USER GUIDE

AUTOMATED TUNER

Models XT98xML Series

Maury Microwave

XT981-571 (A) 3/24

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AUTOMATED TUNER

Models XT98xML Series

Maury Microwave

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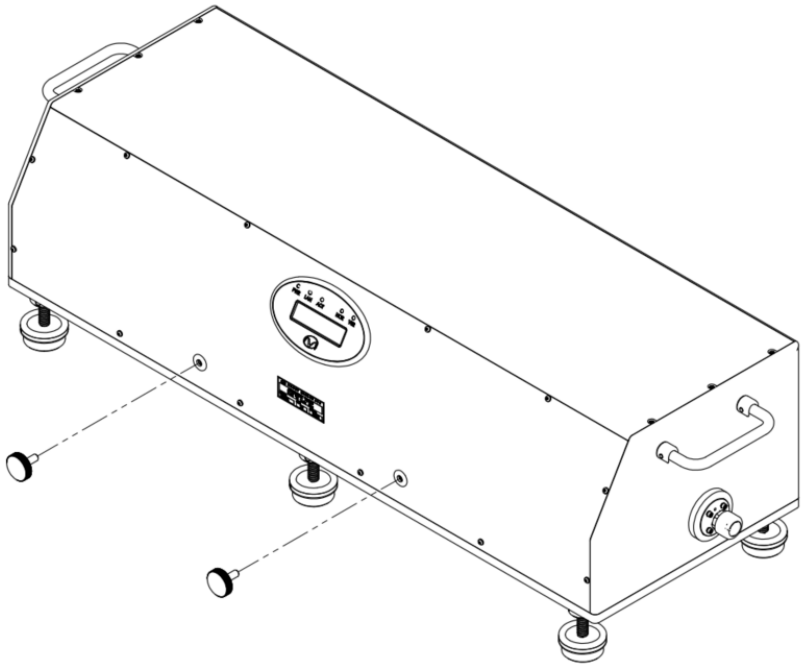
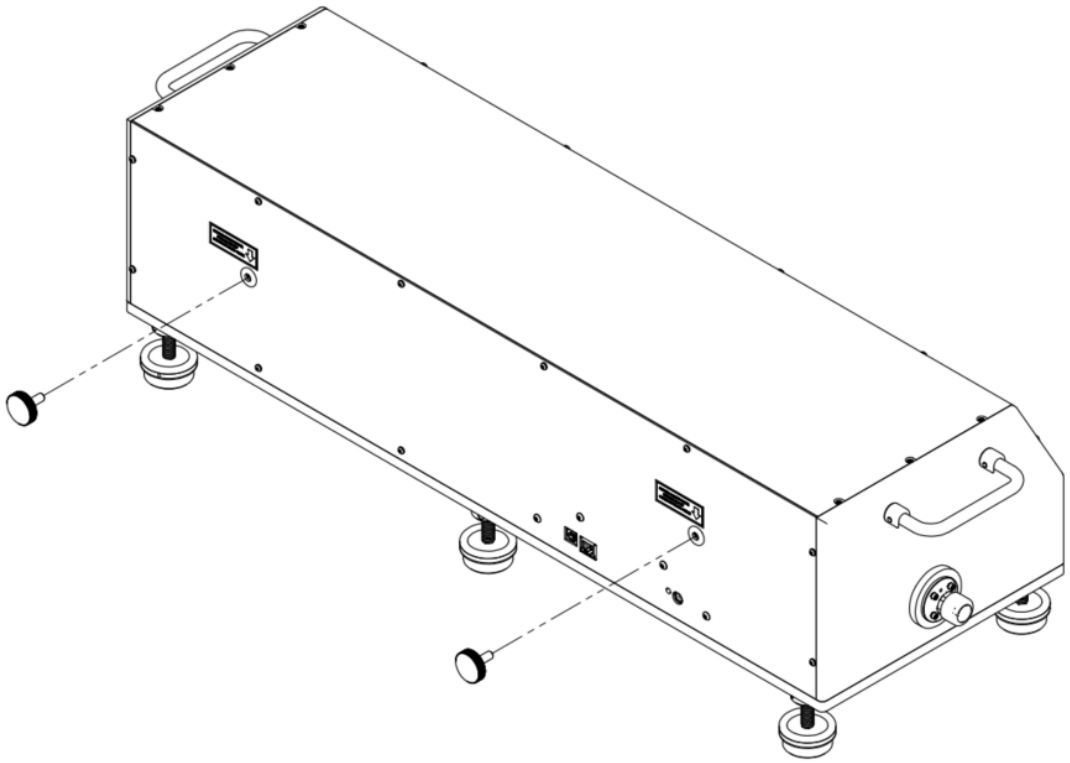
To protect this unit during transit, the tuner carriages have been locked into position via locking screws inserted from the back side of the unit. Before applying power and before using the tuner, it is necessary to remove these screws from their locking position (back) and place them in their storage position (front). Retain this notice along with all packing materials in the event the unit requires future shipment. Before shipping the unit, refer to the Appendix for packaging instructions. Shipping the tuner without properly locking its carriages will cause damage to the carriages and other parts.



