7. **IF** the entire tray including all of its modules are replaced, install the replacement tray in the rack.
8. Turn on the DC breaker, and/or connect the AC source power cord to the back of the base station/repeater.
9. Verify that the base station/repeater is operating properly using Customer Programming Software (CPS).

Shock Hazard. The MTR3000 Base Station/Repeater contains voltages which can cause damage to the base station/repeater or other equipment if a short circuit occurred. Turn off the DC breaker, and/or pull the AC source power cord from the back of the base station/ repeater when servicing this component in the base station/repeater.

10.4.1.4 Antenna Relay

The antenna relay module is not field repairable and should be replaced in its entirety if it is faulty. To replace it,

1. Turn off the base station/repeater power by turning off the breaker at the AC or DC source.
2. Remove the Antenna Relay module (installed on a flange on the rear of the PS module) by
   - disconnecting the control and RF coaxial cables and
   - using a Torque Driver T20 bit, remove the screws which secure the Antenna relay to the base station/repeater.
3. Ensure that the correct replacement Antenna Relay module is being installed.
4. Install the replacement Antenna Relay module by reversing the procedures outlined in step 2 above.
5. Restore power to the base station/repeater.

10.5 Field Tuning Procedures

10.5.1 Base Station/Repeater Preselectors

Depending on the configuration, the base station/repeater may have an External Preselector assembly with the always present internal preselector. 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 base station/repeater. 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 base station/repeater operating frequency (s) are modified. The internal varactor-tuned preselector is factory-tuned to cover the relevant frequency band in its entirety. The internal preselector does not require field tuning even if the Receiver Module is replaced.

Note There is no External Preselector for 800/900 MHz frequency band.

10.5.1.1 External Preselector Tuning Procedure (with basic instruments)

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

10.5.1.1.1 Test Equipment

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

- RF signal generator – Aeroflex 3900 Series Communications System 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 Aeroflex 3900 Series Communications System Analyzer using the spectrum analyzer function
- Torque Driver capable of delivering 1.36 Nm (12 in-lb) of torque with a 10 mm deep well socket
- Tuning probe
- Flat-blade screwdriver

Note When using Aeroflex 3900 Series Communications System Analyzer as the signal generator, the RF signal must be taken from the Antenna port.

10.5.1.1.2 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 with a single receive frequency, see procedure below to calculate the alignment frequency:

1. From the site documentation or the CPS, determine the base station/repeater receive frequency. Add 200 kHz.
2. If the receive frequency is in the range of 403 MHz 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 the actual frequency from Step 1 (see note above).
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 the actual frequency from Step 1 (see note above).
4. If the receive frequency is in the range of 470 to 524 MHz, determine the alignment frequency as follows:
   - If frequency (from Step 1) is > 522 MHz, then alignment frequency = 522 MHz
   - If frequency (from Step 1) is < 472 MHz, then alignment frequency = 472 MHz
   - Otherwise, use the actual frequency from Step 1 (see note above).

For stations with multiple receive frequencies, see procedure below to calculate the alignment frequency:

1. From the site documentation or the CPS, note the receive frequency for each channel supported by the base station/repeater.
2. Calculate midpoint frequency as follows:

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

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

Note Bandwidth limitation in Table 10-1 (i.e. $(F_{highest} – F_{lowest}) \leq$ Bandwidth)

10.5.1.1.3 Preparing Equipment

1. If necessary, disconnect and remove the preselector assembly from the rear of the Station.
2. Connect the preselector, the base station/repeater, and test equipment as shown in Figure 10-7.
3. Using the torque driver and deep well socket, loosen all three tension nuts on the tuning screws.
4. Detune the preselector by turning (ONLY) tuning screws 3 and 4 full clockwise until they just bottom out.

10.5.1.1.4 Tuning Procedure

1. Apply AC power to the base station/repeater PS (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, and adjust tuning screw 2 for a **PEAK**.
4. Tighten tension nut on tuning screw 2 to at least 1.36Nm (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 1.36Nm (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 1.36Nm (12 in-lb) and fine tune tuning screw 4 for a **DIP**.
10. Mount the preselector assembly in the Station, and reconnect the previously-removed cabling.

