

MESA[®] 2.0

MOBILITY ENHANCED SPECTRUM ANALYZER

User Manual



Research Electronics International, LLC

MESA® 2.0 DELUXE CASE CONTENTS



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*Item included in the MESA Basic, but case location may vary.



This document is intended to provide guidance and instruction on using the MESA 2.0 – Mobility Enhanced Spectrum Analyzer for finding hidden electronic devices.

This manual contains proprietary information intended solely for use with the MESA 2.0 product.

The overall effectiveness of this product, and of any surveillance countermeasure, is dependent on the threat level and the user's ability to properly use the appropriate equipment.

REI offers the world's largest commercially available Technical Security training facility. Training courses include classroom instruction and hands-on exercises where students perform sweep exercises in "live" environments utilizing *target-rich* project rooms. The progressive course curriculum is designed for the beginner or the seasoned Technical Security Technician.

Regularly scheduled courses are taught monthly; visit REI's website (www.reiusa.net) or contact REI (sales@reiusa.net) for training dates.

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REI products are designed and intended for legal commercial applications. However, because laws and regulations vary from state to state and country to country, it is the sole responsibility of the purchaser and user/operator to check and comply with all applicable laws and regulations for the possession and operation of this equipment before and after making a purchase.

Information contained in this manual including product operation and specifications is subject to change without notice.

Any product or brand names contained in this manual are used only for identification purposes and are trademarks or registered trademarks of their respective holders.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The Serial Number of each MESA is located on the back of the unit. Please record this number and refer to it whenever you contact your dealer or Research Electronics International concerning this product. Note: Removal or alteration of the serial number automatically voids all warranties of this product.


SERIAL NUMBER: _____



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Warnings and Cautions

MESA 2.0

- CAUTION: Any changes or modifications not expressly approved by REI could void the user's authority to operate the equipment.
- The MESA is for professional use only.
- For your safety do not use the MESA if:
 - The MESA cables or plugs become frayed or otherwise damaged.
 - The MESA housing is cracked or otherwise damaged.
 - You suspect that the unit requires servicing.
- Only use REI-approved power sources, batteries, chargers, and accessories. The supplied power supply is REI #R-00021 (Front Power #A481-1503000I). The supplied battery pack is REI #R-00001 (RRC Power Solutions #RRC-2040), a rechargeable Lithium-Ion battery.
- The slots in the housing of the unit are vents and are part of the ventilation system. Do not block these vents during the operation of the unit.
- The fan that is visible from the back of the unit is part of the ventilation system. The fan does not operate constantly but only as needed to reduce the internal temperature of the unit. Do not forcibly stop or disrupt the operation of the fan.
- Equipment is to be serviced by the manufacturer only. There are no serviceable parts inside. Contact your dealer or Research Electronics International, LLC for repairs. Opening the unit will void the warranty.
- If the equipment is used in a manner not specified in this manual, the protection of the equipment may be impaired.
- For your safety do not use the AC power adapter or the included USB cable if:
 - The cable becomes frayed or otherwise damaged.
 - The power adapter plugs are damaged.
 - The power adapter housing is cracked or otherwise damaged.
 - The power adapter is exposed to rain, liquid, or excessive moisture.

Lithium-Ion Batteries

- CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.
- For your safety do not use any MESA battery if:
 - The battery case is cracked or otherwise damaged.
 - The battery is excessively hot or warm for any reason.
- Avoid shorting the battery, immersing in water, or exposing to fire. Also, avoid excessive physical shock or vibration.
- Only use the specified REI battery chargers or products to charge REI batteries.
- There are no serviceable parts inside the battery. Contact your dealer or Research Electronics International, LLC for repairs. Opening or puncturing the unit can be dangerous and may result in injury.

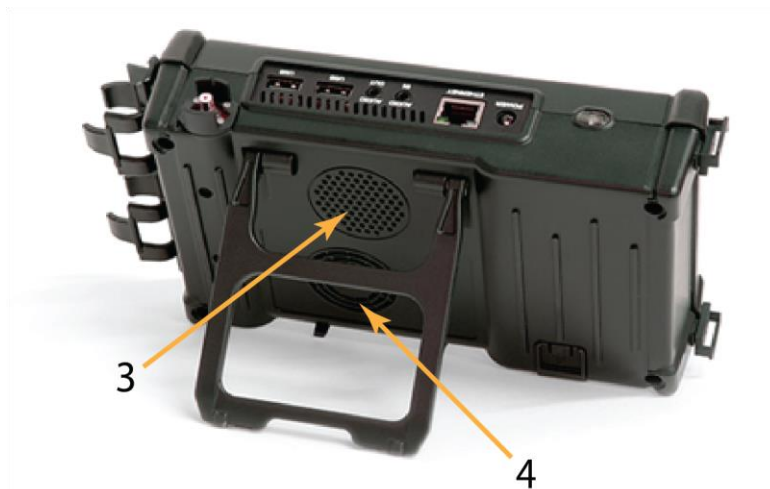
- Using the Lithium-Ion batteries in a manner not specified by this user's guide may override the equipment's built-in protection mechanisms.
- Keep out of the reach of children.
- Dispose of Lithium-Ion batteries in accordance with local regulations.

Equipment Description

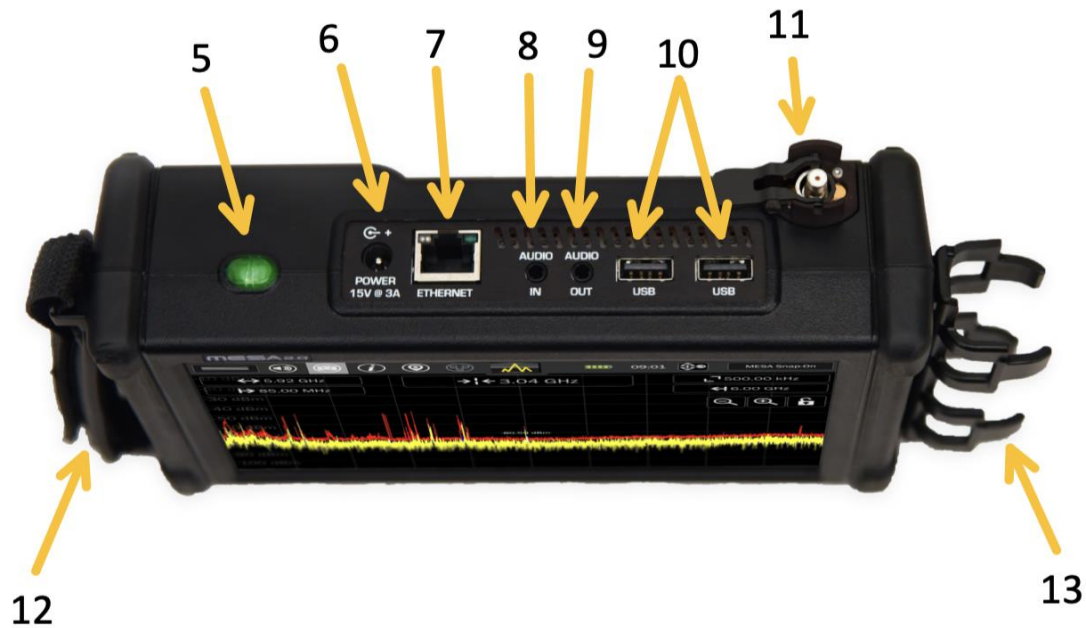
MESA® 2.0 Unit



- 1. Touch Screen Display - user interface for MESA
- 2. Battery Door (on the bottom of the unit) - conceals battery compartment



- 3. Speaker (on the back of the unit) - used to output audio from the unit
- 4. Fan - used for cooling unit



5. Power Button - turns the unit off and on
6. Power input - for AC adapter (only use REI-supplied AC Adapter)
7. Ethernet connector - Used to access the MESA unit remotely using VNC (Virtual Network Computing) 3rd party software
8. Audio Input - for connecting the Acoustic Leakage Detector and the Audio Transformer to test for the presence of audio. The Acoustic Leakage Detector and the Audio Transformer are included with the MESA 2.0 Deluxe package from REI.
9. Headphone Jack - for connection of headphones to monitor audio from the unit.
10. USB Port - for saving files from the MESA and for possible future use as probe/accessory control.
Note: Only a single USB thumb drive (see p. 116 for compatible formats) at a time is supported. Even if a USB hub is connected, only a single storage USB drive is supported.
11. QMA Connector (RF Input) with Quick Disconnect - for connecting the included REI antennas or other RF antennas
12. Hand Strap - to help support holding the MESA unit
13. Probe Grip - for clipping probe handles to the MESA unit

Cleaning and Maintenance

To prevent electrical shock, unplug the MESA from AC power and remove the battery.

For the display, wipe gently with a soft cloth. A small amount of ethyl alcohol or a neutral detergent may be used. Please exercise caution when handling hazardous chemicals.

For general cleaning and decontamination, use a damp cloth with a mild soap solution. For more thorough decontamination, a small amount of 70% isopropyl alcohol could be used.

Operation

The MESA 2.0 has been designed for quick and easy deployment. Depending on the application, some adjustments to the default setting may be needed.

The MESA 2.0 is a **swept** spectrum analyzer featuring a bar graph representation of the spectrum and is used to locate transmitters by monitoring the RF signal strength. When searching for unknown transmitters, it is advised to remove or disable any known transmitters from the target sweep area (i.e., unplug, turn off, or remove any wireless transmitting devices including Wi-Fi and Bluetooth devices, laptops/PCs, mobile phones, wireless transmitting devices, etc.), as any transmitting devices can hinder detection of unknown transmitters.

Setup & Use

A hand strap is provided on the side of the MESA. When using the product in a hand-held manner, hold the unit securely by sliding a hand under the hand strap and gripping the side of the unit. The hand strap and probe grip can be swapped if preferred.

A built-in stand is provided to allow for hands-free support on a tabletop or surface. To release the stand, pull the bottom of the stand away from the MESA unit until it releases from the built-in clips. Continue extending the stand to its furthest position. Place the MESA on a sturdy, level surface resting on its back edge and the stand.



Inserting the Battery

The battery-operated MESA provides for truly hand-held, portable spectrum analysis. To insert a battery:

1. Locate the battery door latch on the rear of the MESA near the bottom edge of the unit.
2. Supporting the MESA unit with both hands, place a thumb on the battery door latch.
3. Simultaneously press on the battery door latch while sliding it away from the unit.
4. Once the battery door is lifted, place a thumb under the edge of it and open it up fully.



5. Slide the battery into the battery slot observing proper contact alignment. Press until the battery is fully seated. Do not force the battery into the slot; resistance may indicate improper battery alignment.
6. Close the battery door until the edge lines up with the lip on the battery door latch. Then place fingers and thumb on both the battery door and the latch and press them close together.

Power Control and Charging

To turn on the MESA unit, ensure that a charged battery is in the unit or connect the supplied AC adapter and press and hold the power button (see page 8) until it begins flashing. During operation, to turn off the MESA unit, press and hold the power button until the "Power Off" graphic appears on the screen.

Press and hold the power button for 8 seconds or more to perform a firmware reset. This method should **only** be used if the unit has locked up and the normal shutdown method is not functioning.

The MESA unit has a built-in battery charger. The MESA unit will automatically begin charging an inserted battery if the AC adapter is connected. Plug the AC Wall adapter into the power outlet and then plug the connector into the port labeled "Power" on the top of the MESA.

Note: If the operating temperature of the unit is elevated, above 37 degrees C, the battery charging will not begin until the temperature drops below 37 degrees C.

Note: It is recommended that the MESA battery be recharged regularly during extended periods of storage (3 months or more) to prevent damage to the battery. Additionally, when storing the MESA for long periods (1 month or more), it is recommended that the battery be removed from the unit and placed in the storage compartment in the case. Storing the MESA with the battery in the unit can deplete it more rapidly, potentially shortening the life of the battery.



MESA® 2.0 Packages

The MESA 2.0 is available in two packages (Basic and Deluxe) with varying probes, antennas, and accessories. Below is a chart showing which probes, antennas, and accessories are included in each package (note that this is subject to change). Additional information can be found in the Probes, Antennas, and Accessories section on the following pages.

Probes/Accessories	MESA 2.0 PACKAGES		
		BSC	DLX
	Fixed Dipole Antenna (85 MHz - 6 GHz)	X	X
	Whip Antenna (30 MHz - 6 GHz)	X	X
	MCP Multi-Carrier Probe (100 kHz - 60 MHz, 5 MHz - 2 GHz)	X	X
	VLF Loop Antenna (10 kHz - 30 MHz)	X	X
	Batteries (2)	X	X
	Down Converter Antenna (500 MHz - 12 GHz)		X
	Directional Antenna (70 MHz - 500 MHz)		X
	Locator Probe (20 MHz - 6 GHz)		X
	Visible Light / Infrared Probe (10 kHz - 50 MHz)		X
	Visible wavelength (400 - 1100 nm)		
	IR wavelength (750 - 1100 nm)		
	Ultrasonic Probe (15 kHz - 80 kHz)		X
	Audio Transformer (300 Hz - 20 kHz)		X
	Acoustic Leakage Detector (300 Hz - 20 kHz)		X
	GPS Adapter		X

Probes, Antennas, and Accessories

Fixed Dipole Antenna (85 MHz - 6 GHz)

The Fixed Dipole Antenna is a versatile, omnidirectional antenna that connects directly to the MESA unit without the need for cables.



Whip Antenna (30 MHz - 6 GHz)

The Whip / Dipole is a versatile, omnidirectional, near-field probe used for locating RF transmitters up to 6 GHz.



MCP Multi-Carrier Probe (100 kHz - 60 MHz, 5 MHz - 2 GHz)

The MCP (Multi-Carrier Probe) extends the functionality of the MESA with the addition of different connectors to allow for the analysis of suspicious signals: an AC power plug and coaxial connectors.

To use the AC power plug, the "MCP (AC Carrier Current)" option must be selected in the Input Info window (see page 20). To use the coaxial connectors, the "MCP (Coax)" option must be selected in the Input Info window.

The MCP can be used to test for carrier current signals on any pair of conductors less than 250 volts. Before testing an unidentified pair of power conductors, a voltmeter should be used to measure the voltage across the conductors. If this voltage exceeds 250 volts, do not test with the Carrier Current Probe. Two power plugs are included for connection to US-style or Euro-style outlets. The included alligator clip cable assembly should only be used on 50V or less. Measurements can be made with three different pair configurations using the switch on the front of the carrier current probe: Hot/Neutral, Neutral/Ground, and Hot/Ground.



Due to power line noise and the broad frequency range that MESA searches, every outlet in an area should be inspected.

The coaxial connectors on the MCP can be used to test for suspicious signals on coaxial cables. The MCP can be used to make both in-line measurements and single-ended measurements. For in-line measurements, connect one side to the Coax Input. The same signal will be output at the Coax Output connector. For single-ended measurements, connect to the Coax Input connector.

VLF Loop Antenna (10 kHz - 30 MHz)

The VLF Loop Antenna is an omnidirectional antenna used for locating low-frequency signals below 30 MHz.



Down Converter Directional Antenna (500 MHz - 12 GHz)

The Down Converter Antenna is a directional antenna that operates in 2 user-selectable bands:

Band 1: 500 MHz - 6 GHz

Band 2: 6 GHz - 12 GHz

When using Band 2, the Down Converter Antenna converts signals occurring above the standard 6 GHz threshold so they can be detected and displayed on the MESA. For details on operation, see page 114.



Directional Antenna (70 MHz - 500 MHz)

This flag-shaped antenna provides directional coverage for lower-frequency signal detection. It is a powered probe and must be used with one of the powered connector cables (see page 19).



Locator Probe (20 MHz - 6 GHz)

The Locator Probe is omnidirectional and is attenuated for use in high RF environments and for locating an RF signal to within a few inches.



Visible Light / Infrared Probe (10 kHz - 50 MHz)

Visible (400 -1100 nm)

IR (750 – 1100 nm)

The Visible Light / Infrared Probe can be used for detecting the presence of IR or visible light. This probe is a powered probe and must be used with one of the powered connector cables (see page 19).



Ultrasonic Probe (15 kHz - 80 kHz)

The ultrasonic probe detects sound waves operating above the upper limit of human hearing capabilities. The ultrasonic probe is a powered probe and must be used with one of the powered connector cables (see page 19).



Audio Transformer (300 Hz - 20 kHz)

The Audio Transformer is a balanced audio coupler to provide electrical isolation for audio testing. A 3.5 mm stereo to 3.5 mm stereo cable is included with the MESA to connect the audio transformer to the MESA. Two push buttons provide a positive and negative bias voltage to the two banana jacks on the audio transformer. The control knob on the audio transformer adjusts the level of the applied bias voltage from 0 to 22 volts. An included set of banana jack test leads with bed-of-nail alligator clips allow the audio transformer to be used on 66 blocks or other wires.



Acoustic Leakage Detector (ALD) (300 Hz - 20 kHz)

With the Acoustic Leakage Detector, the operator can determine the vulnerability of acoustic leakage by placing the probe against structural objects such as walls or windows. The Acoustic Leakage Detector connects to the Audio Input on the MESA.



GPS Adapter

The GPS Adapter is used to obtain GPS coordinates. If the GPS Adapter is connected and enabled, the MESA will tag saved files with the GPS coordinates and will store GPS coordinates for the signals in a signal list. For additional information on storing GPS information, see page 23.



Audio Transformer Batteries

The audio transformer, which is an accessory probe included with the MESA 2.0 Deluxe package, requires two A23C batteries, which are customer replaceable.

To replace the audio transformer batteries:

1. Using a Phillips head screwdriver, remove the two screws from the back of the audio transformer.



2. Locate the two A23C batteries and replace, being careful to observe the polarity marked on the unit.



Connecting the Antenna & Probes

The MESA 2.0 Basic and Deluxe packages include connector cables for connecting probes and antennas.

Powered Connector Cable (only included with the MESA 2.0 Deluxe)

The powered connector cable is included with the MESA 2.0 Deluxe package and is required to operate the flag-shaped Directional Antenna (70 MHz - 500 MHz), the Down Converter Antenna, the visible light / infrared probe, and the Ultrasonic probe. Other passive probes included with the MESA 2.0 Deluxe will also work with the powered connector cable. The powered connector cable has a pin on each end that transfers power to the powered probes. When connecting the powered connector cable to the MESA 2.0, it is important to align the power pin on the cable with the power contact pad on the MESA 2.0 for the connector to snap into place.

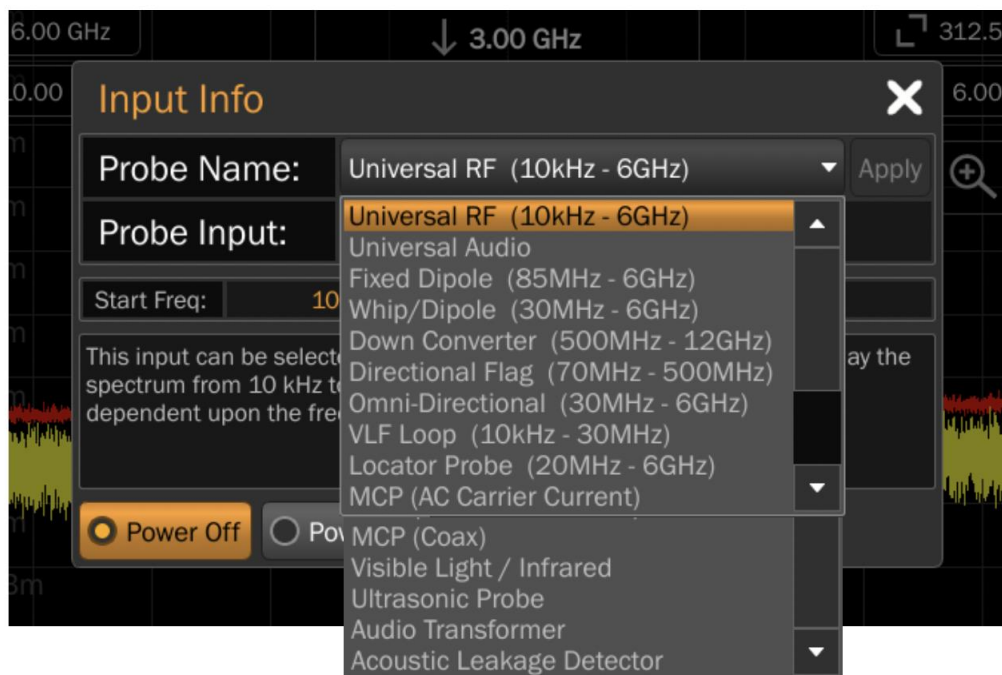


Note: When disconnecting the powered connector cable, **pull from the cable release for leverage**. Do not pull from the cable. Doing so could damage or shorten the life of the cable. It is not necessary to power off the MESA 2.0 when changing probes/antennas. The MESA 2.0 provides a quick-release mechanism to help with removing cables. Press down on the quick-release lever while simultaneously pulling from the cable release for leverage.

Manual Selection of Probes

The MESA detects any REI-supplied antenna or probe that is connected and will automatically adjust the MESA settings, such as span or default mode, for best working with that probe.

The MESA will also allow manual selection of the probe connected.



To manually select a probe:

- 1) Tap the Input Select button in the upper right-hand corner of the screen. This is the button that displays the currently connected probe name. The Input Info window will appear.
- 2) Select a probe/antenna from the Probe Name drop-down box.*
- 3) Press "Apply" next to the Probe Name drop-down box.

*The **Universal RF** is the only manual mode that allows for selection between **Power Off** or **Power On**

Please note: The list of probes and antennas in the **Probe Name** drop-down may have items not included with the purchased MESA 2.0 package.

Caution: REI advises using a blocking capacitor when using 3rd party probes to avoid any negative effects from the small bias voltage that the MESA uses in its probe identification system.

Display Screen Layout



1. Cursor — small down-arrow marking a position in the spectrum. The frequency of the cursor is indicated by the Cursor Frequency box (top middle). The power level at the current cursor position is indicated by the value just above the cursor.
2. Start Frequency — tap the start-frequency value opens a dialog box to set the start frequency. Allowable start frequencies depend on the connected REI probe.
3. Frequency Span — tap the frequency span value to open a dialog box controlling the frequency span. Enter a value (using keypad) and press one of the *unit* keys (kHz, MHz, GHz) to initiate the change. If no change is desired, press the "x" in the (upper right) to close the dialog box. Minimum span is 25 kHz. The maximum span is dependent on the connected probe.
4. Cursor Frequency — The cursor frequency box displays the frequency value of the current cursor position. Tapping the cursor frequency box will open a dialog box that allows precise setting of the cursor position. Doing this will also re-center the screen on the cursor.
5. Resolution Bandwidth — This box displays the current resolution bandwidth value. This value is not manually adjustable. The MESA automatically sets the resolution bandwidth based on the frequency span. The smaller the span, the finer the resolution bandwidth will become.
6. Stop Frequency — when tapped, a dialog box will appear to allow the setting of the stop frequency. Allowable stop frequencies will depend on the REI probe connected.
7. Lock Screen — Press to lock the screen. A second press will unlock the screen. This feature locks the spectrum portion of the display to prevent accidental changes to the cursor or span. All

functions in the status bar will continue to work with the screen locked. Press and hold the lock symbol for at least 5 seconds to initiate Locked Monitor Mode. Locked Monitor Mode enables the MESA to be locked for overnight or extended monitoring to keep others from tampering with the device or settings. For additional details on Locked Monitor Mode, (see page 98).


8. Zoom Out (expand frequency span) — expands the displayed frequency span.
9. Zoom In (narrow frequency span) — narrows the displayed frequency span.

Status Bar


The status bar consists of a row of icons across the top of the screen. These provide quick access to information or settings for the MESA.




Mode Settings Menu

 The mode settings menu contains features and settings specific to the mode the MESA is in. This menu will vary with each mode selected on the MESA.


Volume Control

 Tapping this icon will bring up the volume control. The control will disappear after a few seconds if there is no activity or can be tapped to make it close.


Options for Audio Demod (see page 42) and the I/Q Recorder (see page 41) are also found in the Volume Control. These are grayed out and unusable until the frequency span is 14 MHz or less.

 Press and hold this icon to quickly mute the audio. Press and hold the icon again to return the audio to the previously set volume and to access the volume control.

Screenshot

 Tapping the camera icon in the status bar will take a screenshot and save it to the unit in .jpg format using an automatically generated file name based on a header specified by the user (see page 117). The captured screenshot can be viewed on the MESA using the Image Viewer (see page 96) or from any PC. The camera icon is grayed out when a USB thumb drive is not inserted in one of the ports. USB thumb drives need to be formatted with either FAT32 or exFAT – see note on page 116.

Help

 Tap the Help icon to access information on operating the MESA. The Help feature displays information specific to the currently selected Mode.

GPS Location



When the MESA is receiving GPS coordinates it will tag saved files with GPS information. It will also tag signals in signal lists with GPS coordinates.

	Live	Saved
Latitude:	36.109080°	
Longitude:	-85.493700°	
Altitude:	315.60 m	

HDOP: 1.53
Satellites in View: 8
Reception Strength: Strong
Up Time: 00:06:30

Always Use Live Data ☐ High Contrast View Save Clear

Note: In order to receive GPS coordinates, the GPS Adapter (see page 18) must be inserted into one of the MESA's USB ports. To improve GPS reception, especially on cloudy or overcast days, use a USB extender cable to physically locate the GPS adapter further from the MESA unit.

The MESA provides several options for determining the accuracy of the received coordinates.

- HDOP - Horizontal Dilution of Precision is a value used in satellite navigation to represent positional precision. The smaller the number, the more precise the Latitude & Longitude coordinates are.
- Satellites in View: This is the number of satellites from which the MESA is receiving positional data.
- Reception Strength: Using HDOP & the number of satellites in view, the MESA will estimate the quality of the coordinates received. Possible values for Reception Strength are Weak, Fair, and Strong.

The MESA provides a High Contrast View of the GPS screen to help with viewing the screen outdoors in sunlight. To access the High Contrast View, press the High Contrast View button at the bottom center of the GPS screen. To return to the Normal View, press the Normal View button.

Note: It may take up to 20 seconds after selecting High Contrast View for the display to change

	Live	Saved
Latitude:	36.109048°	
Longitude:	-85.493823°	
Altitude:	331.00 m	

HDOP: 3.21
 Satellites in View: 6
 Reception Strength: Fair

Up Time: 00:05:41


Always Use Live Data ☐ Normal View Save Clear

GPS coordinates are not very well received indoors. For this reason, the GPS location feature enables the user to use saved GPS coordinates for tagging saved data and signals. To use Saved GPS Coordinates:


- 1) At an outdoor location near the site, tap the GPS Location icon.
- 2) Wait until the MESA has acquired Live GPS Coordinates. This may take a few minutes. It is best to wait until the Reception Strength indicator says "Strong".
- 3) Uncheck the "Always Use Live Data" checkbox.
- 4) Press "SAVE". The current Live GPS Coordinates will be copied to the Saved GPS Coordinates. The MESA will now use these coordinates to tag saved files and to tag signals in the signal list.
- 5) Tap the "X" in the upper right-hand corner to close the GPS Location Dialog Box

Note: From a cold start, it is not unusual for it to take several minutes to locate satellites and establish GPS coordinates. On cloudy or overcast days it may take even longer. It is strongly advised to acquire GPS coordinates once and use the Save feature described above to tag all saved files at a single location.

Network Status and Setup

 Tap the Network Icon to access the Network Status and Setup dialog. There are several tabs in the Network Status and Setup to assist with configuring network settings for the MESA. For further details see Network Configuration on page 99.

Battery Life

 The battery icon provides a visual representation of the remaining battery life. Tap the icon for additional details.

The MESA unit can also be powered off from this screen.



Setting the Time Zone, Date, and Time

14:39 Having accurate time and date information on the MESA is critical for ensuring that the timestamps on saved files and signal lists are accurate and reliable.



Tapping the time display in the status bar will open a small dialog box with the date. Press "Edit" in this dialog box to set the time zone, time, & date for the MESA.

The screenshot shows the MESA application interface with a date/time dialog box open. The dialog box has a calendar view for January 2030. The date "Friday, 18 January 2030" is selected. The time is set to "09:52:09 CST". The time zone is "United States/America/Chicago CST". The dialog box also includes a "Cancel" button and an "OK" button. The background shows the same spectrum plot as the previous screenshot.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Hour (24): + 9 -

Minute: + 52 -

Time Zone: United States/America/Chicago CST

Friday, 18 January 2030 09:52:09 CST

Cancel OK

Attenuator/PreAmp



Since the MESA is a highly sensitive receiver, very strong signals can have an overloading effect on the circuitry. Receiver overload is evidenced by strong signals appearing at harmonic frequencies and/or from intermodulation distortion. The built-in attenuator should be turned on to reduce or eliminate the RF overload.

Also, in certain situations when dealing with low-level signals which are partially obscured by the noise floor, it may be necessary to boost the signal strength. This is accomplished by using the built-in pre-amp provided on the MESA unit.

To apply attenuation or boost the signal strength, tap the Attenuator/PreAmp icon in the status bar. Select the desired attenuation/preamp level from the drop-down list.

The Auto Attn setting uses an algorithm to monitor the signal strength and automatically apply attenuation or the pre-amplifier as necessary.