Storage position



Shipping/locked position (carriages must be moved to positions shown on labels)

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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TABLES

FIGURES

GENERAL INFORMATION

XT98xML Series Automated Tuner

The XT98xML Series Automated Tuners, also called Multi-Harmonic Tuners, are precision electromechanical slide screw tuners. These tuners serve 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 tuners are slide screw tuners with more than one carriage for multi-frequency control. Each probe and carriage motion is automated by stepper motors. Each carriage consists of two probes that cover the specific 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 frequency range.

Each probe is individually operated by a stepper motor. All motors are operated in 1/16 (micro) stepping.

The (non-contacting) probes are moved along the transmission line by the carriage. The linear stepper motor will provide a minimum of one-half wavelength lateral movement of the probes at the tuner's lowest rated frequency.

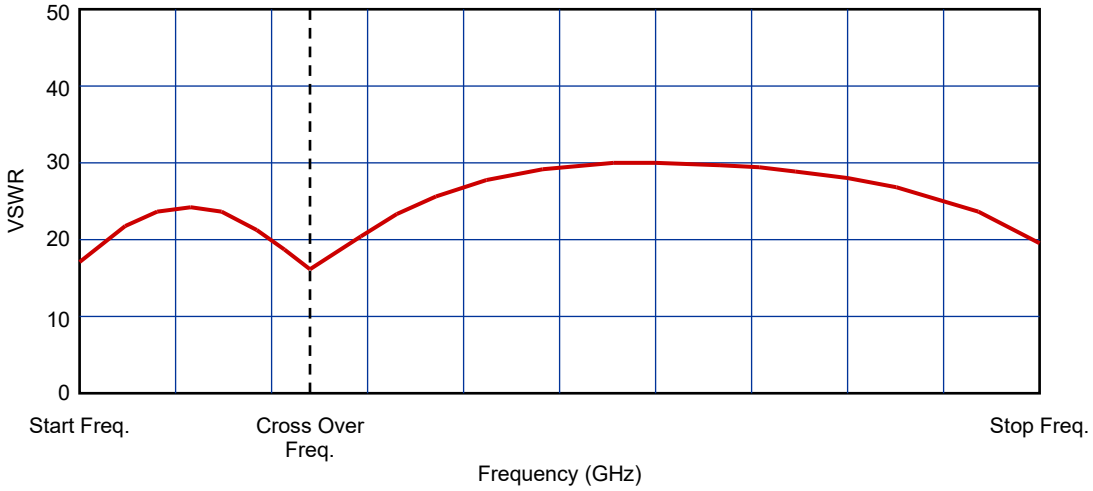


Figure 1. Typical VSWR Response

Operation

The XT98xML series of tuners support multiple mode of remote-control operation:

- Web based control using Ethernet connection
- Telnet based control using Ethernet connection (port 5024)
- COM port serial communication using USB connection (virtual COM port)
- MTUNE Tuner Characterization and Control Software
- Maury application software including: ATS, IVCAD, MT2001

Please consult XT981-557 User Manual for information on configuring your computer for operation of the tuner using Ethernet or USB port.