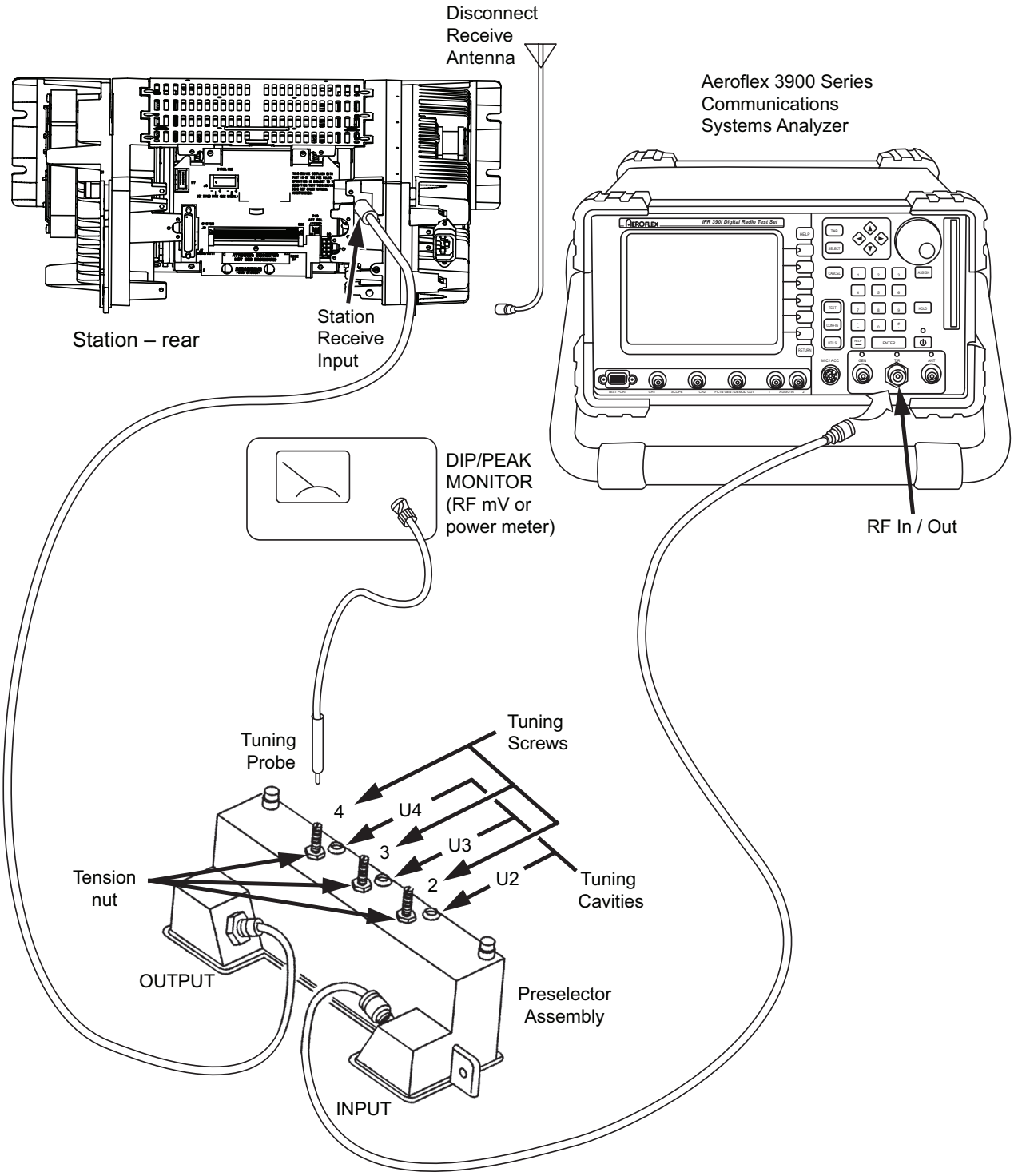

Figure 10-7 Test Equipment Setup for External Preselector Field Tuning

10.5.1.2 External Preselector Tuning Procedure (with advanced instruments)

Organization of this tuning procedure is as follows:

- Section 10.5.1.2.1 on page 10-18 identifies the test equipment needed.
- Section 10.5.1.2.2 on page 10-18 identifies the specific Network Analyzer (NWA) set-up steps for each of the 380–435 MHz, 435–470 MHz, and 470–524 MHz band preselectors.
- Section 10.5.1.2.3 on page 10-19 identifies detailed steps for tuning the 435–470 MHz preselector as an example of the process for also tuning the 380–435 MHz and 470–524 MHz band preselectors. Be sure to review the *Note* at the end of this section during each tuning procedure.

10.5.1.2.1 Test Equipment

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

- Network Analyzer – E5063A / E5071B / E5071C / or other series
- SMA-type calibrator – Agilent 85033E
- Tuning cable – N-type
- Screwdriver – Flat head
- Adaptor – MINI_UHF / SMA_JK
- Adaptor – N-SMA
- Torque measuring wrench

10.5.1.2.2 Equipment Setup

For the **380–435 MHz** preselector,

1. **Initial frequency setup**: Press the START key, input 340 MHz, then press the STOP key and input 585 MHz.
2. **Marker Setup:** Enter the nine (9) marker frequencies shown below into the NWA memory.

Table 10-10 Marker setup table for 380–435 MHz

Mark No.	Frequency	Mark No.	Frequency	Mark No.	Frequency
Mark1	378 MHz	Mark4	437 MHz	Mark7	414.7 MHz
Mark2	382 MHz	Mark5	525 MHz	Mark8	469.7 MHz
Mark3	433 MHz	Mark6	580 MHz	Mark9	451.4 MHz

Note The frequencies in Table 10-10 is with passband 378 MHz–382 MHz and 433 MHz–437 MHz.

3. **Output level setup**: Select MENU, press POWER and input 10 dBm.
4. **Sweep points setup**: Select MENU, press NUMBER OF POINTS soft key, and input 401.
5. **Display mode setup**: Select DISPLAY, press ALLOCATE CHANNELS soft key, then select “X1□”, next return DISPLAY page and press NUMBER OF TRACES and select 2; finally return DISPLAY page again and press ALLOCATE TRACES and select “X2⊟”.
6. **S-parameter plot setup**: Select S12 (S21), press SCALE REF key, then select REFERENCE POSITION soft key, and input 10/DIV, next press REFERENCEVALUE and input 0.

7. **Set S11 (S22) plot as return loss**: Press FORMAT key, select LOG MAG soft key, then select SCALE REF, press SCALE/DIVE and input 1/DIV, and turn to REFERENCEVALUE soft key and input -18.

For the **435–470 MHz** preselector,

1. **Initial frequency setup**: Press START key, input 400 MHz, then press STOP key and input 620 MHz.
2. **Marker Setup:** Enter the nine (9) marker frequencies shown below into the NWA memory.

Table 10-11 Marker setup table for 435–470 MHz

Mark No.	Frequency	Mark No.	Frequency	Mark No.	Frequency
Mark1	433 MHz	Mark4	472 MHz	Mark7	469.7 MHz
Mark2	437 MHz	Mark5	580 MHz	Mark8	504.7 MHz
Mark3	468 MHz	Mark6	615 MHz	Mark9	506.4 MHz

Note The frequencies in Table 10-11 is with passband 433–437 MHz and 468–472 MHz.