Modes

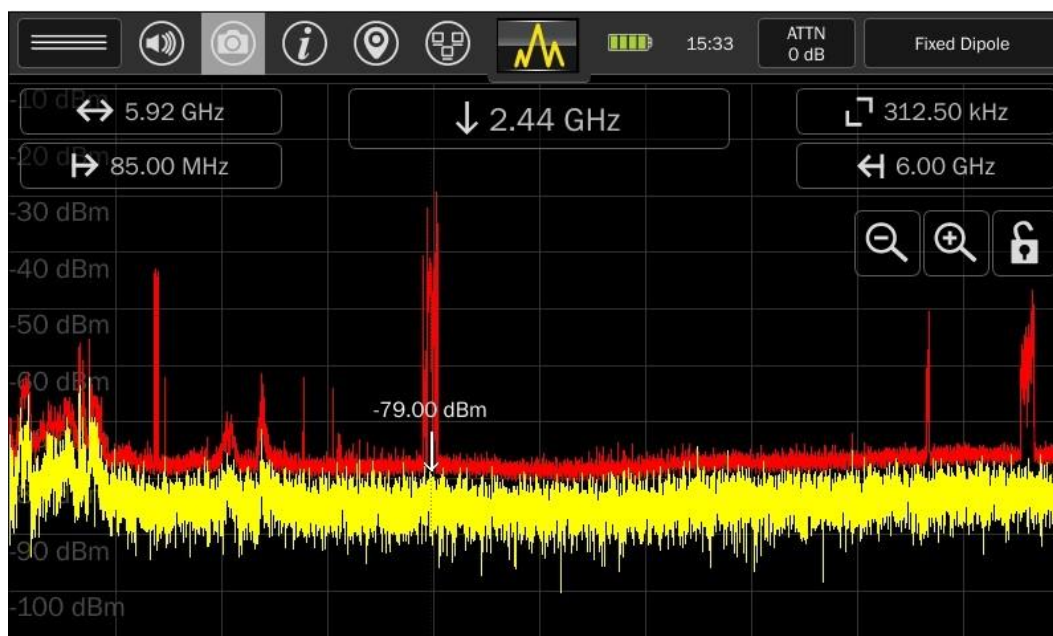
Mode Menu



The Mode Menu, located at the top center of the screen, enables switching between the five main operating modes of the MESA: Spectrum Mode (see below), SmartBars Mode (see page 44), Mobile Bands Mode (see page 55), WiFi Mode (page 65), and Bluetooth Mode (page 81).


Spectrum Mode

Spectrum Mode on the MESA allows easy monitoring of the RF spectrum and analysis of found signals. This section describes the controls for navigating the spectrum and tools necessary for analyzing signals.



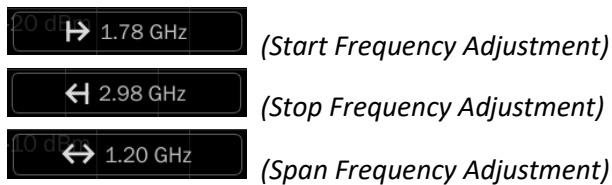
Navigating Spectrum Mode

The MESA unit is capable of scanning and displaying a large portion of the RF spectrum. To fully analyze the RF energy in a given location, it may be necessary to focus on smaller portions of the RF spectrum at a time. This can be accomplished by using one of several available methods:

1. Double-tap to Zoom In - Double-tap anywhere on the spectrum to zoom in with the spectrum centered around the frequency tapped on
2. Zoom In/Out using the Zoom In/Out on-screen buttons  press the Zoom In and Zoom Out on-screen buttons to zoom in or out. When zooming in, the center frequency will remain the center frequency. When zooming out, the center frequency will remain the center frequency, if it can be centered at the new frequency span. If not, the center frequency will become the center frequency of the new span. Press and hold the Zoom In button to jump to a 500 kHz span. Press and hold the Zoom Out button to jump to the maximum span supported by the connected probe.
3. Click & Drag - Pan: If the spectral display is not currently set to maximum span, clicking on the right side of the spectral display, and dragging to the left will pan the spectral display to higher frequencies. Clicking on the left side of the spectral display and dragging to the right will pan the spectral display to lower frequencies. The SPAN parameter will remain constant, but the START and STOP parameters will change as the spectral display pans.
4. Click - Cursor Move: Tap with a finger anywhere within the spectral display to move the cursor to that frequency. For a brief moment, the cursor will appear as a vertical line stretching from the top of the screen to the bottom of the screen to make the cursor easier to see. However, upon lifting finger from the screen, the cursor will again become a short, down-ward facing arrow.
5. Click & Drag - Cursor Adjust: For slightly finer adjustment control of the cursor movement, tap anywhere on the screen and hold until the vertical line cursor becomes a thicker vertical line. With the cursor displayed as a thick vertical line, move finger to the left or right to adjust the cursor. This method of adjusting the cursor is affected by the Snap-to-Peak feature.
6. Snap-to-Peak: If the Snap-to-Peak feature is enabled, the cursor will automatically snap to a nearby peak in the live trace (when the cursor is released) after adjusting the cursor position by using the clicking and dragging method. The feature is enabled by default but can be enabled or disabled in the System Menu (see page 118).
7. Cursor Adjust: For the most precise cursor adjustment, tap the Cursor Frequency box at the top



center of the spectrum to open the Cursor Frequency dialog. Enter a new frequency for the cursor. The cursor will move to the new frequency with the screen centered on the cursor.



8. Start/Stop/Span Frequency Adjustment: Entering a frequency value in the Start Frequency, Stop Frequency, or Frequency Span dialog boxes will also change the frequency display accordingly.

Please note: Electronic equipment can have internally generated Electromagnetic Interference (EMI) leakages from clock signals, power supplies, or other electronic circuitry which may be seen in the spectrum analyzer display as low-power, very narrow signals. REI uses internal shielding to minimize these false spurs, but they may be visible when zoomed in to very narrow resolution bandwidths.

Cached Peaks

As the spectrum is zoomed in on, the resolution bandwidth will change. It is not possible to maintain peaks while zooming in due to the changes in resolution bandwidth. The MESA includes the feature, cached peaks, to enable viewing of peaks obtained at previous resolution bandwidths.

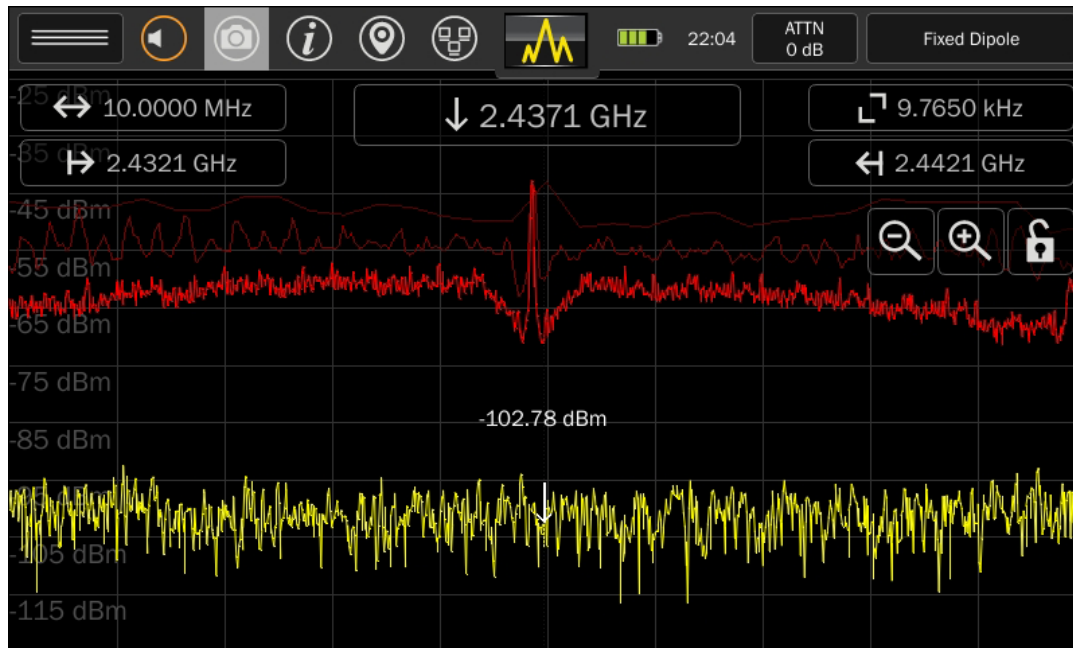


To enable cached peaks:

- 1) In Spectrum Mode, select Cached Peak from the Mode Settings Menu. When the Cached Peak feature is enabled, this button will be highlighted orange.

To view cached peaks:

- 1) After enabling cached peaks, connect an antenna or probe that supports nearly the full 6 GHz bandwidth of the MESA, such as the Fixed Dipole Antenna.
- 2) Notice at full span, the resolution bandwidth is 312.50 kHz. Zoom in 2 times using the Zoom In onscreen button.



- 3) Notice that the resolution bandwidth has now changed to 39.0620 kHz. Note the faint red line above the peak trace. This is the cached peak trace from the 312.50 kHz resolution.
- 4) Zoom in 2 more times using the Zoom In button. Notice that the resolution bandwidth has now changed to 9.7650 kHz. There are now two faint lines above the peak trace. The lightest one, with the highest noise floor, is the cached peak from the 312.50 kHz resolution. The slightly darker one with the lower noise floor is the cached peak from the 39.0620 kHz resolution.

Note: The 312.50 kHz resolution cached peak and the 39.0620 kHz cached peak are the only peaks that are cached. Continued zooming will result in increasingly finer bandwidth resolutions, no other cached peaks will appear.

Note: The noise floor of the cached peaks will be significantly higher than that of the active trace and peak trace. This is because the cached peak was collected at a coarser bandwidth resolution. These will also appear more segmented for the same reason.

Mode Settings

The mode settings menu can be opened from the top left button on the screen by tapping the drawer icon in the status bar. The settings available in this menu will change depending on the Mode that the MESA is currently in. Here are the settings available in Spectrum Mode.



System Menu

This option provides access to system settings such as brightness, software version, image viewer, audio player, network settings, prefix settings, ITU region, power-down cache, snap-to-peak, settings export, settings import, and factory reset. For additional information see page 117.

Peak

This option toggles the display of the peak trace. The peak trace is the red trace.

Clear Peak

This option clears the peak trace and begins collecting a new peak trace.

Cached Peak

This option enables/disables the cached peak display as described above.

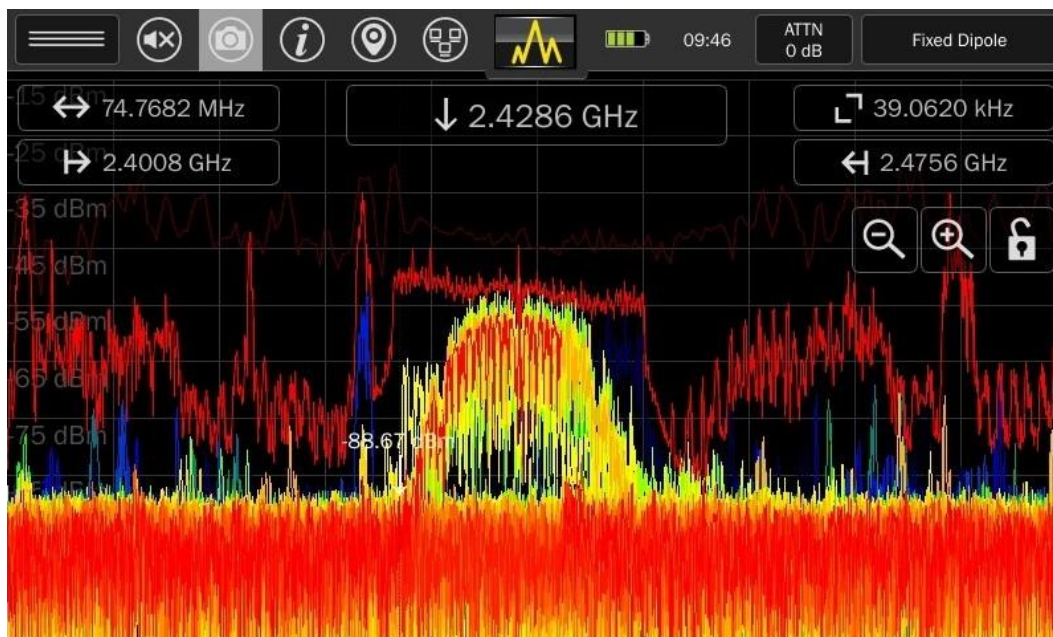
Average

This option toggles the display of the average trace. The average trace is created by averaging a specified number of real-time traces. The average trace is displayed as a blue trace.

When first selected, the Average Peak option will temporarily display a slider bar to custom set the number of traces to be averaged. (The range option is 2-64 with a default of 16.) Move the slider bar to select the desired number. The bar will disappear after a few seconds.

Persistence Trace

This option toggles the display of the persistence trace. The persistence trace displays the trace data from each sweep of the receiver using fading colors to indicate how frequently and recently each signal was encountered. Transient signals are displayed in darker colors (blues & greens) and fade quickly, whereas more permanent or persistent signals are displayed in brighter colors (reds and yellows). This enables the user to easily identify transmit signals even when surrounded by multiple transient signals or noise.

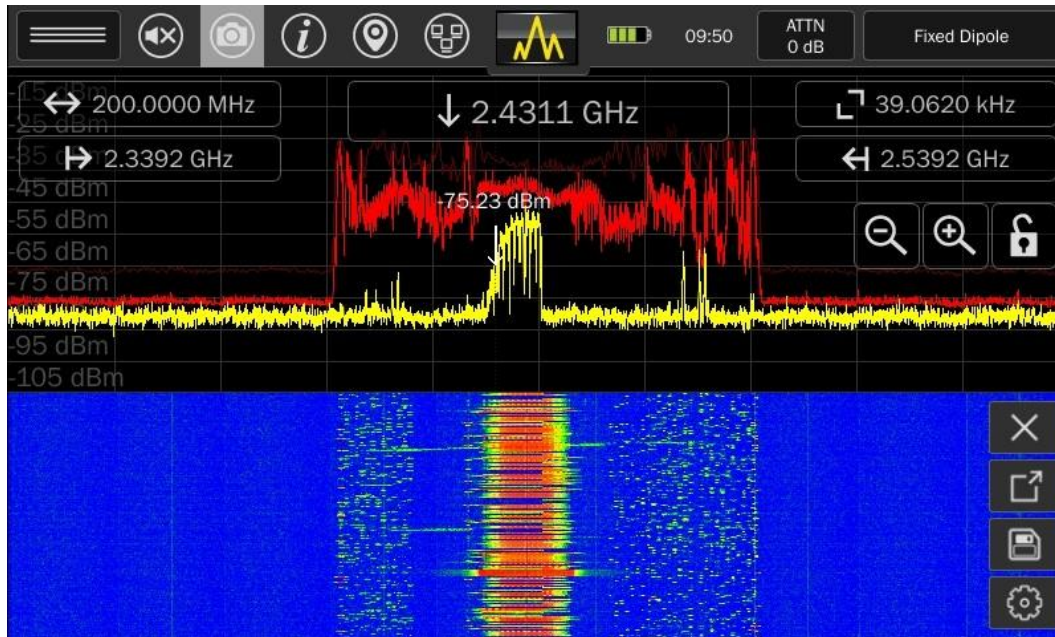


Note: The Persistence Trace option is only available in the Mode Settings Menu at spans of 200 MHz and below.

Note: The persistence trace update rate will begin to get noticeably slower at spans less than 500 kHz. This is normal. This is because a longer dwell time is necessary at smaller spans to perform the acquisitions needed for the persistence trace display.

Waterfall

This option toggles the display of the waterfall. The waterfall captures a series of traces and displays them in a waterfall format. This is a quick way to observe the RF spectrum over a period of time and easily identify intermittent transmissions such as burst transmitters.



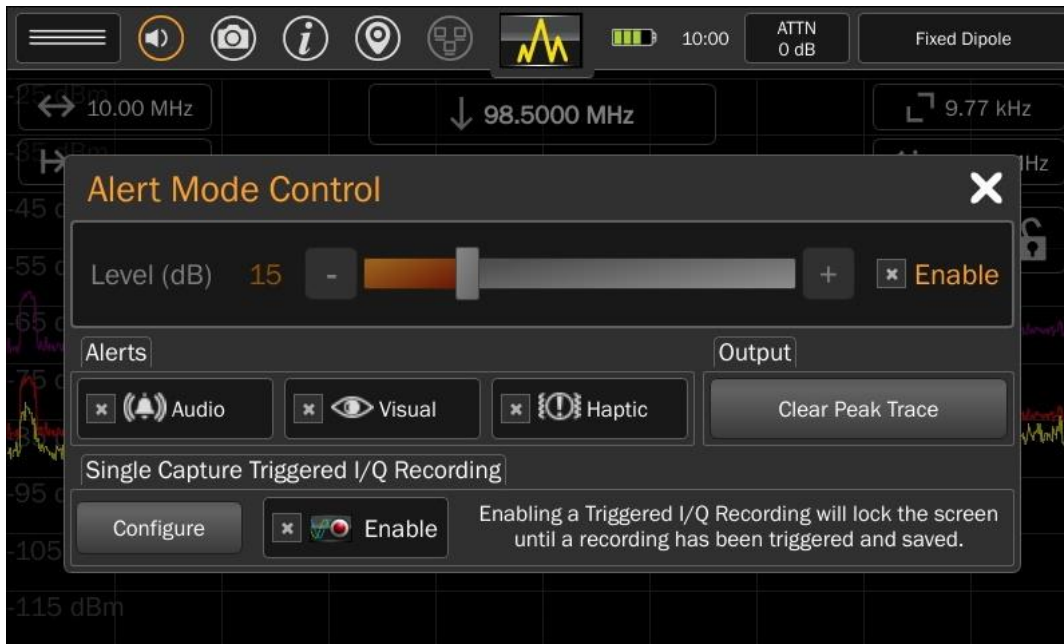
The following options are available from the Waterfall sidebar:

- Press the "x" to close the Waterfall display
- Press the *Full-Screen* button to view the waterfall full screen on the MESA display
- Press the *File Dialog* button to save an image of the waterfall to an inserted USB thumb drive (see note on p. 116)
- Press the *Configuration* button to change the number of lines updated per second for the waterfall image.

It is also possible to scroll down to view past traces in the waterfall by tapping and dragging the waterfall.

Alerts

This option enables alerts whenever the signal level monitored exceeds a specified threshold. Three types of alerts are available: audio alerts, visual alerts, and haptic alerts.



When the alert feature is selected from the mode menu, a dialog box appears. The following adjustments are available from the dialog box:

Threshold Level - Use the slider bar to set how far above the peak trace a signal should be before it triggers an alert. To begin receiving alerts, check the enable box beside the threshold level adjustment. The threshold level must be adjusted before the enable box is checked.

Audio - Check the Audio box to enable audible alerts. A tone will sound anytime that the threshold is crossed by the live trace.

Visual - Check the Visual box to enable visual alerts. A marker will appear at each point that the threshold is crossed.

Haptic - Check the Haptic box to enable haptic alerts. Haptic feedback will be felt anytime that the threshold is crossed by the live trace.

Clear Peak Trace - This button will clear the current peak trace. If the threshold level has already been enabled, it will not be affected by clearing the peak trace. If the peak trace is cleared before enabling the threshold, the threshold level will be based on the cleared peak. It is best to allow a peak to collect for a while before enabling the threshold level.

Single Capture Triggered I/Q Recording

The MESA 2.0 is capable of capturing and recording the in-phase and quadrature components of a signal (I/Q Data) in order to analyze those signals with other test equipment. When used with the Alerts feature on the MESA 2.0 it is possible to trigger the I/Q Recording based on an event tripping the set threshold level.

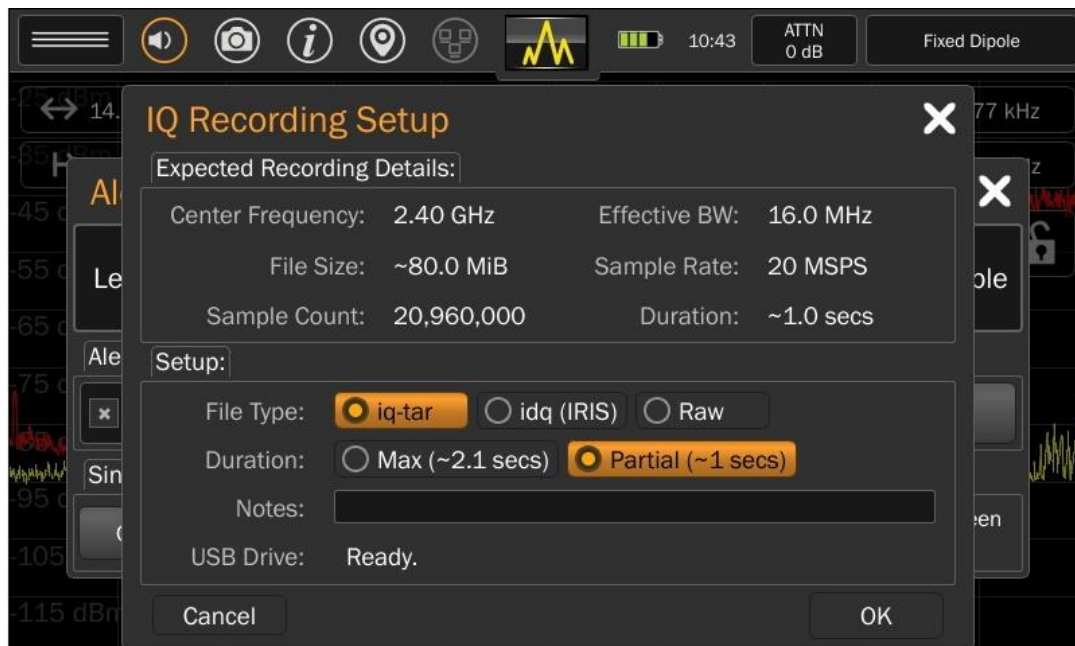
To enable the I/Q Recording feature, the frequency span of the MESA 2.0 must be 14 MHz or less and a USB drive with available space must be inserted into the USB port. (See p. 116 note on supported file systems.)

It is also necessary to select *both* the enable checkbox beside the threshold adjustment *and* the enable box in the Single Capture Triggered I/Q recording section.

After closing the Alerts dialog, MESA 2.0 will begin monitoring for any signal to trip the set threshold. During this time the screen is automatically locked to prevent changes to the frequency span, as this could result in mixed sample rates in the IQ recording buffer.

Once triggered, it is necessary to re-enable the single capture triggered I/Q Recording from the Alerts dialog if further triggered I/Q Recordings are desired.

To adjust the settings for I/Q Recording, press the configure button on the Alert Mode Control dialog. (These settings are also available from the Mode Settings Menu when the frequency span is 14 MHz or less.)



Three possible file types are available for the I/Q Recording files: iq-tar, idq (IRIS), & Raw.

- iq-tar (default): a binary format that includes meta-information (e.g. sample rate) about the data. The iq-tar container packs several files into a single .tar archive file. The iq-tar files can be read by equipment that supports Rohde & Schwarz's iq-tar format.
- idq (IRIS): able to be read by the IRIS Spectrum Software available from Transformational Security (www.powerfulsecurity.com).
- Raw: Same as the iq-tar format but with no metadata nor any 'tar' packaging.

There are two duration options available:

- Max: Will record at the maximum IQ buffer size up to 10 seconds.
- Partial: Will record at half the maximum.

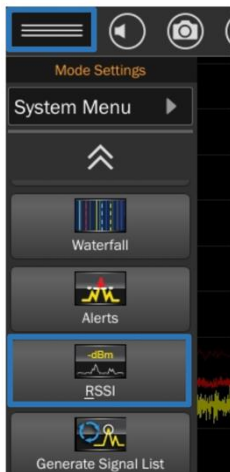
The available duration for each option depends upon the frequency span of the spectrum. To increase the available durations, decrease the frequency span. The max available duration is 10 seconds.

A "notes" field is provided to enable the user to add up to 256 characters of text to be included with the iq-tar file format. The user notes field is only supported by the iq-tar format; the user notes field is not accessible if either the idq (IRIS) or the Raw formats are selected.

RSSI

The MESA includes an RSSI locating feature to aid in narrowing down the physical location of a bug. RSSI stands for Received Signal Strength Indicator.

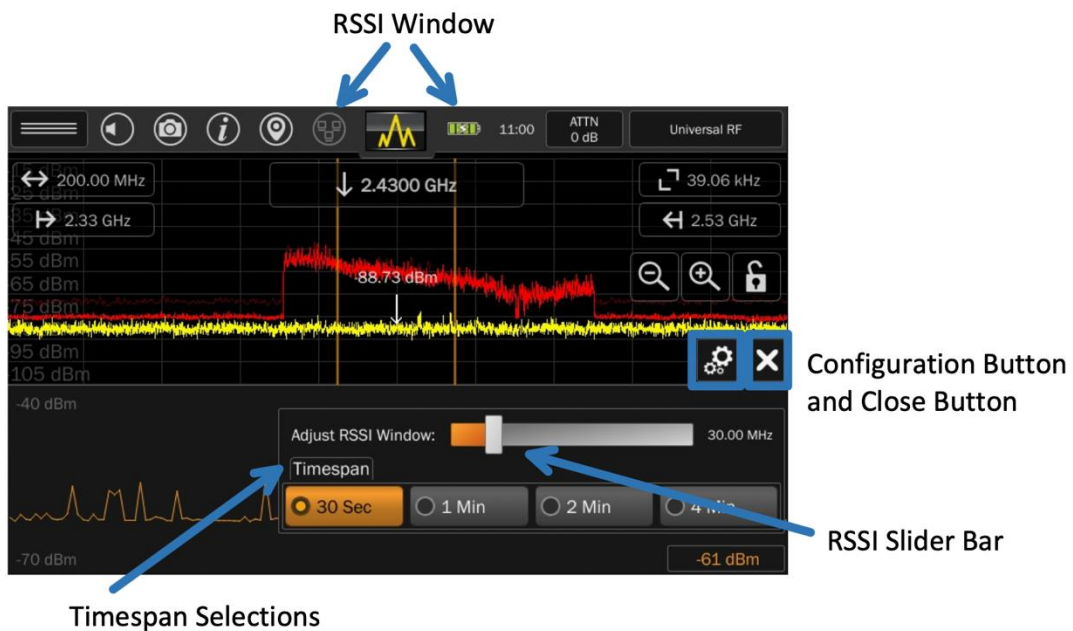




The RSSI option in the Mode Settings Menu turns the RSSI feature on.

The spectrum portion of the graph will be compressed and displayed on the top half of the screen. The RSSI feature will be displayed on the bottom half of the screen.

The two vertical lines in the spectrum (pictured below) represent the RSSI Window or the area of the spectrum whose relative signal strength is represented by the RSSI graph. The spectrum can be panned or zoomed in/out to adjust the frequency span being monitored.



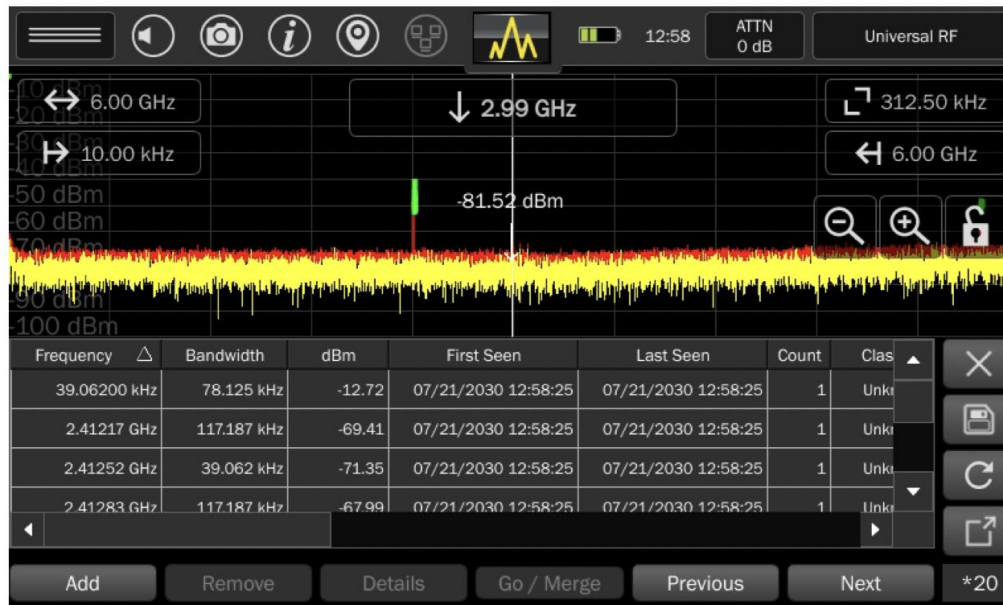
The RSSI Window can be adjusted by tapping/selecting the *Configuration* button in the RSSI graph. Use the slider bar to adjust the window.

The amount of time represented in the horizontal span on the graph can be adjusted by tapping the *Configuration* button in the RSSI graph. Select the desired time option by tapping the button.

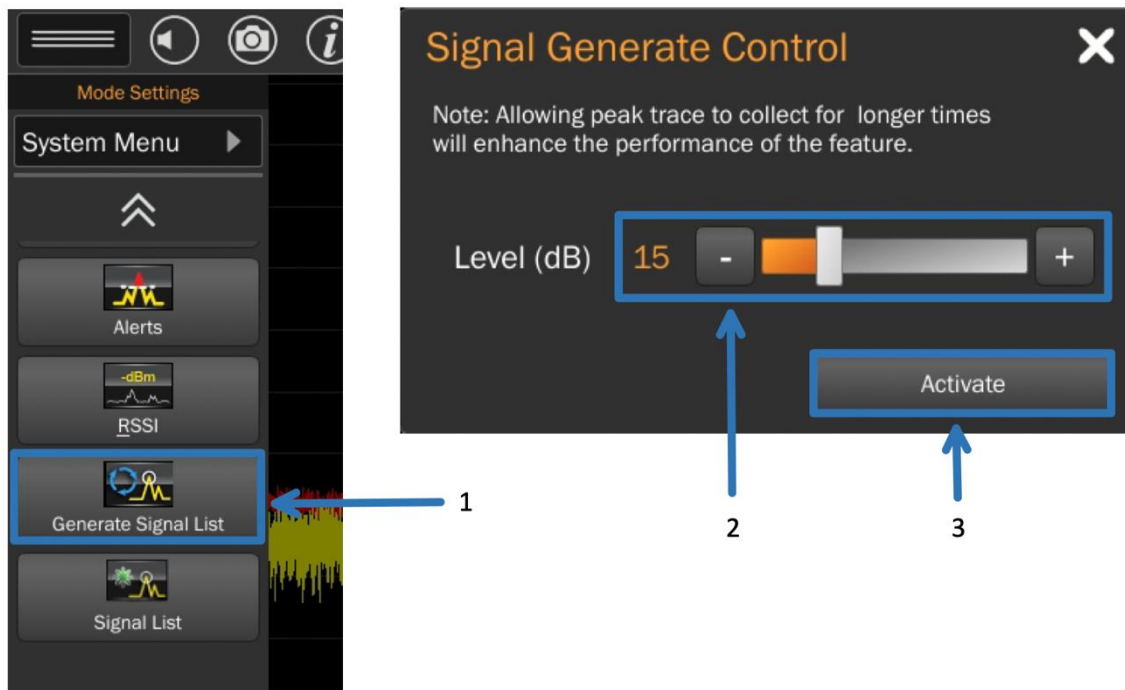
To close the RSSI graph, tap the "x" in the right-hand corner of the RSSI graph.

