Maury Microwave

User Guide

Automated Tuner

Models MT984AU & MT985AU Series

MT984-325 (Rev E) 8/13

User Guide

Automated Tuner

Models MT984AU & MT985AU Series

Maury Microwave

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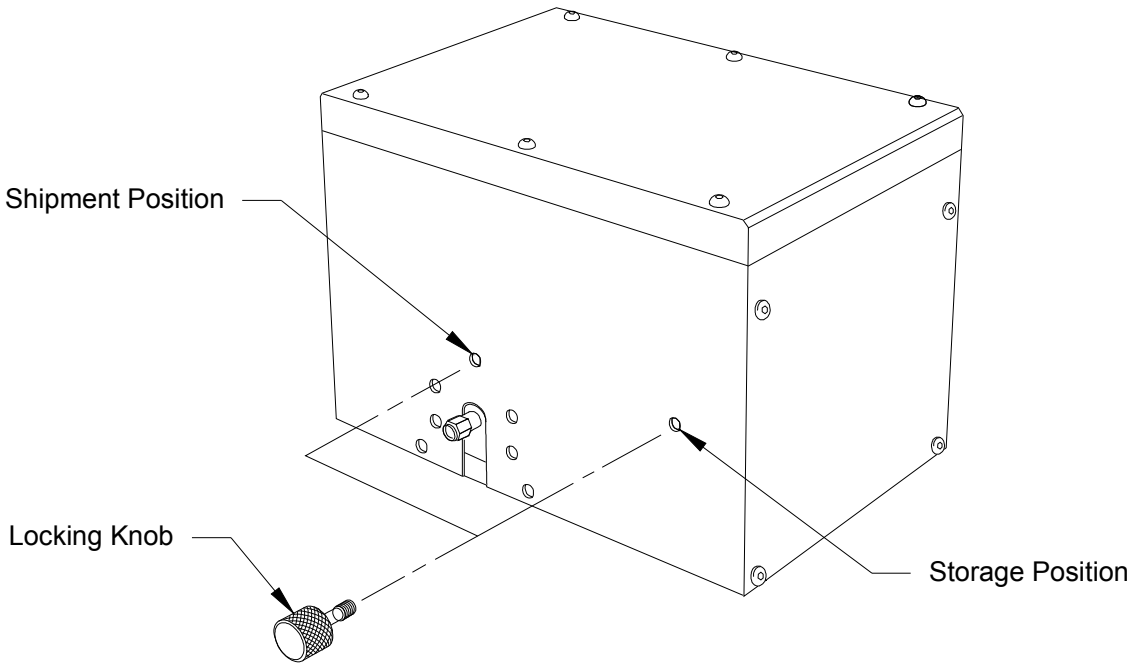
maurymw.com

MT984-325 (Rev E) 8/13

To protect this unit during transit, the tuner carriage has been locked into position via a locking screw inserted as shown below. Before applying power, it is necessary to remove this screw from its shipment position and place it in its storage position. Retain this notice along with all packing materials in the event unit requires future shipment. Before shipping the unit, refer to the Appendix for packaging instructions.



Warranty

Maury Microwave hardware products are warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Maury Microwave will, at its option, either repair or replace products which prove to be defective.

Maury Microwave software products are warranted against defects in material and workmanship of the media on which the product is supplied for a period of ninety (90) days from date of shipment. Maury also warrants that the product shall operate substantially in accordance with published specifications during the same warranty period. During the warranty period, Maury Microwave will, at its option, either repair or replace products which prove to be defective. Maury does not warrant that the operation of the product shall be uninterrupted or error-free.

For warranty service or repair, all products must be returned to Maury Microwave and must be issued a return authorization number by Maury prior to shipment. Buyer shall prepay shipping charges to Maury. Obligation is limited to the original Buyer.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or wear resulting from normal use. No other warranty is expressed or implied. Maury Microwave specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

The remedies provided herein are the Buyer's sole and exclusive remedies. Maury Microwave shall not be liable for any direct, indirect, special, incidental, or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other financial loss) arising out of the Buyer's use of or inability to use the product, even if Maury or an authorized Maury dealer has been advised of the possibility of such damages.

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General Information

MT984AU & MT985AU Series Automated Tuners

The MT984AU & MT985AU Series Automated Tuners are precision electromechanical slide screw tuners. These tuners serves as a matching network for reducing reflections caused by mismatches present in a transmission line or to introduce a controlled mismatch into an otherwise matched transmission line.

The tuner is a slide screw tuner in which the probe and carriage motions are automated by stepper motors. The tuner has two probes to cover the operational frequency range. The low frequency probe is designed to induce a mismatch in the frequency range below the specified cross over frequency. The high frequency probe is designed to induce a mismatch in the frequency range above the specified cross over frequency. Each probe should be used in its designated range.

Each probe is individually operated by a stepper motor. The probe motors are operated in half-stepping.

The (non-contacting) probes are moved along the transmission line by the carriage. The stepper motor and anti-backlash gear train will provide a minimum of one-half wavelength lateral movement of the probes at the tuner's lowest rated frequency. The carriage motor is operated in half-stepping mode.

The tuner is designed with the probes offset toward the male connector to allow the highest matching range possible. This end of the tuner should always be connected to the device being matched.