3. See 380–435 MHz instrument setup (Step 3 to Step 7).

For the **470–524 MHz** preselector,

1. **Initial frequency setup**: Press START key, input 450 MHz, then press STOP key and input 670 MHz.
2. **Marker Setup:** Enter the nine (9) marker frequencies shown below into the NWA memory.

Table 10-12 Marker setup table for 470–524 MHz

Mark No.	Frequency	Mark No.	Frequency	Mark No.	Frequency
Mark1	468 MHz	Mark4	526 MHz	Mark7	504.7 MHz
Mark2	472 MHz	Mark5	615 MHz	Mark8	558.7 MHz
Mark3	522 MHz	Mark6	669 MHz	Mark9	541.4 MHz

Note The frequencies in Table 10-12 is with passband 468–472 MHz and 522–526 MHz.

3. See 380–435 MHz instrument setup (Step 3 to Step 7).

10.5.1.2.3 Tuning procedures and methods

After instrument setup, calibrate the instrument according to the standard template, then save all parameters into the memory before proceeding with unit tuning. Correctness and accuracy of calibration can be ensured before tuning process.

The procedures for tuning are the same for the 380–435 MHz, 435–470 MHz, and 470–524 MHz band preselectors. The example shown below applies for the 435–470 MHz band preselector.

1. Unit connection
   a. If necessary, disconnect and remove the 435–470 MHz band preselector assembly from the rear of the base station/repeater.
   b. Connect the 435–470 MHz band preselector to the NWA via the adaptors and cables shown in Figure 10-8.
   c. Using the torque driver and deep well socket, loosen all three tension nuts on the adjustment screws.
   d. Detune the preselector by turning tuning (ONLY) screws 3 and 4 full clockwise until they just bottom out.

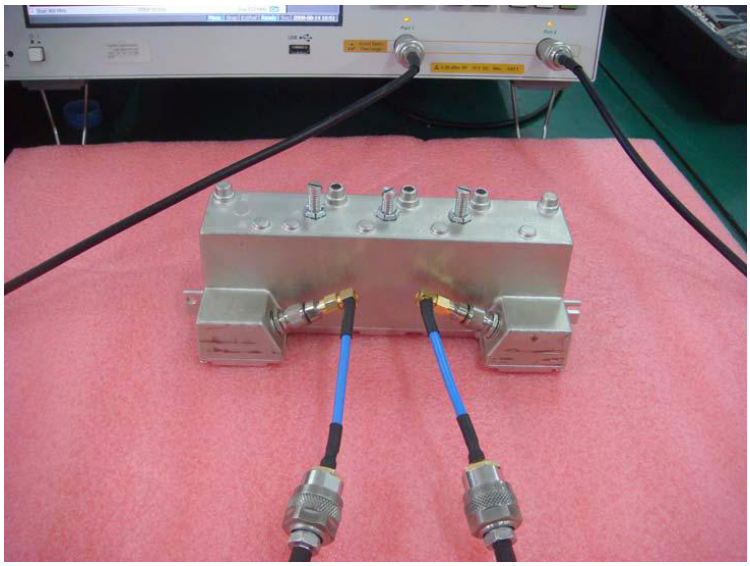

Figure 10-8 Connection of the 435–470 MHz band preselector

2. Unit Tuning
   a. Initial Curve

      With the detuned preselector, the NWA display should be similar to that shown in the full START-STOP bandwidth of Figure 10-9.

      To expand and thus better display the curve, readjust the STOP band value to a lower value (such as 505 MHz as shown in Figure 10-10).

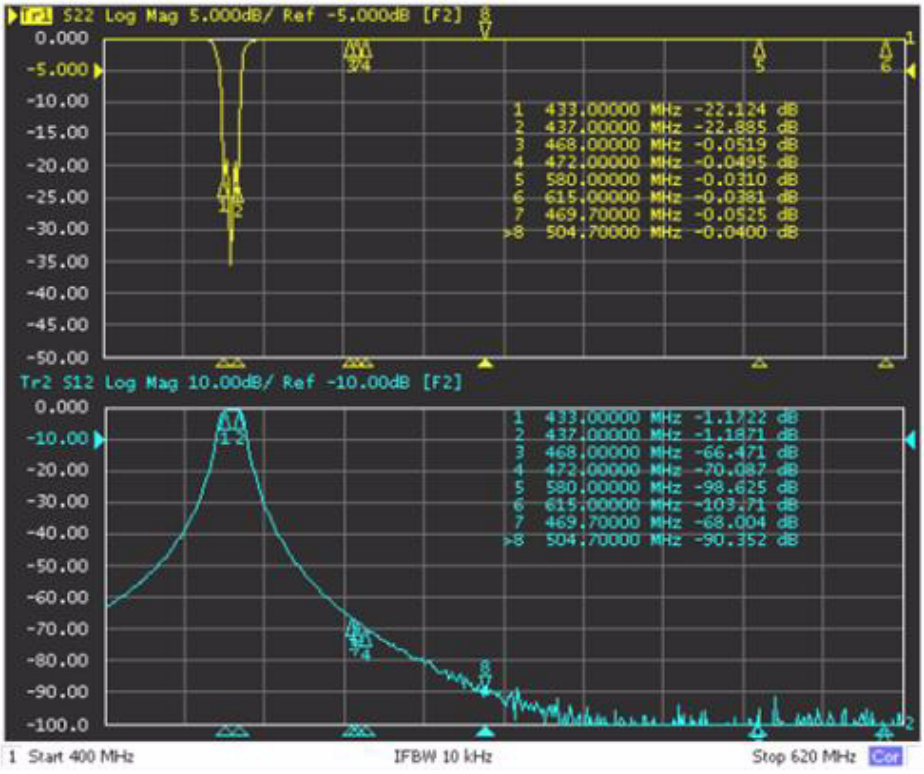

Figure 10-9 Initial curve (Start 400 MHz, Stop 620 MHz)