Specifications

Electrical Specifications

Table 1. Tuner Electrical Specifications

Model	Connector Type	Frequency Range (GHz)	Cross Over Freq. (GHz)	Matching Range (min)						Insertion Loss [1] (max)	Vector Repeatability (min)	Power Capability [2]
				Single Freq. Tuning		Two Freq. Tuning		Three Freq.Tuning				
				Fmin	Fmax	Fmin	Fmax	Fmin	Fmax			
XT981ML01	7mm	0.65 – 8.0	1.65	100:1	40:1	10:1 – 100:1	10:1 – 100:1	n/a		0.3 dB	-50 dB	250 W CW 2.5 kW PEP
XT982ML01		0.6 – 18.0	3.5							0.8 dB	-40 dB	50 W CW 0.5 kW PEP
XT982ML03		0.8 – 18.0	2.6					10:1 – 100:1	10:1 – 100:1	1.0 dB		
XT983ML01	3.5mm (M/F)	2.0 – 26.5	4.4					n/a		0.9 dB		25 W CW 250 W PEP

[1] With probes fully retracted.

[2] Power rated at maximum VSWR.

Motion Control Specifications

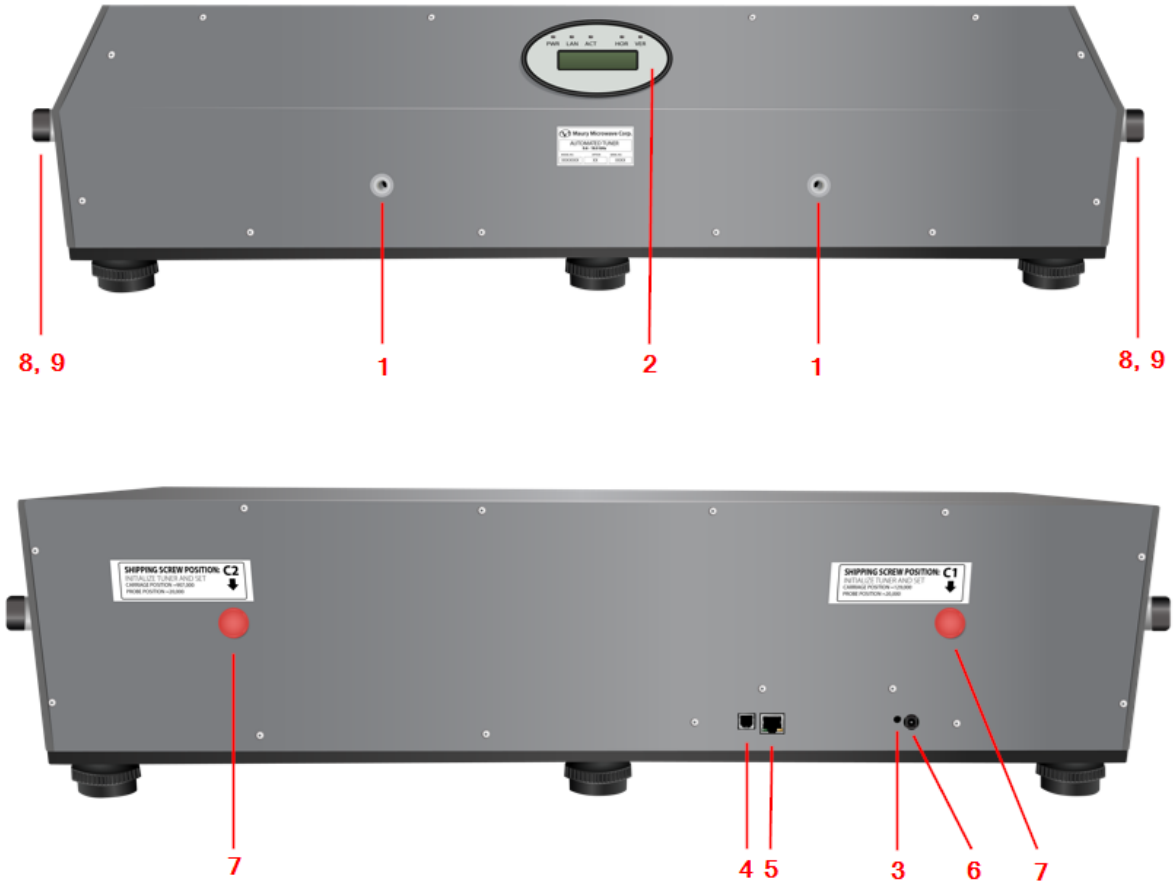
Probe Motor Step Size [1] ..... 7.8 µin [0.198 µm]