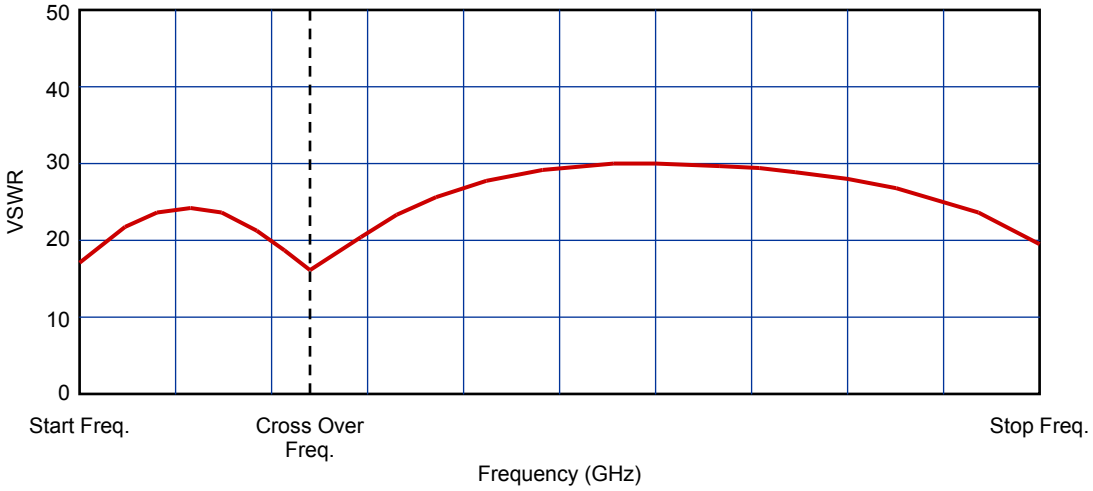

Figure 1. Typical VSWR Response

Operation

The MT984AU & MT985AU Series USB tuners can only be controlled using a host computer with MT993V04 tuner driver DLL or TunHubMech.exe stand alone tuner driver. All drivers are available from Maury Microwave and are also included with ATS software, version 5.20.00 or later.

There is no capacity for local control of the tuner as a stand alone device.

Specifications

Electrical Specifications

Table 1. Tuner Electrical Specifications

Model	Connector Type	Frequency Range (GHz)	Cross Over Freq. (GHz)	Matching Range (min)	VSWR (1)	Insertion Loss (1)	Vector Repeatability	Power Capability (2)
MT984AU01	2.4mm (male - High Matching Port)	8.0 – 50.0	20	10:1	1.15:1 max	0.6 dB max @ DC-48 GHz 0.65 dB max @ 48–50 GHz	40 dB min	10 W CW 100 W PEP
MT985AU01	1.85mm (male - High Matching Port)	8.0 – 65.0	26.5		1.25:1 max	1.15 dB max		
MT985AU02	1.85mm (male - High Matching Port)	8.0 – 67.0	26.5					

(1) With probes fully retracted.

(2) Power rated at maximum VSWR.

Motion Control Specifications

Probe Motor Step Size (1) ..... 31 µin [0.787 µm]

Carriage Motor Step Size (1) ..... 50 µin [1.27 µm] (approx. 0.15° per step @ 50 GHz)

50 µin [1.27 µm] (approx. 0.20° per step @ 65 GHz)

50 µin [1.27 µm] (approx. 0.20° per step @ 67 GHz)

Positioning Accuracy..... ±1 step

(1) Based on half stepping the motors.

Installation

Safety Precautions

The MT984AU & MT985AU Series Automated Tuners are not electrically, chemically, nor mechanically hazardous to the operator. The following precautions are necessary to protect the instrument:

- Use extreme care in moving, handling, and storing this instrument, and avoid physical contact with other instruments.
- The tuner power source must be OFF before connecting power to the tuner to avoid potential damage to the tuner.
- Adjust the instrument supports to provide proper alignment with mating devices. Never allow the instrument to be supported by the connectors. Refer to Figure 2 for effect of improper support.
- Do not move the instrument by pulling an attached cable.
- Visually and mechanically inspect the connectors regularly to maintain performance characteristics and minimize damage to the instrument or any mating devices.
- To keep the precision components inside the tuner clean, the cover should be kept on the tuner at all times, except when the tuner is being serviced.

Software Installation

If this is the first time a Maury Automated Tuner is being installed on the host computer, ATS software, version 5.20.00 or later, must first be installed before connecting the tuner to the computer.

Tuner Installation

- Before installing the tuner, inspect each end of the cable connectors and the tuner connectors to ensure that all are clean and undamaged before connecting.
- Align the mating connectors with the tuner connector and connect the male tuner connector to the device under test.
- The tuner power source must be OFF before connecting power to the tuner to avoid potential damage to the tuner.
- Connect power and USB cables.
- Turn tuner power source ON.
- The host computer will detect the tuner as a new USB device and automatically install the tuner drivers.

  If you experience any difficulties in connecting to the tuner or installing the tuner drivers, refer to the *Troubleshooting USB Tuner Driver* help file found in the *C:\Program Files\Maury\ATS52x\HelpDoc* directory of your computer.