Generate Signal List

This option will generate a signal list based on a reference peak trace.



- 1) Select **Generate Signals List** from the Mode Menu
- 2) When dialog box appears, set desired threshold level using the slider bar
- 3) Press **Activate**



The reference peak trace will collect for a minimum of five seconds. After this, continue collecting the peak trace for as long as desired. The longer the peak trace is collected, the more accurate it will be and the more likely it will include any suspect signals present.

- 4) When ready, press *Generate Signal List*.



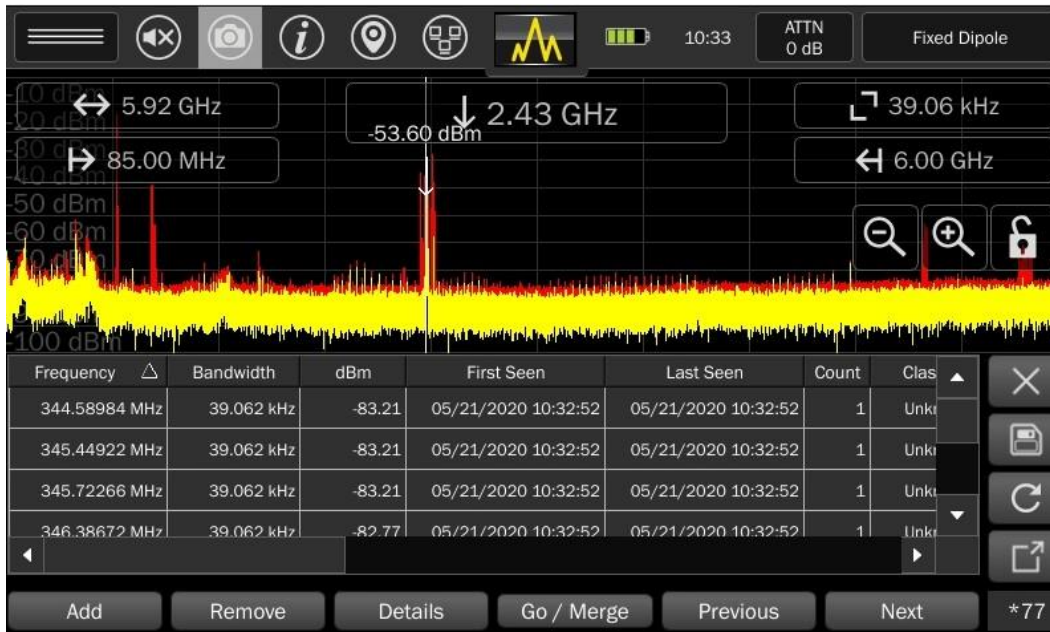
The MESA will analyze the peak reference trace, establishing an average baseline. Any frequency that crosses the set threshold level will be added to the signal list.

The *Generate Signal List* option in Spectrum Mode is a one-time event. The peak trace is swept through one time for any signal crossing the threshold, these frequencies are added to the signal list, and the signal list is displayed. The user may manually add or remove signals, but the MESA does not continue monitoring the current peak trace and the threshold level. This is why it is important to let the peak trace collect for as long as possible. To continuously monitor the spectrum and automatically add signals to the signal list, see the SmartBars Signal Resolution Mode (page 49).

For additional details on the signal list window, see page 89.

Signal List

This option toggles the display of the signal list window. The spectrum portion of the graph is compressed and displayed on the top half of the screen, while the signal list displays on the bottom half of the screen.

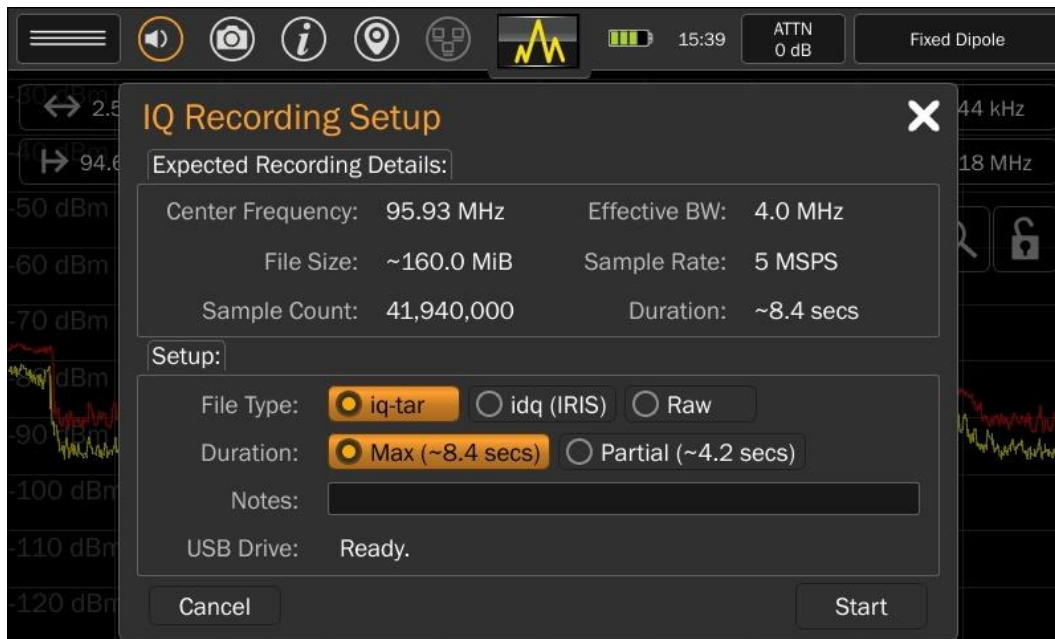


If no signal list is currently open in memory, the signal list window will be empty.

For additional details on the signal list window, see page 89.

I/Q Recording

This option enables the capture and recording of in-phase and quadrature components of a signal (I/Q Data) in order to analyze those signals with other test equipment.



Note: The I/Q Recording option is only available in the Mode Settings Menu at spans of 14 MHz and below. The circle around the sound icon will be gold when it is available. A trigger-based I/Q Recording is also available on the MESA 2.0 (see page 35).

To record I/Q Data:

1. Set up the I/Q Recording using the configurations found in the IQ Recording Setup dialog (see explanations below).
2. Press **Start**. The **Start** icon will be grayed out if the USB Drive is not inserted OR if the USB does not have enough free space.
3. While the I/Q Recording is in progress, the screen is automatically locked to prevent changes to the frequency span. An onscreen indicator provides progress information.

Three possible file types are available for the I/Q Recording files: iq-tar, idq (IRIS), & Raw.

- iq-tar (default): a binary format that includes meta-information (e.g. sample rate) about the data. The iq-tar container packs several files into a single .tar archive file. The iq-tar files can be read by equipment that supports Rohde & Schwarz's iq-tar format.
- idq (IRIS): able to be read by the IRIS Spectrum Software available from Transformational Security (www.powerfulsecurity.com).
- Raw: Same as the iq-tar format but with no metadata nor any 'tar' packaging.

There are two duration options available:

- Max: Will record at the maximum IQ buffer size up to 10 seconds.
- Partial: Will record at half the maximum.

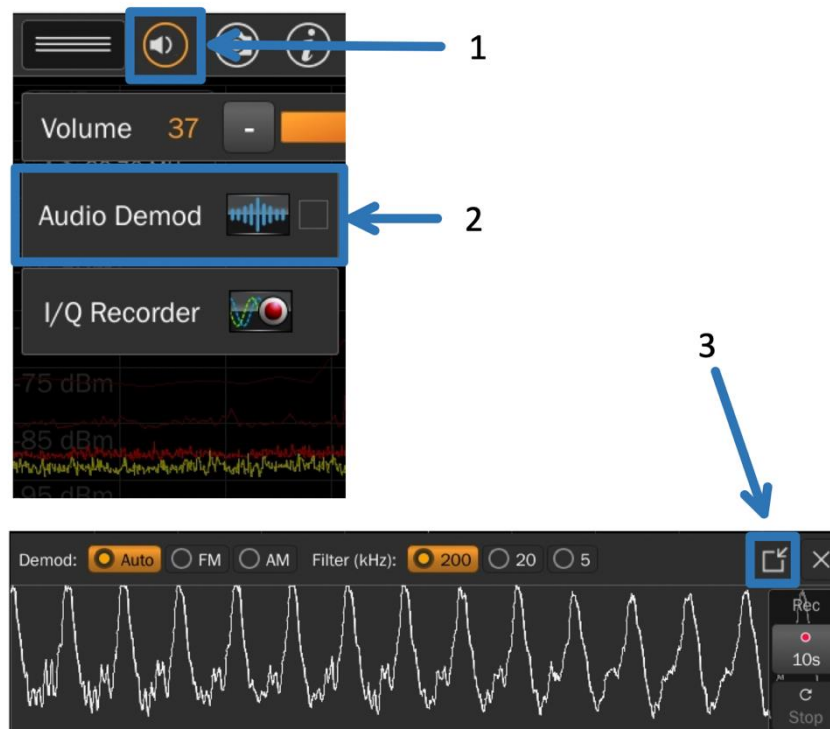
The available duration for each option depends upon the frequency span of the spectrum. To increase the available durations, decrease the frequency span. The max available duration is 10 seconds.

A “notes” field provides the user with up to 256 characters of text to be included in the iq-tar file format. The user notes field is only supported by the iq-tar format; the user notes field is not accessible if either the idq (IRIS) or the Raw formats are selected.

Audio Demod

Demodulation of AM and FM signals is possible with the MESA:

- 1) With the cursor located at the signal to be demodulated, tap the Volume Icon in the status bar.
- 2) From the volume bar dialog, select the Audio Demod Icon. The spectrum portion of the graph will be compressed and displayed on the top half of the screen. An oscilloscope view will be displayed on the bottom half of the screen. Note: The Audio Demod option is only enabled at spans below 14 MHz. When the MESA is at a span where audio demodulation is available, the circle around the volume icon in the status bar will turn orange.
- 3) To minimize the oscilloscope, press the minimize button at the top right of the oscilloscope.



Audio Demod Settings

With Audio Demod active, audio demod settings are available at the top of the oscilloscope:

- Demod Type: Select from three different options - Auto, FM, and AM.
- Filter Bandwidth: Select from three different bandwidths - 200 kHz, 20 kHz, and 5 kHz.



Audio Recording

It is possible to record small snippets of demodulated audio with the MESA.

To Record Audio:

- 1) Insert a thumb drive into the USB connector on the MESA. (See p. 116 for supported file systems.)
- 2) With Audio Demod active and the oscilloscope visible, press the record button located to the right of the oscilloscope.
- 3) The MESA will begin recording audio to the inserted thumb drive. To increase the recording time, tap the record button again. With each tap of the record button, the record time will change, cycling through these 3 options: 10 sec, 1 min, and 5 min. A counter just above the record button will display the remaining time.

To close the oscilloscope, press the "X" button.

SmartBars™

SmartBars mode quickly detects and locates RF energy by displaying new signals or increased RF energy compared to a reference trace from outside the target sweep area in a bar graph. New energy is indicated by an increase in one of the bars. Tapping on the bars displays more detailed views. Also, SmartBars does not display spectrum information linearly. The MESA uses a patented process to display highly populated areas of the spectrum more prominently with more screen real estate while condensing areas of the spectrum that have no signals.



The following REI-supplied probes support SmartBars mode:

- Whip/Dipole
- Fixed Dipole
- Locator Probe

It is possible to use any probe with SmartBars by manually selecting "Universal RF" from the Probe Selection Input (see page 20) but be aware that SmartBars will show portions of the spectrum that may not be supported by the probe.

Note: REI advises the use of a blocking capacitor when using 3rd party probes to avoid any negative effects from the small bias voltage that the MESA uses in its probe identification system.

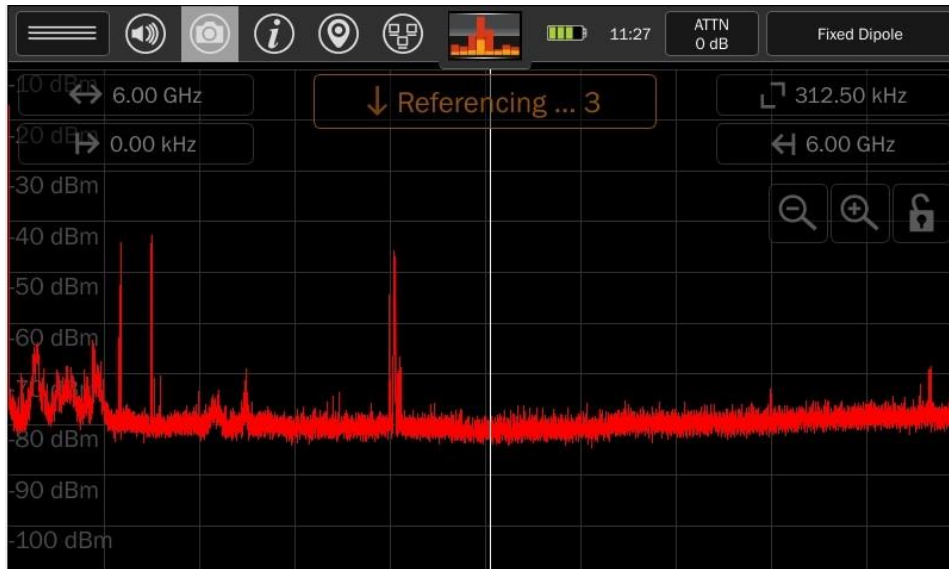
Starting SmartBars™

1. Select SmartBars from the Mode Menu at the top center of the screen.
2. From the SmartBars Signal Control dialog box, select either **Fast Scan** or **Signal Resolution**. **Fast Scan** mode uses a resolution bandwidth of 312.5 kHz for spans of 200 MHz and wider, which results in a faster sweep speed. **Signal Resolution** mode uses a finer resolution bandwidth of 39.06 kHz, but it allows a threshold level to be set and records any signal that crosses the threshold while in Signal Resolution mode to a signal list.
3. If **Signal Resolution** mode is chosen in Step 2 above, adjust the Level (dB) slider bar to the desired threshold level.
4. Press **Activate**. (See p.53 for instructions to **Restore** a saved Reference Trace)



5. The MESA will begin collecting a reference trace for a minimum of 5 seconds. During this time, the top center of the screen will say "Referencing..." with a countdown. If desired, the reference trace can be collected for longer. Ideally, collect the reference trace outside of the area to be swept. The longer the reference trace is allowed to collect, the more likely it is to contain known signals.

6. Once the minimum reference trace collection time has passed, the "Referencing..." box at the top center of the screen will switch to "Start SmartBars". When ready to begin sweeping, press "Start SmartBars" and then enter the area to be swept.



Note: During the collection of the reference trace, the screen can be locked with a pin code to prevent tampering with the collection of the reference trace. Press and hold the lock icon on screen for at least 5 seconds. Then follow the onscreen prompts. For additional details regarding locked monitor mode, see page 98.

Navigating SmartBars™ Mode

Note: The screenshots below show the *Fast Scan* version of SmartBars. However, navigation works the same in both *Fast Scan* and *Signal Resolution* modes.

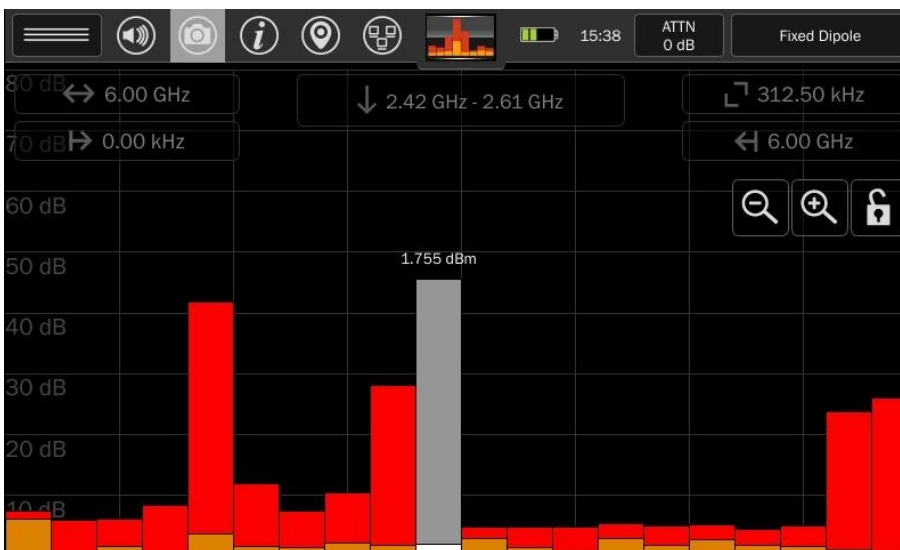
After starting SmartBars, the spectrum will be displayed as 20 individual SmartBars which represent the full range of the connected probe. Each SmartBar is comprised of equal power normalized to the absolute power of the reference trace.

The SmartBars will change height over time as their power varies relative to the reference trace.

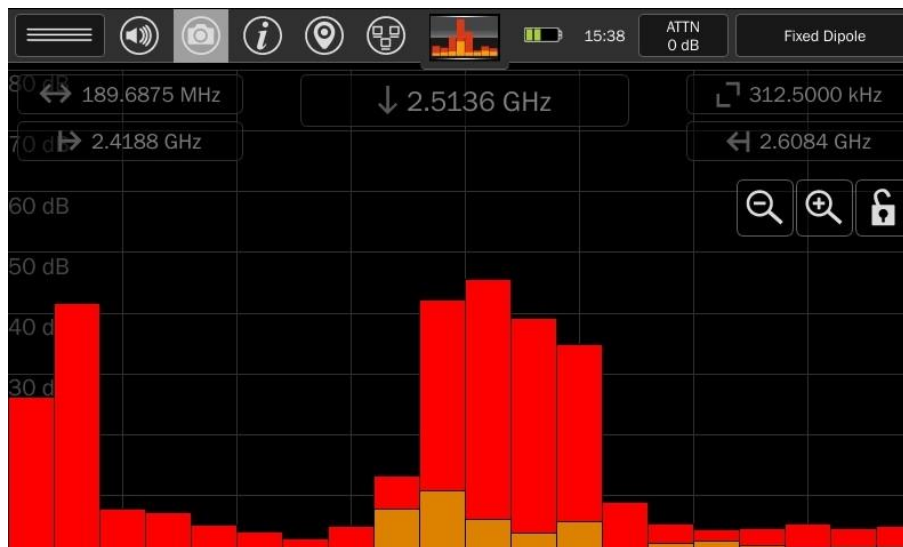
Two SmartBars traces are displayed: a red peak trace and an orange live trace.



Tapping a SmartBar will select it. The selected peak trace bar will change to gray. The selected live trace bar will change to white.

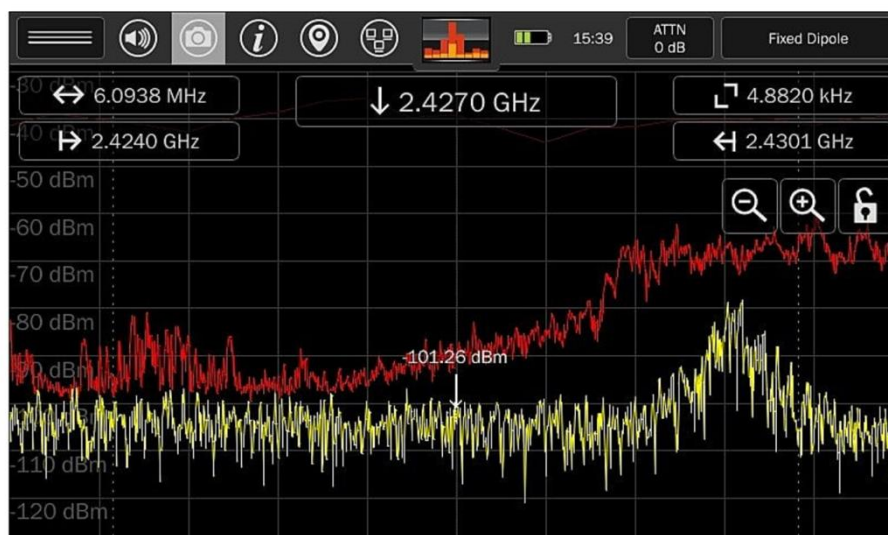


Tapping a selected SmartBar will zoom in to the portion of the spectrum represented by the span of the selected SmartBar. Again, the portion of the spectrum will be displayed as 20 sub-bars of equal power.



Notice the spectrum indicators at the top of the screen (span, start frequency, stop frequency). These will change to indicate the new span.

Tapping one of the sub-bars will select it. Tapping a selected sub-bar will zoom in to the portion of the spectrum represented by the span of the sub-bar displayed as a trace graph.



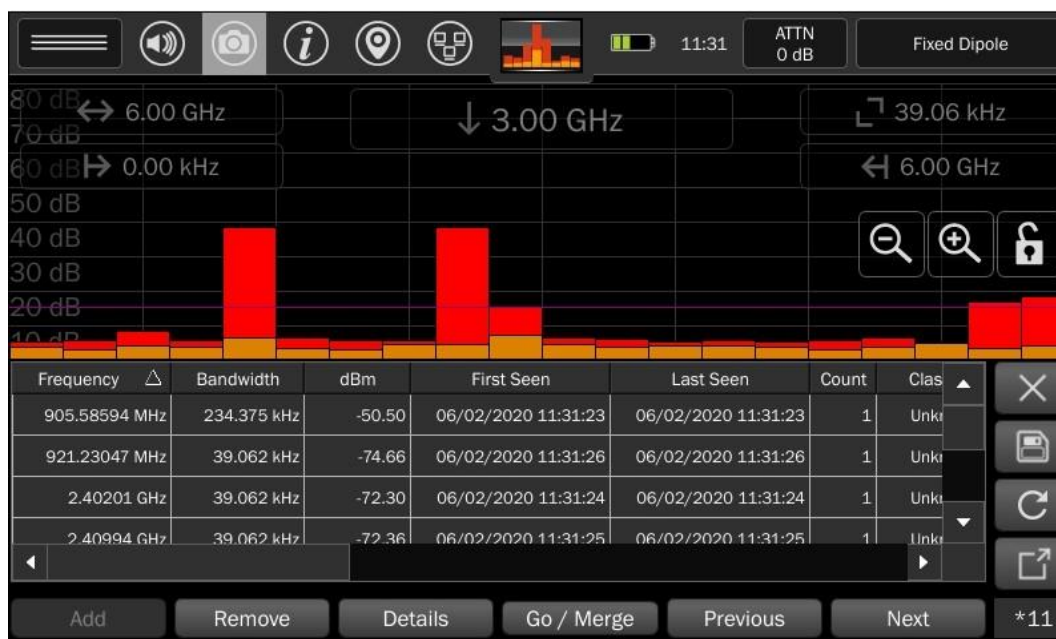
(To return to the SmartBars view, repeatedly press Zoom Out until the displayed span is greater than 200 MHz. Changing the Span directly by tapping the Span Indicator at the top of the screen and changing the value to one that is greater than 200 MHz will also accomplish this.)

When displaying the spectrum, vertical green lines represent the boundaries of the SmartBars.



Signal Resolution SmartBars™

Upon starting Signal Resolution SmartBars Mode, a new, blank signal list is generated. The MESA monitors and compares the reference trace to the current live trace. Any time a signal in the live trace exceeds the reference trace by the user-defined threshold, the MESA will add a signal to the signal list.

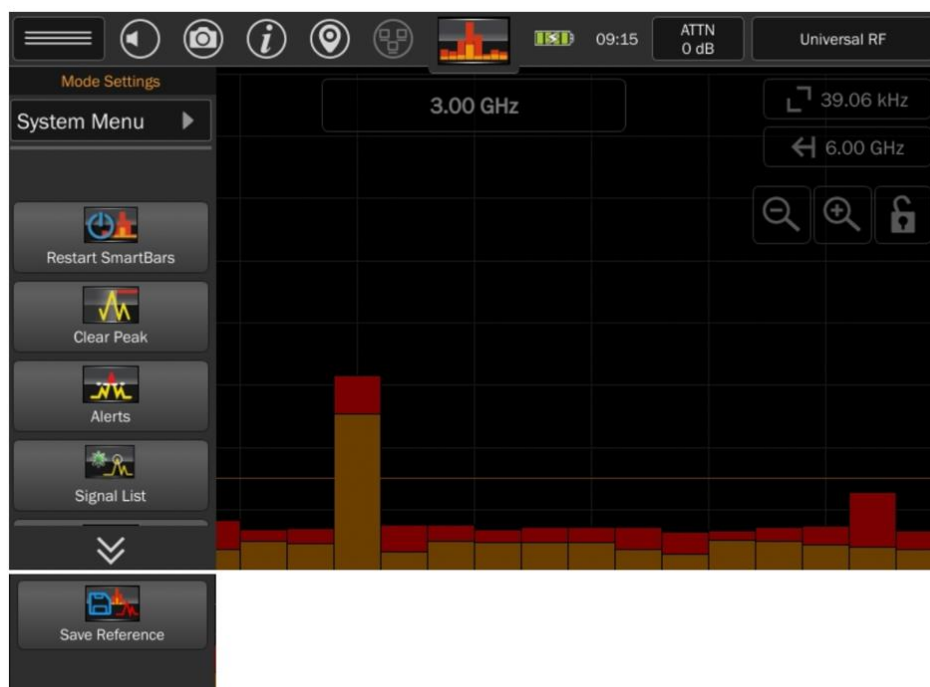


A merging algorithm is employed so that over time signals such as frequency hoppers or FM transmitters, which initially appear as several distinct, closely spaced signals are eventually grouped into one signal with a larger bandwidth as the envelope of this signal begins to fill in with peaks. Generation of this signal list continues, adding any newly detected signals to the list until Spectrum Mode is achieved via zooming in or until SmartBars Signal Resolution mode is exited.

When finished collecting signals in the Signal Resolution SmartBars Mode, save the signal list. Be sure a thumb drive is inserted into the MESA and press the File Dialog Button on the right side of the signal list. For other details regarding signal list operations see page 89.

Mode Settings

The mode settings menu can be opened from the top left button on the screen. The settings available in this menu will change depending on the current mode selected. Even within the SmartBars mode, the options available in the Mode Settings Menu will change depending on whether SmartBars is still displayed, or if it is zoomed in far enough to display the spectrum traces. Here are the unique settings available in SmartBars Mode:



System Menu

This option provides access to system settings such as brightness, software version, image viewer, audio player, network settings, prefix settings, ITU region, power-down cache, snap-to-peak, settings export, settings import, and factory reset. For additional information see page 117.

Restart SmartBars™

Selecting Restart SmartBars from the Mode Settings Menu starts the process of collecting a reference trace again. The SmartBars Signal Control box appears and allows the selection of either **Fast Scan** or **Signal Resolution** and adjustments to be made to the dB level setting. See p.53 for more on the **Restore** option.

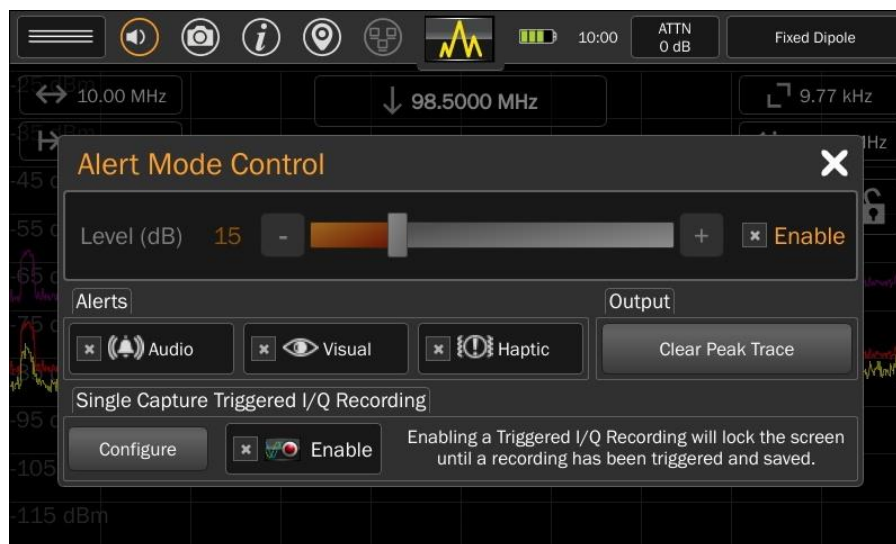
Clear Peak Trace

This option clears the peak trace and begins collecting a new peak trace.

Alerts

This option enables alerts whenever the signal level exceeds a specified threshold. It operates very similarly to the way Alerts operate in Spectrum Mode. Three types of alerts are available: audio alerts, visual alerts, and haptic alerts.

When the alert feature is selected from the mode menu, a dialog box appears. The following adjustments are available from the dialog box:



Threshold Level - Use the slider bar to set how far above the initial reference trace a signal should be before it triggers an alert. To begin receiving alerts check the enable box beside the threshold level adjustment. The threshold level must be adjusted before the enable box is checked.

Audio - Check the Audio box to enable audible alerts. A tone will sound anytime that the threshold is crossed by the real-time trace.

Visual - Check the Visual box to enable visual alerts. No specific visual markers will appear when the SmartBars are shown, although any peak trace that is higher than the purple threshold line is an indication that a signal within that bar has crossed the threshold. However, when zoomed into the point where trace graphs are shown, a marker will appear at each point where the threshold is crossed.

Haptic - Check the Haptic box to enable haptic alerts. Haptic feedback will be felt anytime that the threshold is crossed by the real-time trace.

Clear Peak Trace - This button will clear the current peak trace. If the threshold level has already been enabled, it will not be affected by clearing the peak trace. If the peak trace is cleared before enabling the threshold, the threshold level will be based on the cleared peak. It is best to allow a peak to collect for a while before enabling the threshold level.