Carriage Motor Step Size [1] ..... 234.4 µin [5.954 µm] (approx. 0.384° per step @ 8GHz)
62.5 µin [1.588 µm] (approx. 0.069° per step @ 18.0GHz)
(approx. 0.101° per step @ 26.5GHz)

Positioning Accuracy ..... ±3 steps (probes)
±6 steps (carriage) – XT981 models
±8 steps (carriage) – XT982/3 models

[1] Based on 1/16 (micro) stepping the motors.

GETTING TO KNOW YOUR TUNER



1. Locking screw location during normal use (storage)
2. LCD/ Main Display
3. Reset Button
4. USB port
5. Ethernet port
6. Power supply port
7. Locking screw location during shipping/transport
8. Connector
9. Connector caps (install when tuner is not in use or during shipping)

Patented XT Tuner Technology

(U.S. Patent No. 9,209,786)

XT Technology

- XT-series tuners represent the next evolution in tuner technology. Faster, more accurate, more repeatable.
- Upgraded mechanics result in:
  - Tuner characterization: 40-60%[1] faster than previous series
  - VSWR test: 20-40%[2] faster than previous series
  - Linear encoders on the horizontal axis ensure accurate carriage positioning and improve repeatability of 5–8 dB[3].

[1]MT983BL01vs XT983BL01 characterized at 550 points with PNAx N5242A at 2 GHz and 26.5 GHz.

[2]MT983BL01vs XT983BL01 tuning VSWR circle of 10:1 with 10 degree steps at 2 GHz and 26.5 GHz.

[3]MT983BL01vs XT983BL01 repeatability defined as re-measuring characterized state.

INSTALLATION

Safety Precautions

The XT98xML 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 cord 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.
- 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 or TCS software, version 5.36.05 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.
- The tuner power source must be OFF, or disconnected from the wall power, before connecting power cord to the tuner to avoid potential damage to the tuner.
- Connect the DC power and either RJ45 network or USB cables.
- When using USB connection, the host computer will detect the tuner as a new device and automatically install the tuner drivers (Tuner_USB.inf)
- When using TCPIP connection, the computer's Ethernet connector has to be configured to match the tuner network settings. See XT981-557 User Manual for more information.

MAINTENANCE

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 2 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. Special care should be taken when removing the collet to insure the center conductor is not damaged or loosened from the connector (7mm connectors only). The center conductor surface should not protrude beyond the outer conductor surface or be recessed more than specified in Table 2. If this condition is not satisfied, do not connect any other device to the connector (connector repair is required).

Table 2. Connector Specifications

Model	Connector	Gage Kit	Pin Depth Specification (recessed)
XT981ML01	7mm	MMC A028D	0 to 0.0015”
XT982MLxx			
XT983ML01	3.5mm	MMC A050A	0 to 0.003”

Lubrication

Periodic application of a lubricant to certain moving parts is required to reduce wear and extend the operational life of the Automated Tuner. The lubrication schedule is dependent upon the amount of use the tuner receives. In a normal usage scenario, lubrication at one (1) year intervals should be sufficient. In heavy use applications, lubrication should be performed every six months.

Lubricant: Maury Part Number: 199-G-014-02
(DO NOT use other lubricants)

Lubrication Process

1. Set the probe motors to their maximum position per Table 3 in order to expose the majority of the lead screws.
2. Set the carriage motor to position zero.
3. Turn tuner OFF and disconnect any cables connected to the back of the tuner.
4. Remove the tuner’s back and top cover panels, in that order, by removing eight (8) screws (XT983ML01, longer tuners will have more screws) around the edges of the back panel and six (6) screws on the top panel. DO NOT remove the side or front panels.
5. Apply a small amount of lubricant to the vertical and horizontal lead screws shown on Figure 2. The amount of lubricant to be applied should be enough to cover the entire surface of the lead screws on every thread.
6. Exercise the probes up and down from limit to limit to evenly distribute the lubricant.
7. Cycle the carriage from end to end to evenly distribute the lubricant.
8. Wipe up any excess lubricant.