NOTE: *Verify that the tuner connectors are correctly aligned before any measurements are attempted. Improper connector alignment may damage the tuner. Refer to Figure 2 for effect of improper alignment.*

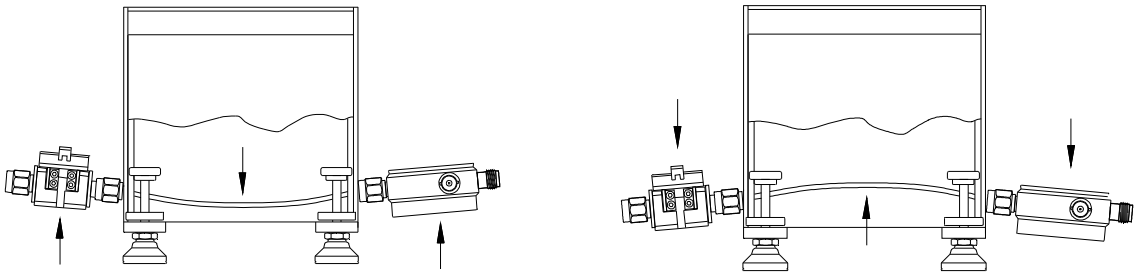

Figure 2. Effects of Improper Connector Support

Performance Tests

The tests described in this section enable the operator to verify the minimum performance levels of the MT984AU & MT985AU Series Automated Tuners. The tests are:

- VSWR Range
- VSWR (Probes Retracted)
- Loss (Probes Retracted)
- Repeatability

Equipment Required

1. MT1020B Power Distribution Unit and USB / power cable
   or MT1020D Power Supply and power cable
2. USB cable
3. Vector Network Analyzer (VNA)
4. VNA test cable
5. Fixed Termination

Running TunHubMech.exe

1. Install MT993 ATS software, version 5.20.00 or later, and start software.
2. Select “Instruments” from the “Setup” menu.
3. From the Instrument Setup dialog box, click “Tuners” button.
4. In “Tuners” dialog box, select “Details”.
5. Select “Browse” from the “Tuner Properties” dialog box, and select “TunHubMech.exe”.
6. In “Tuner Properties” dialog box, select “Scan” to scan for the tuner.
7. Verify the correct tuner model and serial number.
8. Select “Test” and TunHubMech.exe will be executed.

Table 2. Recommended Fixed Terminations

Model	Connector Type	Termination Type (Performance Verification)
MT984AU01	2.4mm	2.4mm - MMC 7931A1 (female) & 7931B1 (male)
MT985AUxx	1.85mm	1.85mm – MMC 7832A (female) & 7832B (male)