Signal List

This option toggles the display of the signal list window on the bottom half of the screen. If no signal list is currently open in memory, the signal list window will be empty. For additional details on the signal list window, see page 89.

Save Reference

This feature allows the user to save a reference trace to restore for future use.

Saving a Reference Trace

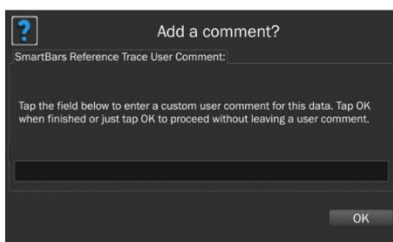
To save a reference trace:

- 1) Tap the mode menu button
- 2) Select ***Save Reference***
- 3) Enter user comment (optional)
- 4) Click ***OK***

A box stating “Saving...” indicates the information is being saved.

A second box will indicate the file has been successfully saved and gives the filename.

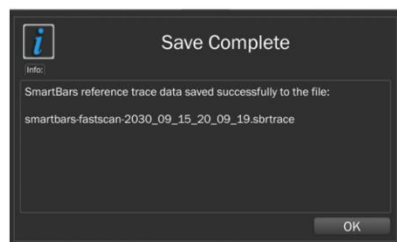
- 5) Click ***OK***



3



4



5

The filename can be changed (if desired) on a computer. In order for the MESA to restore the file it must be stored on the USB drive with the “.sbrtrace” filename extension.

Restoring a Reference Trace

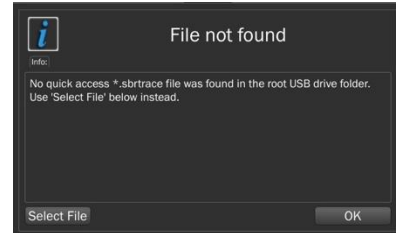
A stored reference trace can be restored upon entering the SmartBars Mode (p.45).

To use the **Quick Restore** option:

- 1) Select **Restore**
- 2) In the “Quick Restore?” dialog box, click **OK** to restore the suggested file
- 3) Adjust the Signal Level Offset, if desired, by either the slider bar or the +/- buttons
- 4) Click **OK**



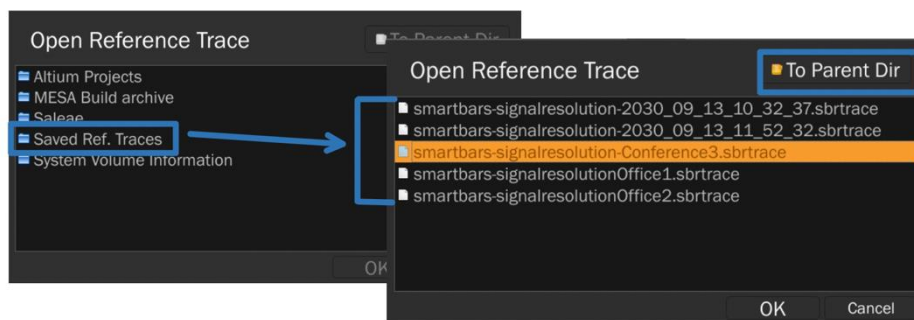
For the Quick Restore suggestion, the MESA selects the last opened saved Reference Trace file. If this file is not available, MESA selects the most recently saved file. If there is no signal resolution stored on the USB drive or if the signal resolution file is saved into a sub-folder, this message will appear:



To use the **Select File** option (instead of the *Quick Restore* suggestion or if no file is found):

1. Press **Select File** from the “Quick Restore?” query (or the “File not Found” if appropriate)
2. From the list of saved Reference Traces, make a selection or open the folder* (double tap) containing the files
3. Highlight the desired trace to open

4. Click **OK**



5. In the “Restore Smart Bars?” box adjust the signal level (if desired) and Click **OK**



If needed, there is a return **To Parent Dir** option in the Open Reference Trace box. Use this to return to the parent directory during a search for a saved reference trace.

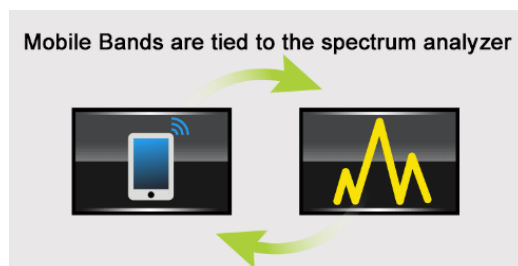
*Any folders containing reference traces will be user-created. Again, all files need to retain the extension “.sbrtrace”

SmartBars Signal Control box warning

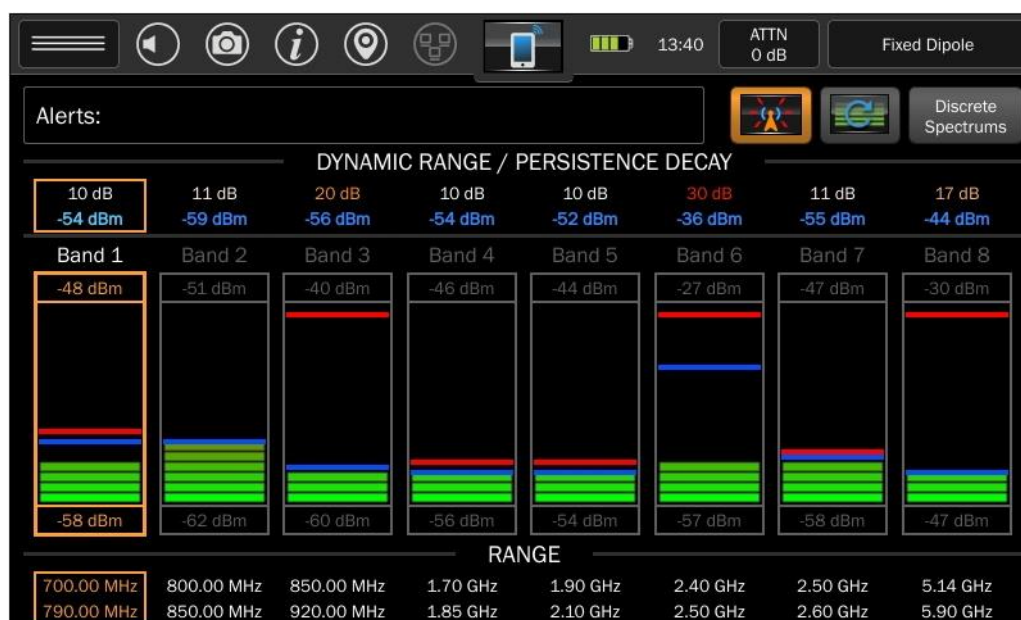
Occasionally, when restoring a saved reference trace, the MESA will warn the user (in red text) they may lose a signal list. If this list has already been saved, this message indicates only that *new* signals may have been found since the list was saved and could be lost.



Mobile Bands





Mobile bands mode displays up to 8 bar graphs at once. Each bar graph displays power within a specified band. In this mode, the spectrum data is presented as if there are multiple bandpass-filtered power detectors working in tandem.



Each bar graph represents the power within a specified frequency band and there is an associated min, max, peak, and persistent power shown. Above the bars is an associated number for dynamic range (equal to $P_{\max} - P_{\min}$) and persistent power (moving average). Above and below the bar graph shows the min and max powers. Within each bar graph, the blue and red bars indicate the persistent and peak powers respectively. The frequency range is displayed below the bar.

Mobile Band bar graphs are more than a simple power graph. To view the spectrum behind a given bar tap on a bar graph. The spectrum is displayed with a span that covers the selected graph. Green vertical dashed lines represent the boundaries of the bar graph that was selected.

In the spectrum display, the normal functions are available such as peak, persistence, signal lists, etc.

Pressing Zoom In  will reduce the frequency span. Pressing Zoom Out  will increase the frequency span. Zooming out beyond the bar graph frequency limits will return to the bar graph screen.

Discrete Bands



It is possible to display the spectrums of all the bar graphs simultaneously. To do so, press the “Discrete Spectrums” button in the top right area of the screen.


This allows focus on the spectrum of select bands rather than the entire 6GHz frequency range. This feature may be more useful if only the bands that desired to be monitored are enabled (see the next section “Editing Mobile Bands” to learn about enabling/disabling select bands.)



Tap any of the discrete bands to select it. The selected band will be highlighted with an orange border. The spectrum indicators at the top of the screen (span, start frequency, stop frequency) will change to reflect the correct values for the selected band. The name of the selected band will be displayed at the top center of the screen.

Tap any selected band a second time to view the spectrum for just that single band. Green vertical dashed lines represent the boundaries of the bar graph that was selected. In the spectrum display, the normal functions are available such as peak, persistence, signal lists, etc.

Pressing Zoom In  will reduce the frequency span. Pressing Zoom Out  will increase the frequency span. Zooming out beyond the selected band’s frequency limits will return to the discrete bands screen.

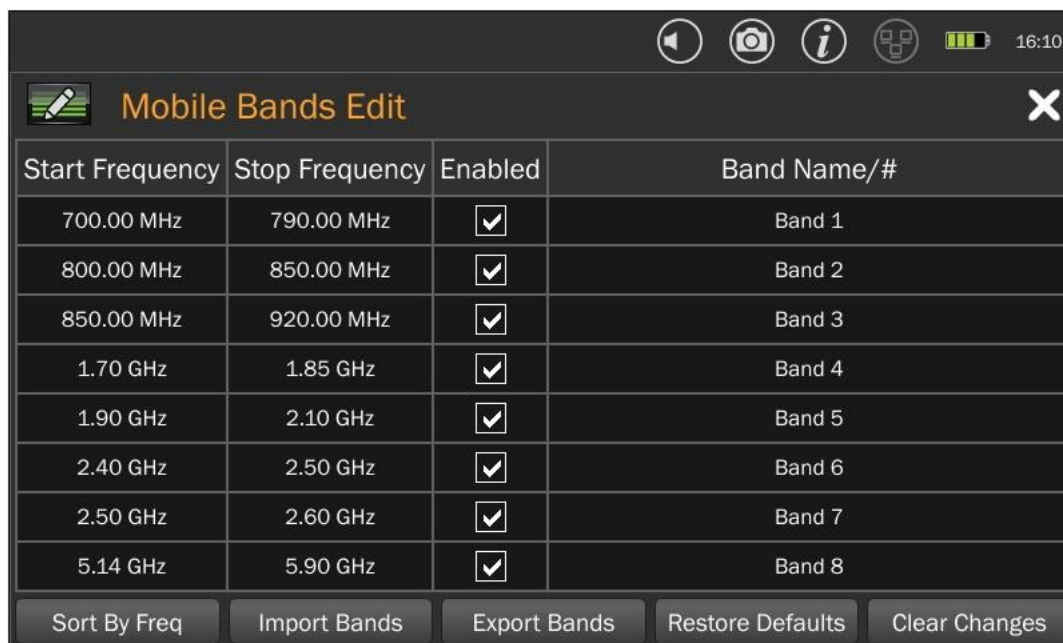
Pressing Zoom Out  on the discrete bands will return to the Mobile Bands screen.

Editing Mobile Bands

The default bands are set up to cover commonly found cellular, Bluetooth, and Wi-Fi devices.

Default Band	Frequency
1	700-790 MHz
2	800-850 MHz
3	850-920 MHz
4	1.70-1.85 GHz
5	1.90-2.10 GHz
6	2.40-2.50 GHz
7	2.50-2.60 GHz
8	5.14-5.90 GHz

These frequencies, however, may not be optimal for all situations. Therefore, there is an option in the menu for customizing mobile band frequencies.



1. Select **Edit Mobile Band** from the Mode Settings Menu in the upper left corner of the screen *or* tap on the frequency range at the bottom of one of the bars. The Mobile Bands Edit dialog will appear.
2. From this dialog, Start and Stop frequencies of each range can be edited. Tap the frequency to be edited. Frequency bands cannot overlap. If a Start or Stop frequency is edited so that it overlaps another band, the affected frequencies will be highlighted in red. The settings will require adjustment before they can be applied.

3. Additionally, for each band there is an **Enabled** checkbox. When this checkbox is de-selected, the band will be removed from the display.
4. Each band can also be given a custom name using the "Band Name/#" column. This name will appear above each band on the Mobile Bands screen.
5. When finished making changes, select the "x" in the upper right corner of the dialog. A dialog box will ask for confirmation of saving the desired changes.
6. If any of the edits change the frequency order of the bands, use the **Sort By Freq** button to reorder the bands from the lowest frequency to the highest frequency.
7. To return to the factory default values, select **Restore Defaults** from the bottom right of the dialog.
8. To discard any changes made during the editing session, select **Clear Changes** from the bottom right of the dialog.

Saving/Recalling Mobile Band Configurations

The MESA allows custom mobile band configurations to be saved and recalled for a later time.

To save a custom mobile band configuration:

1. Select **Edit Mobile Band** from the Mode Settings Menu *or* tap on the frequency range at the bottom of one of the bars to enter the Mobile Bands Edit dialog.
2. Configure the settings to be saved.
3. Ensure that a USB thumb drive (see note on p. 116) is in one of the USB ports.
4. Select **Export Bands** from the bottom of the Mobile Bands Edit dialog.

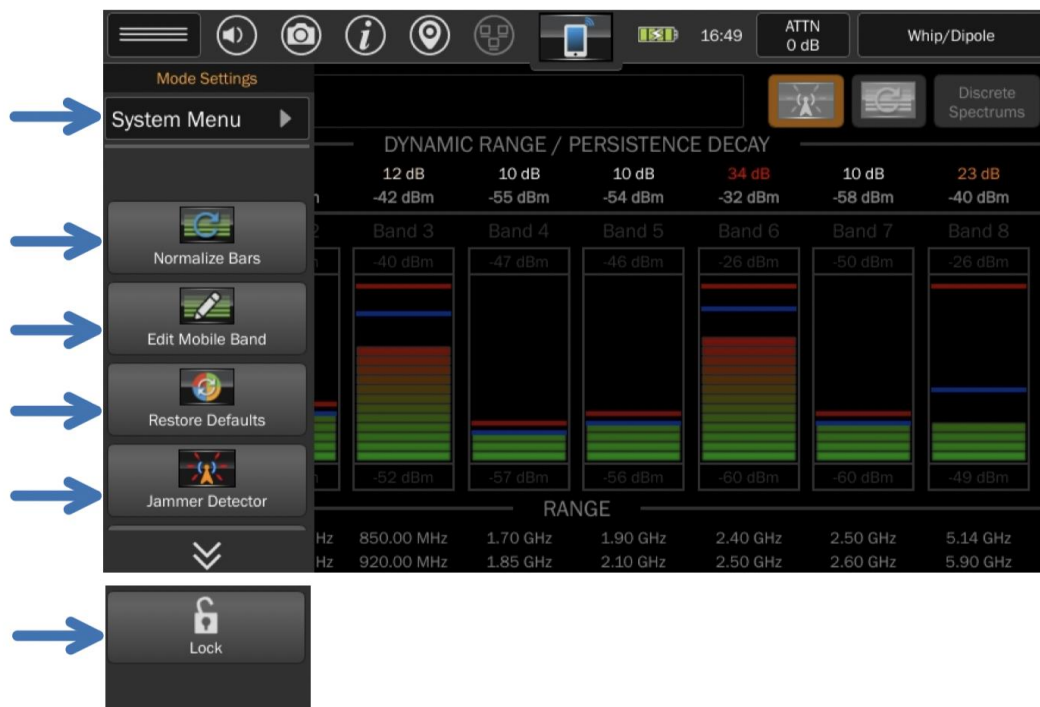
2.40 GHz	2.50 GHz	<input checked="" type="checkbox"/>	Band 6
2.50 GHz	2.60 GHz	<input checked="" type="checkbox"/>	Band 7
5.14 GHz	5.90 GHz	<input checked="" type="checkbox"/>	Band 8
Sort By Freq	Import Bands	Export Bands	Restore Defaults
			Clear Changes

To recall a previously saved mobile band configuration:

1. Ensure that a USB thumb drive with the saved configuration is in one of the USB ports.
2. From the Mobile Bands Edit dialog, select **Import Bands**.
3. From the file manager window, select the desired configuration file and press **Open**.
4. The screen will return to the Mobile Bands Edit dialog with the settings from the recalled configuration.
5. To apply the configuration, press the "x" in the upper right corner of the dialog. A dialog box will ask for confirmation of saving changes.

Mode Settings

The mode settings menu can be opened from the top left button on the screen. The settings available in this menu will change depending on the Mode that the MESA is currently in. The following options are available in Mobile Bands Mode.



System Menu

This option provides access to system settings such as brightness, software version, image viewer, audio player, network settings, prefix settings, ITU region, power-down cache, snap-to-peak, settings export, settings export, and factory reset. For additional information see page 117.

Normalize Bars

This option resets the dynamic range (min & max powers) of the current bands. The MESA scans the bands and tries to pick the best initial dynamic range. The dynamic range will eventually expand for any signal exceeding the max value. This option is also available from the main screen in Mobile Bands mode. Just press the Normalize Bars icon at the top right of the screen.

Edit Mobile Band

This option provides a way to manually set up frequencies and to add/remove bands from the display with a range of 1-8 bands.

Restore Defaults

This option restores the 8 default mobile bands at 700-790 MHz, 800-850 MHz, 850-920 MHz, 1.70-1.85 GHz, 1.90-2.10 GHz, 2.40-2.50 GHz, 2.50-2.60 GHz, 5.14-5.90 GHz.

Jammer Detector

This option provides a way to enable or disable the Jammer Detector feature, configure the Jammer Detector's settings, and view the Jammer Detector log.

Lock

The Lock option provides a method for preventing the Jammer Detection feature from being disabled or any of the settings from being changed. This allows a more experienced user to set up the MESA for Jammer Detection and then hand the unit off to another operator, who is possibly less trained or less reliable, for monitoring. The user will still be notified if there is a possible jammer detection, but they will not be able to turn the feature off or change any of the settings.

Jammer Detector

RF Jammers are used to block or interfere with the physical transmission and reception of wireless communications. In most cases, they work by generating RF energy to overwhelm or confuse RF transmissions. They can deny service indiscriminately or they can target specific classes of transmission (GPS, Wi-Fi, Bluetooth, cell phone, etc.).



The Jammer Detector feature on the MESA provides an easy method for detecting the possible presence of a jamming device.

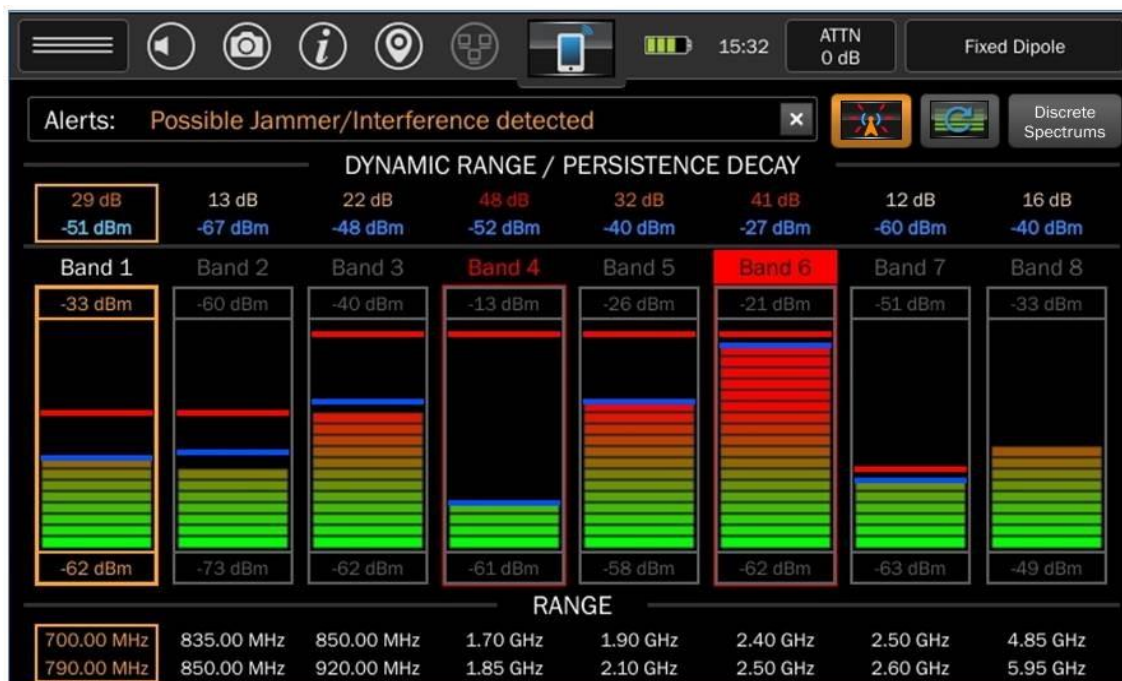
The Jamming Detector feature is available only when the MESA is in Mobile Bands mode. The feature is enabled by default.

To enable or disable the Jammer Detector feature:

1. Select ***Jammer Detector*** from the Mode Settings Menu at the top left of the screen. The Jammer Detector Settings dialog will appear.
2. For ***Feature***, select Enable or Disable.
3. Press ***OK*** at the bottom right corner of the dialog.

Or

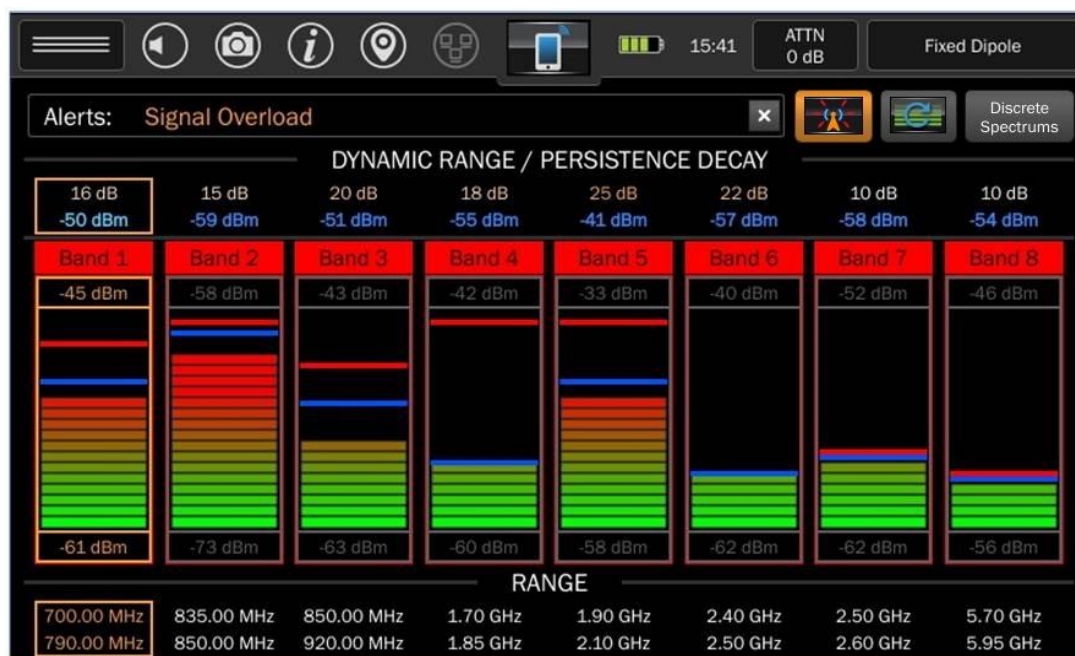
1. From the Mobile Bands main screen, press the Jammer Detector icon to the right of the Alerts box to enable or disable the feature.



With the Jammer Detector feature enabled, please notice the following alerts:

- If the MESA is exposed to a possible jammer, an alert "Possible Jammer/Interference detected" will appear in the Alerts dialogue at the top of the screen. The alert will be latched and will remain on screen until the user dismisses it by pressing the "x" on the right side of the Alerts dialogue box.
- Any band that has an active alert will be outlined in red and the band name will be shown with a red highlight. See Band 6 in the image above.
- Any band that had a previous alert but is no longer displaying an active jammer alert will be outlined in red and the band name will be shown in red text. See Band 4 in the image above.

If the receiver is overloaded due to an extremely strong signal in the area, it may mask the presence of a jammer. If this occurs, the alert "Signal Overload" will appear in the Alerts dialogue and all bands will be highlighted in red.



If the Signal Overload alert appears:

1. Apply attenuation (see Page 27)
2. Dismiss the "Signal Overload" alert by pressing the "x" on the right-hand side of the Alerts dialogue box
3. Continue to monitor for jammers

Jammer Detector Settings

The **Jammer Detector Settings**, available from the Mode Settings Menu at the top left of the screen, allow for the configuration of the Jammer Detector feature.



Feature

This option enables or disables the Jammer Detector feature.

Power

This option determines the required power level threshold to trigger a jammer alert. There are 3 possible settings:

- Weak: This setting will most easily trigger a jammer alert
- Medium: This setting uses a nominal value for the power level threshold required to trigger an alert.
- Strong: This setting uses the highest power threshold, requiring stronger jamming signals to trigger an alert.

Sensitivity

This option determines the sensitivity of the Jammer Detector feature based on the duration of the jamming signal. There are 3 possible settings:

- High: This setting will most easily trigger a jammer alert.
- Medium: This setting requires the jamming signal to be present for a nominal number of sweeps before triggering the jammer alert.
- Low: This setting will require the longest duration of the jamming signal before triggering an alert.

Audio Alert

This option will enable or disable an audible tone when a jamming alert is experienced.

Haptic Alert

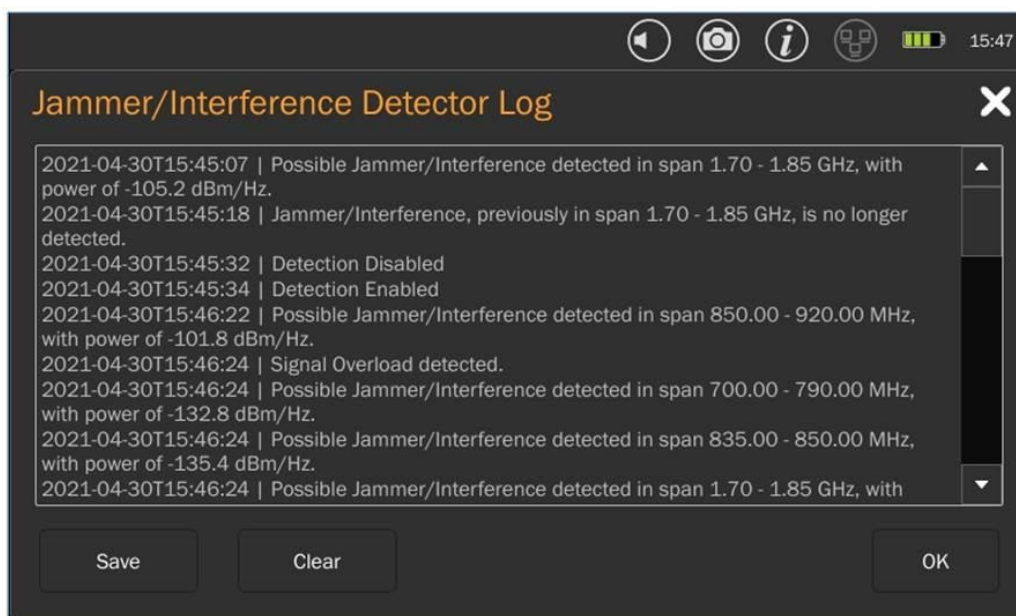
This option will enable or disable haptic feedback when a jamming alert is experienced.

Logging

This option enables or disables the Jammer/Interference Detector log. The log will record when possible jamming or interference is detected and also when it is no longer detected.

To View the Jammer/Interference Detector Log:

1. From the Jammer Detector Settings Dialog Box, select **View Log**.

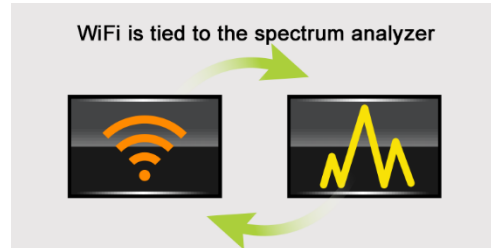


To save the Jammer/Interference Detector Log:

1. Ensure that a thumb drive (see p. 116 note) is in one of the USB ports.
2. Select **Save** from the bottom left of the Jammer/Interference Detector Log.

Wi-Fi

The MESA 2.0 combines both a Wi-Fi module and a spectrum analyzer.



The MESA 2.0 is capable of both identifying a list of WiFi networks *and* viewing the RF spectrum of those networks using MESA's spectrum analyzer. MESA 2.0 scans the wireless networks in range and displays a list of found devices by mac address, network name (if available), power level, and number of channels. These devices can be filtered into Access Points (APs), Clients, and Not Connected (NC) Clients seen as probe requests.

<div><div>⋮</div><div>🔍</div><div>📍</div><div>📶</div><div>🔋</div><div>09:33</div><div>ATTN 0 dB</div><div>Universal RF</div></div>						
<div>Stop {52 sec} Scanning Networks ...</div> <div><div>📶 APs #3</div><div>🖥️ Clients #7</div><div>🔌 NC Client #1</div></div> <div>Page</div>						
#	MAC	SSID/Name	Manufacturer	>-75 dBm	Ch	ID
1	CC:C9:5D:11:25:B5	🖥️	Apple Inc.	-48	149+	?
2	98:DA:C4:8E:6E:49	🖥️	TP-LINK TECHNOLOGI...	-50	155	?
3	99:DA:C4:8E:6E:49	🖥️		-55	149+	?
4	C0:C9:E3:4F:A2:AE	📶 SAND01	TP-LINK TECHNOLOGI...	-61	8+	?
5	C0:C9:E3:4F:A2:AD	📶 SAND01	TP-LINK TECHNOLOGI...	-62	149	?
6	42:D3:CD:89:6B:2E	🖥️		-62	149+	?
7	5C:0C:E6:AD:E9:8D	🖥️	Nintendo Co.Ltd	-64	6	?
8	98:DA:C4:8E:6E:4A	📶 SAND01	TP-LINK TECHNOLOGI...	-66	3+	?

Preparing to Scan

After entering WiFi mode and before beginning a scan, it is helpful to adjust the WiFi scan settings to ensure the MESA 2.0 WiFi list is manageable and includes only desired devices for evaluation.