9. DO NOT apply lubricant to any other areas or parts of the tuner.
10. Replace the cover plates onto the tuner, installing the top plate first.

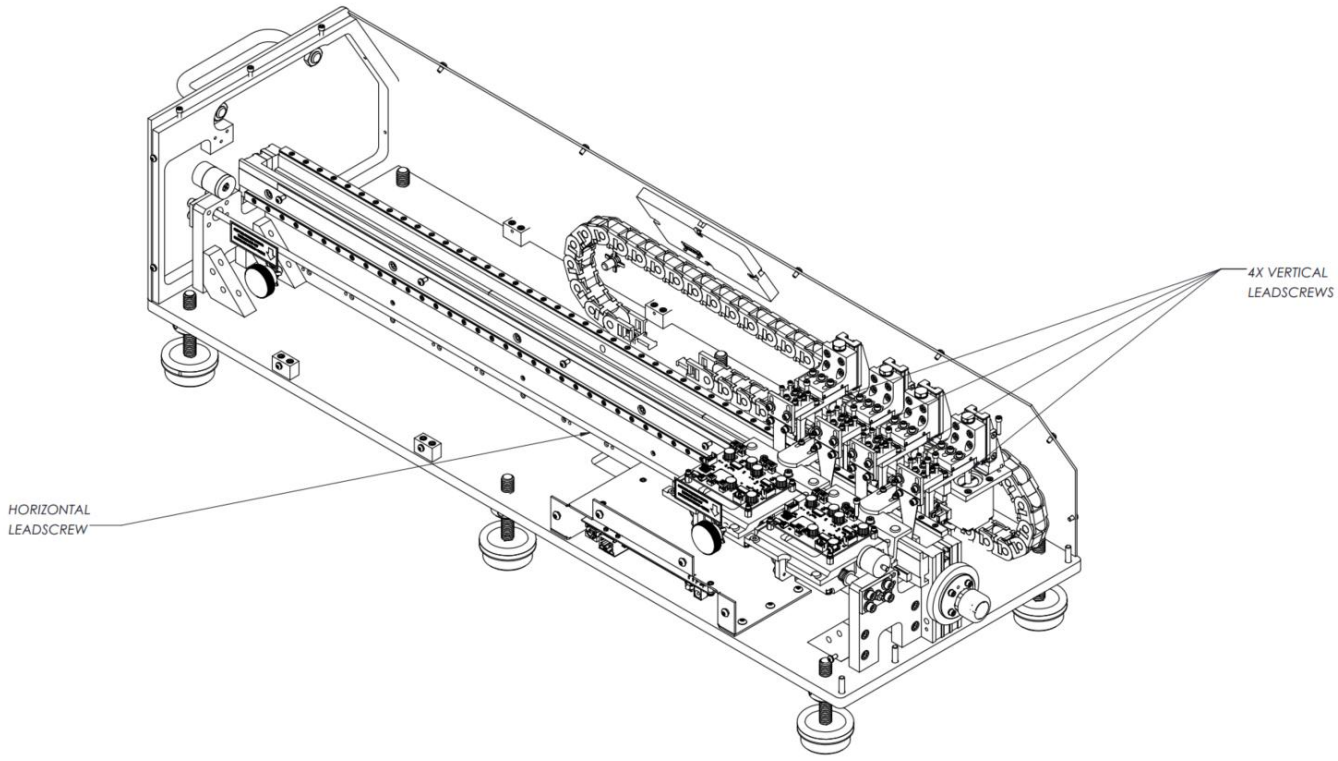


Figure 2. Lubrication Points (one side panel hidden to show carriage detail)

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 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 carriages must be secured in their 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. See Figure A 1. The instructions provided herein will properly prepare the tuner for return to the factory.

