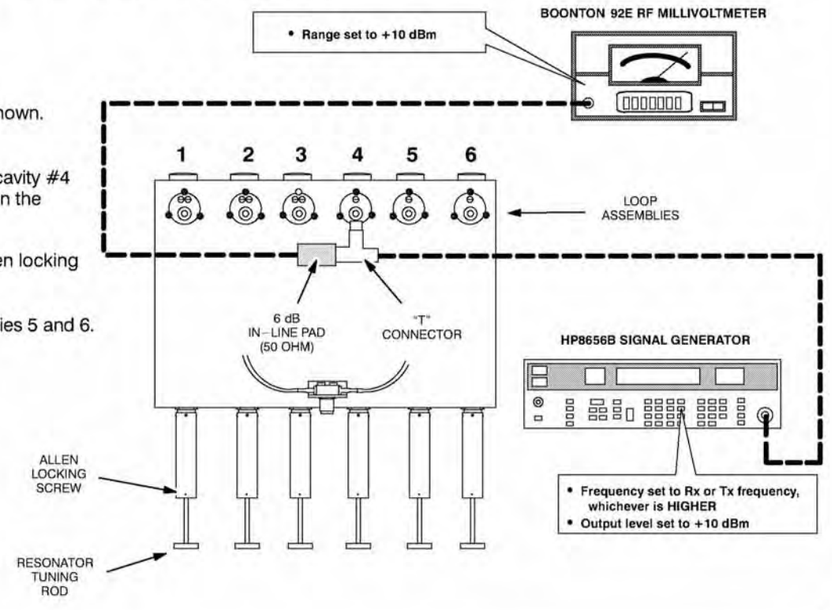
1 TUNING LOW PASS RESONATORS

1. Set up test equipment as shown.
2. Push or pull tuning rod for cavity #1 to obtain a **PEAK** reading on the millivoltmeter.
3. Use allen wrench and tighten locking screw.
4. Repeat steps 2 & 3 for cavities 2 and 3.



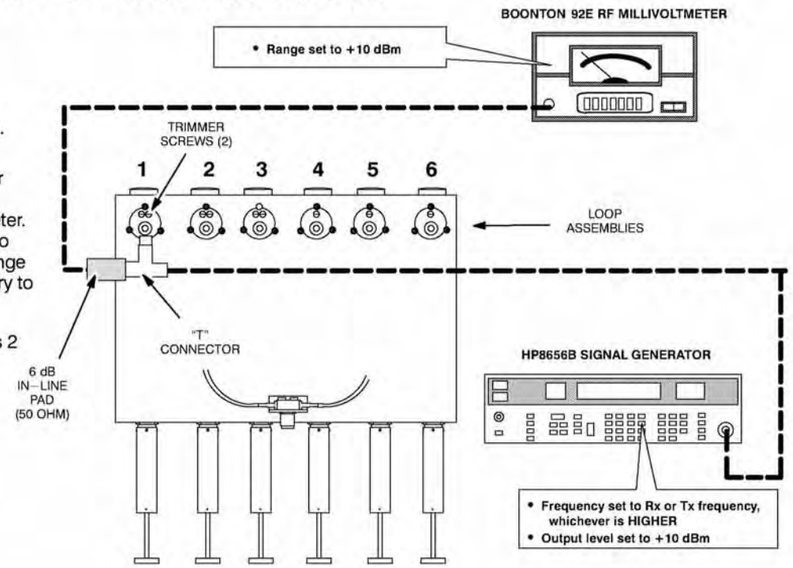
2 TUNING HIGH PASS RESONATORS

1. Set up test equipment as shown.
2. Push or pull tuning rod for cavity #4 to obtaina **PEAK** reading on the millivoltmeter.
3. Use allen wrench and tighten locking screw.
4. Repeat steps 2 & 3 for cavities 5 and 6.



3 TUNING HIGH NOTCH LOOP ASSEMBLIES

1. Set up test equipment as shown.
2. Use tuning tool to adjust trimmer screws for cavity #1 to obtain **minimum** reading on millivoltmeter. (Adjust trimmer screws equally to obtain minimum. Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Repeat steps 1 and 2 for cavities 2 and 3.



4 TUNING LOW NOTCH LOOP ASSEMBLIES

1. Set up test equipment as shown.
2. Use tuning tool to adjust trimmer screw for cavity #4 to obtain **minimum** reading on millivoltmeter. (Adjust trimmer screw to obtain minimum. Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Repeat steps 1 and 2 for cavities 5 and 6.

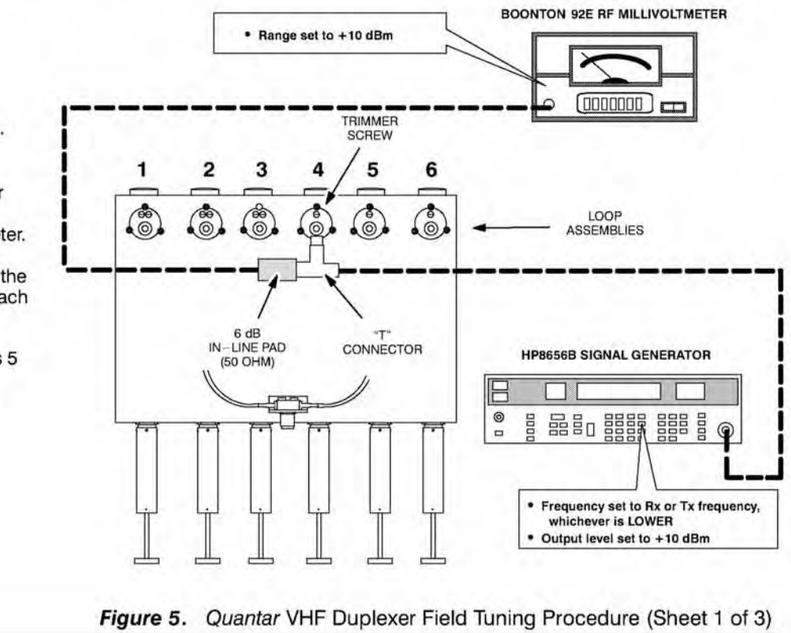
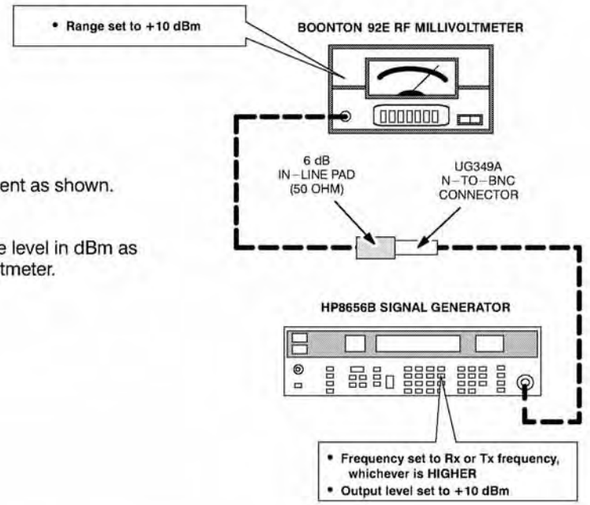
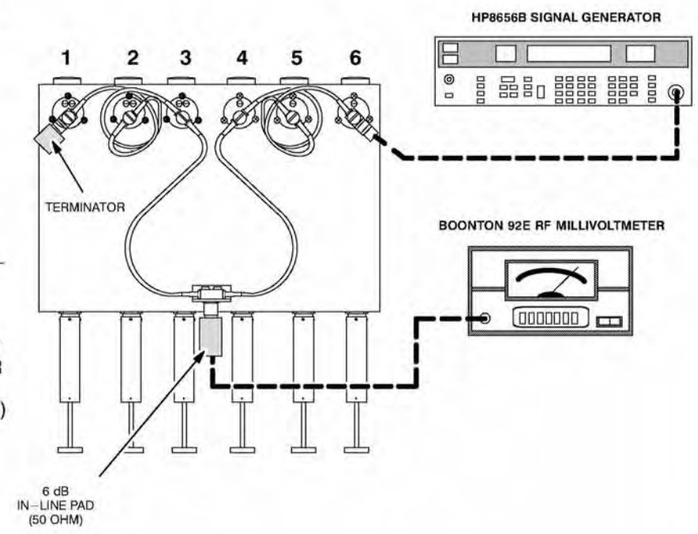


Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 1 of 3)

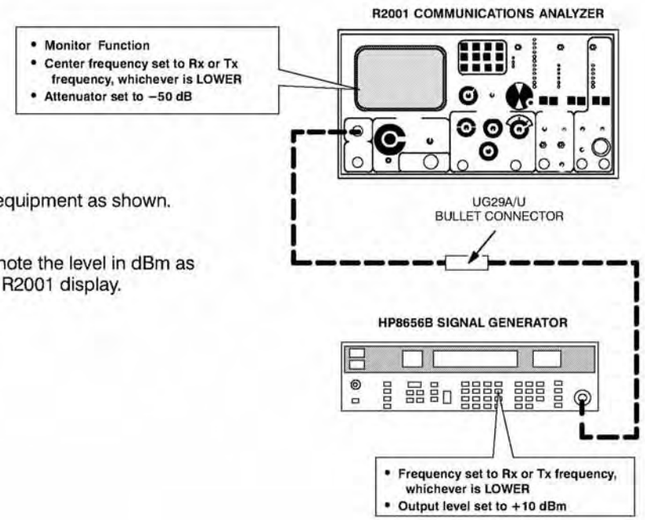
5 VERIFYING INSERTION LOSS



1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the millivoltmeter.
3. Connect the duplexer cable assembly 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 1–5 for Low–Pass/High–Notch cavities with the following exceptions:
   1) Set Frequency Generator for Rx or Tx frequency, whichever is **LOWER**
   2) Connect Signal Generator to Low Pass duplexer input (cavity #1)
   3) Connect terminator to cavity #6.



6 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 75 dB to meet specification for Isolation.
6. Repeat Steps 1–5 for Low–Pass/High–Notch cavities with the following exceptions:
   1) Set Frequency Generator and R2001 for Rx or Tx frequency, whichever is **HIGHER**
   2) Connect Signal Generator to Low Pass duplexer input (cavity #1)
   3) Connect terminator to cavity #6.

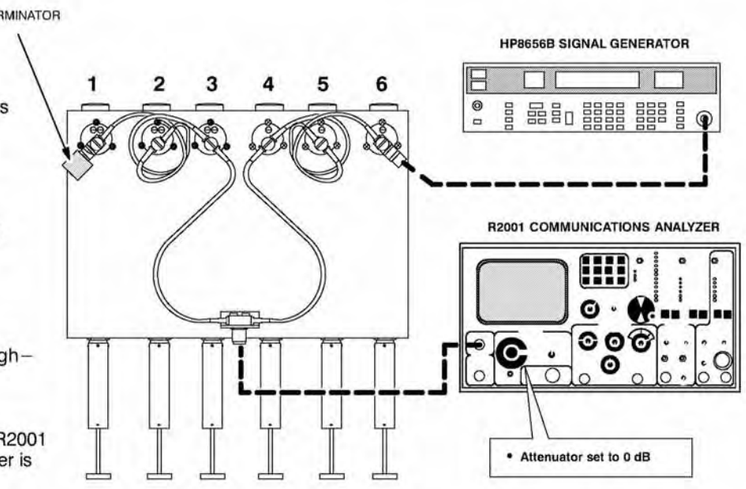
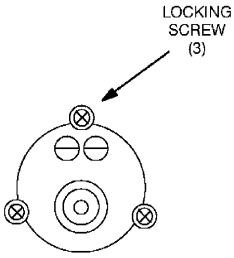


Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 2 of 3)

7 POST–TUNING CHECKS

1. Make sure all locking screws are tight. Re–install dust covers on all trimmer capacitors.



2. Make sure all tuning rod locking screws (6) are tight.

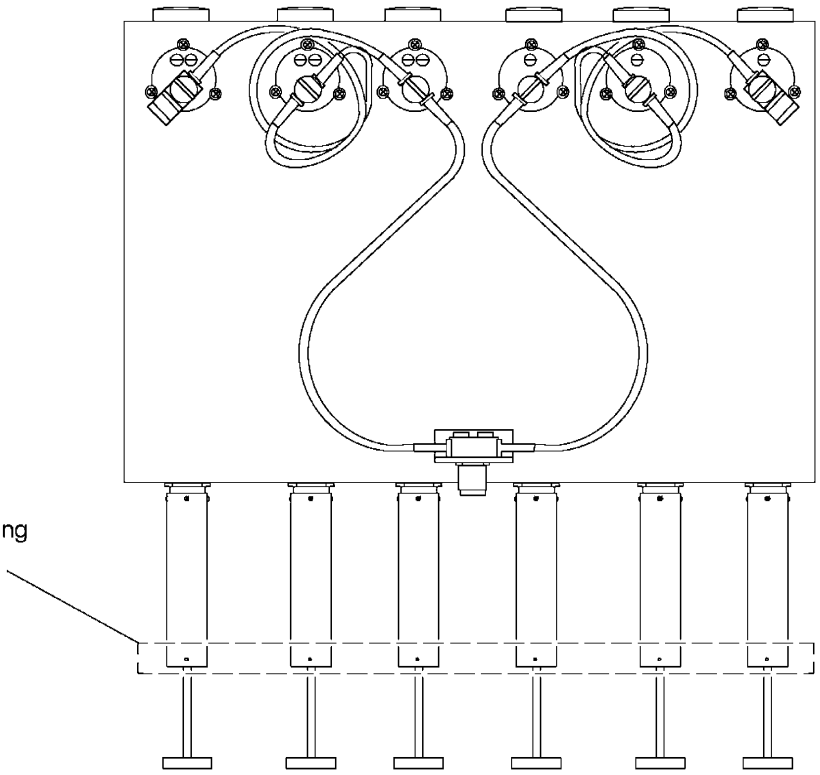


Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 4 of 4)

MOTOROLA

UHF DUPLEXER MODULE

Options X182BU (380–403 MHz)
X182AC (403–435 MHz)
X182AD (435–470 MHz)
X182AE (470–490 MHz)
X182AF (490–520 MHz)

1 DESCRIPTION

Options X182AC–AF and BU provide band–dependent duplexer modules for use with *Quantar* and *Quantro* UHF stations. This section provides a general description, identification of adjustments and inputs/outputs, performance specifications, and a typical mounting location detail. 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 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.

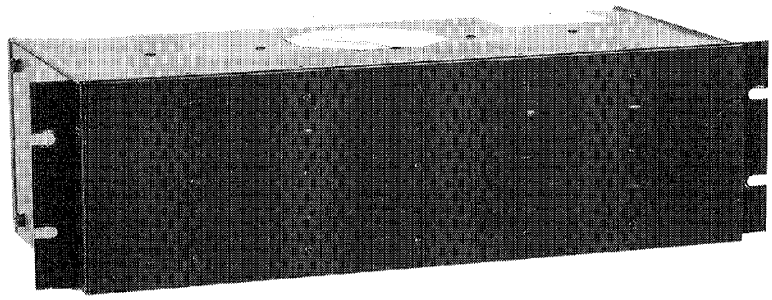


Figure 1. Typical UHF Duplexer Module

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2 ADJUSTMENTS AND INPUTS/OUTPUTS

Figure 2 shows the location of the adjustment screws and rf input and output connectors for the duplexer module.