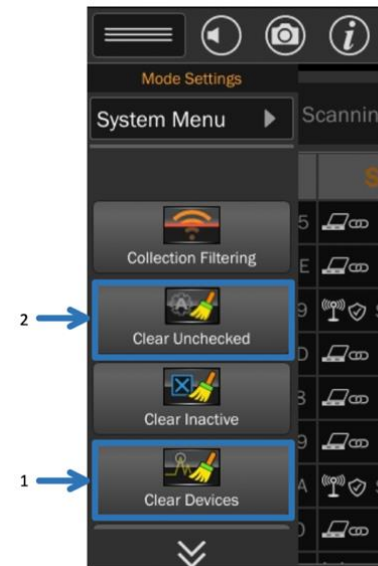
Clearing the Device List

There may be an existing device list from previous WiFi scans. It may be helpful to do one of the following:

- 1) Clear the entire device list by selecting the **Clear Devices** option from the Mode Settings menu.

Or

- 2) Clear only devices that are classified as “Unknown” by selecting the **Clear Unchecked** option. Devices classified by the user as “Threat,” “Friendly,” or “Inactive” from previous scans will be preserved.



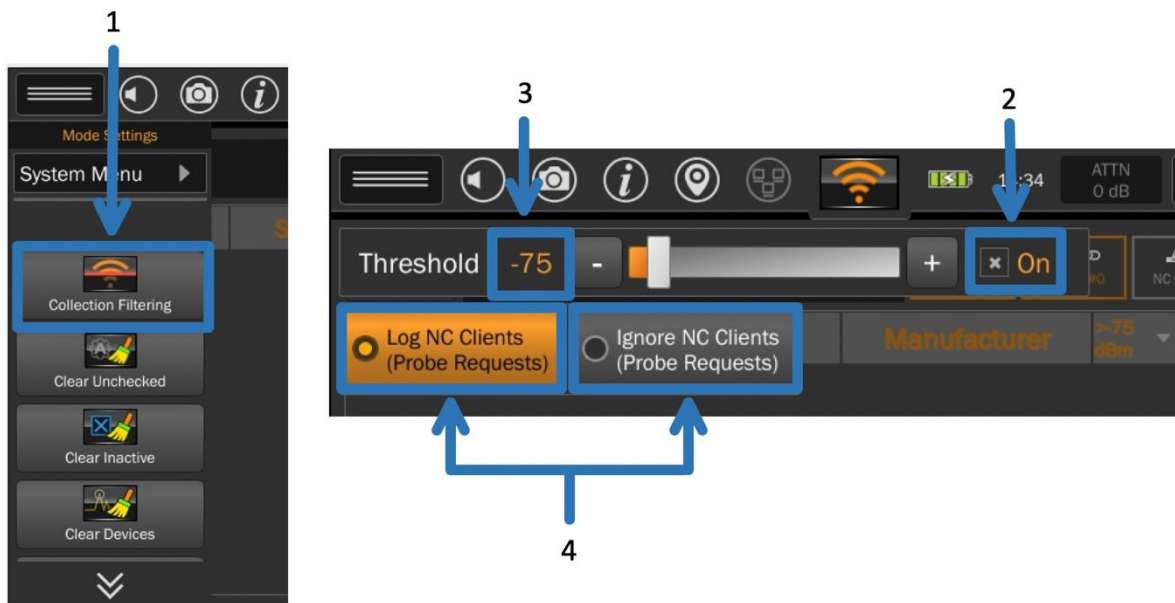
Collection Filtering

The MESA 2.0 collects data (in packets called frames) from all WiFi devices within range. It may be helpful to filter this collection and narrow it to the desired search area. From the **Mode Menu**, **Collection Filtering** provides 2 ways to selectively reduce the amount of data being collected: adjusting RSSI Threshold and ignoring NC Clients. These options may be helpful in areas of unusually large amounts of WiFi traffic or if a **WiFi Load Warning** is triggered (see p. 67).

- **RSSI Threshold** bar allows the power threshold to be raised for incoming signals. Signals below the RSSI Threshold will not be logged.
- **Ignore NC Clients (Probe Requests)** button will cause the MESA to no longer log signals from clients not connected to an Access Point and ignore **NC Clients**. This data will no longer be collected. (For more on Clients and Access Points see page 71, #3.)

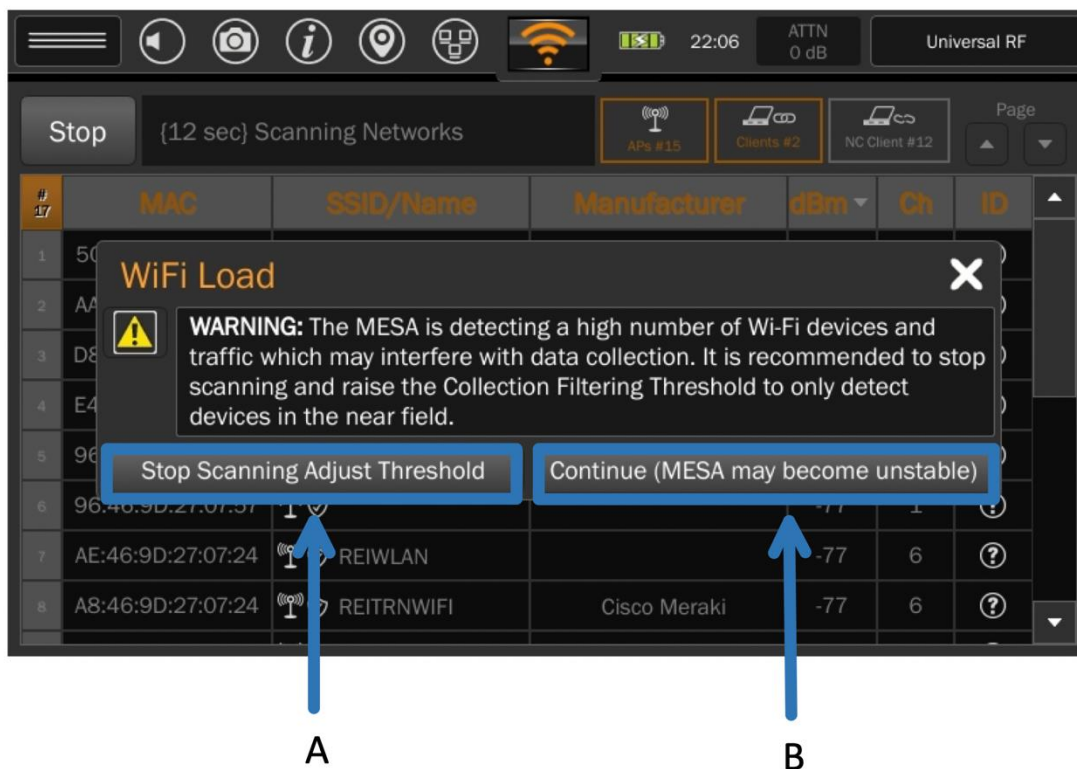
To use Collection Filtering:

- 1) Select **Collection Filtering** from the Mode Menu.
- 2) Click the **On** button.
- 3) **Threshold** —Use the slider bar to adjust up (or down) to the desired threshold setting.
- 4) To **Ignore NC Clients (Probe Requests)** click that button.



WiFi Load Warning

When encountering unusually large amounts of WiFi traffic, the MESA 2.0 will alert the user to adjust the **Threshold** setting.



A popup dialog warning box will appear with two options:

A) Stop Scanning Adjust Threshold

If “Stop Scanning” is selected, the scan will be stopped but not cleared. Follow the instructions on **Collection Filtering** (see page 66) to adjust the **Threshold** setting to narrow the search to the target area. Consider selecting **Ignore Probe Requests (NC Clients)** to further reduce WiFi traffic data.

Or

B) Continue (MESA may become unstable)

Selecting this option will continue the scan with no changes.

Please note: This may result in the MESA behaving sluggishly or needing to be restarted.

Performing the WiFi Scan and Viewing Live Updates

To begin the WiFi scan, press the START button at the top of the left of the WiFi mode screen. Any **Access Point (AP)**, **Client**, or **Not Connected (NC) Client** found during the scan will be added to the list.

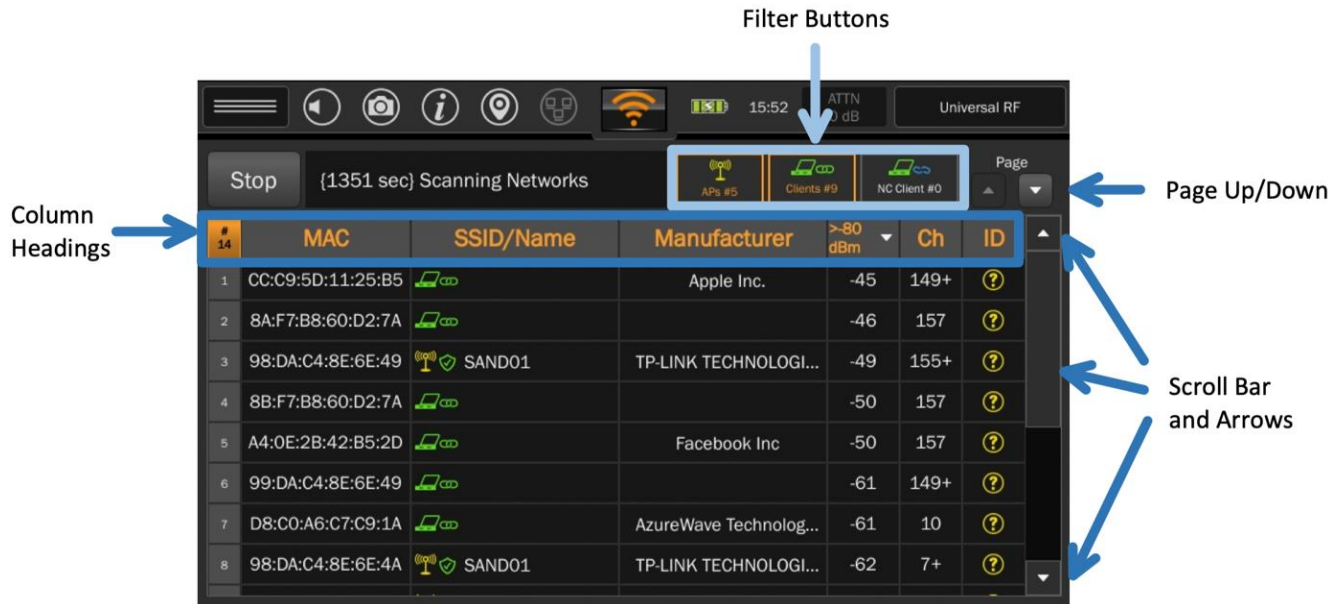
On the initial WiFi scan, the MESA 2.0 requires a minimum 15-second scan, allowing the MESA adequate time to scan several sweeps of all the individual WiFi channels.

After the initial 15-second scan, the user can choose to stop/pause the scan by pressing **STOP** (top left) or allow the scan to continue. The longer the scan is allowed to continue, the more devices the MESA 2.0 is likely to find. During live scanning the user can do the following:

- Scroll through the list using the bar or arrows on the right side of the screen
- Highlight a particular device by tapping once, un-highlight with a second tap
- Filter devices into **APs**, **Clients**, or **NC Clients** by selecting each button (NC Client button will be grayed out if the Ignore NC Clients button is selected — see section above).
- Order list by selecting column headings: **MAC**, **SSID/Name**, **Manufacturer**, **dBm**, **Ch**, and **ID**
- Clear devices in the list by selecting **Clear Devices**, **Clear Unchecked**, or **Clear Inactive** in the Mode Menu
- Save the device list

The functions not available during Live Scanning:

- Detail View mode
- Changing the ID of a device (threat, friendly, etc.)



Any time after the initial 15 seconds, pressing the **STOP** button will pause/stop the scan. The user can then proceed to **Evaluating the WiFi Scan Results** (see next page). (Again, a longer scan time will allow the MESA to log more devices.)

However, if continued scanning is desired and the user has *not* cleared the list, the **START** button can be pressed, and the scan will be continued. New devices will be added to the list, as they are discovered, without the existing list being automatically reordered.

Evaluating the WiFi Scan Results

After stopping the scan, there are several options for evaluating the results:

Sorting the WiFi Display List

Lists can be ordered by columns: **MAC**, **SSID/Name**, **Manufacturer**, **dBm**, **Ch**, and **ID**. Tapping once will select that column and order it. A second tap on the same column heading will reverse that order. For example: tapping on the **dBm** column heading will order it from weakest signal to strongest signal. A second tap will order it from strongest to weakest. Tapping on the **ID** column will send identified devices to the top or bottom of the list, as indicated by the arrow.

Note: Under the manufacturer column, the word "Randomized" will indicated the device is using a randomized MAC address (a feature designed to protect device's privacy) rather the device's actual MAC address. These randomized addresses will change periodically (often every 4 minutes or as long as every 15 minutes).

Filtering the WiFi Display List

All the WiFi devices displayed can be filtered into Access Points (APs), Clients, and NC Clients. The three buttons on the top right, below the clock, control this. These may be displayed in any combination, all, or none. An icon under the SSID/Name column also indicates if a device is an Access Point, Client, or NC

Client. Deselecting a WiFi category does not stop collection. This information is still being collected (during a scan) but is not displayed.

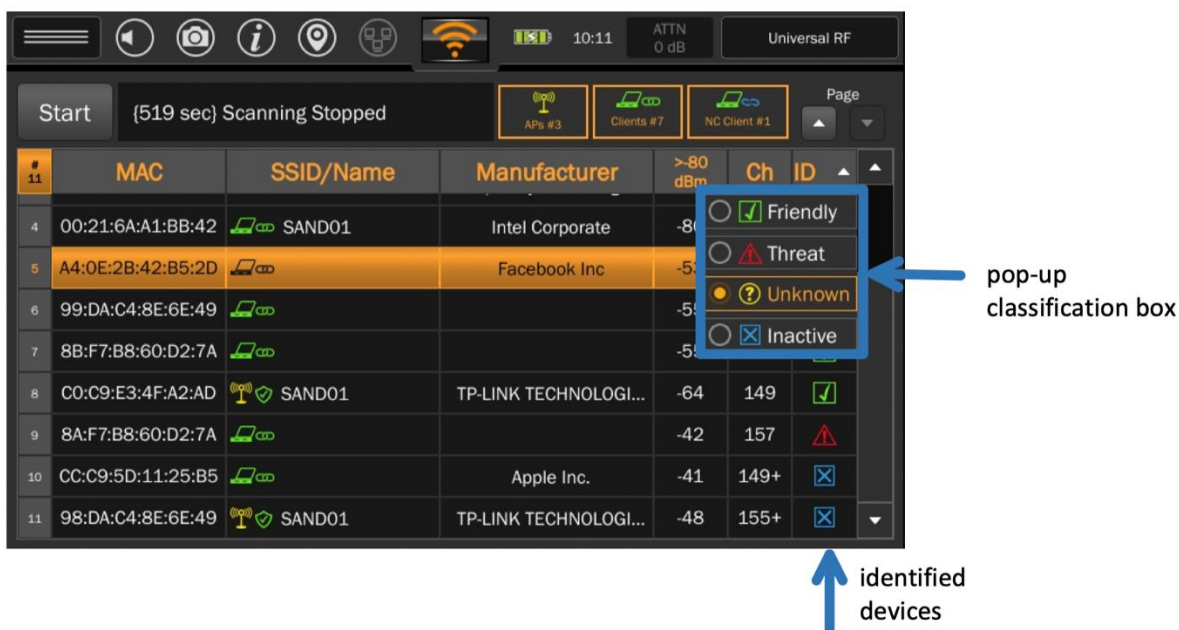
Classifying Devices in the WiFi List

An ID column serves to classify user-found devices. As the list is worked through, indicate in this column if a device is **Friendly**, **Threat**, **Unknown**, or **Inactive**. These identified devices can then be sent to the bottom of the list by tapping the column heading. A second tap will order them at the top.





To change the ID for a device:

- 1) Tap in the ID column of the row for the device to classify.
- 2) Select one of the values from the resulting pop-up list.

SSID/Name Column



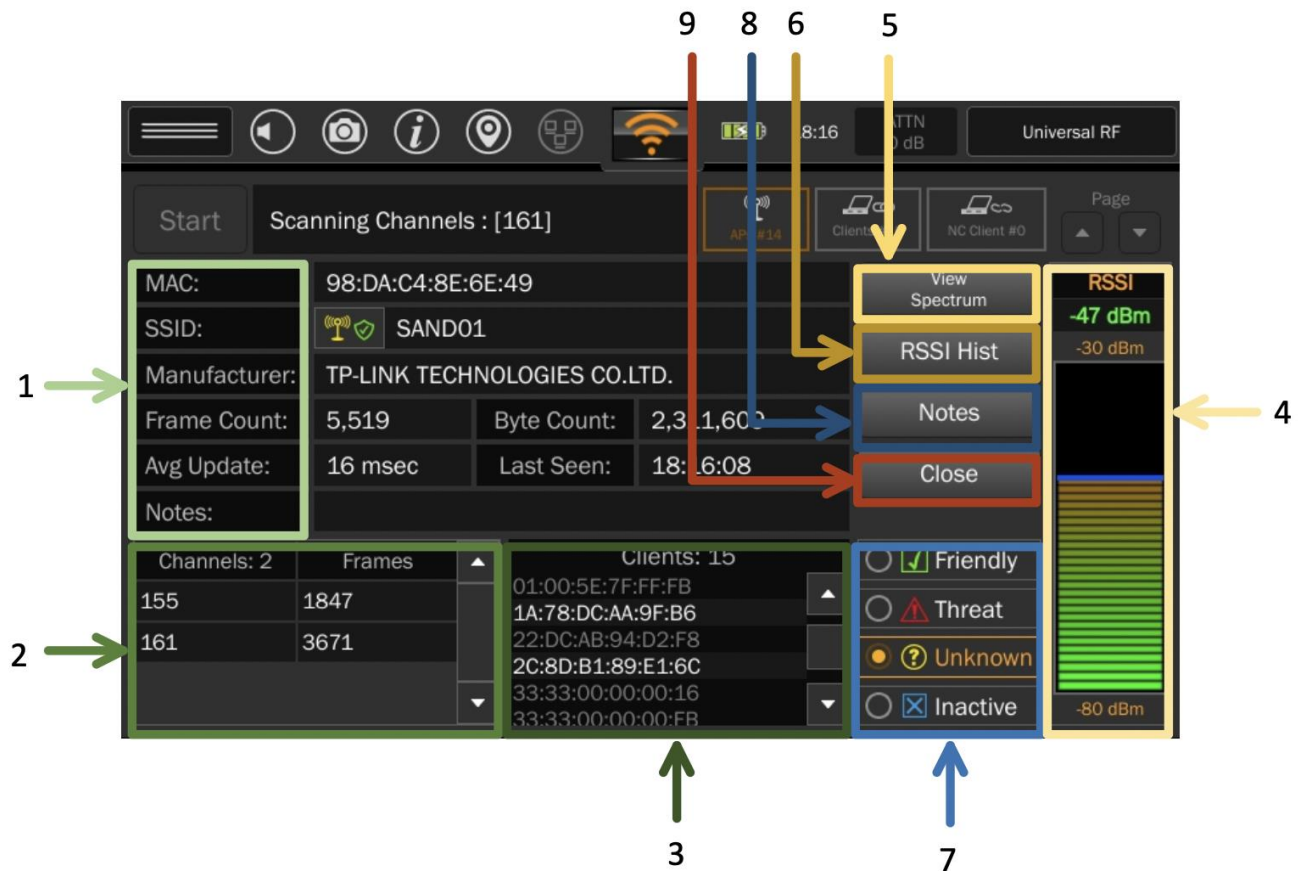
In this column, the MESA 2.0 will identify WiFi devices by several parameters. First, the device will be classified as an Access Point (AP) or a Client and indicate this by a symbol:

-  Access Point, secured
-  Access Point, unsecured
-  Client, connected to an AP
-  NC Client, not connected to an AP

If AP/Client device names are available, they will be listed beside the symbol. However, a name in blue indicates an NC Client's probe request and *not* the actual device's name. An NC Client is not connected to an Access Point. (For more on how the MESA 2.0 classifies devices, see #3 below).

Detail View

Selecting a device from the Wi-Fi list allows for further evaluation. Details for the selected device will appear in Detail View screen. To access this mode, tap anywhere in the row of the desired device. The Detail View screen will appear.



1) Stats & Details

In the **Detail View**, there are additional details regarding the device including the number of frames detected from the device, the number of bytes detected from the device, the average update rate, the time that it was last seen, and the manufacturer (if available, determined from the MAC address). Within the SSID column will be an icon indicating the security status of the device. If the icon is greyed out, security details are not available. If the icon is colored, then it is

a clickable button. Selecting this button will bring up security details for the Wi-Fi device.



2) Channel List

Devices may be detected on more than one WiFi channel. All the channels on which the device was detected will be displayed in the **Channel List** at the bottom left of the **Detail View** along with the number of frames sent by the individual channel. While in **Detail View**, the MESA 2.0 will repeatedly scan all channels sequentially in the **Channel List** looking for transmissions from the device.

To isolate the scan to a single channel:

- Tap the desired channel in the channel list so it is highlighted.
- To scan another channel, simply tap on the desired channel.
- To return to scanning all channels in the **Channel List**, tap the highlighted channel again to unselect.

3) Access Points/Client/Not Connected (NC) Client List

Within Detail View, this list shows the MAC addresses associated with the selected device. For Access Points, the list will contain associated Clients. For Clients, the list will contain connected Access Points. However, in the case of a Not Connected (NC) Client, the space labeled as AP will contain a list of probe requests, rather than connected APs. Often this probe request will appear as FF:FF:FF:FF:FF:FF which is the broadcast global probe request. Occasionally, a specific MAC address will be displayed, which indicates a formerly connected AP that this NC Client is searching for. An NC Client is not currently connected to any Access Point.

When analyzing these lists, keep in mind, not all listed connections will show up in the WiFi Main Screen list. There are several possible reasons for this:

- An Access Point may be connected to a Client that itself is not in range of the MESA 2.0.
- A Client is sending probe requests for an AP that it was formerly connected with. An example would be a phone searching for a favorite coffee shop's saved WiFi router.
- A Client has moved out of range. An example: an office worker left for lunch with their phone.
- A Client may no longer be transmitting a WiFi signal.
- An Access Point has moved out of range *

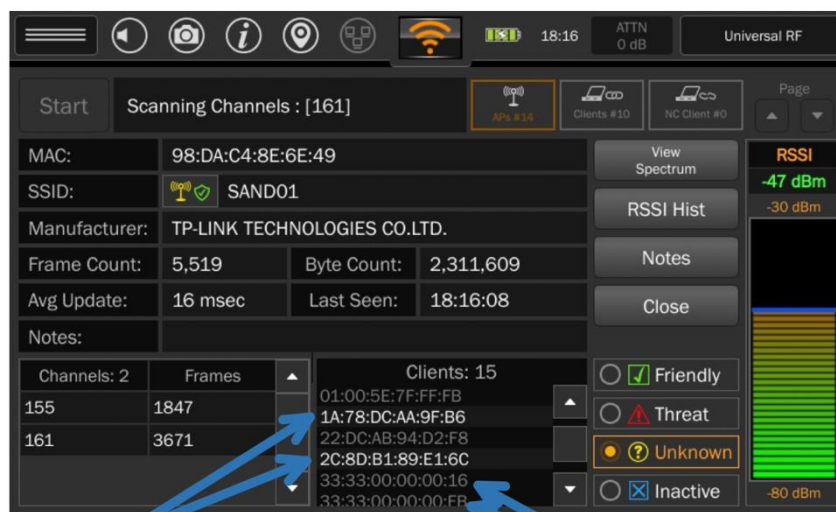
*Clients can be stationary, like a desktop computer or printer, or they can be movable, i.e., laptop computers and cellular phones. Access Points, however, are more often stationary. Finding a stationary Client device that is searching for an Access Point *that is no longer present* should raise interest.

Devices are classified by the MESA 2.0 as Access Points, Clients, or NC Clients based on data packets called frames. A specific type of identifier frame is called a beacon frame. These beacon frames are how the MESA 2.0 identifies the device. Some devices will initially be classified as a Client, but as the additional frames are received, they may be promoted to an Access Point. At the beginning of a scan, a Client device might first appear as an NC Client, but with adequate scan length (depending on the received frames), it may become classified as a Client. A longer scan will better classify and identify devices, so it's beneficial to run the scan longer than the minimum of 15 seconds.

Occasionally an Access Point, when handling large amounts of data, will create an additional virtual device. This "device" may be identified by the MESA 2.0 as a Client. Physically, it will be the same device as the original AP that created it. In conclusion: Allowing the MESA to scan for a few minutes will better classify found devices. Physically finding the device before analyzing its AP/Client connections is a good practice.

Cross Referencing AP/Client Lists

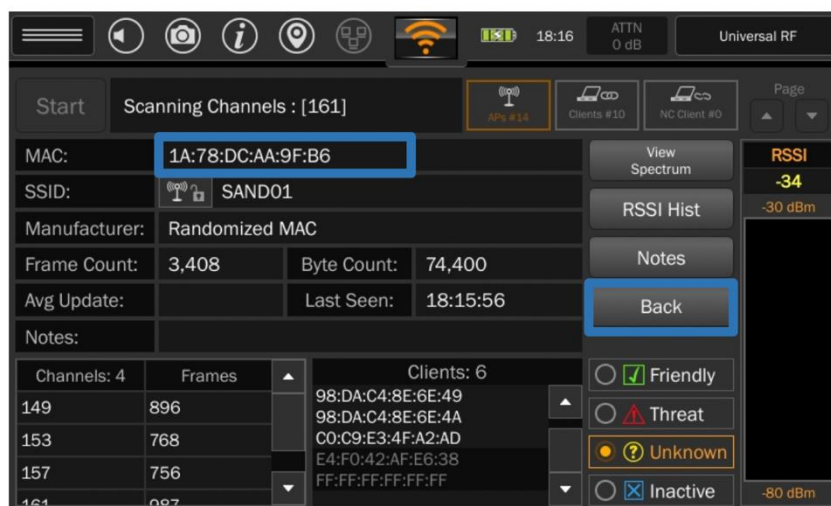
Within the Client/AP box Wi-Fi addresses will be either white or gray. Grayed addresses indicate addresses not found in the main Wi-Fi list.



Clients also in Main Device List (clickable)

Clients not in Main Device List (grayed and not clickable)

White addresses are clickable and will bring up the Detail View for the selected associated address. To return to the original selected device, click the **Back** button.



4) RSSI Bar Graph

The Bar Graph in the bottom right of the Detail View screen displays the RSSI data for the device. The Bar Graph displays a range of -30 to -80 dBm. Above the Bar Graph box, the power of the selected device is displayed. If the number is green, the device is currently and actively transmitting at this power level. If the number is yellow, it is the latest RSSI value detected but the device is not currently transmitting. Note: If the MESA has been moved out of range of the selected device, there may not be any RSSI data. Additionally, if the MAC address for the device has rolled due to MAC randomization, there may not be any RSSI data.

5) View Spectrum

To view the spectrum for the device: From the Detail View screen, press the “View Spectrum” button located near the top right of the screen. The MESA 2.0 will begin displaying the RF Spectrum and Waterfall view for the selected device/network. While in spectrum view, the span is limited to the detected channels’ frequency, but the normal options are available (peak, average, persistence, etc.)



- a. The green dashed vertical lines represent the frequency span of a device’s channel(s). If in Detail View, a specific channel has been selected, the frequency span will be

displayed for that channel only. If there is no channel selected, the frequency span will include all the channels.

- b. **Waterfall View** appears automatically and appears at the bottom of the screen when **Spectrum View** is selected.
- c. To close **Waterfall View**, select the X. The Spectrum View will remain. To bring back the Waterfall View, select it from the **Mode Menu**.
- d. To enlarge **Waterfall View** to full screen, select this option. **Waterfall View** can be minimized using the same button.
- e. To save an image of the **Waterfall**, select the save button. This will be saved to the USB thumb drive (see p.116 for compatibility), which needs to be inserted. A reminder dialog box will appear if none is inserted.
- f. To change the updates per second, select the gear icon. Updates per second can be set between 1 and 20, in one-second increments.
- g. To exit Spectrum View, select the zoom-out icon.



6) View Histogram

From the Detail View, the received signal strength can be viewed over time by pressing the **RSSI Hist** button. The Detail View screen is still visible above the histogram window. To close the histogram view, press the “x” button in the top right of the window.



7) Classification

Devices can be also classified from the Detail View as “Friendly”, “Threat”, “Unknown” or “Inactive” from the Detail View screen. Simply tap on the desired ID designation in the ID box to the left of the RSSI bar graph.



8) Notes

Make a notation on individual devices by tapping on the “Notes” button (in Detail View). A keyboard window will appear. The keyboard window can be closed by pressing the **Done** button. Items with notation will appear in Detail View with an asterisk “*” in the Notes button. Notes will be preserved with a saved list.

9) Close Button

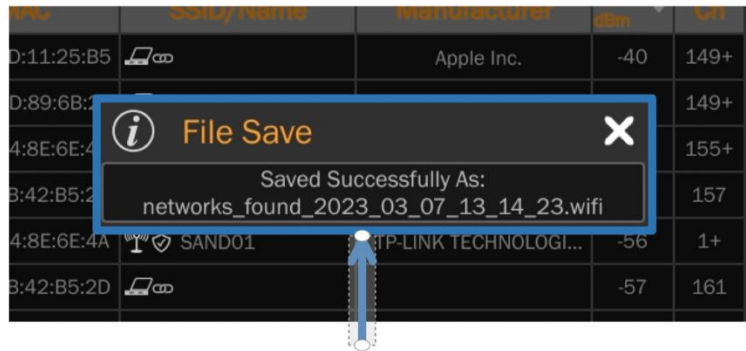
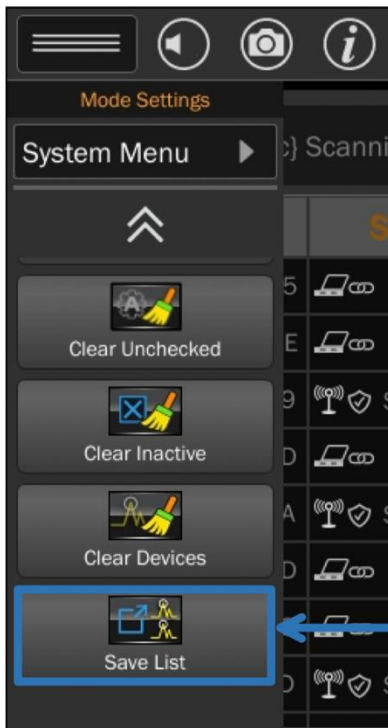
To close the Detail View screen and return to the WiFi list, press **Close** located above the ID box.