Instructions for Locking Tuner Carriages before Shipping (MTune3 method)

Step 1. MTune3 Application and Tuner Configuration

- Open the MTune3 application by typing the following address in your web browser.

  https://apps.maurymw.com/home

- Select “Control” from the main menu.
- Under “Setup”, click on the “+” sign to add a tuner (source or load).
- Click on the tuner box to show the tuner properties.
- Under available instruments (see Figure 3), select the type of connection (NI Visa, USB or IP), and enter the corresponding resource:
  - NI Visa: TCPIP0::<IP address>::5025::INSTR for an Ethernet connected tuner

    ASRL<port #>::INSTR or COM<port #> for the USB connection (which shows up as a serial port)
  - USB: COM<port #>
  - IP: <IP address> (PC must also be set accordingly – Dynamic or Static)
- Click on “Connect”. Once connected, the configuration diagram will show the tuner model, serial number and number of carriages.

Step 2. Initialize the Tuner

- Under “Load Tuning”, select “Initialize”. Observe the tuner display to know when the initialization process has completed. The process will be completed once the LEDs stop flashing.

Step 3. Move the Carriages to Shipping Position.

- Click on the 3 vertical dots next to the “+” sign in the middle of the page. Select “Set Tuner Positions” (see Figure 4).
- Refer to the labels on the back of the tuner for each carriage locking position. The labels will list the carriage and probe positions for each carriage.
- Enter the carriage and probe positions in the corresponding boxes as seen on Figure 5.

- Click on “Move” and wait for the display LEDs to stop flashing.

Step 4. Lock the Carriages

- Remove the locking screws from their storage location on the front tuner panel (see Figure A 2).
- Install the locking screws on each of the holes below the labels on the back tuner panel.
- The screws should go all the way in without any resistance or pressure. If there is resistance half way while inserting the screws, stop immediately and check the carriage position again.

Step 5. Package Tuner

- Refer to Figures A 1a and A 1b for proper tuner packaging. Table 3 shows the type of shipping crate needed for the different multi-carriage tuners.
- If you do not have the proper packaging kit, please contact your Maury representative or Sales agent.