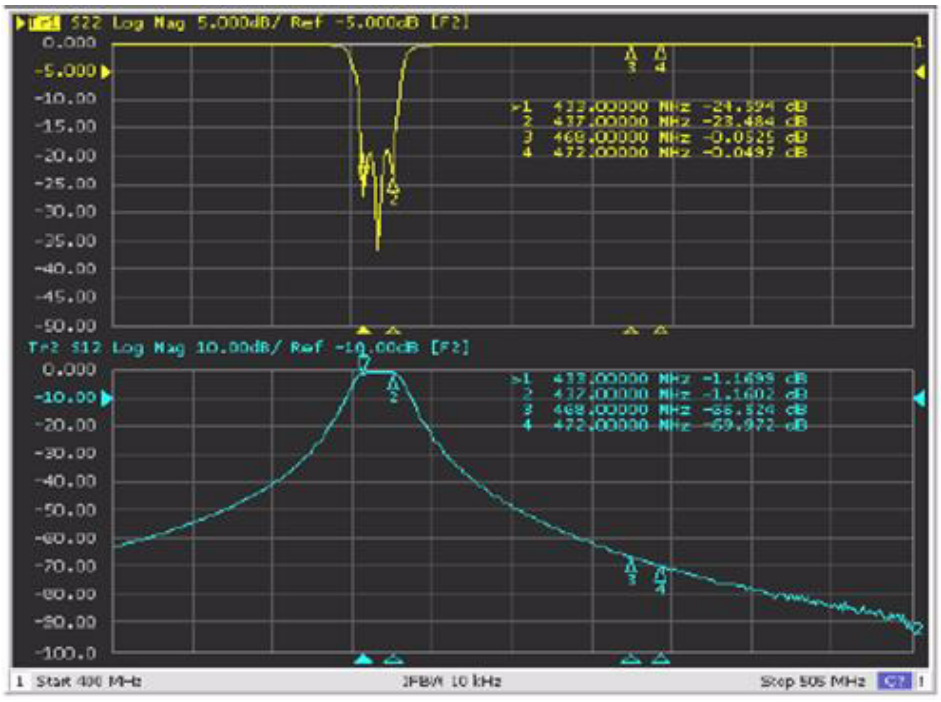

Figure 10-10 Initial curve (Start 400 MHz, Stop 505 MHz)

b. Rough Tuning

i. Adjustment of the tuning screws changes the position of the frequency peaks on the displayed curves. As an example, note that when screw 4 is adjusted counterclockwise, the resonance peak moves to the left and if turned clockwise, the peak moves to the right as indicated by the yellow arrow in Figure 10-11.

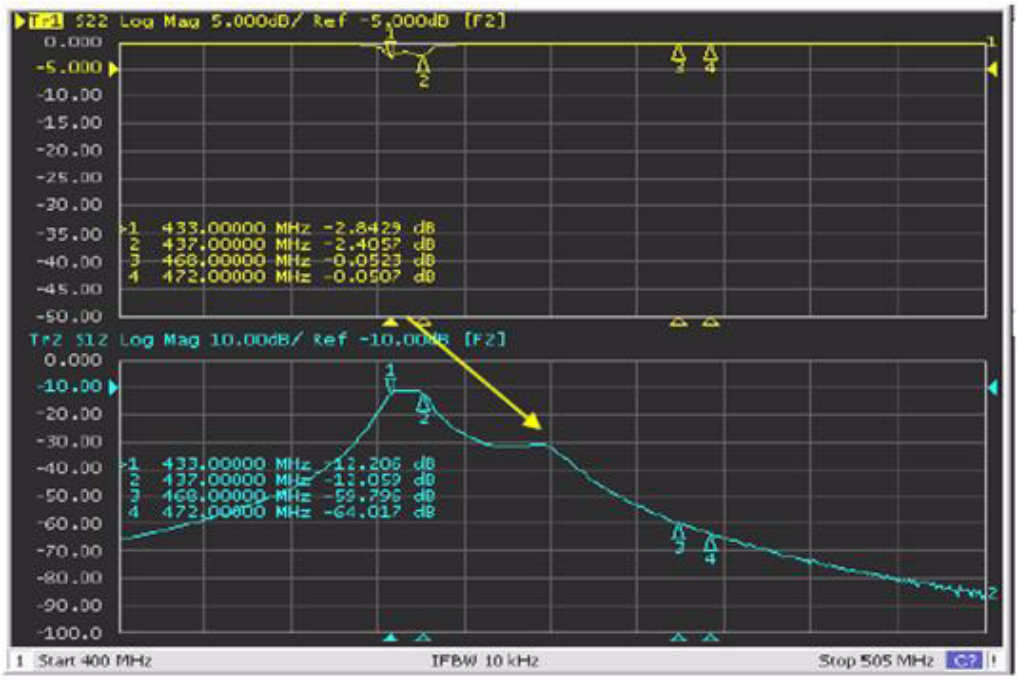

Figure 10-11 Passband tuning of tuning screw 4

ii. Adjust tuning screw 4 until the peak moves into the 468–472MHz range (the area between Marker 3 and Marker 4). See Figure 10-12.