Saving the WiFi List

It may be helpful to save the WiFi device list for further evaluation on a PC or for a report:



- 1) Ensure that a thumb drive (see p. 116 for file system compatibility) is inserted into one of the USB ports on the MESA 2.0.
- 2) Select **Save List** from the Mode Settings Menu. (Note: This option will be grayed out and unavailable unless there is a thumb drive inserted into one of the USB ports.)

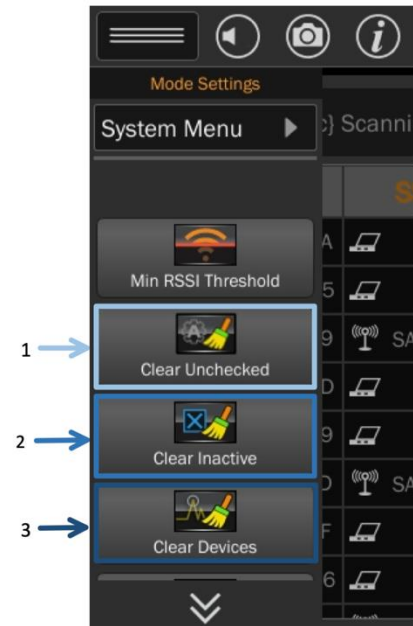
- 3) The list is saved as a comma-separated value (CSV) file with a file extension of WiFi. This file can be opened with Excel or other spreadsheet programs. It may be helpful to change the extension to .csv in most cases.



Clearing the Device List

The device list may be cleared at any time both during live scanning and after the scan is stopped. There are three options for clearing devices from the list:

- 1) Clear Unchecked: This option will clear only devices that have not been identified as **Friendly**, **Threat**, or **Inactive** by the user and are still labeled as **Unknown** with a yellow question mark. 
- 2) Clear Inactive: This option will clear only devices identified by the user as **Inactive**, indicated by a blue "x." All others will remain on the list. 
- 3) Clear Devices: This option will clear **all** devices from the list.



Bluetooth

The MESA 2.0 can detect nearby Bluetooth by receiving advertising packets from these devices. It will create a list of these devices as they are detected. Detected devices will be listed with information as to their device address, name, OUI/Mfg/UUID, dBm, user notes, and user-created ID. Device name and manufacturer information may not be available for all devices.

#	Address	Name	OUI/Mfg/UUID	dBm	Notes	ID
07	66:A1:D4:33:95:5A		Apple, Inc.	-57		?
08	73:6C:A3:43:88:D5		Google, Amazon.co...	-63		?
09	4F:36:C4:14:7E:93		Apple, Inc.	-64		?
10	60:74:F4:01:9A:E1	GBK_H619D_9AE1	Private,	-64		?
11	D9:7F:E0:58:EF:C7	Mi Smart Band 6	Anhui Huami Inform...	-69		?
12	E4:BF:4A:59:58:83		Robert Bosch GmbH	-73		?
13	5E:56:D2:19:63:B3		Google, Amazon.co...	-75		?
14	D0:03:DF:4C:D3:F6	[TV] Samsung Q6 S...	Samsung Electronic...	-79		?
15						

Note: Devices that are paired and encrypted will not be detected.


Devices can be filtered into Classic or Low Energy (LE). The MESA 2.0 scans for both Bluetooth Classic (Standard)—such as cell phones—and Bluetooth LE (Low Energy) and can detect Bluetooth devices through version 5.0, including BLE.

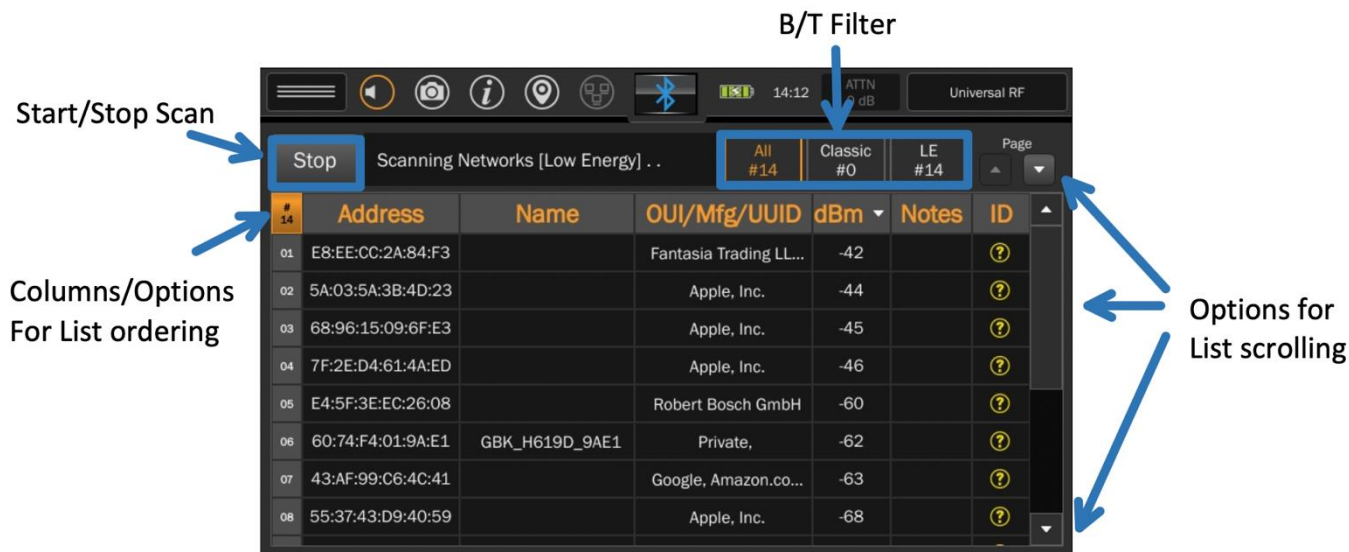
Bluetooth Versions	Date Rate (Mbps)	Range *	Alias	Notes
v1.2	1.0/.07	30 ft.	Classic/Std.	
v2.1 + EDR	3.0/2.1	30 ft.		audio, secure paring
v3.0 + HS	24 Mbps	300 ft.		Uses WiFi
v4.0	0.27	200 ft.	BLE - Low Energy	Low power, low data, peripherals
v5.0	0.125 to 2	800 ft.	BT5	New, latest, trades speed for distance

Table 1, Bluetooth versions supported by MESA 2

*Range without obstacles

Bluetooth Scanning and Device List

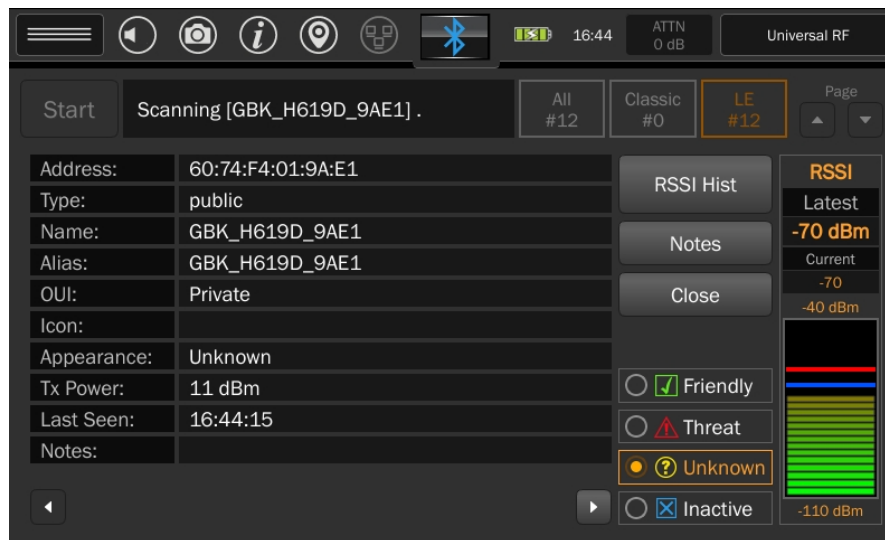
To begin a scan in Bluetooth Mode, select **Start**. Devices will be added to the list as they are discovered. The device list can be ordered by the Address, Name, etc. by tapping on the top of each column. A second tap will reverse the order of that column. If desired, the list can be filtered into either Classic or LE by selecting that button. All devices will still be scanned, but only the selected (Classic or LE) will be displayed. Devices can be highlighted during a scan, but details cannot be viewed until the scan is stopped. Devices can be classified in the ID column from List View, but it can be easier to do this while the scan is stopped. Tap the  icon to bring up the classification box. See p. 82.



Note: A LE Bluetooth device may originally appear in the **Classic** filter but be promoted to the **LE** filter once the MESA receives additional information from the Bluetooth device. It will not appear again in the Classic filter unless the device list is cleared.

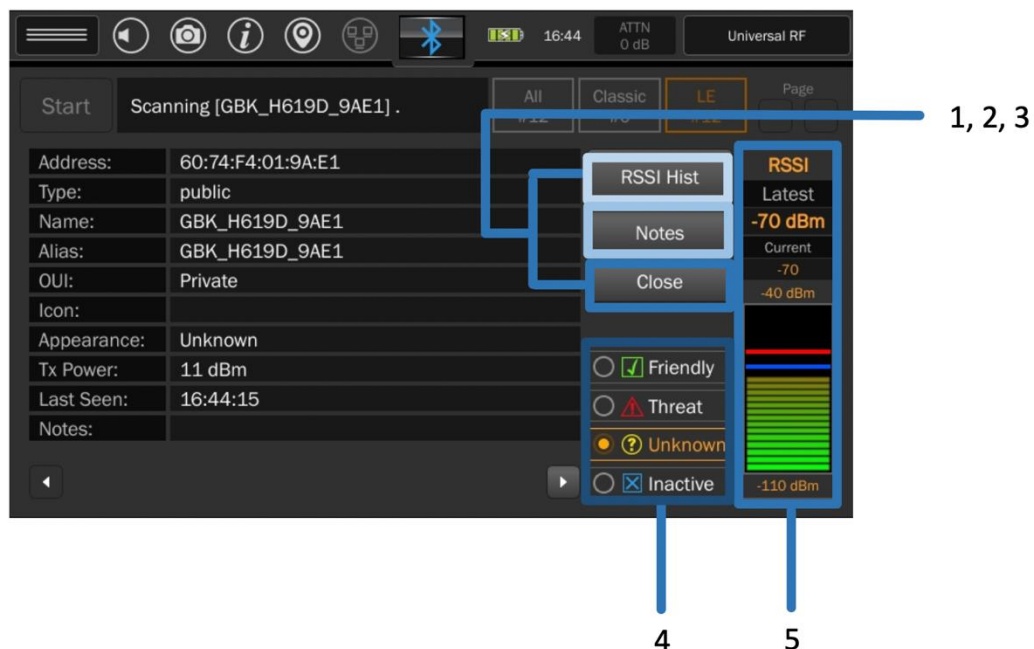
Detail View

To evaluate individual devices, the scan needs to be stopped. Each found device can be viewed in Detail View by clicking on the item in the list. The Detail View will include the RSSI Histogram, Notes, and Classification boxes as well as an RSSI real-time bar graph. These are on the right of the screen. On the left will be the first of three pages of tables containing manufacturer information. (See p. 85.)



Histogram, Classification, RSSI bar graph

Within the Detail View for the individual device are several options for evaluation.



- 1) RSSI Hist — pressing this button will bring up the selected device's RSSI (Received Signal Strength) Histogram. Close this window by pressing the “x” in the upper right corner.



- 2) Notes — select this to record any notes for an individual device. A box containing a keyboard will appear. Select **Done** when finished.



- 3) Close — Press this button to leave Detail View and return to the found Bluetooth device list.

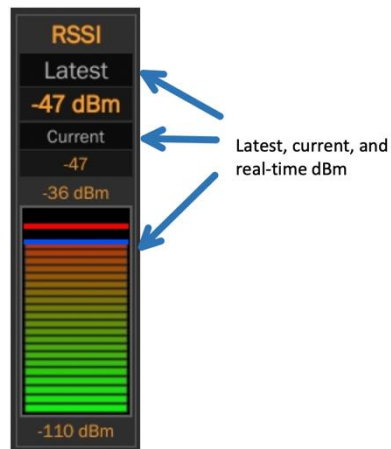
- 4) Device Classification (user-created) — Individual devices can be classified by the user as Friendly, Threat, Unknown, or Inactive. Select the classification by tapping the desired name. This classification will now appear on the device list page under the ID column. Devices can also be classified from the list view, see p. 81.



- 5) RSSI Bar — The RSSI bar gives real-time Received Signal Strength from a Bluetooth device.

If a device does not display an RSSI value, it may do so for the following reasons:

- No longer in range of the MESA
- Lost power (e.g., battery died)
- Has paired with another device during the scan
- No longer transmitting under that B/T address (e.g. new random B/T address)
- Stopped transmitting

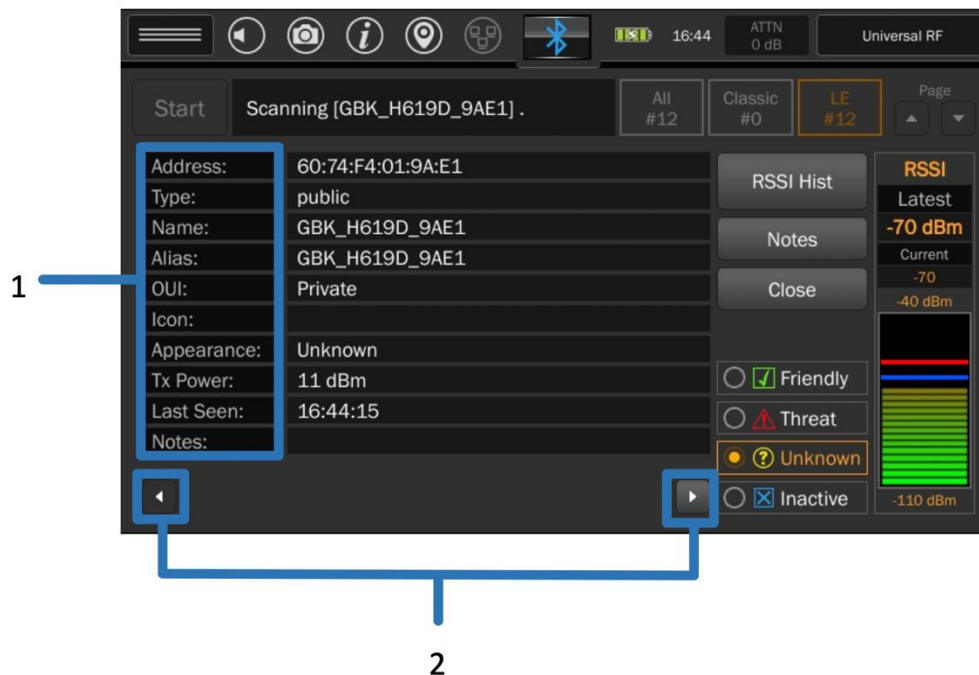


Note: A device that no longer displays an RSSI value will remain on the list until the list is cleared

Detail View Table, Page 1

When a Bluetooth device is selected from the Device List the user is presented with Detail View. On the left side of the screen, there is a table containing additional device information. This table is divided into three pages.

This first page contains a table of information regarding the individual device. The information given is as follows:



- 1) Device information table for page 1 of the Detail View
 - a. **Address** — unique 16-bit Bluetooth device number
 - b. **Type** — public, private, random, if unavailable field will show *DATA NOT PROVIDED*
 - c. **Name** — name created by manufacturer or possibly owner of device, if unavailable field will show *DATA NOT PROVIDED*
 - d. **Alias** — name created by manufacturer or possibly owner of device, if unavailable field will show *DATA NOT PROVIDED*
 - e. **OUI** — Organizationally Unique Identifier; can be *Private*, or provide name of parent corporation/manufacturer, if unavailable field will show *NOT REGISTERED*
 - f. **Icon** — will contain a text representation of the appearance (i.e. clock, watch thermometer), commonly will be blank
 - g. **Appearance** — general description of appearance when supplied (i.e. a phone, a thermostat, a docking station etc.)
 - h. **Tx Power** — transmitting power listed in decibel milliwatts
 - i. **Last Seen** — time listed is military time
 - j. **Notes** — this field will display any user-generated notes for an individual device

- 2) Page navigation buttons —these buttons navigate between the three pages of the device table information

Detail View Table, Page 2

The second page of the Detail View Table contains:

- Manufacturer data — includes Key (general number assigned by company for a particular style of device, e.g. all Apple “Find My” devices will have the number 004C); company data and Raw Data numbers
- UUIDs — “Universally Unique Identification” number which is a 128-bit label; Contains Key, Service, Service Data; note that individual Bluetooth devices can have multiple UUID numbers
- Navigation buttons



Detail View Table, Page 3

This page contains information often only available for Classic (Standard) devices. They are as follows:

- Major Service Class — Specifies the primary device category (e.g. computer, phone, audio/video)
- Major Device Class — Further refines the device type within the major class (e.g. laptop, headset, wearable)

- Minor Device Class — Indicates specific services supported by the device (e.g. audio streaming, telephone, networking)

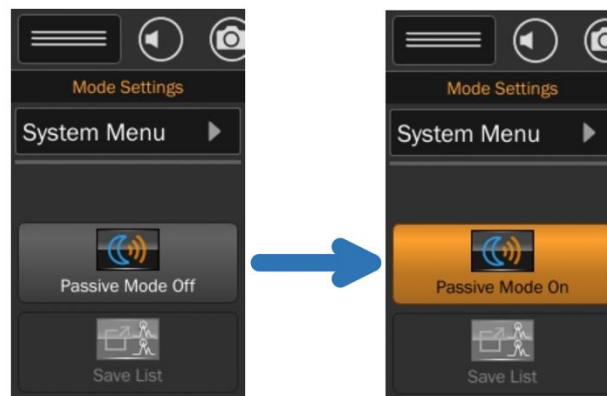


Note: for the entire Detail View table, blank fields indicate that information was unavailable in a particular Bluetooth device's advertising packet data.

Passive Mode

When using the MESA in an environment with RF transmission restrictions, the user may wish to take advantage of the passive feature. When this feature is enabled, the MESA will not transmit any Bluetooth data frames while scanning for Bluetooth devices. It will only receive them.*

To enable Passive Mode, click the Mode Menu button and select **Passive Mode On** from the drop-down menu.

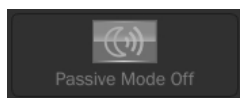


**Due to the nature of Classic (Standard) Bluetooth device request/response protocols, the MESA cannot detect these devices while in Passive Mode. Only Low Energy (LE) devices can be detected.*

Passive Mode can be selected before starting a scan or during a scan only if the scan has been stopped. Passive Mode cannot be enabled during a scan (List View) or while in Detail View. Passive Mode can be turned off using these same guidelines. The Passive Mode On/Off button will be grayed out and not clickable during a scan or when in Detail View:



Passive Mode On, but not clickable (MESA B/T Mode needs to be in List View and stopped)



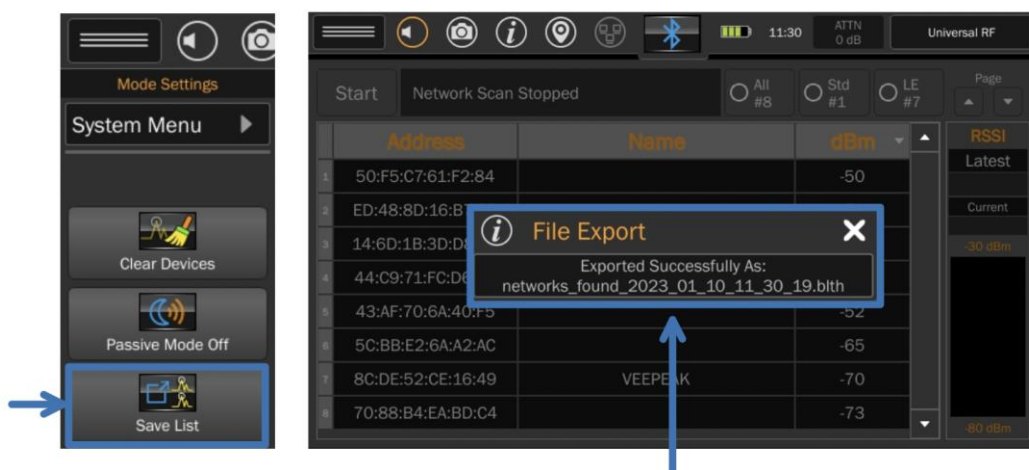
Passive Mode Off, but not clickable (MESA B/T Mode needs to be in List View and stopped)

Manufacturer data in List View and Detail View may be impacted when using Passive Mode.

Saving the Device List

The device list can be saved both during a scan and after the scan is stopped. First, ensure a thumb drive (formatted with FAT32 or exFAT, see note on p.116) is inserted into one of the USB ports. Then, select “Save List” under the Mode Settings Menu. A dialog box will appear confirming the saved list and displaying the file name.

*If saving the list is attempted without a thumb drive inserted, a dialog box with the message “could not open file” will appear.



To view the Saved List file, the user may find it easier (depending on their spreadsheet application) to rename the extension “.csv.” To open the file, it may need to be changed.

Clearing the Device List

The device list can be cleared by selecting “Clear Devices” from the Mode Menu. This can be done both during a scan and when the scan is stopped. Clearing the device list may be helpful during a search to eliminate randomized Bluetooth addresses that have moved/changed to a new Bluetooth address. (This device is often still transmitting but under a new address.) All user notes and classification ID will be lost when the device list is cleared.

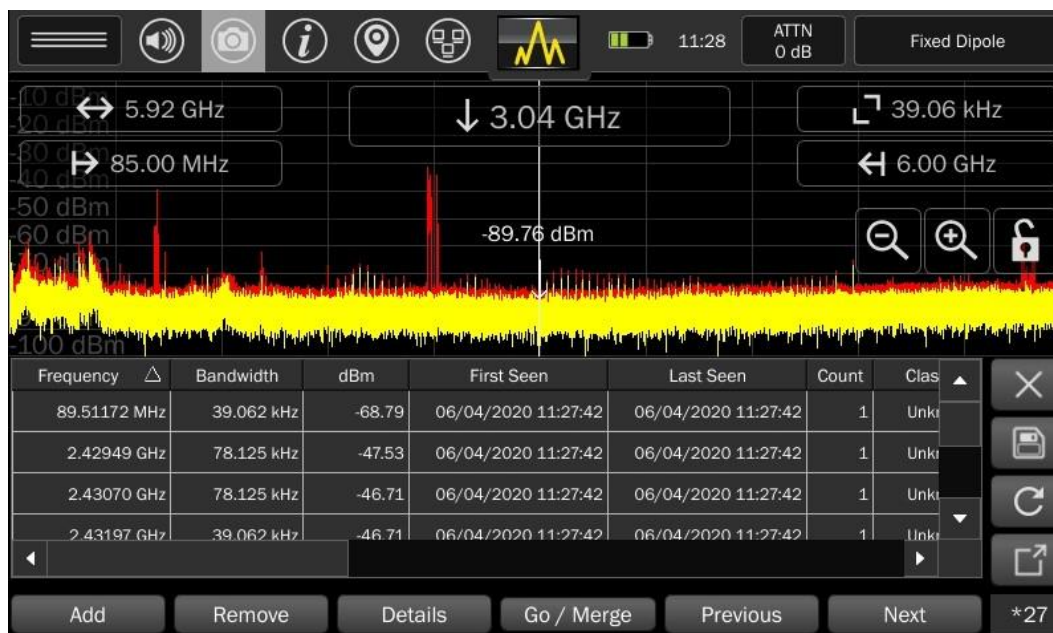


Additional Features

Signal List Window

A signal list for storage and recall for frequencies of interest along with additional information such as signal amplitude, bandwidth, threat level, the number of times that signal has been seen, location, and Band ID information.

Signal lists can be automatically generated through either the Generate Signal function (see page 38) or the SmartBars Signal Resolution mode (see page 49).



The signal list appears below the Spectrum window. The following sections provide details on signal list operations.

The signal list parameters stored in the signal list include:

- Frequency - Where in the spectrum the signal has occurred.
- Bandwidth - When a signal is initially added, bandwidth will be equal to the resolution bandwidth at the time the signal was added. However, as the merging algorithm begins to group closely spaced signals together (SmartBars Signal Resolution Mode only), the bandwidth value will also change to represent the envelope of their combined bandwidths.
- dBm - Signal level in dBm.
- First Seen - This field will represent when the signal was added to the signal list.
- Last Seen - In SmartBars Signal Resolution Mode, if a periodic and repetitive signal is detected, this field will automatically be updated each time the signal reappears. This will denote the last time the signal was seen. For Spectrum Mode signal list generation or when adding a signal manually to the signal list, this field will be equal to the First Seen field.
- Count - In SmartBars Signal Resolution Mode, if a periodic and repetitive signal is detected, this field will automatically keep track of the number of times the signal appears.
- Class - Using the Class field, signals can be tagged with 3 different designations: "Known", "Unknown", or "Threat". The Class field must be set manually by the user.
- ITU - General Frequency Band Information for specific ITU regions. To ensure accuracy for a given location, be sure to set the ITU region (see page 118).
- Wireless - Specific Band Information for known wireless protocols (GSM, CDMA, LTE, etc.) To ensure accuracy for a given location, be sure to set the ITU regions (see page 118).
- Other Details - More specific band information (e.g. Amateur Radio 60 meters, Instrument Landing System, VHF Television, etc.) This information is only available if the MESA is set to ITU Region 2 (see page 118).
- FCC - Contains information for the bands defined by the FCC rules. The FCC Rules Part Number is listed in the description (e.g. Maritime (80), Amateur Radio (97), etc.) This information is only available if the MESA is set to ITU Region 2 (see page 118).
- Atten/Gain - Indicates the attenuation or gain setting (see page 27) on the MESA at the time the signal was recorded.
- Latitude/Longitude/Altitude - Indicates GPS location information when the signal occurred (or at the time of the last seen occurrence). GPS Location information must be available or saved (see page 23) for this information to be present.

- UTC Offset - Represents the time difference between local time and UTC. This field depends on the time zone a particular MESA is set for. UTC Offset is provided in the format +/- [hh]:[mm].
- Probe - The selected probe on the MESA when the signal occurred.

Adding Signals

To manually add a signal to the signal list:

- 1) Position the cursor at the signal to be added.
- 2) Press the "Add" button at the bottom of the signal list. A dialog box will appear with all the details of the signal to be added. If everything is as desired, press the "OK" button.

Removing Signals

To remove a signal from the signal list:

- 1) Tap the signal in the signal list so that the row is highlighted.
- 2) Press the "Remove" button at the bottom of the signal list.

Viewing Details of Signals

For each of the signals in the signal list, all the details can be viewed in one concise screen:

- 1) Highlight the signal to view details.
- 2) Press the "Detail" button at the bottom of the signal list.

From the details screen, the frequency, displayed power level or displayed bandwidth of the signal can be edited. Each signal can be labeled as "Known", "Unknown", or a "Threat" by selecting one of these options from the "Class" drop-down box on the details screen.

Traversing a Signal List

Controls exist for easily moving the cursor from one signal to the next within a signal list.

- 1) With a signal list open, highlight a signal within the list to display on the spectrum by tapping it.
- 2) With a signal highlighted, press the "Go/Merge" button. The MESA will zoom in with the cursor on the highlighted signal.
- 3) Press "Previous" to move the cursor and the highlight to the previous signal in the list.
- 4) Press "Next" to move the cursor and the highlight to the next signal on the list.

Merging Signals Within the Signal List

In SmartBars Signal Resolution mode, a merging algorithm is employed. This algorithm will merge closely spaced signals in the signal list with overlapping bandwidths. This will cause transmissions such as frequency hoppers or FM transmitters, which initially appear as several distinct closely spaced signals, to be eventually merged so they appear as one signal with a larger bandwidth. However, it is also possible to manually merge two distinct signals in the list together to indicate that they are the same signal. This is especially useful in Spectrum Mode signal generation, where a signal list generation is a one-time event, and the merging algorithm is not employed.


To manually merge two or more signals within the signal list:

- 1) Click and drag vertically across signals in the signal list to highlight multiple signals. If a keyboard and mouse are connected to the USB port, the Shift + Click and Ctrl + Click operations may be used to highlight the signals.
- 2) Press the "Go/Merge" button.
- 3) A dialog box will appear asking for confirmation to merge the highlighted signals. Press "Yes" to confirm.

Note: Some information may be lost when manually merging signals. For example, if two signals that have different information in the probe field are merged, the merged signal will only retain the information from one of the signals.

Viewing the Signal List Full Screen

It is possible to view the signal list in full screen.


- With the signal list open and displayed on the bottom half of the screen, press the full-screen button. 

Note: The spectrum or SmartBars will be hidden while the signal list is viewed full screen.

- To return to the half-screen view of the signal list, press the return from full-screen button. 

Clearing the Signal List

To clear a signal list:


- 1) Select the Clear Signal List button. 
- 2) A dialog box will appear asking to confirm clearing the signal list. Three options are available:
 - a. New — Press **New** to clear the signal list and generate a new one.
 - b. Clear — Press **Clear** to clearing the signal list (leaving an empty signal list).

- c. Cancel — Press **Cancel** to cancel the clear signal list operation.

Saving the Signal List

It is possible to save a signal list to a USB thumb drive (see p. 116 for file system compatibility) to access from a PC or from an OSCOR Blue or OSCOR Green. Signal lists are saved in .csv format and may be opened with a spreadsheet program such as Microsoft Excel.