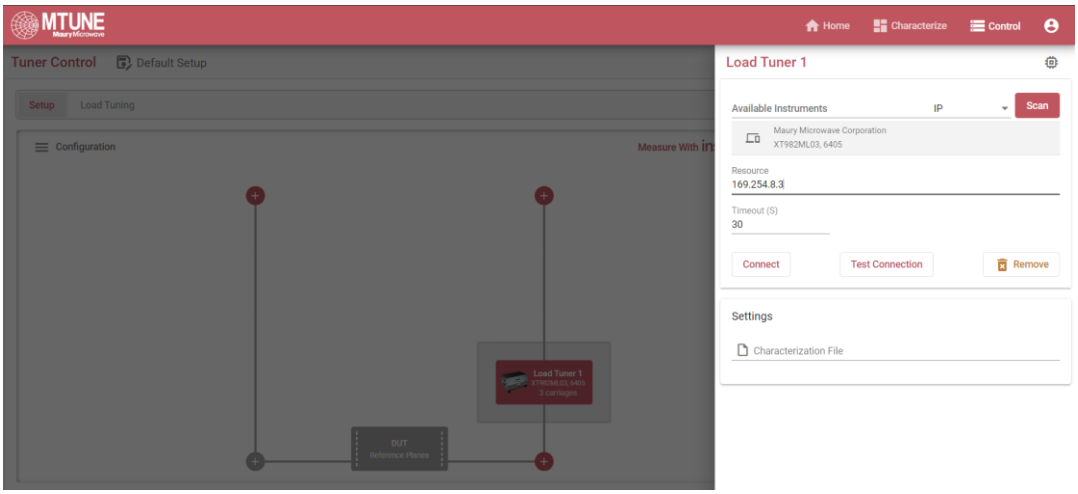


Figure 3. Available Instruments

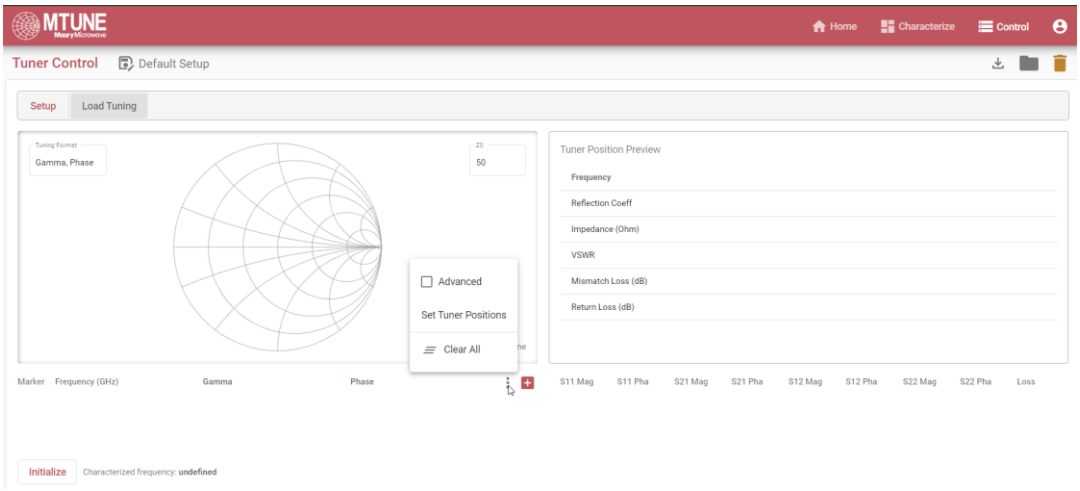


Figure 4. Set Tuner Positions

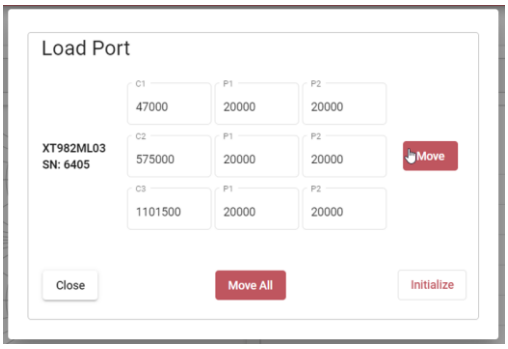


Figure 5. Carriages Locking Positions

Table 3. Travel Range

Model	Probe Travel Range (steps)	Packing Type (see Figures A 1a & A 1b)
XT981ML01	0 to 70,000	Wood crate
XT982MLxx	0 to 40,000	
XT983ML01	0 to 24,000	Cardboard box

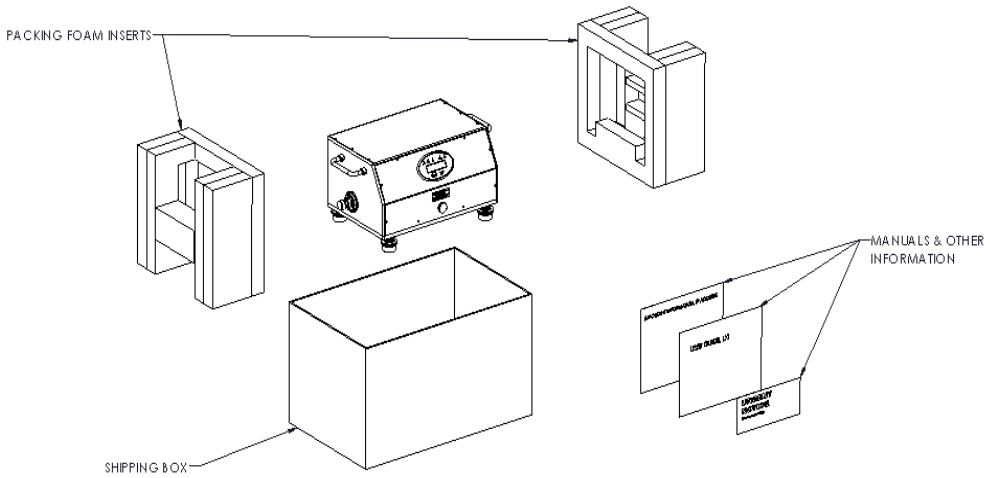


Figure A 1a. Packing Kit (cardboard box)