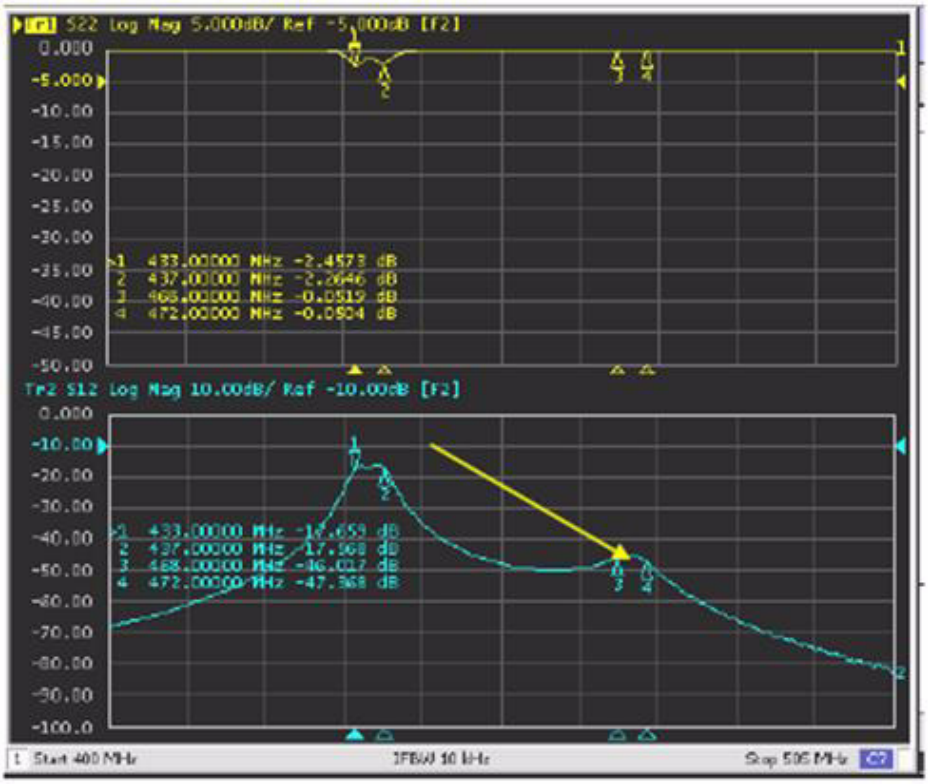

Figure 10-12 Passband tuned to required range (tuning screw 4)

iii. Tune at screw 3 until the peak adjusted by it moves into the passband similar to that shown in Figure 10-13 and then into the area between Marker 3 and Marker 4. See Figure 10-14.