To Save a Signal List:

- 1) Ensure that a USB thumb drive is connected to one of the USB ports on the MESA.
- 2) Press the File Dialog button. 
- 3) The filename that will be used for the saved file is displayed near the bottom of the file dialog box.
- 4) Press the CSV button to save the Signal List to a file that can be opened using a spreadsheet program or a text editor on a PC. The resulting file will use a .csv extension.
- 5) Press the OSCOR button to save the Signal List to a file that can be opened on an OSCOR Green or OSCOR Blue. The resulting file will use a .signals extension.





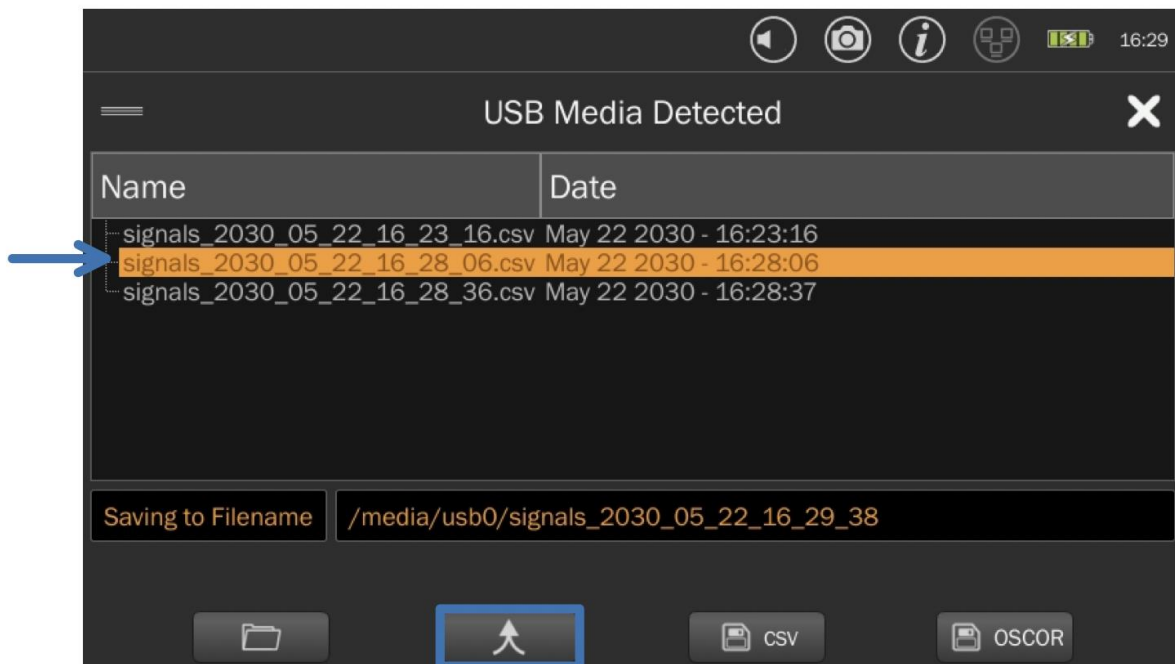
Note: Some of the data fields that are available on the MESA, but not available on the OSCOR Blue and Green (e.g. Latitude, Longitude, and Altitude) will be removed from this file.

Merging the Signal List

If desired, a newly generated Signal List can be merged with a previously saved list.



To Merge a Signal List:

- 1) Ensure a USB thumb drive (see p. 116 for file system compatibility) is inserted into one of the USB ports of the MESA.
- 2) Press the File Dialog button. 
- 3) Select (by a single tap) the previously saved Signal List to merge the currently generated Signal List into. The Signal List will be highlighted in orange.
- 4) Press the Merge Button. 
- 5) The current Signal List is now added to the selected previously saved Signal List.



Open a Previously Saved Signal List

It is possible to open a signal list that was previously saved on the MESA.

- 1) Ensure that the previously saved signal list (in CSV format) is on a USB thumb drive (see p. 116) that is inserted into one of the USB ports on the MESA.
- 2) If the signal list table is not open, select "Signal List" from the Mode Settings Menu.
- 3) Press the File Dialog button. 
- 4) From the file list, select the file (.csv) to be opened.
- 5) Select the Open button. 
- 6) A dialog box will confirm the successful import of the saved signal list. Press "OK" to close this dialog box.

Hiding a Signal List

To hide a currently displayed signal list, press the "X".

Note: The signal list is still open in memory; it is just hidden from the display. When powering down is attempted, the MESA will ask if it should save the signal list.

Image Viewer & Audio Player

The Image Viewer and Audio Player are located within the System Menu. The System menu can be accessed at the top of the Mode Settings Menu in any of the five modes (Spectrum, SmartBars, Mobile Bands, WiFi, Bluetooth).

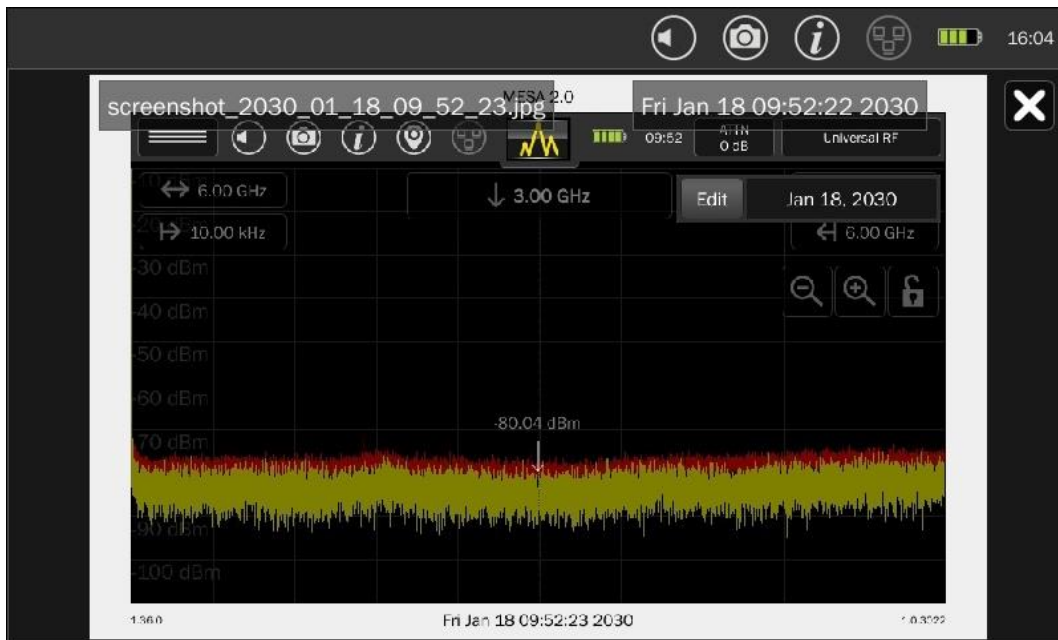
Any images that the MESA previously stored on a USB drive can be selected from the list and viewed.

The Image Viewer opens with a list of thumbnail images for any image stored on an inserted USB thumb drive.

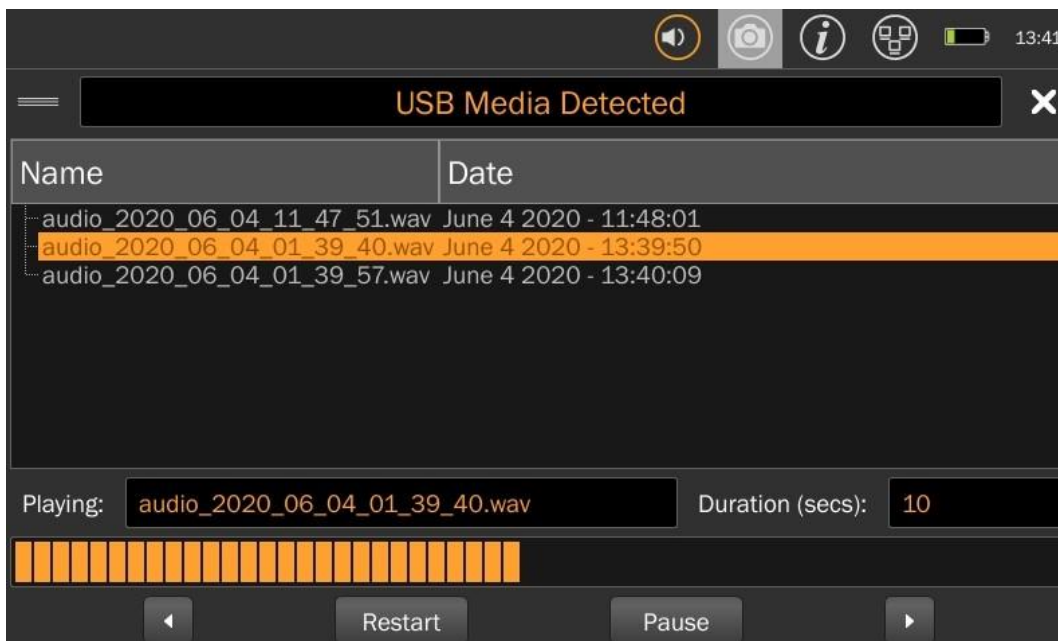


Double tap any thumbnail image from the Image Viewer's initial screen to see the image in full screen. Tap the "x" in the upper right corner to close the full-screen image and return to the thumbnail list.

Tap the "x" in the upper right corner of the image viewer to close the viewer.



With the Audio Player, any audio files that the MESA previously stored on a USB drive also can be selected from a list and replayed. At the bottom of the audio player screen, the left and right arrows



help select the file. Play/Pause and Restart at the bottom allow for playing, pausing, and restarting audio files from the beginning.

Press the "x" in the upper right corner of the screen to close the Audio Player.

Locked Monitor Mode

Locked Monitor Mode enables the MESA to be locked for overnight or extended monitoring to keep others from tampering with the device or settings.

To initiate Locked Monitor Mode:

1. From Spectrum or SmartBars Mode, press and hold the Lock Icon on the screen for at least 5 seconds.
2. Set a 4-digit PIN code to lock the device & press OK.
3. Enter the same 4-digit PIN code again to verify the PIN code.
4. The MESA is now in Locked Monitor Mode.

The lock screen displays an event log, which can be saved to an inserted thumb drive. The event log will record actions that occurred while the MESA was in Locked Monitor Mode, such as whether the AC Power supply was connected or disconnected, whether the power button was pressed, or whether a PIN Entry was attempted.

The screen will automatically fade to black after a few seconds. To display the lock screen again, tap anywhere on the screen.

To unlock the MESA:

1. From the lock screen, press **Unlock**.
2. Re-enter the PIN code used to lock the device. The device will now once again be unlocked.

Notes:

- It is **very important** to remember the PIN code used to lock the device.
- If an incorrect PIN code is entered, use the backspace key to erase the incorrect entry and try again.
- After 10 unsuccessful attempts to unlock the MESA, a delay of 30 seconds will occur.
- After 10 more unsuccessful attempts to unlock the MESA, a delay of 60 seconds will occur. Increasingly longer delays will occur with further incorrect entries.
- If unable to successfully unlock the MESA device, email support@reiusa.net, or call (931-537-6032) during REI's normal business hours (M – F 8:00 am – 4:30 pm CST)

Network Configuration

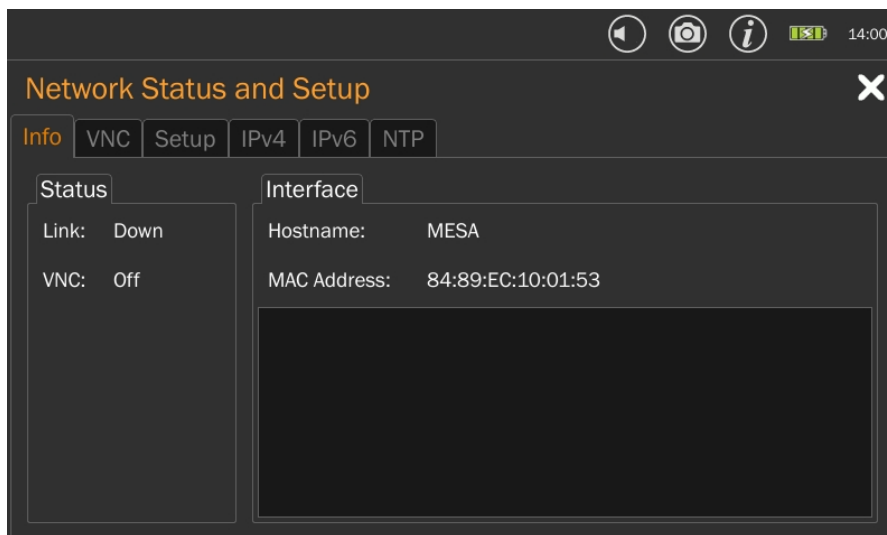
The network settings can be accessed from the network icon at the top of the screen and the System Menu. The button is active whether white or grayed out. White indicates the MESA is connected to a network via ethernet cable.



The network settings screen has five tabs:

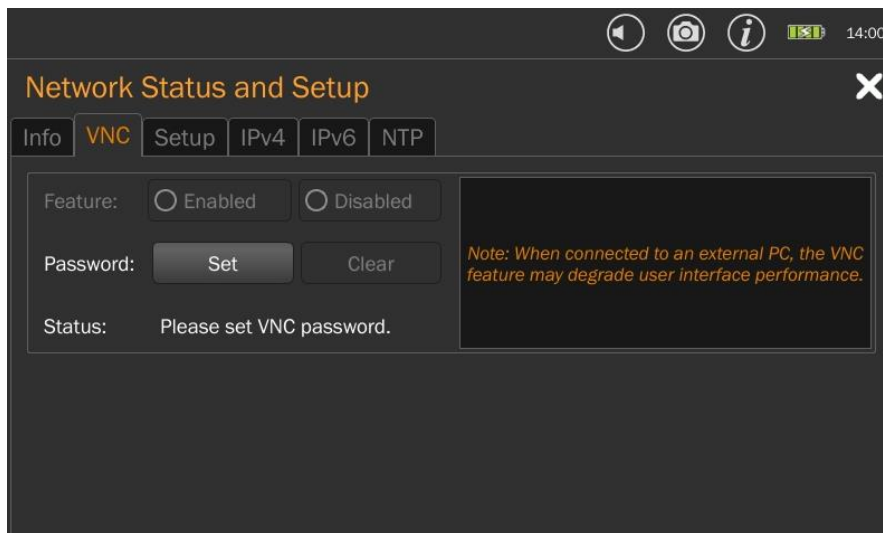
Info:

The Status subtab shows the current state of the link and VNC. When connected to a network via Ethernet cable, the Link shows “Up” when connected and “Down” when there is no connection. The interface subtab displays the hostname (default: MESA), MAC address, IPv4 settings, IPv6 settings.



VNC:

The VNC subtab allows users to enable a VNC server. The VNC server allows users to view and control a MESA from a remote location. A password must be set before the VNC will be enabled. This password will be required at the remote viewer. After enabling the VNC server, the MESA can be controlled by the touchscreen or via a remote viewer. When setting up the VNC viewer the MESA IP address, port number, and password are required. The IP address and the port number (5900) can be found on the Info Tab. The VNC server must be enabled to see the port number.



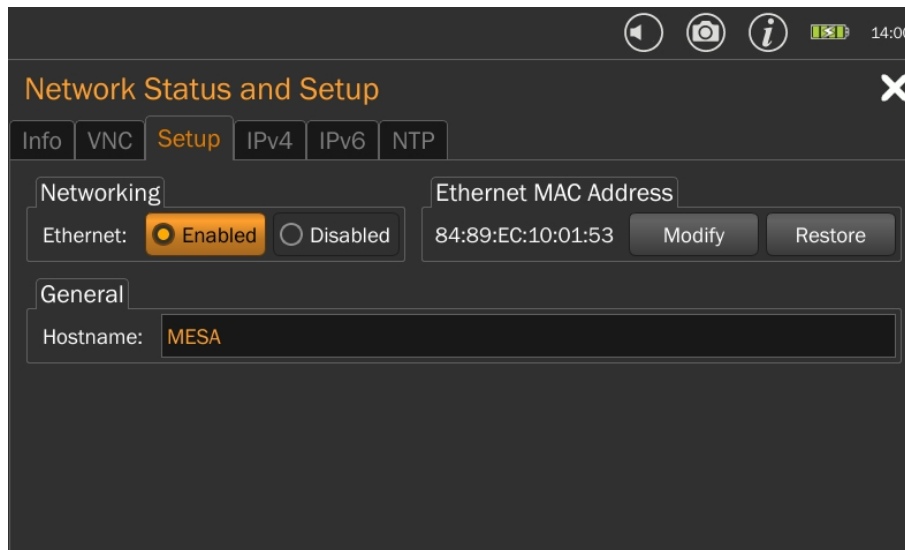
For Windows 10 based machines, VNC Viewer and RealVNC Viewer have been tested.
https://play.google.com/store/apps/details?id=com.realvnc.viewer.android&hl=en_US
<https://www.realvnc.com/en/connect/download/viewer/>

For Android phones, the VNC Viewer and Mocha VNC have been tested.
https://play.google.com/store/apps/details?id=com.realvnc.viewer.android&hl=en_US
https://play.google.com/store/apps/details?id=dk.mochsoft.vncpaid&hl=en_US

For IPADs, Mocha VNC has been tested.

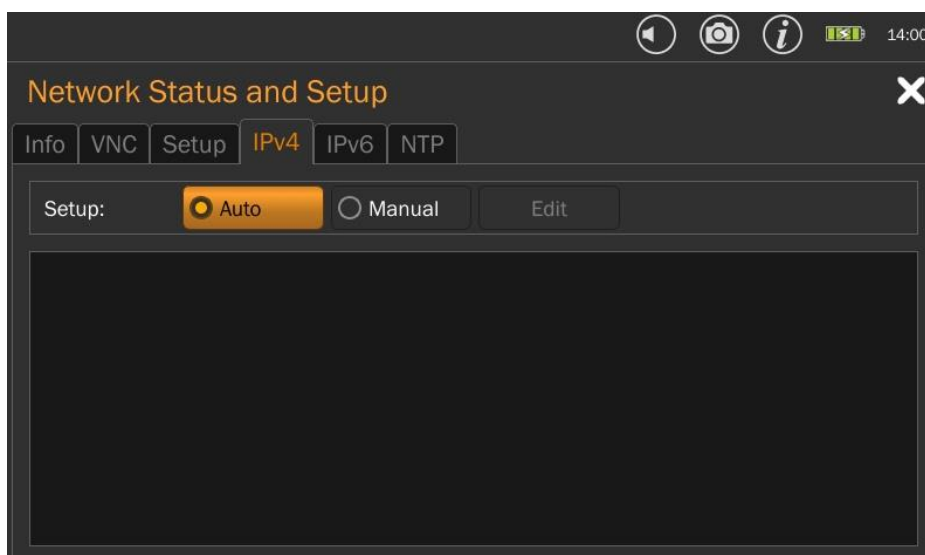
Setup:

The Networking subtab enables/disables Ethernet. The General subtab allows users to set the hostname (for example this is the name that will show up in a list of devices connected to a router). The Ethernet MAC Address subtab allows users to set a custom MAC address, generate a random address, or restore the default address.



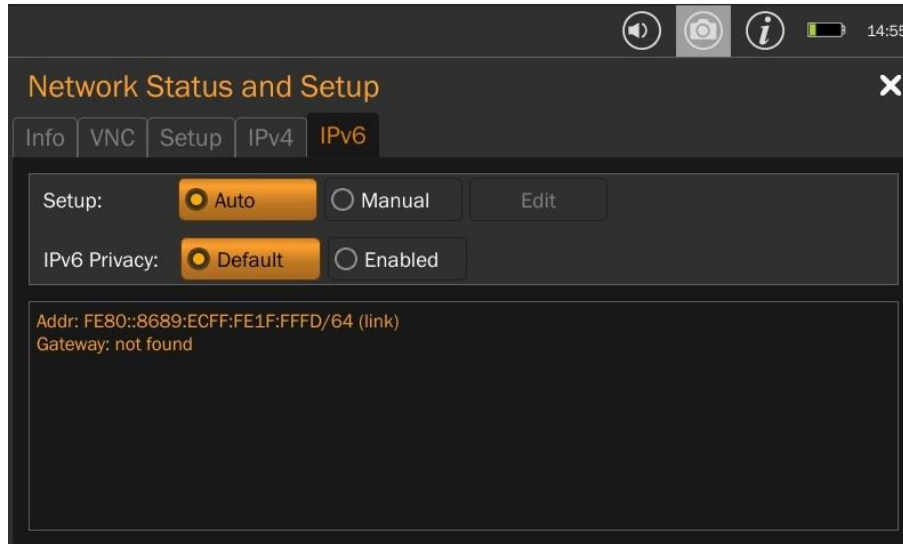
IPv4:

Displays the IPv4 settings. By default, these settings are set to automatic but offer the ability to manually set the address, netmask, and gateway.



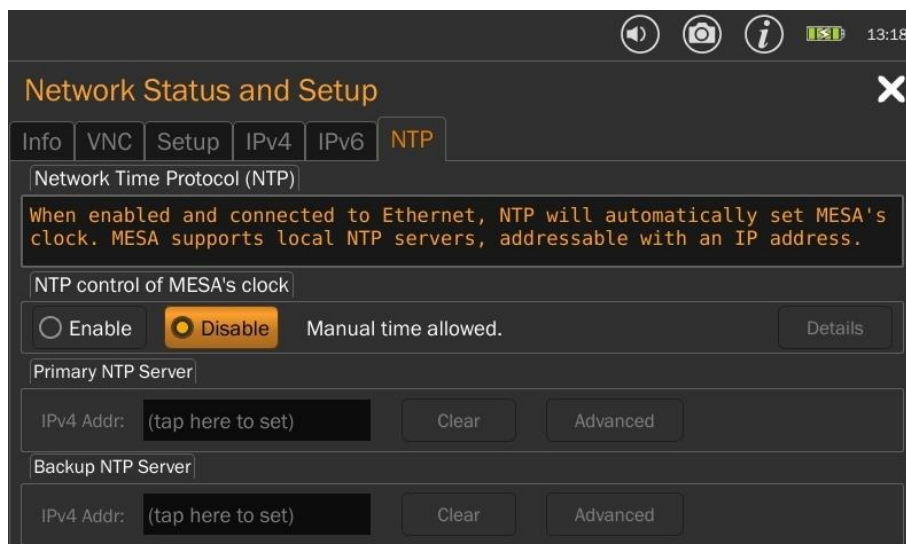
IPv6:

Displays the IPv6 settings. By default, these settings are set to automatic, but this tab offers the ability to manually set the address, prefix length, and gateway. There is also the option to turn on privacy settings. When privacy settings are turned on the MESA changes its address daily.



NTP:

Network Time Protocol allows the user to have the time set via a connected network. This applies to users who have connected a MESA constantly to the network and would prefer to have the time set automatically rather than manually. Select **Enable** to use this feature.



VNC Operation

How to start VNC Server

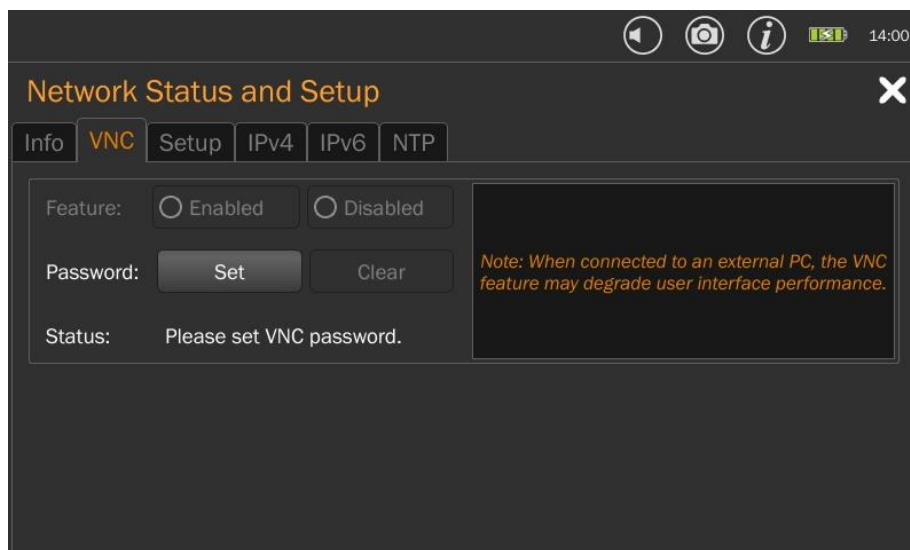
The MESA can be remotely accessed using the built-in Ethernet port. Third-party Virtual Network Computing (VNC) software is a commercially available tool for connecting to a device such as the MESA.

Starting the MESA VNC server:

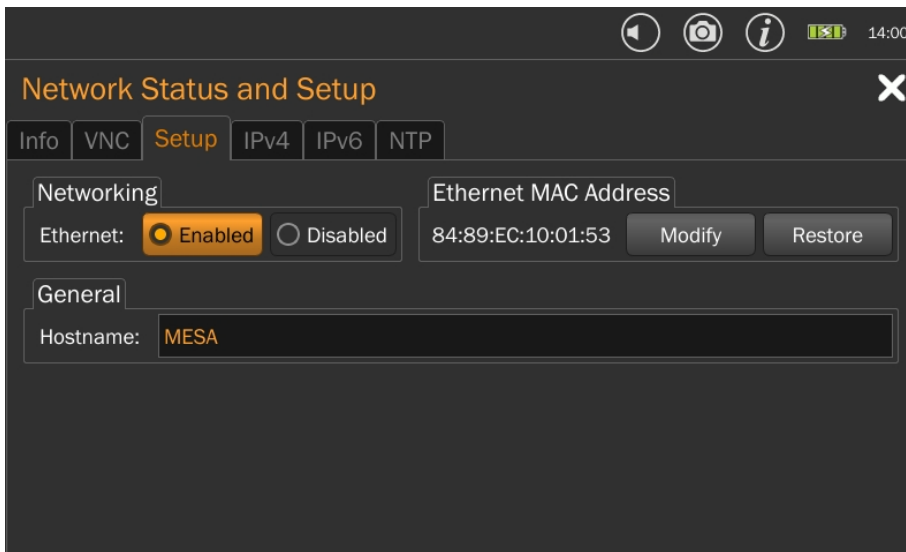
1. Connect the MESA to a network using the Ethernet Jack located at the top of the unit.
2. Open MESA Network Settings menus by selecting the Network Icon from the status bar.



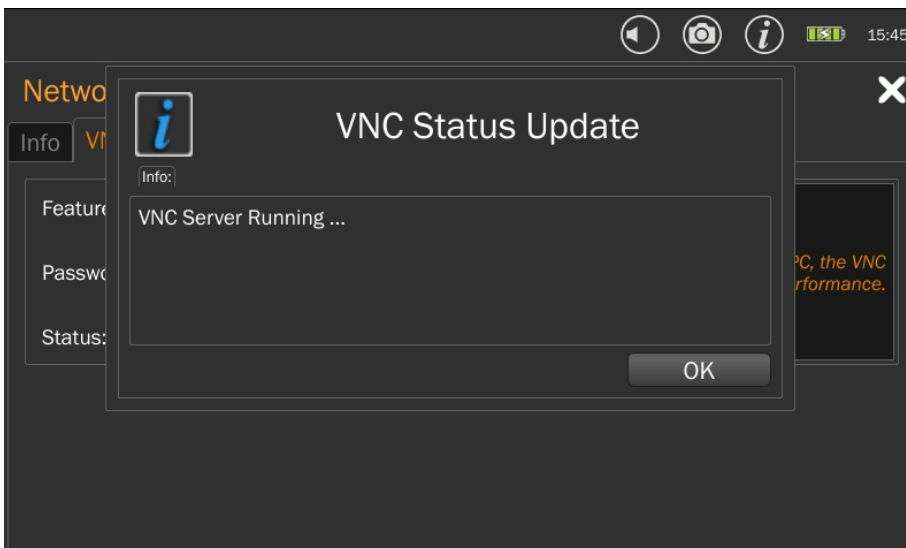
3. Record the IP address.
4. Select VNC Tab.



5. Set a VNC password, press done,,,,,,,,, then Select **Enabled**.

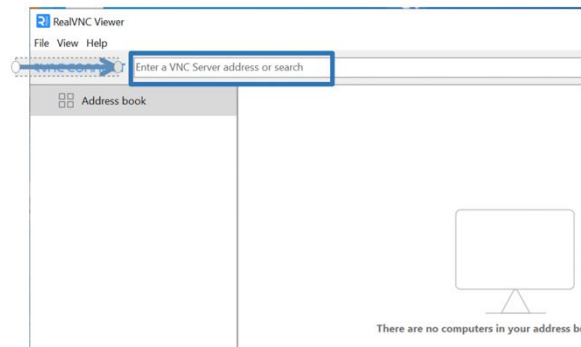


6. A VNC status Update window should appear and display a “VNC Server Running ...” message.

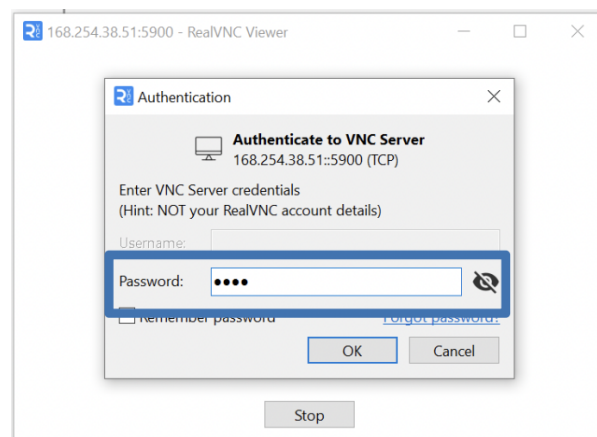


How to start VNC Viewer

1. Start the VNC viewer and enter the IP address that was recorded in the VNC setup. (Number

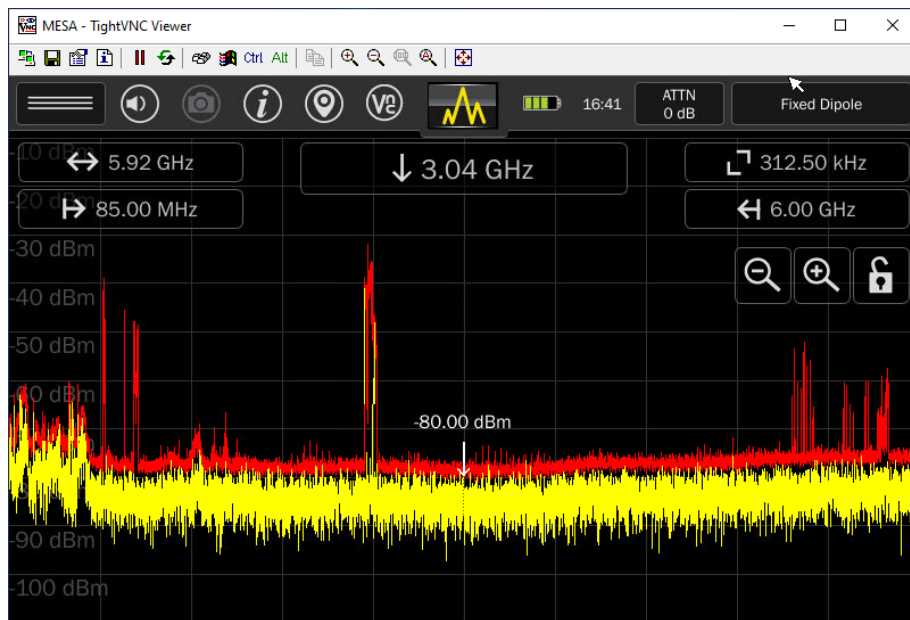


2. The viewer will request the password set in the VNC server.



The MESA server image should appear on the viewer screen. Now the MESA can be remotely controlled using a mouse. In spectrum mode, a left mouse double click on the mouse will zoom in and a right mouse click will zoom out. A single left mouse click will show the cursor.