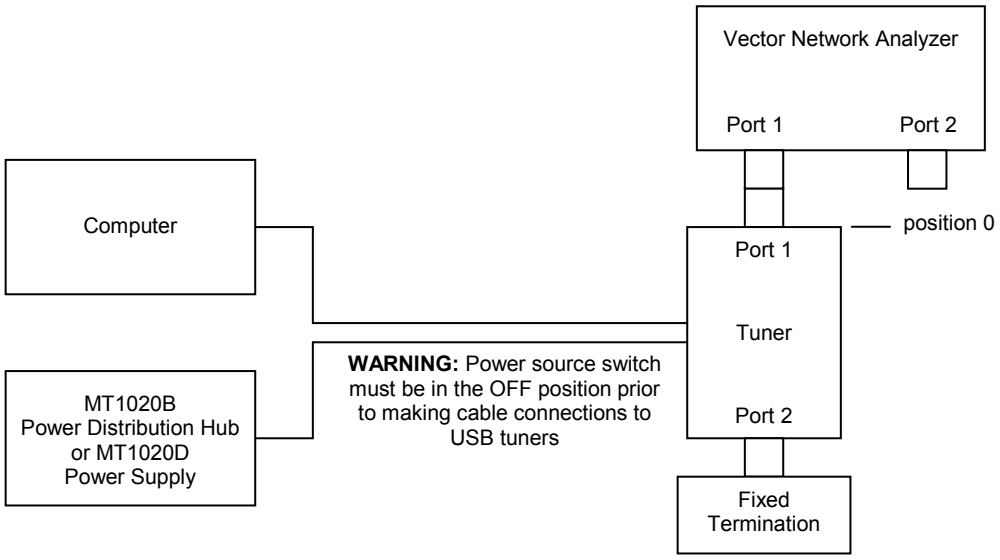

Figure 3. Single Port Test Configuration

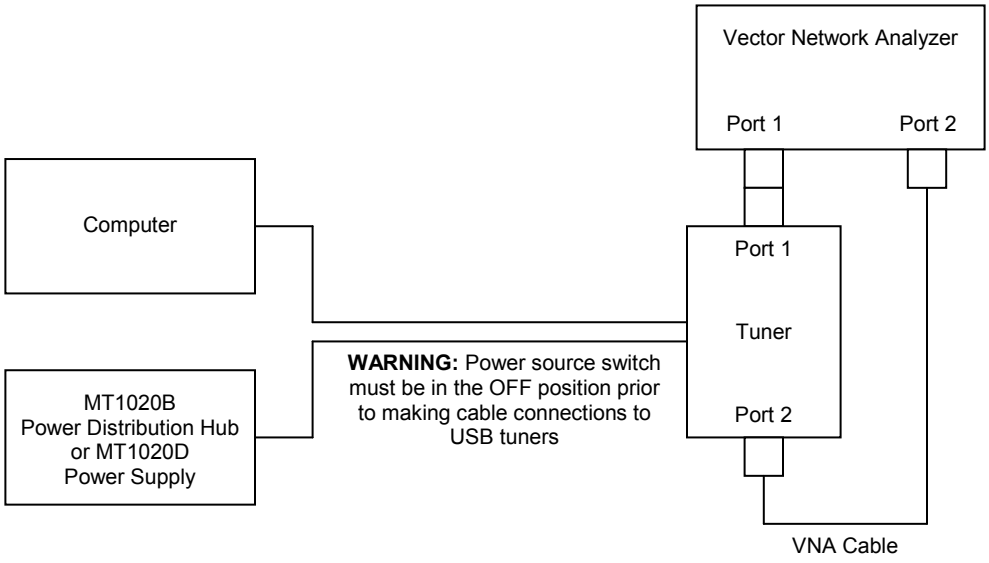

Figure 4. Two Port Test Configuration

VSWR Range Test

Low Frequency Range Test

1. Calibrate the VNA to perform a single port measurement over the frequency range of the tuner per Table 1. VNA resolution is critical; 401 points is recommended with narrow IF bandwidth.
2. Using a fixed termination per Table 2, connect the equipment as shown in Figure 3.
3. Initiate TunHubMech.exe program.
4. Select “Find Tuner” from the “Test” menu. Verify Tuner model and serial number. Select “OK”. Click “OK” when found.
5. Select “Init Tuner” from the “Test” menu. Initializing Tuner dialog box appears on the screen once “Initialize Tuners Now” has been selected. Tuner Initialized dialog box appears. Click “OK”.
6. Select “Move Motor (No Init)” from “Test” menu. “Step Only-Move Motor” dialog box appears.
7. Click “Scan Device”. Scan for all USB tuners connected to the host computer and list all USB tuners in "Device Number" pull down section.
8. Enter “2” into "Motor Number" in the "Movement" section to select the low frequency probe motor.
9. Enter “0” into "Desired Position" in the “Set Movement” section.
10. Click "Move Motor" to move the low frequency probe to zero position.
11. Enter “3” into "Motor Number" in the "Movement" section to select the high frequency probe motor.
12. Enter “4500” into "Desired Position" in the “Set Movement” section.
13. Click “Move Motor” to move the high frequency probe to fully retracted position.
14. Set the VNA controls for a convenient display and verify that the VSWR in the low band, from the start frequency to the cross over frequency of the tuner per Table 1, is as specified in Table 1. The VNA display should be similar to the sample shown in Figure 5.

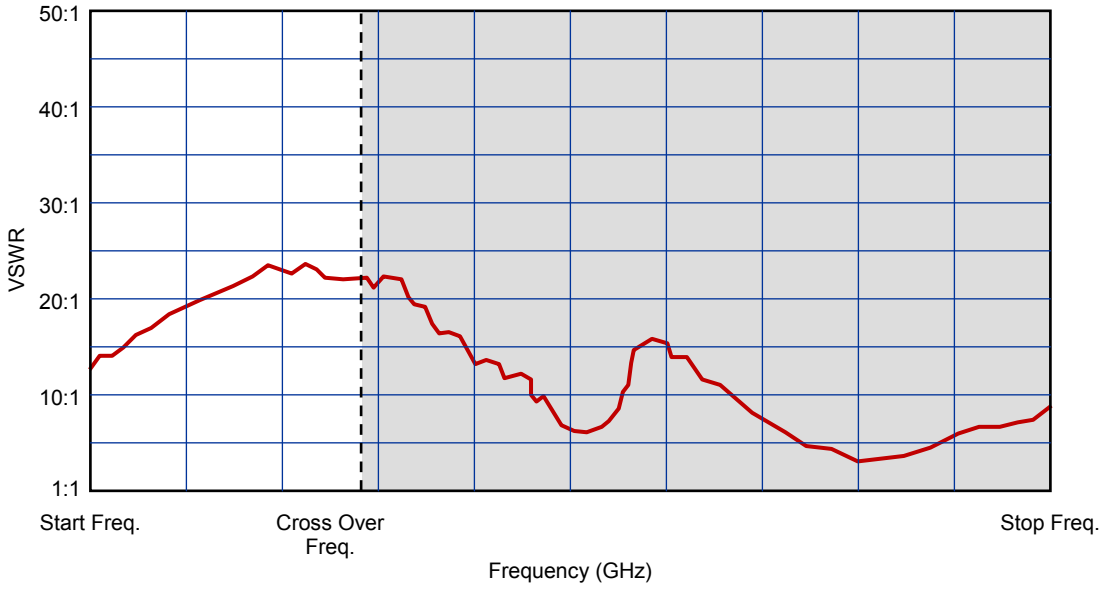

Figure 5. Low Band VSWR Range Display

High Frequency Range Test

1. Enter “2” into "Motor Number" in the "Movement" section to select the low frequency probe motor.
2. Enter “4500” into "Desired Position" in the “Set Movement” section.
3. Click "Move Motor" to move the low frequency probe to fully retracted position.
4. Enter “3” into "Motor Number" in the "Movement" section to select the high frequency probe motor.
5. Enter “0” into "Desired Position" in the “Set Movement” section.
6. Click “Move Motor” to move the high frequency probe to zero position.
7. Set the VNA controls for a convenient display and verify that the VSWR in the high band, from the cross over frequency to the stop frequency of the tuner per Table 1, is as specified in Table 1. The VNA display should be similar to the sample shown in Figure 6.