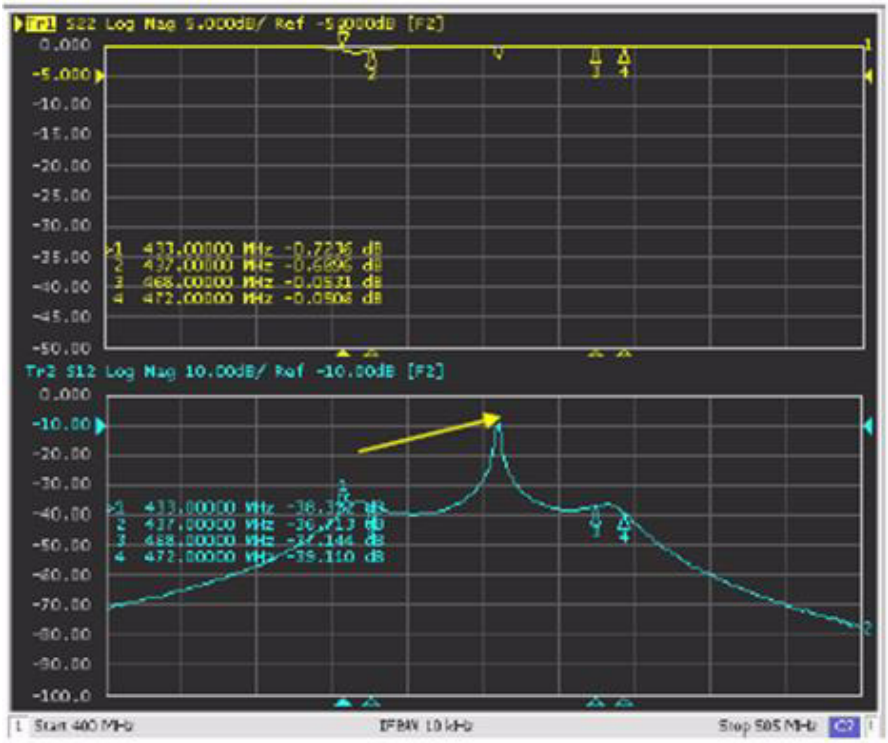

Figure 10-13 Passband tuning of tuning screw 3

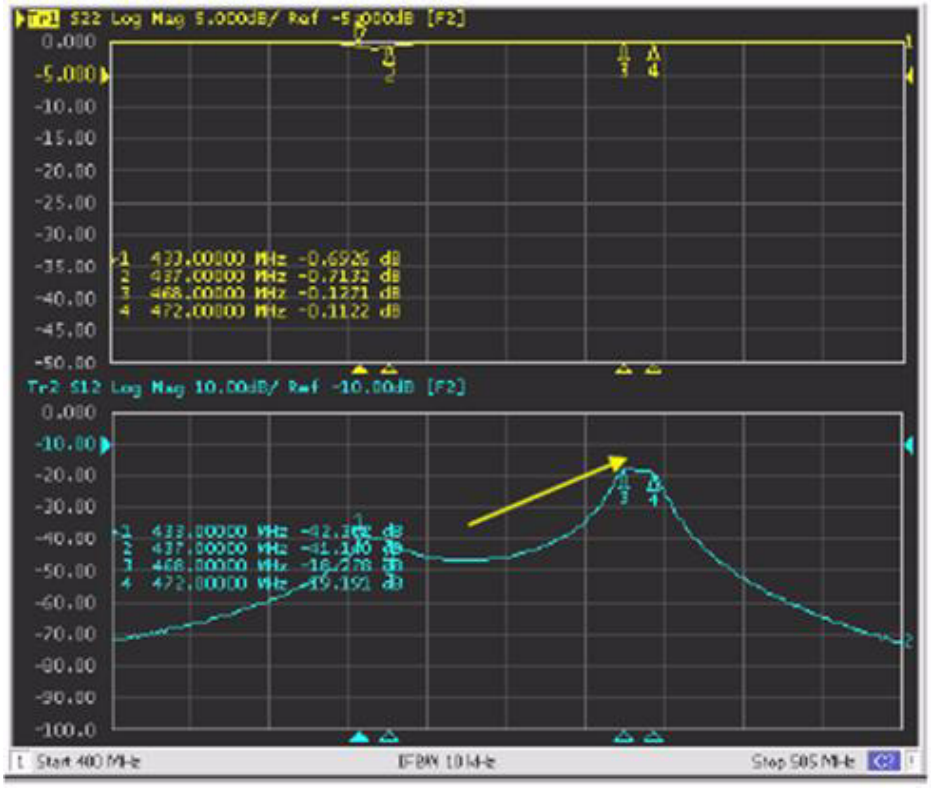

Figure 10-14 Passband tuned to required range (tuning screw 3)

iv. Tune at screw 2 until the return loss curve dips in alignment with the passband similar to that shown in Figure 10-15. This completes the Rough Tuning procedure.

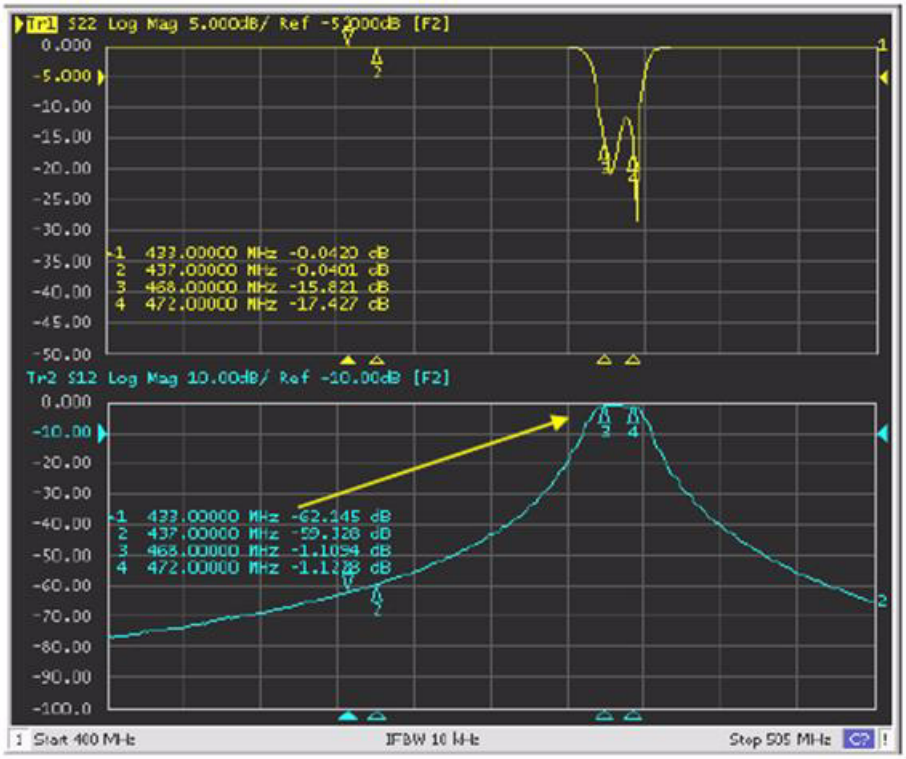

Figure 10-15 Passband tuned to required range (tuning screw 2)

v. Tighten the three tuning nuts to approximately 1.0 Nm (10 in-lbs), until the tuning screws are not loose but still can be adjusted.

c. Fine Tuning

i. The 435–470 MHz band preselector is now roughly tuned to the required passband. See Figure 10-16 and Figure 10-17. The preselector performance will now be fine-tuned to specification-required frequencies and levels.