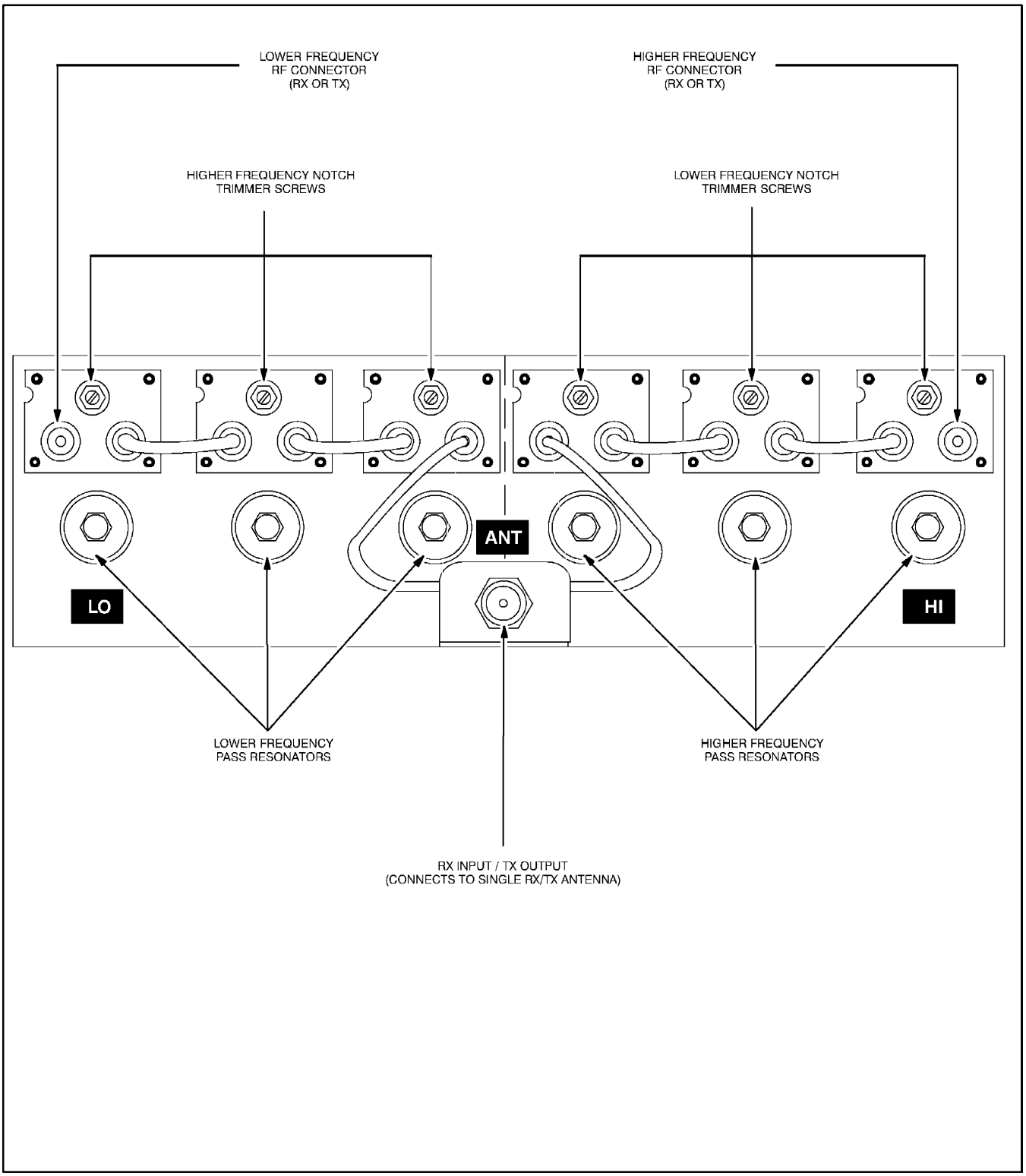


Figure 2. *Quantar* / *Quantro* UHF Duplexer Module Adjustment Screws and Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the duplexer module.

Performance Specifications

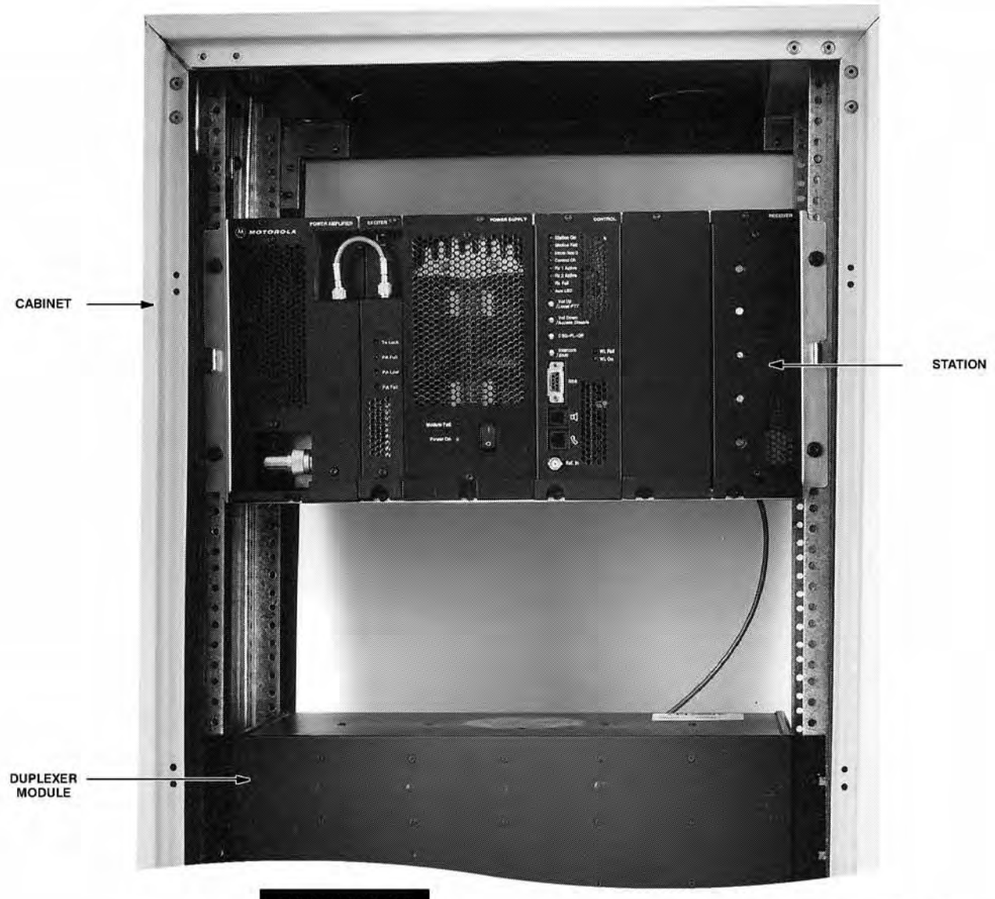
Table 1. Duplexer Performance Specifications (Options X182AC–AF and BU)