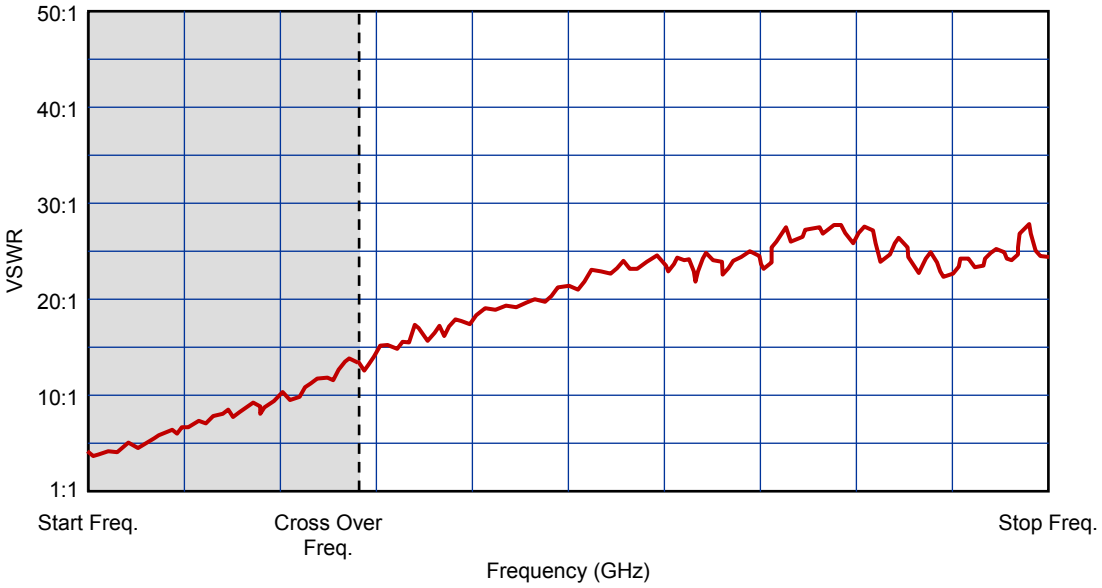

Figure 6. High Band VSWR Range Display

VSWR Test (Probes Retracted)

1. Calibrate the VNA for a two port measurement over a frequency range of the tuner per Table 1.
2. Connect the equipment as shown in Figure 4.
3. Initiate TunHubMech.exe program.
4. Enter “2” into "Motor Number" in the "Movement" section to select the low frequency probe motor.
5. Enter “4500” into "Desired Position" in the “Set Movement” section.
6. Click "Move Motor" to move the low frequency probe to fully retracted position.
7. Enter “3” into "Motor Number" in the "Movement" section to select the high frequency probe motor.
8. Enter “4500” into "Desired Position" in the “Set Movement” section.
9. Click “Move Motor” to move the high frequency probe to fully retracted position.
10. Set VNA controls for a convenient display and verify that the maximum VSWR is as specified on Table 1 over the full frequency range of the tuner per Table 1. The VNA display should be similar to the sample shown in Figure 7.

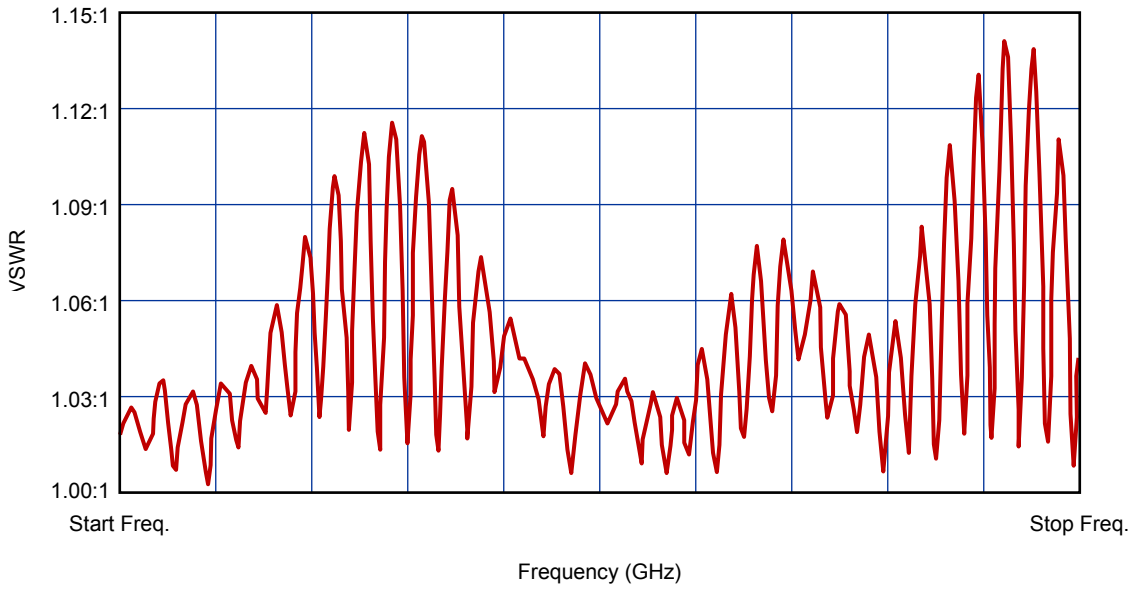

Figure 7. VSWR Display (Probes Retracted)

Loss Test (Probes Retracted)

1. Calibrate the VNA for a two port measurement over a frequency range of the tuner per Table 1.
2. Connect the equipment as shown in Figure 4.
3. Initiate TunHubMech.exe program.
4. Enter “2” into "Motor Number" in the "Movement" section to select the low frequency probe motor.
5. Enter “4500” into "Desired Position" in the “Set Movement” section.
6. Click "Move Motor" to move the low frequency probe to fully retracted position.
7. Enter “3” into "Motor Number" in the "Movement" section to select the high frequency probe motor.
8. Enter “4500” into "Desired Position" in the “Set Movement” section.
9. Click “Move Motor” to move the high frequency probe to fully retracted position.
10. Set VNA controls for a convenient display and verify that the insertion loss is as specified in Table 1 over the full frequency range of the tuner per Table 1. The VNA display should be similar to the sample shown in Figure 8.