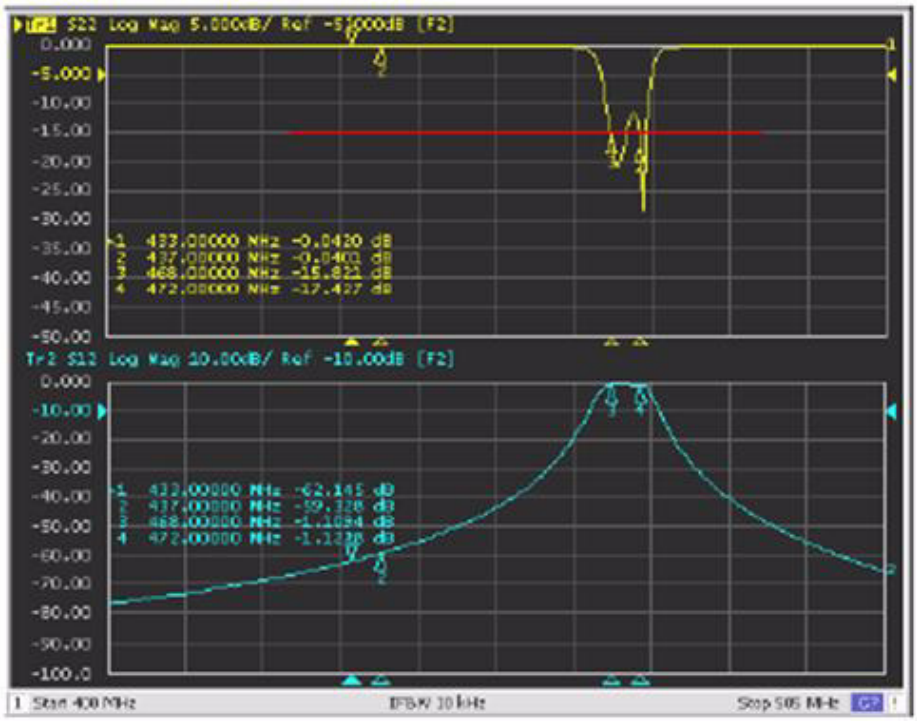

Figure 10-16 Passband and return loss after rough tuning

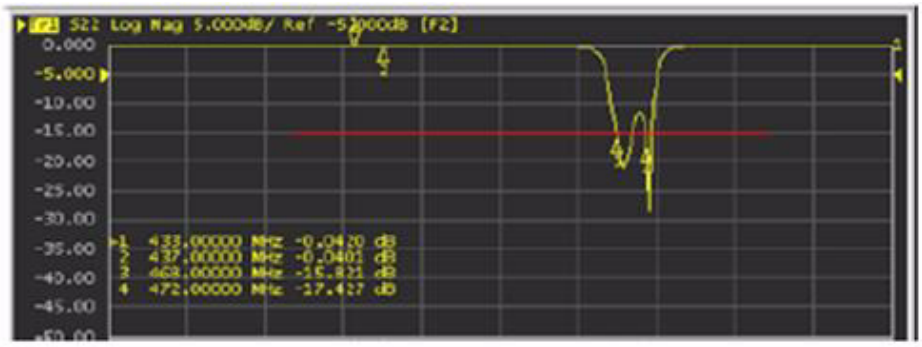

Figure 10-17 Return loss

ii. In this process, make only small (less than 10°) adjustments. Working with each of the tuning screws 2, 3, or 4 (one at a time), make slight adjustments in either direction while observing the return loss curve. For example, turning one of the screws clockwise may result in worse return loss such as shown in Figure 10-18 or better as shown in Figure 10-19.

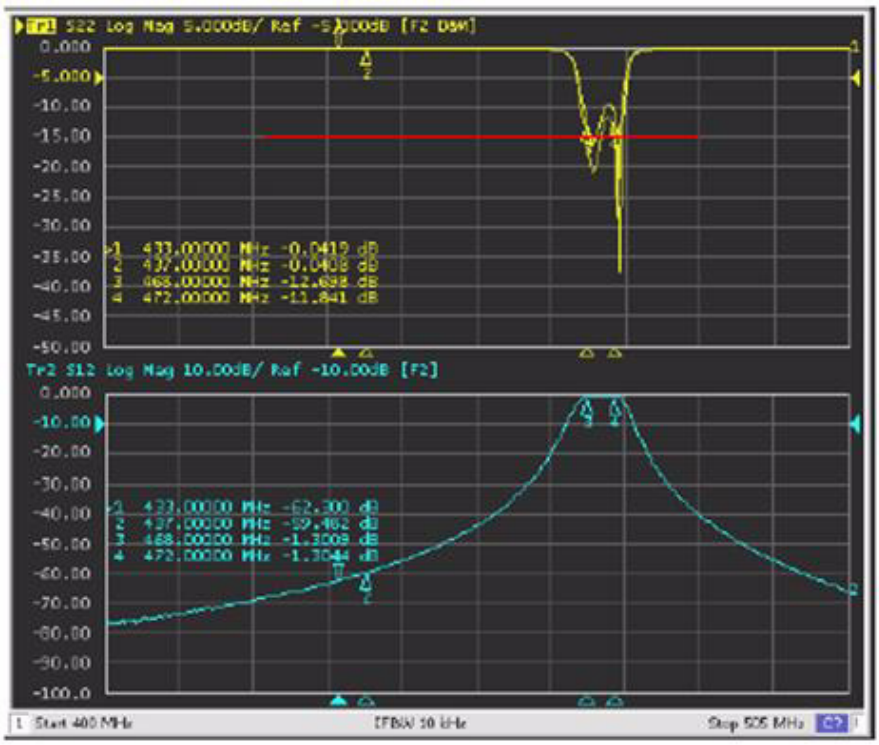

Figure 10-18 Turn screw clockwise

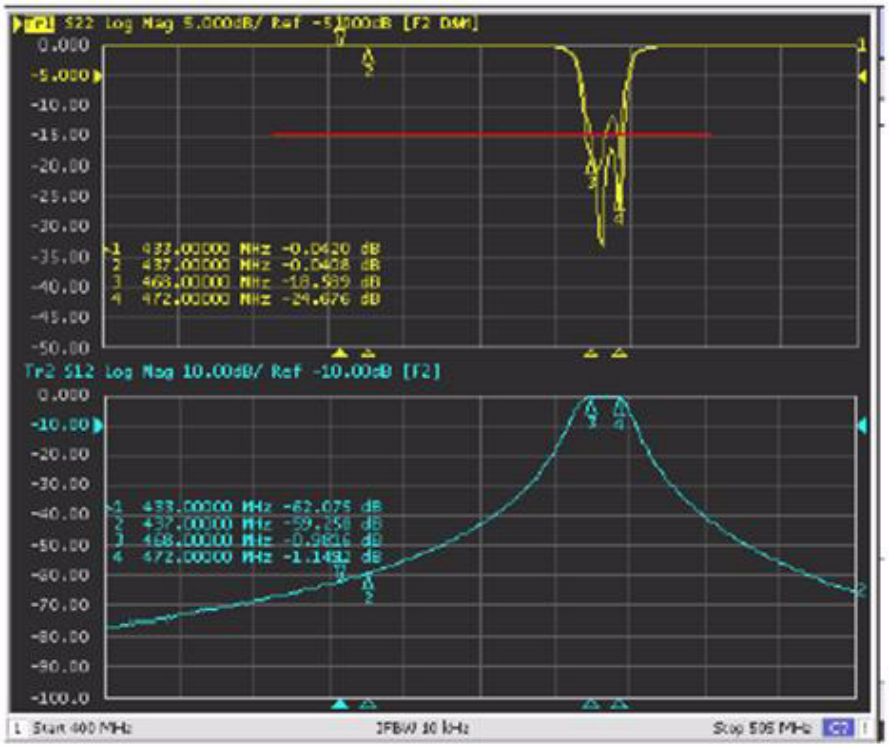

Figure 10-19 Turn screw counter clockwise

iii. Continue this process of adjusting each of the screws one at a time by very small rotations until the optimized return loss performance is provided as shown in Figure 10-20 where all of the return loss curve is well below the red limit line.