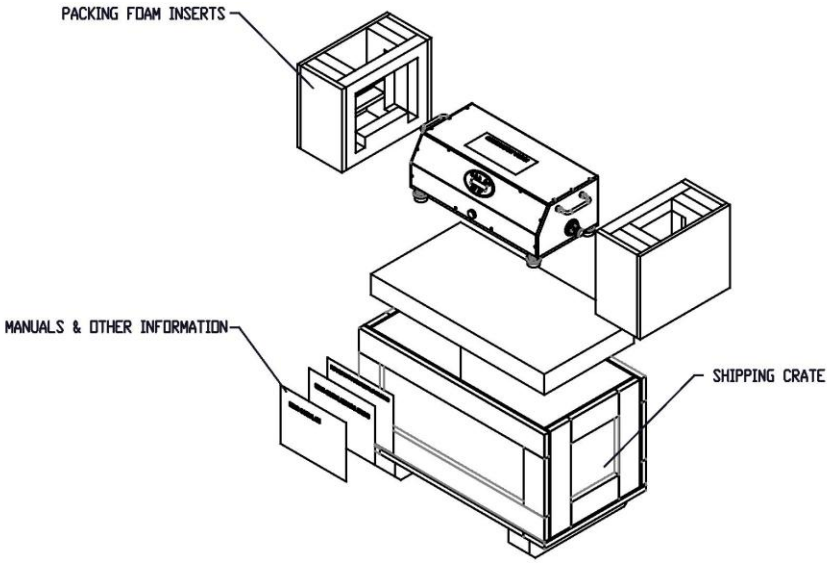
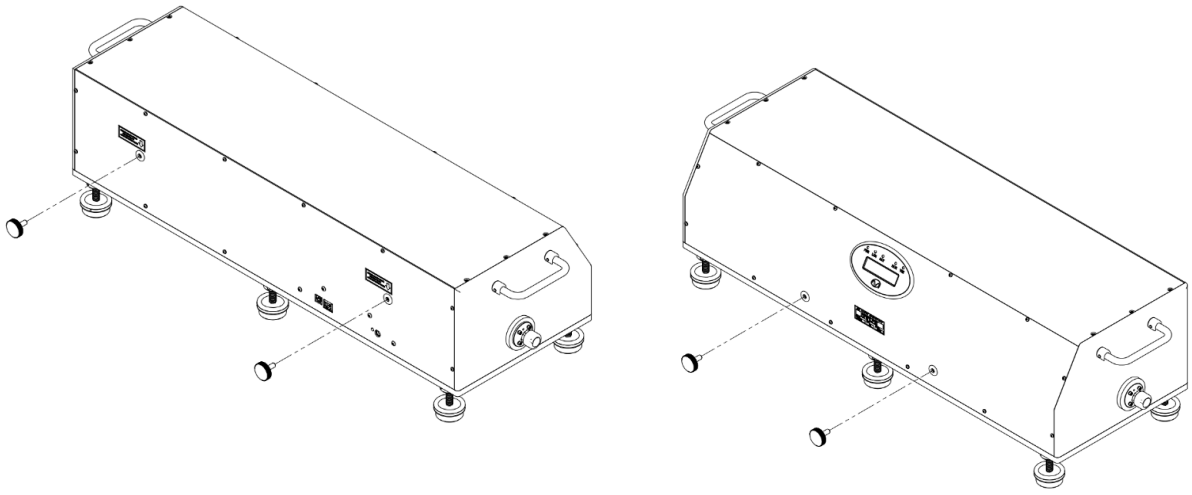


Figure A 1b. Packing Kit (wood crate)



Shipping position

Storage position

Figure A 2. Locking Screw Storage and Shipping Location

Data Sheet Resources

VNA Calibration Kits

https://maurymw.com/product-category/precision-calibration/vna-calibration-and-verification/calibration-kit/

Connector Gage Kits

https://maurymw.com/product-category/interconnect/tool/gage-kit/

Torque Wrenches

https://maurymw.com/product-category/interconnect/tool/torque-wrench/

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