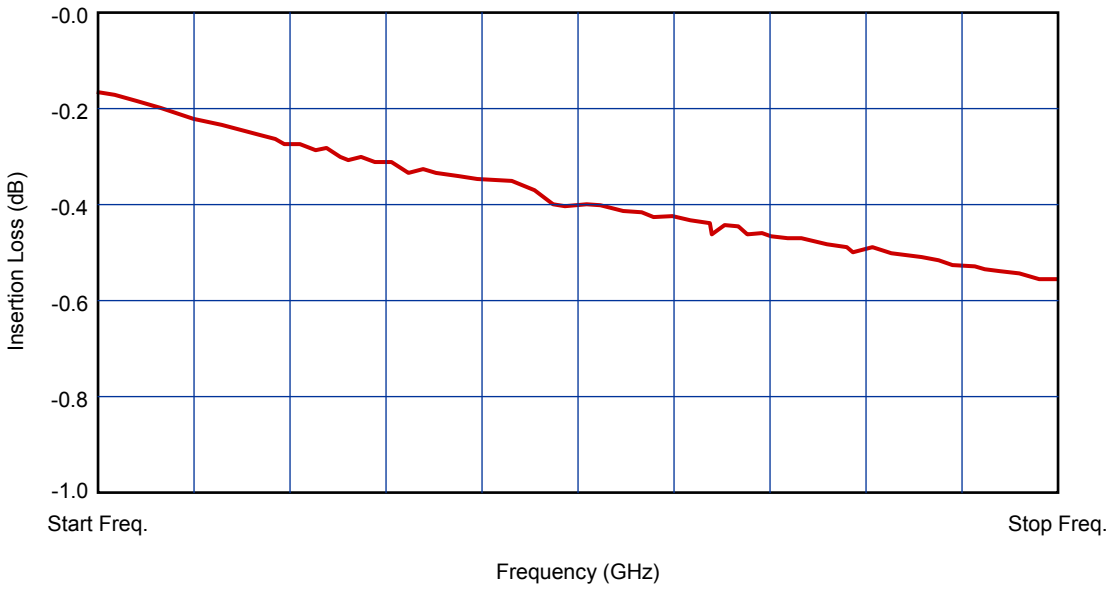

Figure 8. Insertion Loss Display (Probes Retracted)

Repeatability Test

1. Initiate TunHubMech.exe program.
2. Select “Find Tuner” from the “Test” menu. Verify Tuner model and serial number. Select “OK”. Click “OK” when found.
3. Select “Init Tuner” from the “Test” menu. Initializing Tuner dialog box appears on the screen once “Initialize Tuners Now” has been selected. Tuner Initialized dialog box appears. Click “OK”.
4. Under "Test" menu, select "Repeatability Test".
5. Set parameters per Notes 1 and 2 and click "OK".

   Note 1: Make sure the selected test position is in the available travel range of the tuner. This is 0 to 15300 for the carriage and 0 to 4500 for the probes.

   Note 2: For frequencies below the crossover frequency, keep probe 2 (the high frequency probe) at 4500. For frequencies above the crossover frequency, keep probe 1 (the low frequency probe) at position 4500.

6. After saving S11 data to memory, click "OK". This is done manually via the front panel of VNA.
7. Current S11 response is saved to VNA memory. Record Tune - position select "Data - Memory" trace on VNA. Move tuner to a new position greater than 100 steps away from the parameters set for the carriage position and probe position.
8. Move tuner back to reference position. Verify VNA trace "Data-Memory" is less than -40 dB verifying repeatability specification of > -40 dB.
9. Repeat S11 repeatability test at all positions of interest.
10. Repeat the above procedure for S21 repeatability test.

    Note 3: Display Data-Memory in Log Magnitude format. This will display the repeatability vs. frequency for the selected position. The VNA display should be similar to the samples in Figure 9 for the low frequency probe and Figure 10 for the high frequency probe.