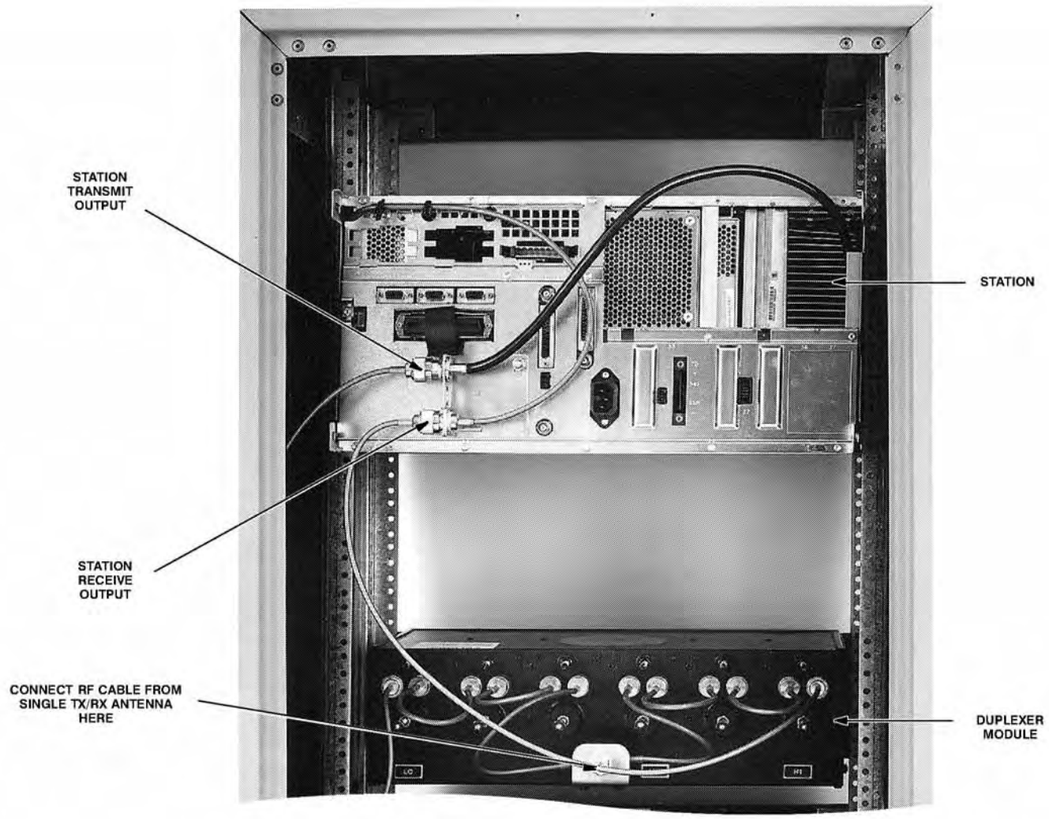
Parameter	Specification
Operating Frequency Model X182BU Model X182AC Model X182AD Model X182AE Model X182AF	 380–403 MHz 403–435 MHz 435–470 MHz 470–490 MHz 490–520 MHz
Insertion Loss (Transmitter to Antenna)	1.3 dB max
Insertion Loss (Antenna to Receiver)	1.3 dB max
TX–to–RX Frequency Separation (Min.)	5 MHz (X182AC, AD, BU) 3 MHz (X182AE, AF)
TX Noise Suppression at RX Freq.	120 dB min (X182AC, AD) 110 dB min (X182BU) 100 dB min (X182AE, AF)
RX Isolation at TX Freq.	120 dB min (X182AC, AD) 110 dB min (X182BU) 100 dB min (X182AE, AF)
Return Loss	17 dB minimum
Maximum Input Power	250 W
Temperature Range	–30°C to +60°C
Size	5¼" (H) x 14" (D) x 19" (W) EIA Rack Mountable
Weight	23 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.





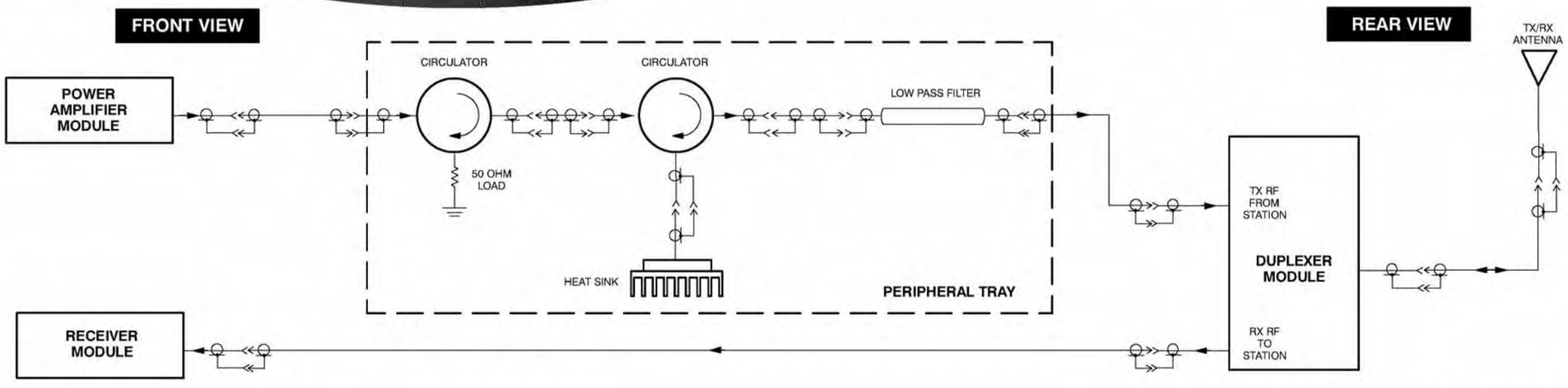


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

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

Note: *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.*

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.

Tuning is performed by injecting rf signals and making tuning adjustments (using the resonator and notch adjusting 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 Communications Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8656B or equivalent)
- 50Ω N–type terminator
- Tuning tool (5/32" x 4" screwdriver)
- N–to–N bullet connector (UG29A/U or equivalent)
- 7/16" Nutdriver
- 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 4 to prepare for tuning the duplexer module.