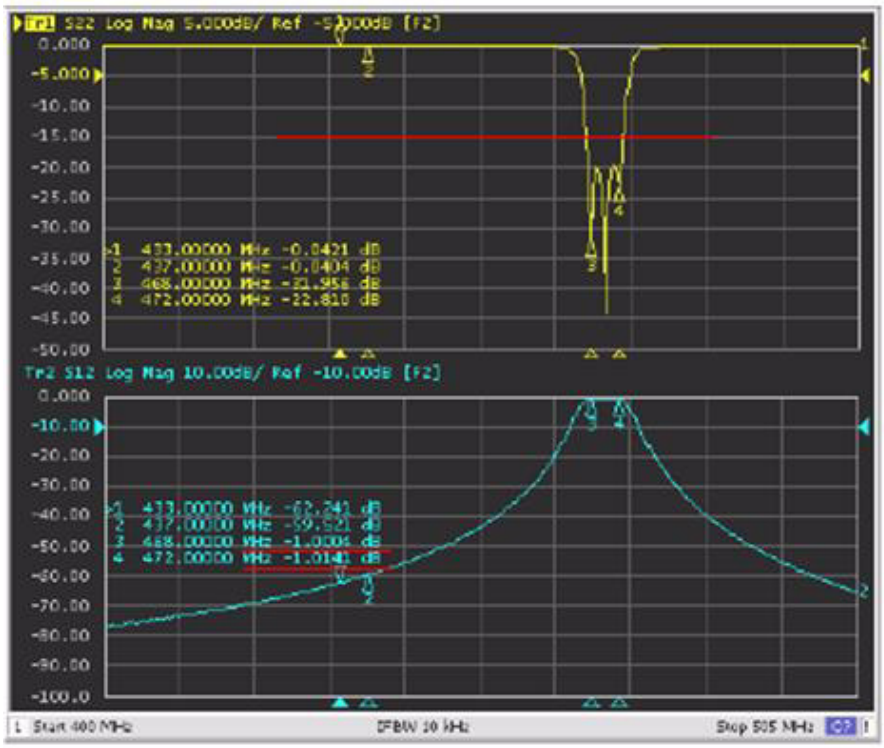

Figure 10-20 Result after fine tuning

3. Final Inspection
   a. Inspect the final performance curves and parameter plot against the standard mask template needed to meet specifications. See Figure 10-21.

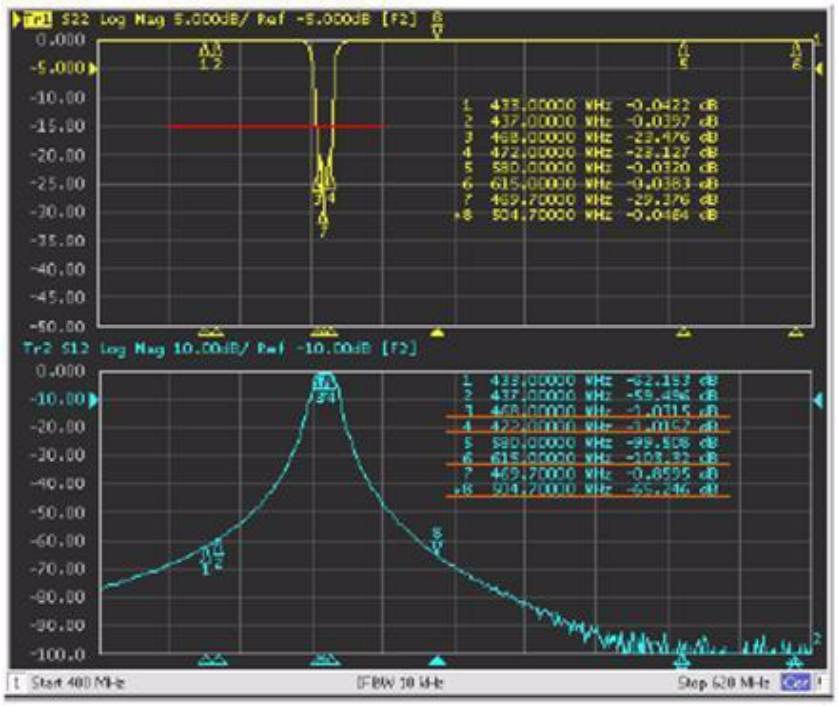

Figure 10-21 Inspect against mask template

b. Tighten the tuning nuts to approximately 1.36 Nm (12 in-lbs), so the screws are secure. Make very slight adjustments at any of the screws to compensate for change tightening that screw causes.

4. Reassembly

a. Mount the preselector assembly in the Station, and reconnect the previously-removed cabling.

Note

- All instruments should be properly calibrated before operation.
- All joints between cavity and instrument should be checked. Loose connections can greatly impact the tuning results.
- Rejection meets specification requirements after passband and return loss are tuned, and it is needless to check one by one. However, the passband shall be tuned to the center frequency. In other words, insertion loss of two side frequencies of passband is approximate.
- Lock the tension nut with proper torque force: 1.2 Nm~1.3 Nm. Excessive torque will lead to excessively tight locking (hard to tune) and inadequate to loose locking (tuning screw falling off)