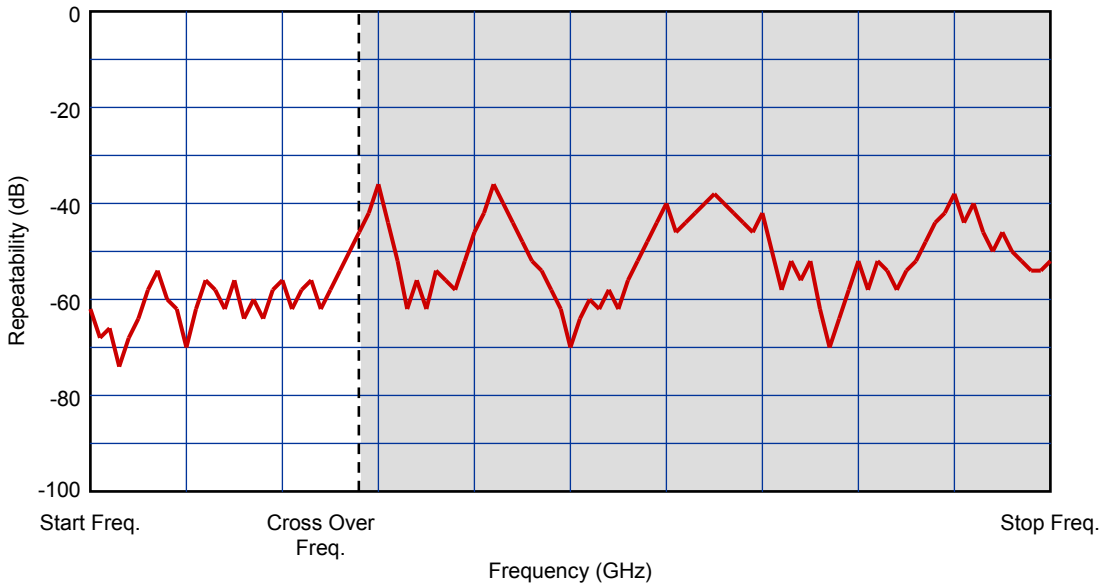

Figure 9. Low Band Repeatability Display

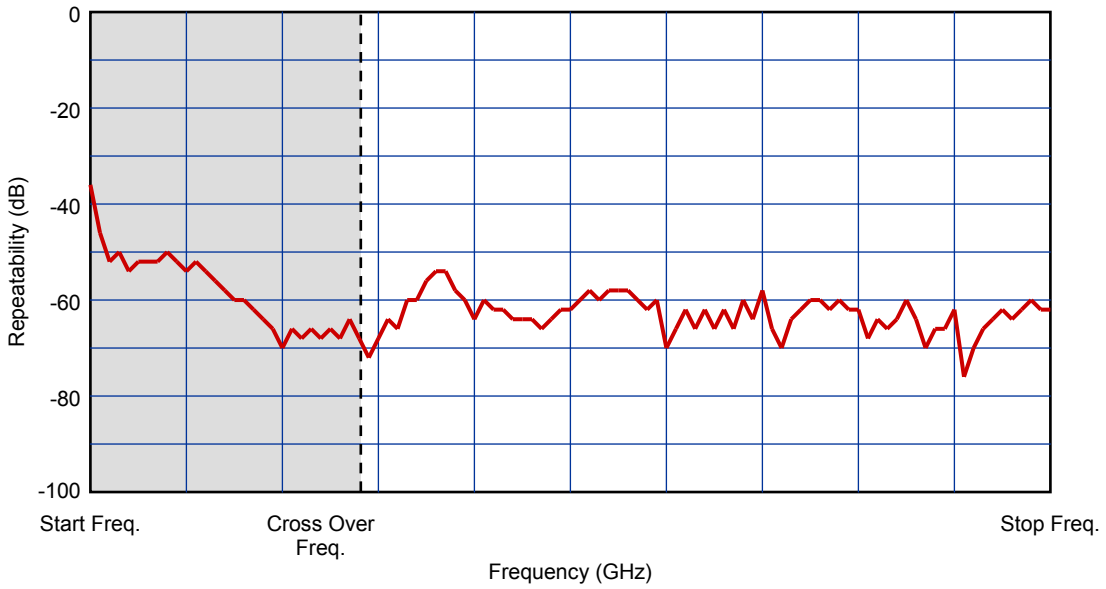

Figure 10. High Band Repeatability Display

Connector Maintenance

Periodically inspect the connectors for signs of damage. Tuners with damaged connectors should be returned to the factory for repair. Connectors should be cleaned using dry compressed air of a very low velocity first; then cleaned with a solvent such as isopropyl alcohol. Clean the contacting surfaces, alignment parts and threads using a lint free swab. Reapply dry compressed air to evaporate any residual solvent. After cleaning, re-inspect the connector to make sure that no fibers have been left around the contact or mating surfaces.

Mechanical inspection of the connector requires the use of a connector gage (refer to Table 3 for recommended gage kits). The connector gage will measure the location of the mating surface on the center conductor with respect to the mating surface on the outer conductor. The center conductor surface should not protrude beyond the outer conductor surface or be recessed more than specified in Table 3. If this condition is not satisfied, do not connect any other device to the connector (connector repair is required).

Table 3. Connector Specifications

Model	Connector	Gage Kit	Pin Depth Specification (recessed)
MT984AU01	2.4mm	MMC A035C, A035E or A048A	0 to 0.0015”
MT985AUxx	1.85mm	MMC A048A	0 to 0.001”

Lubrication

The tuner is lubricated at the factory. No additional lubrication is required.

Appendix

Packaging of the Automated Tuner

All shipping containers and packing materials for the Automated Tuner should be retained in the event it becomes necessary to return the instrument to the factory. If the instrument fails to meet specifications or the contents are incomplete, notify the carrier and Maury Microwave Corporation immediately and wait for instructions before returning any products. In the event that you have to return the tuner for any reason, please refer to the following packaging instructions.

Packing Instructions

To protect the tuner during transit, the carriage must be secured in its locking position and the tuner packaged in its original shipping container and packing materials. If you do not have the original shipping container and/or packing materials, contact your Maury Microwave representative or the factory and a packaging kit will be provided. The instructions provided herein will properly prepare the tuner for return to the factory.

Instruction for Locking Tuner Carriage before Shipping

Step 1. Initialize the tuner

- Using ATS software, open the tuner control dialog window by double clicking on the green area around the tuner on the block diagram, or from the main menu, select *View* > *Tuner* and select either “Source Port” or “Load Port” to open the Tuner Control dialog window.
- Select “Control” tab, and click “Initialize Tuner”.
- Once the tuner is initialized, Carriage, Probe 1 and Probe 2 will show the initialized positions.