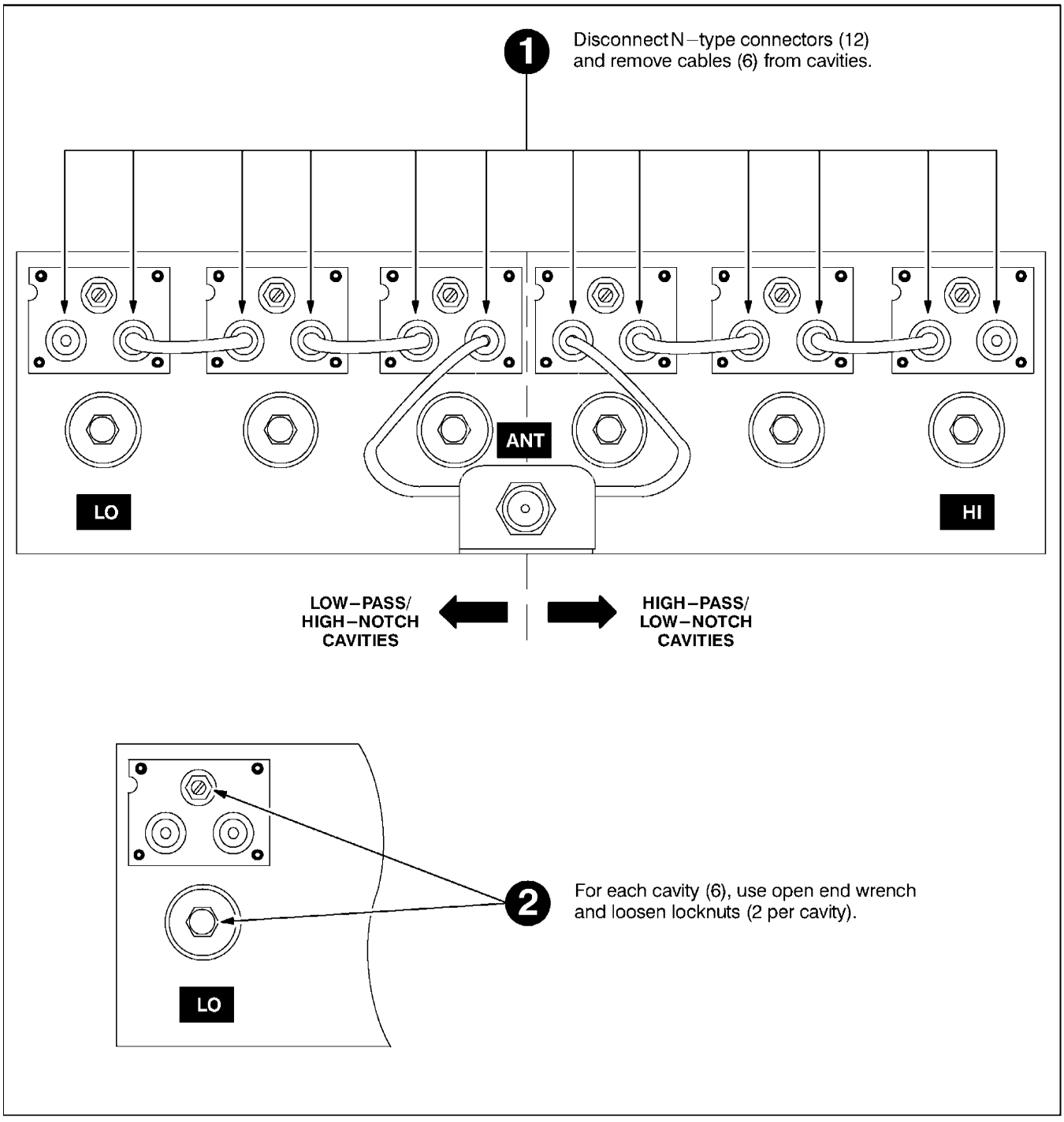


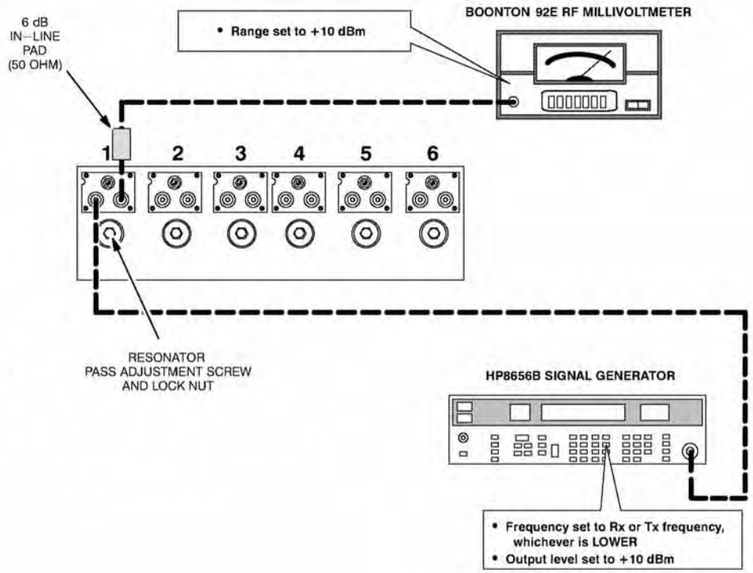
Figure 4. Preliminary Tasks Prior to Tuning Duplexer

Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in Figure 5. 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.

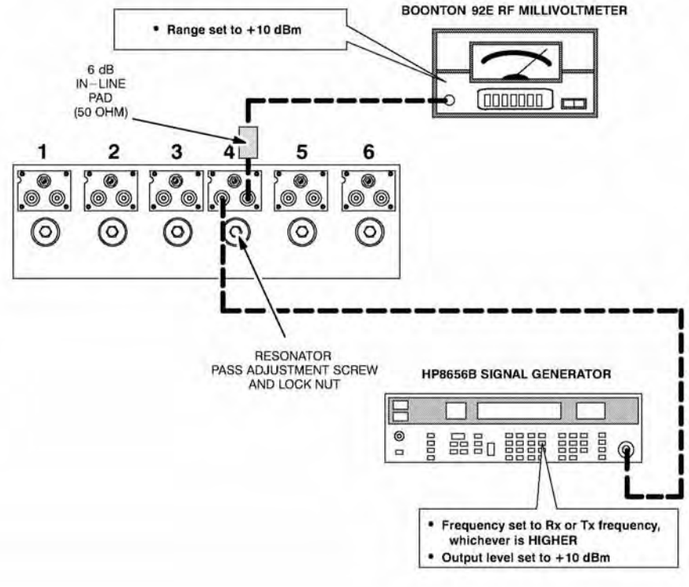
If the duplexer module is tuned according to instructions and does not meet specifications for return loss, insertion loss, and/or isolation, you must return the duplexer for repair.

1 TUNING LOW PASS RESONATORS



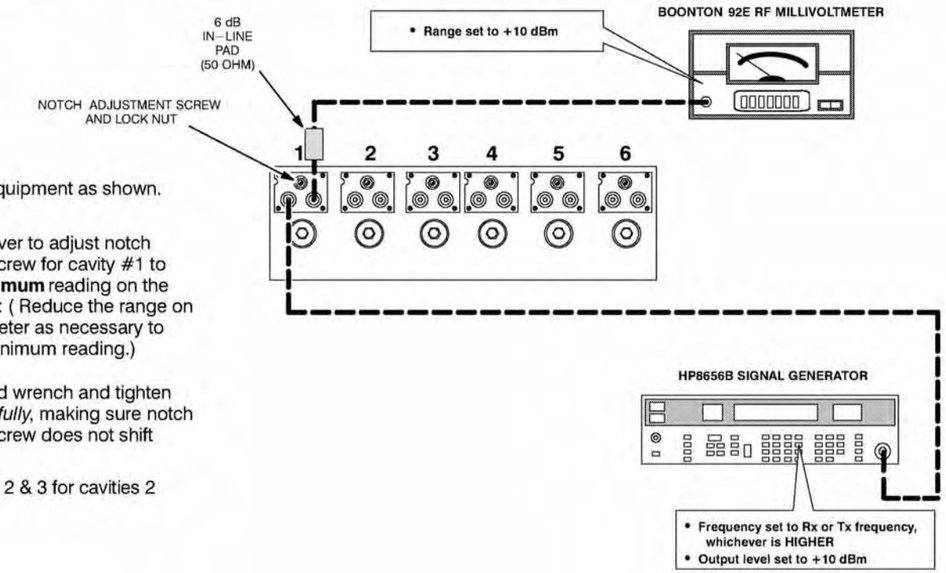
1. Set up test equipment as shown.
2. Use nut driver to adjust pass adjustment screw for cavity #1 to obtain a **PEAK** reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut *carefully*, making sure pass adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities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

2 TUNING HIGH PASS RESONATORS



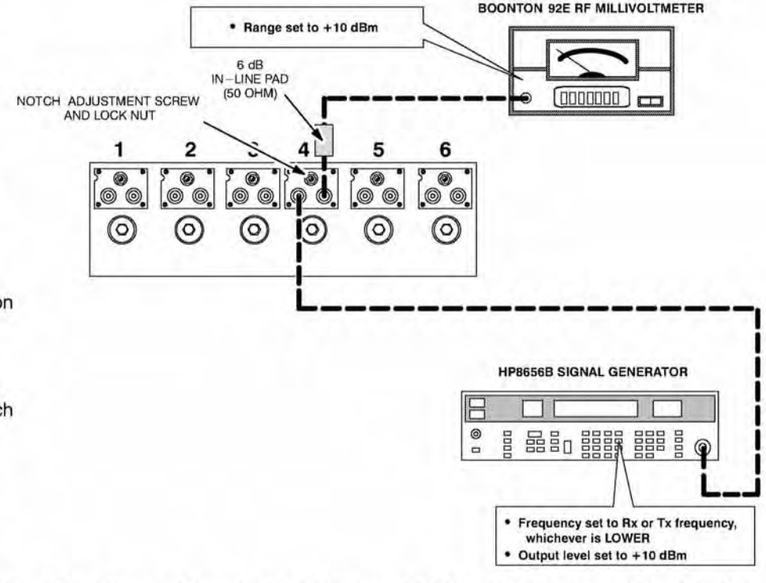
1. Set up test equipment as shown.
2. Use nut driver to adjust pass adjustment screw for cavity #4 to obtain a **PEAK** reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut *carefully*, making sure pass adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities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

3 TUNING HIGH NOTCH LOOP ASSEMBLIES



1. Set up test equipment as shown.
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 2 & 3 for cavities 2 and 3.

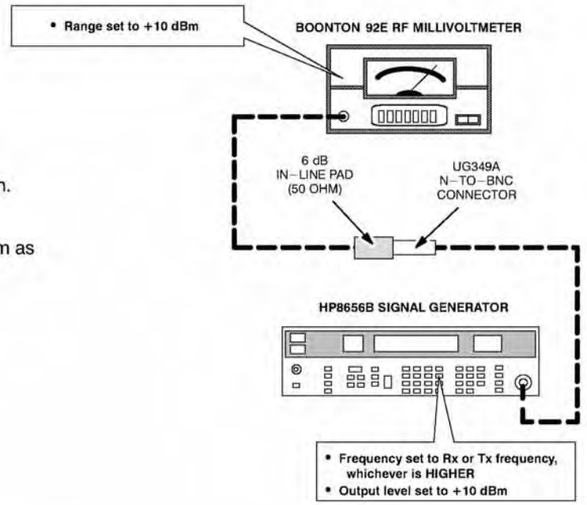
4 TUNING LOW NOTCH LOOP ASSEMBLIES



1. Set up test equipment as shown.
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 2 & 3 for cavities 5 and 6.

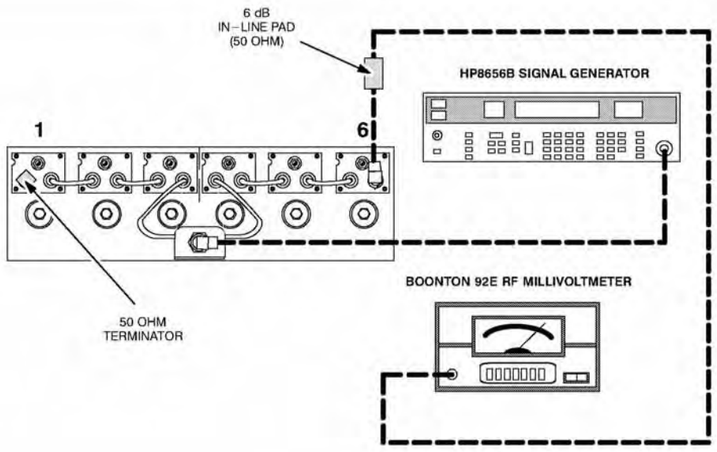
Figure 5. *Quantar / Quantro* UHF Duplexer Field Tuning Procedure (Sheet 1 of 3)

5 VERIFYING INSERTION LOSS

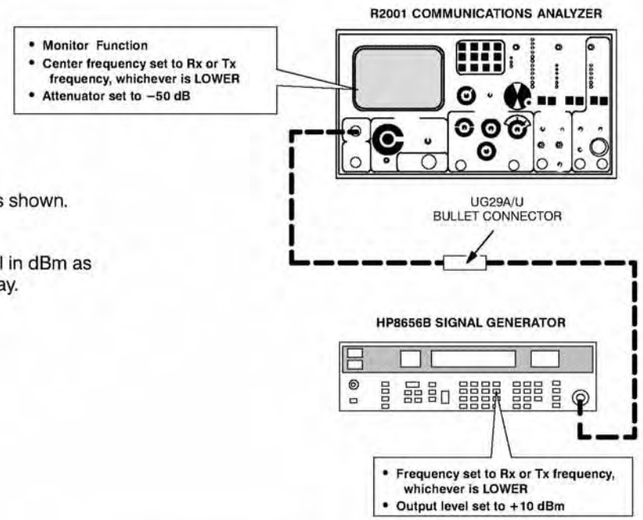


1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the millivoltmeter.
3. Connect the duplexer cables and test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the millivoltmeter.
5. Subtract the absolute number noted in Step 2 from the number noted in Step 4. The difference should be less than 1.3 dB to meet specification for Insertion Loss.
6. Repeat Steps 1–5 for Low–Pass/High–Notch cavities with the following exceptions:

   1) Set Frequency Generator for Rx or Tx frequency, whichever is **LOWER**
   2) Connect Millivoltmeter to Low Pass duplexer input (cavity #1)
   3) Connect terminator to cavity #6.



6 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:

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

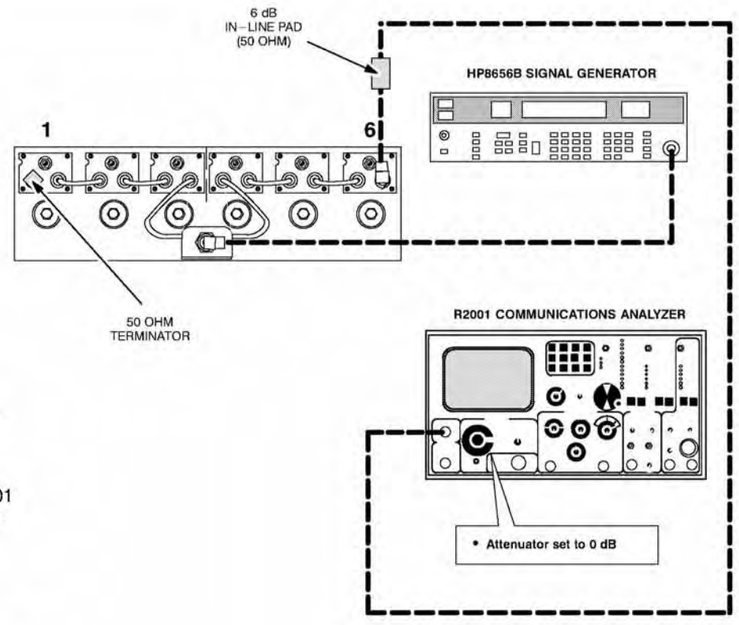


Figure 5. *Quantar / Quantro* UHF Duplexer Field Tuning Procedure (Sheet 2 of 3)