Step 2. Move tuner to lock position

- Initiate TunHubMech.exe program.
- Select “Find Tuner” from the “Test” menu. Verify Tuner model and serial number. Select “OK”. Click “OK” when found.
- Select “Init Tuner” from the “Test” menu. Initializing Tuner dialog box appears on the screen once “Initialize Tuners Now” has been selected. Tuner Initialized dialog box appears. Click “OK”.
- Select “Move Motor (No Init)” from “Test” menu. “Step Only-Move Motor” dialog box appears.
- Click “Scan Device”. Scan for all USB tuners connected to the host computer and list all USB tuners in "Device Number" pull down section.
- Enter “2” into "Motor Number" in the "Movement" section to select the low frequency probe motor.
- Enter “2200” into "Desired Position" in the “Set Movement” section.
- Click "Move Motor" to move the low frequency probe to half of its initialized position.
- Enter “3” into "Motor Number" in the "Movement" section to select the high frequency probe motor.
- Enter “2200” into "Desired Position" in the “Set Movement” section.
- Click “Move Motor” to move the high frequency probe to half of its initialized position.
- Enter “1” into "Motor Number" in the "Movement" section to select the carriage motor.
- Enter “0” into "Desired Position" in the “Set Movement” section.
- Click “Move Motor” to move the carriage probe to the zero position.
- Enter “1” into “Step” in the “Step Movement” section.
- Click “LOW Move” to move the carriage position in the negative direction.
- Click “LOW Move” until the low limit sensor is triggered, at which point an error message will be displayed (Error moving motor!). This sets the carriage to its locking position.

Step 3. Insert the locking screw into the locking position

- Remove the locking screw from the storage position and place it in the shipment position. (See Figure A1)
- The screw should go all the way in without any resistance or pressure. If there is resistance half way while inserting the screw, stop immediately and check the carriage position again. Do not over torque.

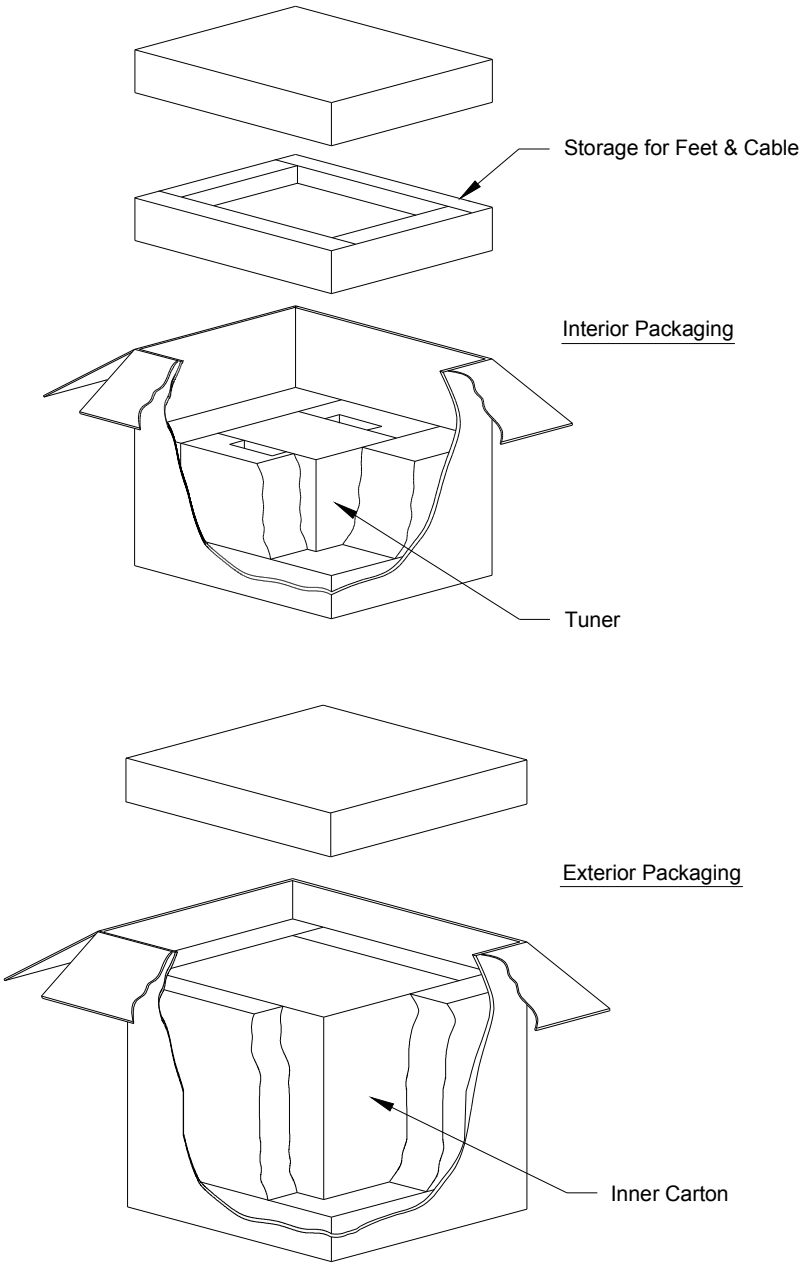

Figure A1. Tuner Packaging

Data Sheet Resources

4T-073 – 2.4mm Automated Tuners
http://www.maurymw.com/pdf/datasheets/4T-073.pdf
4T-079 – 1.85mm Automated Tuners
http://www.maurymw.com/pdf/datasheets/4T-079.pdf

2Z-057 – Precision Calibration Kits – 2.4mm
http://www.maurymw.com/pdf/datasheets/2Z-057.pdf
2Z-056 – Precision Calibration Kits – 1.85mm
http://www.maurymw.com/pdf/datasheets/2Z-056.pdf

2Y-022A – "Metrology Grade" 2.4mm Connector Gage Kit
http://www.maurymw.com/pdf/datasheets/2Y-022A.pdf
2Y-048 – "Metrology Grade" 1.85/2.4mm Digital Connector Gage Kit
http://www.maurymw.com/pdf/datasheets/2Y-048.pdf
2Y-001 – Connector Gages and Connector Gage Kits
http://www.maurymw.com/pdf/datasheets/2Y-001.pdf

2Y-050A – Torque Wrenches
http://www.maurymw.com/pdf/datasheets/2Y-050A.pdf

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