7 POST–TUNING CHECKS

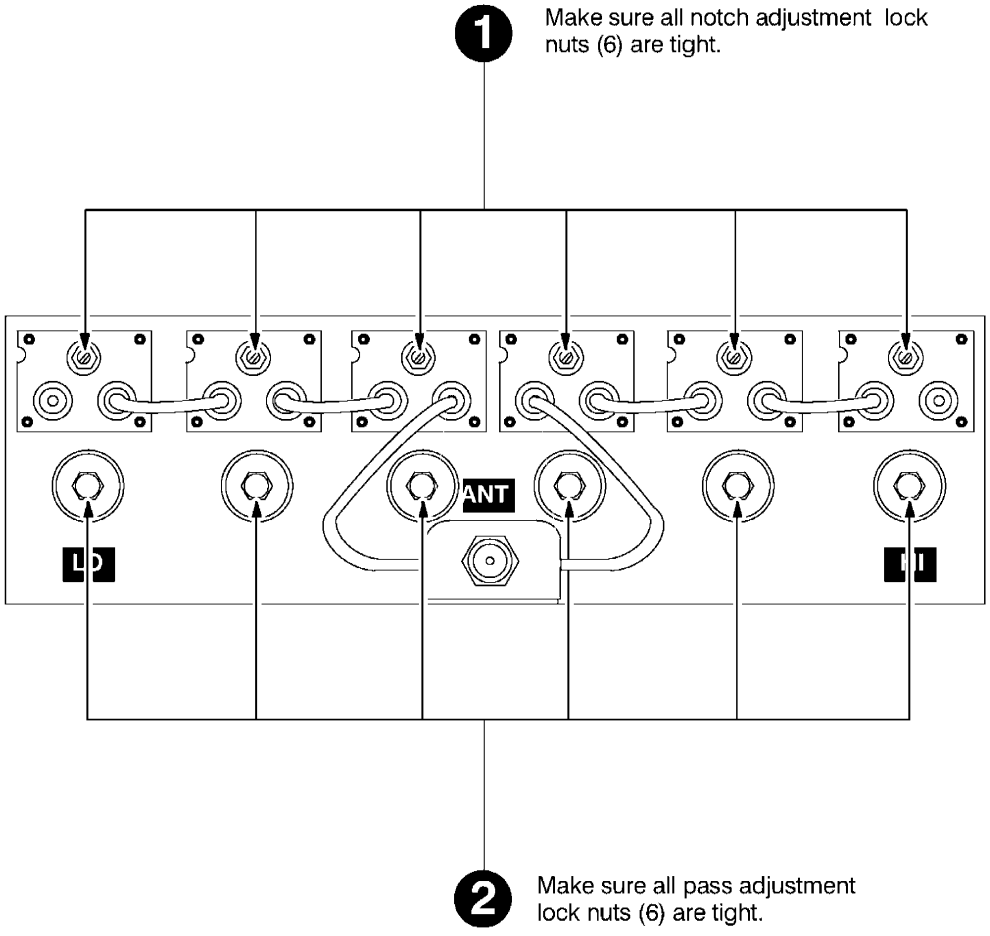


Figure 5. *Quantar/Quantro* UHF Duplexer Field Tuning Procedure (Sheet 3 of 3)

MOTOROLA

DUPLEXER MODULE

Options X182AG
RX (806–824 MHz)
TX (851–869 MHz)
X182AH
RX (896–902 MHz)
TX (935–941 MHz)

1 DESCRIPTION

Options X182AG and X182AH provide a duplexer module for use with *Quantar* 800 MHz and 900 MHz stations, respectively. This section provides a general description, identification of inputs/outputs, performance specifications, and a typical mounting location detail. The duplexer module is considered non–repairable and requires no field tuning.

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 ten resonant cavities (five for transmit and five for receive) contained in a temperature–compensated copper enclosure designed to mount in a standard EIA 19" equipment rack.

Each set of five 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.

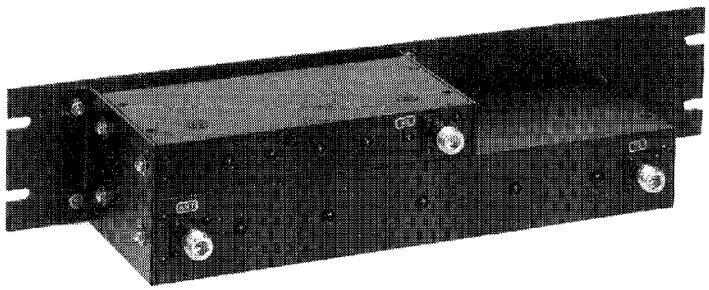


Figure 1. Typical 900 MHz Duplexer Module

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2 INPUTS/OUTPUTS

Figure 2 shows the input and output rf connectors for the duplexer module.

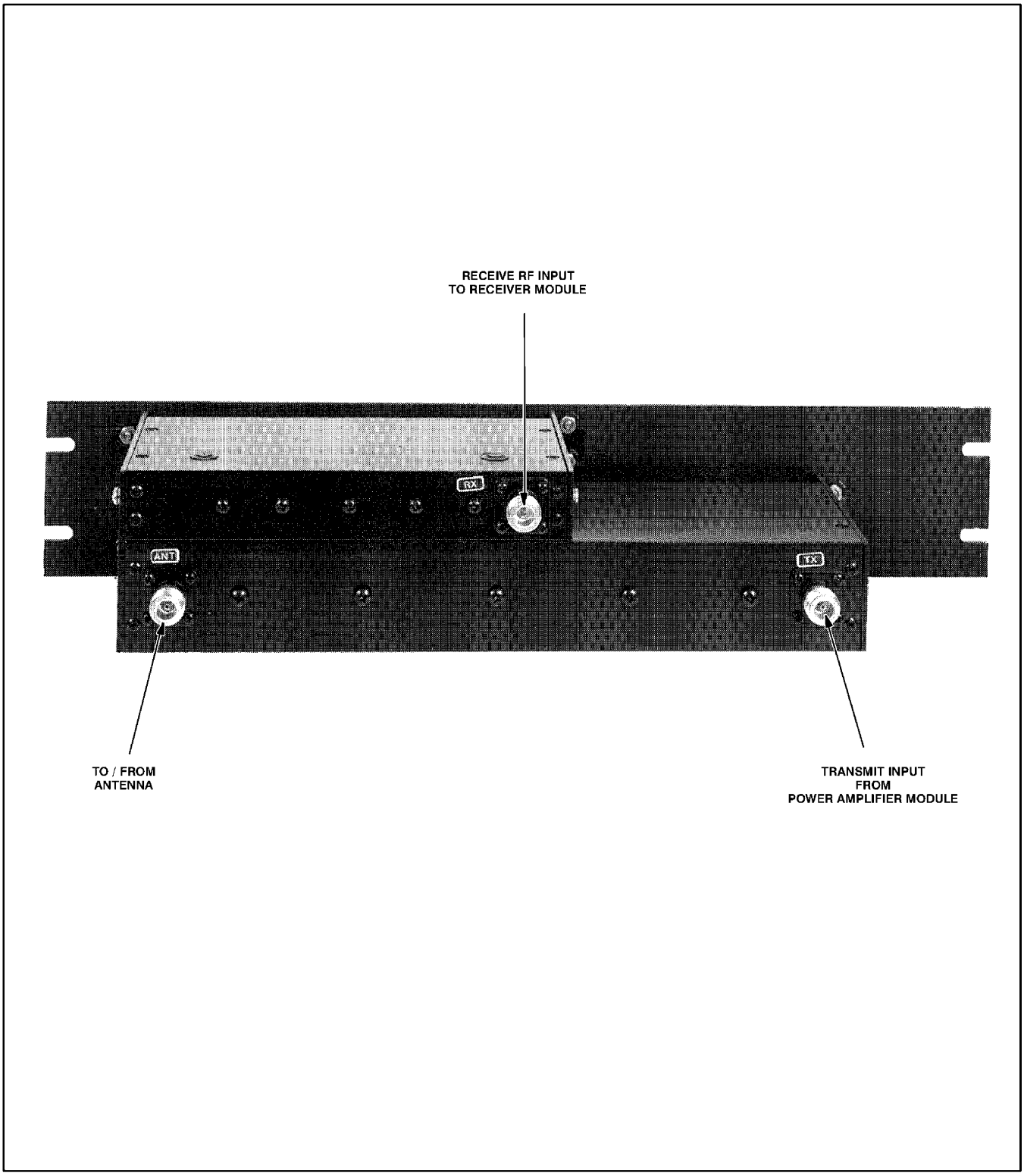


Figure 2. *Quantar* 800 MHz/900 MHz Duplexer Module Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 and Table 2 show the electrical performance specifications for the 800 MHz and 900 MHz duplexer modules.

Table 1. Duplexer Performance Specifications (Option X182AG)

Parameter	Specification
Operating Frequency	806–869 MHz
Insertion Loss (Transmitter to Antenna)	1.0 dB max
Insertion Loss (Antenna to Receiver)	1.0 dB max
Frequency Passband	RX 806–824 MHz TX 851–869 MHz
TX Noise Suppression at RX Freq.	80 dB min
RX Isolation at TX Freq.	80 dB min
Frequency Separation	45 MHz
Return Loss	14 dB minimum
Maximum Input Power	500 W
Temperature Range	–30°C to +60°C
Size with rack mounting panel	3½" (H) x 5¾" (D) x 19" (W) EIA Rack Mountable
Weight with rack mounting panel	7.5 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

Table 2. Duplexer Performance Specifications (Option X182AH)

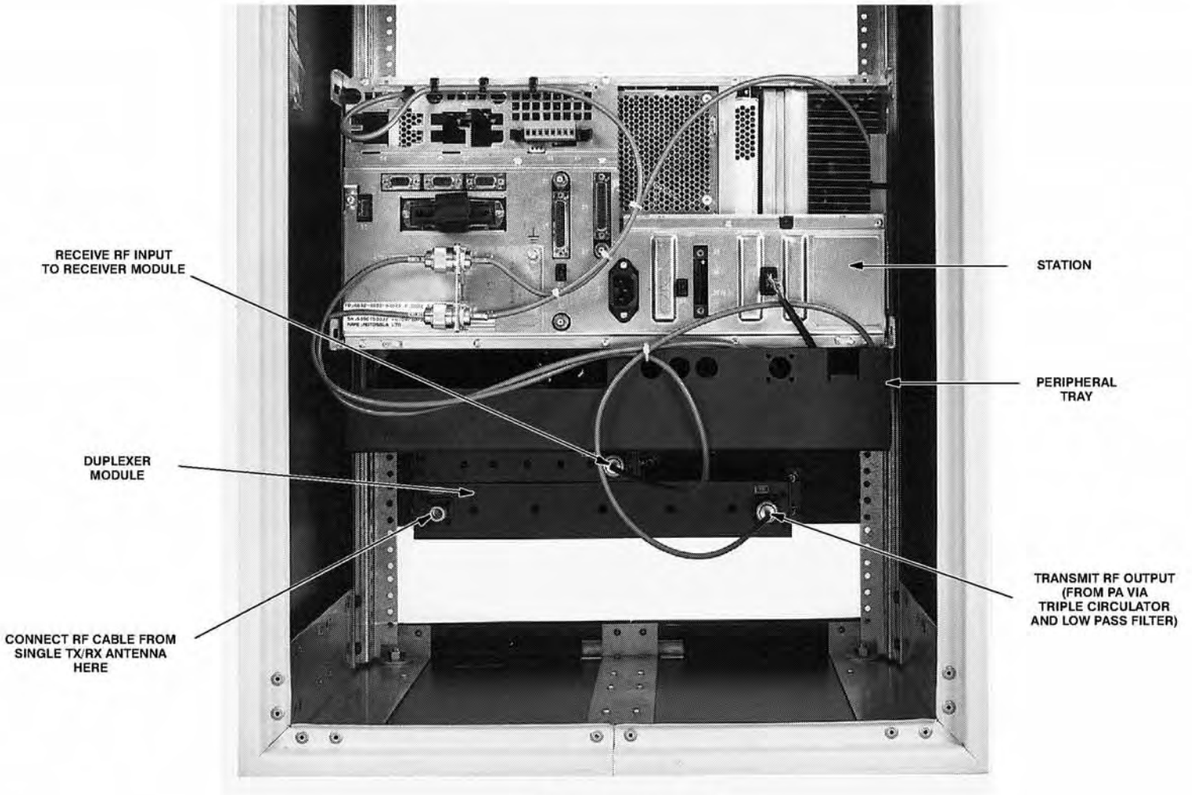
Parameter	Specification
Operating Frequency	896–941 MHz
Insertion Loss (Transmitter to Antenna)	1.0 dB max
Insertion Loss (Antenna to Receiver)	1.0 dB max
Frequency Passband	RX 896–902 MHz TX 935–941 MHz
TX Noise Suppression at RX Freq.	75 dB min
RX Isolation at TX Freq.	75 dB min
Frequency Separation	39 MHz
Return Loss	15 dB minimum
Maximum Input Power	500 W
Temperature Range	–30°C to +60°C
Size with rack mounting panel	3½" (H) x 5¾" (D) x 19" (W) EIA Rack Mountable
Weight with rack mounting panel	7.5 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.

FRONT VIEW



REAR VIEW

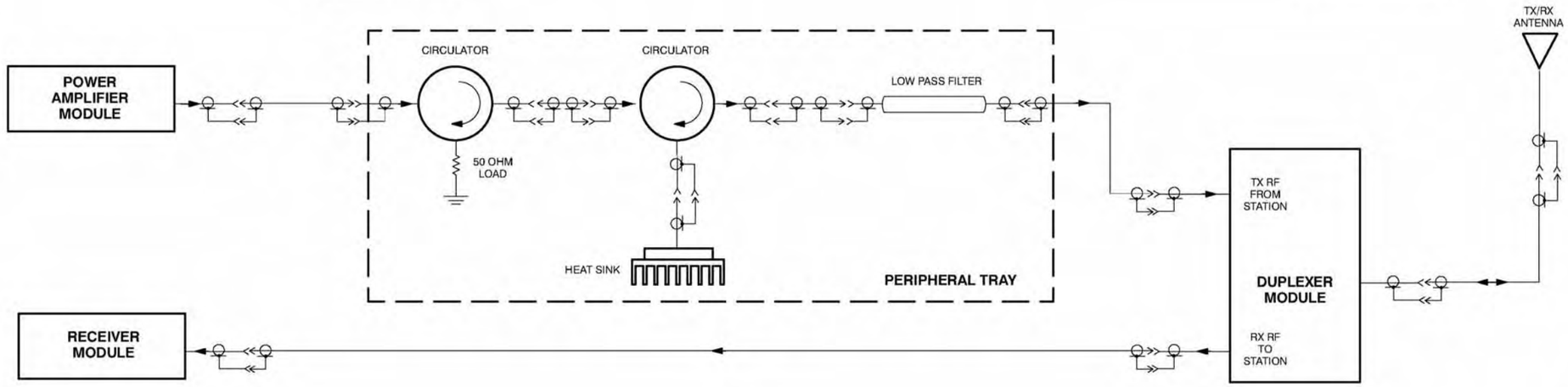


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

END OF PART 12