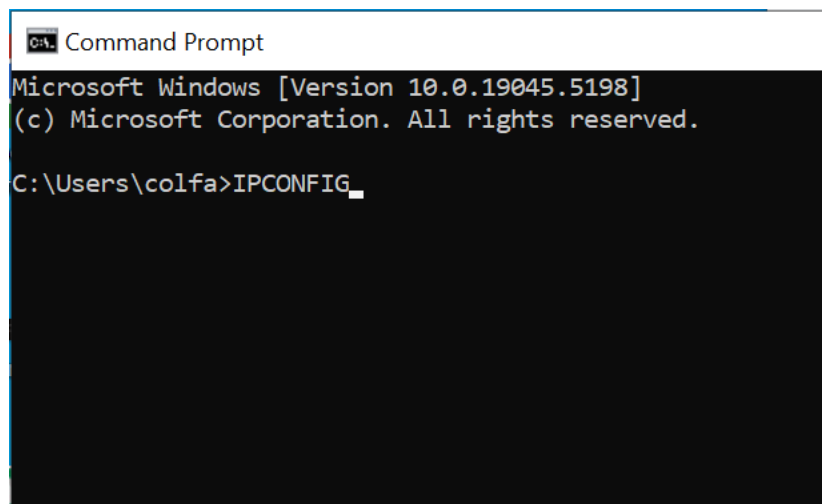
Depending on the VNC Client being used, operation may differ slightly.



Connecting the MESA to a PC with an Ethernet cable

The MESA can be directly connected to a PC using an ethernet. CAT 5 - 8 cables are acceptable. Before doing this, please install a VNC viewer on the computer to be used. There are many free and open-source third-party VNC (Virtual Network Computing) clients available on the internet. An internet search should turn up several options. REI recommends researching and evaluating different options before selecting a VNC client. For demonstration, these instructions were written using Real VNC Viewer.

- 1) Connect the PC to the MESA (the ethernet jack is located on the top of the unit — see p. 8)
- 2) Make sure both PC and MESA are powered on
- 3) On the PC, type "CMD" (by the Windows icon) to open a command prompt window
- 4) At the arrow > type "IPCONFIG", then press enter



```
Command Prompt
Microsoft Windows [Version 10.0.19045.5198]
(c) Microsoft Corporation. All rights reserved.
C:\Users\colfa>IPCONFIG
```

- 5) A window will appear. Scroll to find “Ethernet adapter Ethernet:” and use the Autoconfiguration **IPv4 Address** and **Subnet Mask** numbers as instructed below

```
Command Prompt
Microsoft Windows [Version 10.0.19045.5198]
(c) Microsoft Corporation. All rights reserved.

C:\Users\colfa>IPCONFIG

Windows IP Configuration

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::766c:c3d6:7d29:7c79%16
    IPv4 Address. . . . . : 168.254.38.50
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 168.254.38.1

Unknown adapter Local Area Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

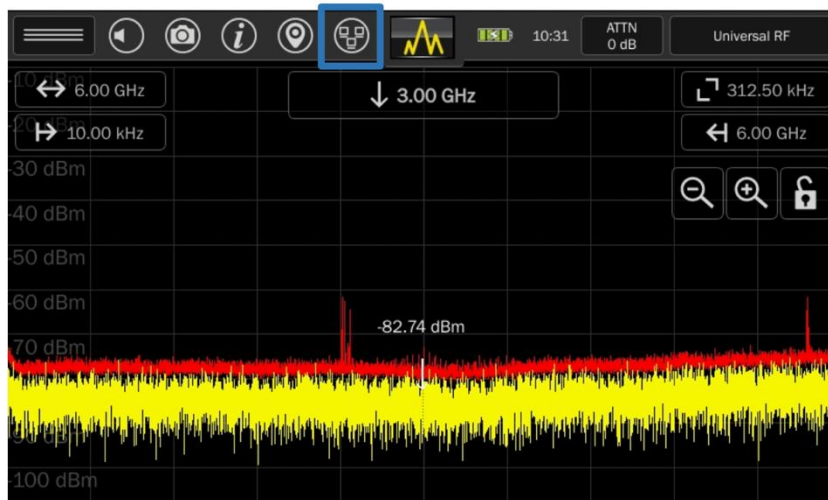
Wireless LAN adapter Local Area Connection* 1:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

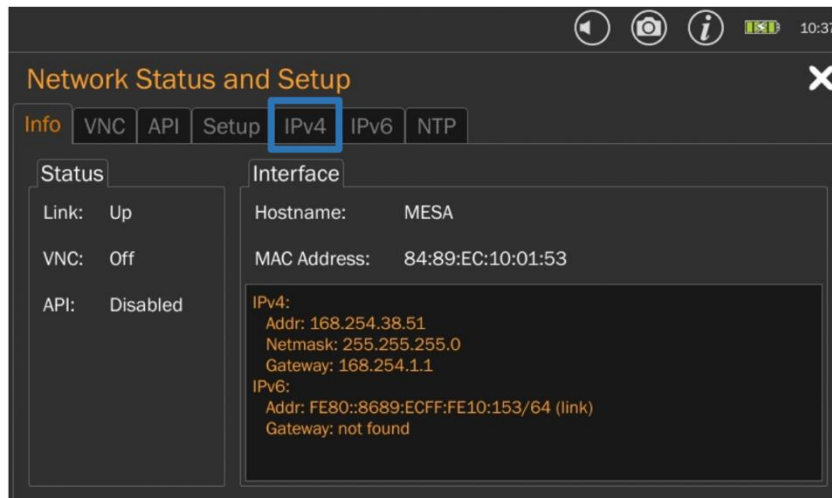
Wireless LAN adapter Local Area Connection* 10:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :
```

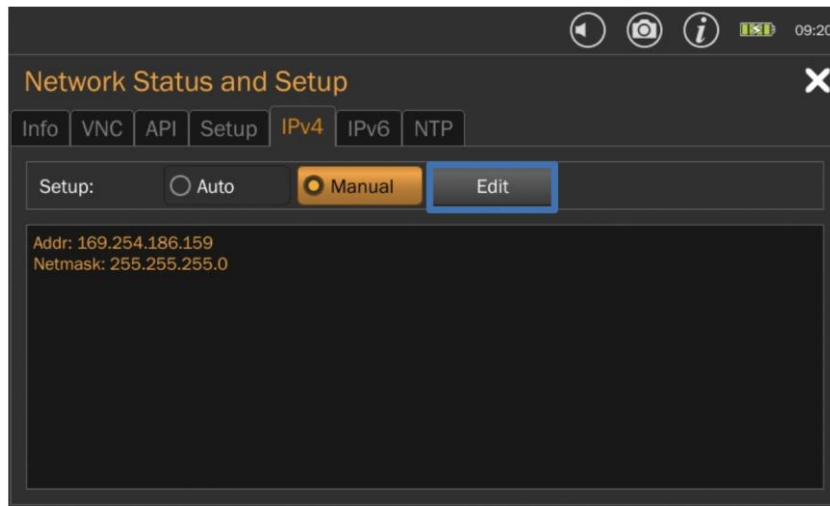
- 6) Open the networking menu in the MESA by tapping the **networking** icon



7) Select the **IPv4** tab

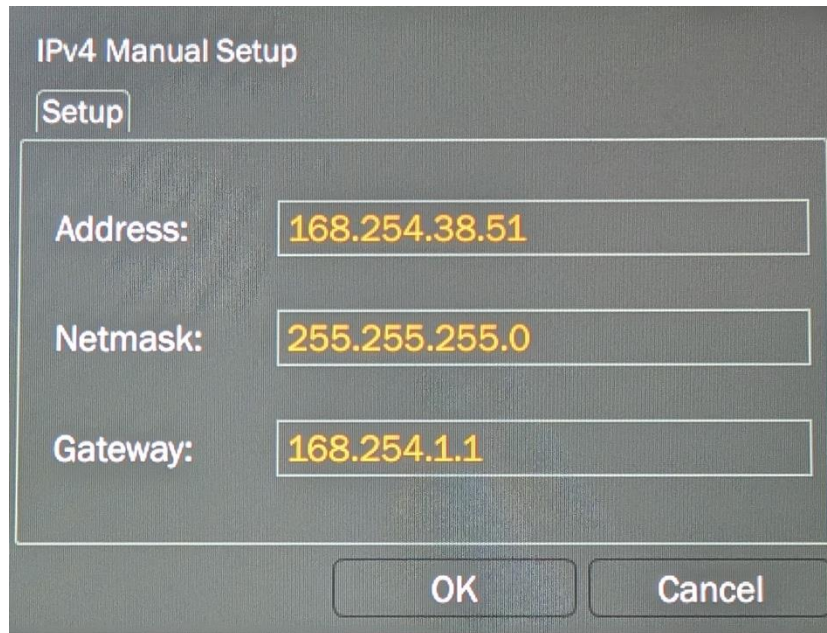


8) **Manual** is highlighted by default (leave as is), select the **Edit** button (**Auto setup** is an available feature that can be selected by the user and is successful in some cases but is not recommended for direct ethernet connections)



- 9) In the **IPv4 Manual Setup** window, enter the Autoconfiguration IPv4 Address, but add +1 to the last three numbers, i.e. $159 + 1 = 160$. This will prevent the PC from attempting to connect to itself. (Any number can be added or subtracted but +1 is easiest to remember, and keep in mind the resulting number cannot be 0 or 255 but will need to be in between those numbers.)

Please note: when entering the address, to proceed to the next octet (box) after a two-digit or single-digit number, press the “.”



IPv4 Manual Setup

Setup

Address: 168.254.38.51

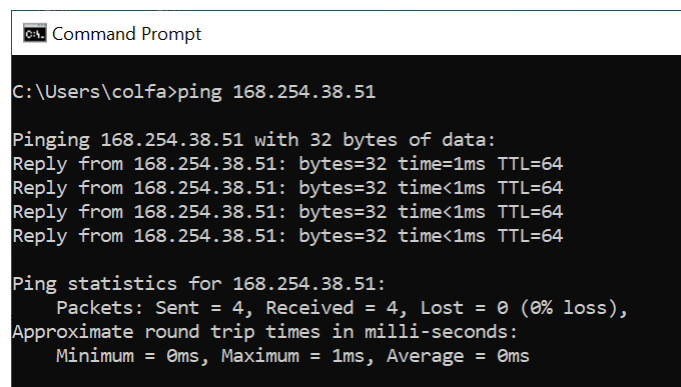
Netmask: 255.255.255.0

Gateway: 168.254.1.1

OK Cancel

- 10) Set the default gateway to the same as the previous IP address but change it to .1.1 for the last two octets (boxes).

- 11) Scroll to the bottom of the Command Prompt window and type after **C:\Users\username:** “ping” + spacebar + IP address (IPv4 address just set on the MESA]. For example, in the photo below it appears like this: “**ping 168.254.38.51**” (Address octet is only for example, the user’s will be different).



```
C:\Users\colfa>ping 168.254.38.51

Pinging 168.254.38.51 with 32 bytes of data:
Reply from 168.254.38.51: bytes=32 time=1ms TTL=64
Reply from 168.254.38.51: bytes=32 time<1ms TTL=64
Reply from 168.254.38.51: bytes=32 time<1ms TTL=64
Reply from 168.254.38.51: bytes=32 time<1ms TTL=64

Ping statistics for 168.254.38.51:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Note: the purpose of step 11 is to test for connection to the MESA. A successful connection to the MESA should look like the above photo

An unsuccessful connection may appear like this:

```
C:\Users\colfa>ping 168.254.38.52

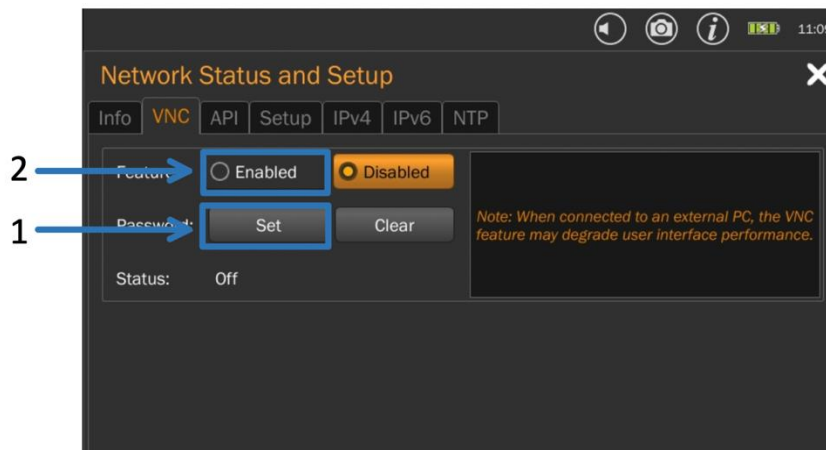
Pinging 168.254.38.52 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 168.254.38.52:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

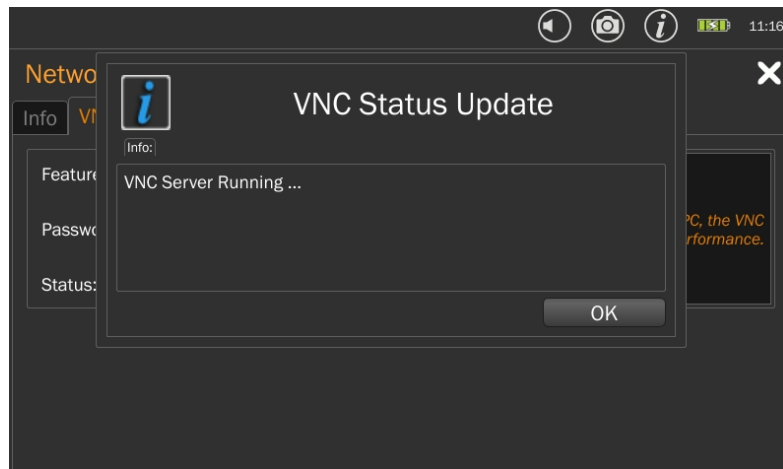
Check that the addresses match on both the IP configuration (PC) and the MESA. If necessary, restart devices and repeat steps 1 through 11.

12) Install desired VNC viewer on the PC

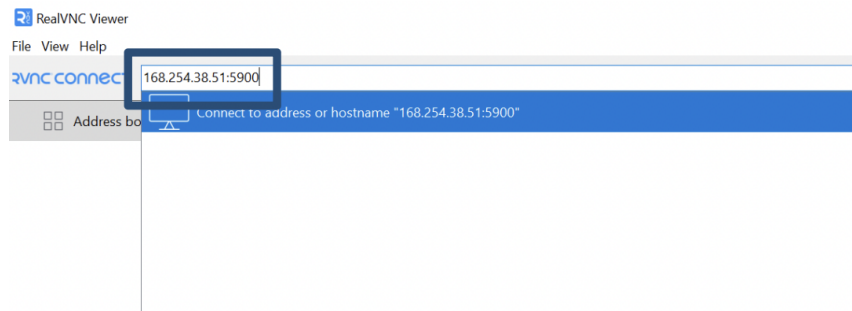
13) Open **VNC** tab on the MESA first, choose **Set**, create a password, then click **Enabled**



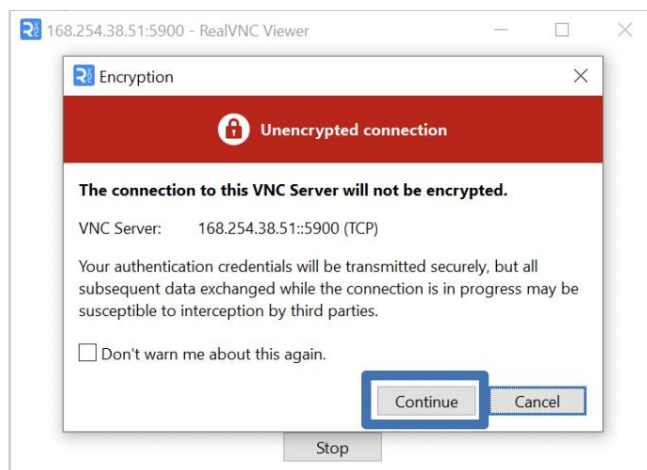
14) This popup window will appear. Press **OK**



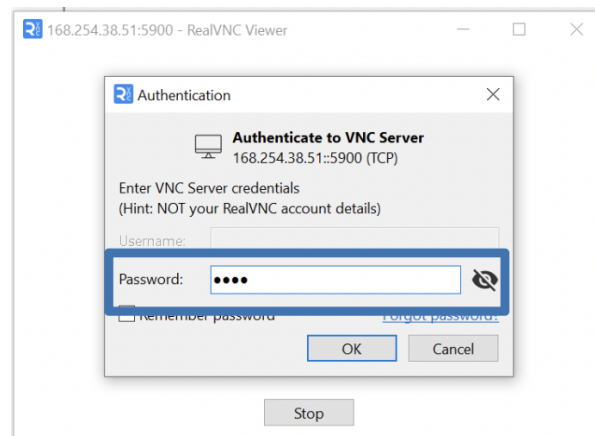
15) Start the VNC viewer on PC. Enter IP address set in MESA plus “:5900” with no spaces. Click **Connect**



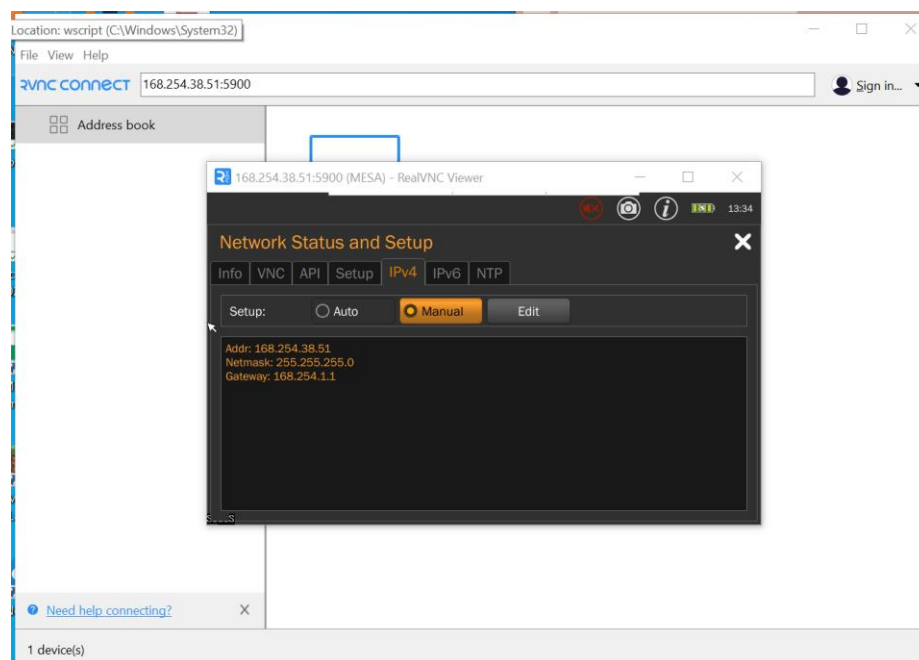
16) In the pop-up window, click **Continue**



17) Enter the password created earlier on the MESA in step 13. Click **OK**



18) A window on the PC should appear identical to the MESA screen. The MESA can now be viewed and controlled remotely through the connected PC.



*Note: If the PC does not have automatic configuration available (i.e., Linux users), an IP address will need to be set manually. Select an IP address in the **private IP address range** (generally of the form 192.168.x.x or 10.x.x.x) and do not use a range that is being used for another network to which the computer is connected (i.e., if your Wi-Fi or other Ethernet port is connected to a network that uses 192.168.1.x, don't set the manual IP address in that range.) Both the MESA and the PC will need to be using different addresses in the same range.*

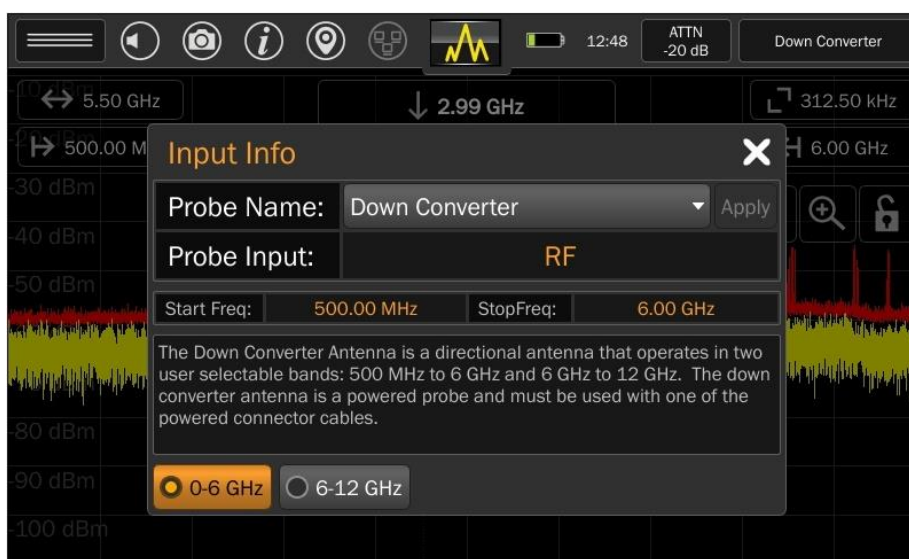
Down Converter Directional Antenna Operation

The Down Converter Antenna is a powered directional antenna that operates in two user-selectable bands:

Band 1 (low): 500 MHz – 6 GHz

Band 2 (high): 6 GHz – 12 GHz

When using the upper band (Band 2), the Down Converter Antenna converts signals occurring above the standard 6 GHz threshold so they can be detected and displayed on MESA. To switch between the high and low band, while the antenna is connected, press the input select button (or probe name) in the top right corner of the MESA display. In the drop-down menu select Down Converter if the Down Converter is not already selected. If the down converter was not already selected, press “Apply” after selecting Down Converter.



In the lower bottom of the Input Info dialog, the **0 – 6 GHz** and **6 – 12 GHz** buttons select between bands. The start and stop frequencies change depending on the down converter state. After selecting the desired band, press the "x" to close the Input Info dialog box.

Note: The MESA Down Converter is available in the MESA 2.0 Deluxe Package.

Universal RF Antenna Input

The MESA automatically detects any of the REI-provided probes when connected and automatically sets up the correct Span, Start Frequency, and Stop Frequency for the connected probe. Occasionally, it may be necessary to view the spectrum outside of a probe’s operational range. For these situations, a “Universal RF” option has been provided.

To view the RF spectrum outside the range of the connected probe:

1. Open the Input Info dialog by pressing the input select button (or probe name) in the top right corner of the MESA display.
2. In the Input Info dialog box, select “Universal RF” from the drop-down menu.
3. Select “Apply”.

Several powered probes are included with the MESA 2.0 Deluxe package, such as the Down Converter Antenna (500 MHz – 12 GHz) and the Directional Antenna (70 MHz – 500 MHz). In order to use these probes with the Universal RF option, it will be necessary to press the “**Power On**” button at the bottom of the Input Info dialog box.

Note: It is not possible to use band 2 (6 – 12 GHz) of the Down Converter antenna while using the Universal RF option. Only band 1 (500 MHz – 6 GHz) will be available.

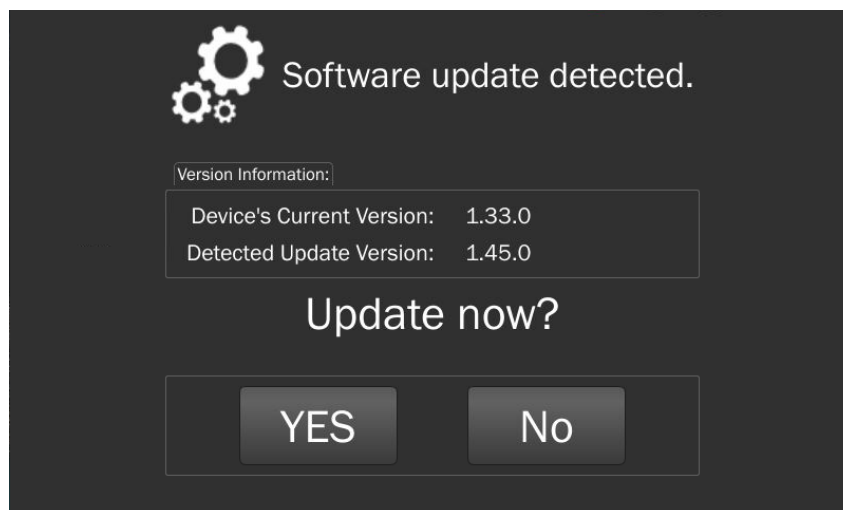


Updating Software

MESA Software Updates must be performed with the MESA unit connected to the AC Power Supply and with the battery sufficiently charged. This is necessary to prevent the MESA from losing power during the update process.

To update MESA software:

1. Download the latest software from REI's website: <https://reiusa.net/>
2. Copy the downloaded .bin file onto the root drive of a USB drive (formatted for FAT32 — see note below).
3. Insert the USB thumb drive into the MESA.
4. After the MESA has a few seconds to read the drive, the software update screen is displayed. This screen will indicate the version number found. Confirm that it is the expected version.
5. Select "YES", and the MESA will begin the software update. The software update can take upwards of 10 – 15 minutes. A progress bar is active during the update. DO NOT REMOVE THE USB THUMB DRIVE DURING THIS PROCESS.
6. At the end of the software update, the MESA will automatically restart.



Note: The MESA 2.0 is shipped with a USB thumb drive formatted with the file system FAT32. If using a user-supplied USB thumb drive, please ensure it is formatted with FAT32 (or exFAT). Only MESA 2.0 (and MESA 1.0) units installed with the latest software update will support the exFAT file system. The NTFS file system is not supported.

If any issues are experienced during the update process, contact REI.

+1 (931) 537-6032

www.reiusa.net

support@reiusa.net

System Menu

Several system settings are available in the Systems Menu, which is located at the top of the Mode Settings Menu.



Brightness

This setting adjusts the brightness of the Touch Screen Display.

Version

The software version and unit serial number can be displayed in this dialog.

Image Viewer

Screenshots taken with the MESA can be viewed on the MESA in the Image Viewer. See p. 96 for additional details.

Audio Player

Audio recordings made with the MESA can be played on the MESA in the Audio Player. See p. 96 for additional details.

Network Settings

In addition to being available from the status bar, network settings are also available from the System Menu.

Prefix Settings

Automatic file naming is used for any of the files saved to a USB thumb drive (screenshots, waterfalls, signal lists, and audio files). The file name is based on a user-configurable prefix followed by the date and time.

The Prefix Settings option in the System Menu configures the prefix for each of these file types.

- Screenshots (default setting = "screenshot")
- Waterfall Images (default setting = "waterfall")

- Signal Lists (default setting = "signals")
- Audio Recordings (default setting = "audio")
- I/Q Recordings (default setting = "iq")

The **Job Prefix** field can be used to add a global prefix to all saved files. If the Job Prefix field is defined then this text is prepended to any file name (along with the prefix for specific file types) created by the MESA. If Job Prefix is blank, then no global prefix is added to file names.

ITU Region

To ensure accurate Band ID information, it is necessary to confirm the ITU region is set correctly for the current location.

ITU Region 1 comprises Europe, Africa, the Middle East west of the Persian Gulf including Iraq, the former Soviet Union, and Mongolia.

ITU Region 2 covers the Americas, Greenland, and some of the eastern Pacific Islands.

ITU Region 3 contains most of non-former-Soviet-Union Asia, east of and including Iran, and most of Oceania.

See https://en.wikipedia.org/wiki/ITU_Region for more information.

Power-Down Cache Setting

The power-down cache setting, if enabled, will save the current MESA state to an internal cache. The state is then restored the next time the device is powered on. The internal cache is always deleted after being restored. This is useful if, for example, when encountering low battery power and batteries need to be changed (see page 12).

Snap-to-Peak Setting

The snap-to-peak feature makes it easy to move the cursor directly to peaks in the live trace. The snap-to-peak setting in the system menu allows the feature to be enabled or disabled. It is enabled by default.

To use the Snap-to-Peak feature:

1. Enable the Snap-to-Peak feature from the System Menu if it is not already enabled.
2. In Spectrum Mode, tap anywhere on the screen and hold until the vertical line cursor becomes a thicker vertical line.
3. Without lifting your finger, drag the vertical line cursor close to a peak in the live trace.
4. Lift finger off the screen to release the cursor. It will snap to the nearest peak.

Note: If after using the snap-to-peak feature the cursor is immediately dragged again, the MESA will assume more "exact" behavior is desired and will not use the snap-to-peak feature when the cursor is released a second time. Wait a longer period of time after releasing the cursor (approximately 3 seconds) and the MESA will continue using the snap-to-peak feature.

Save Settings

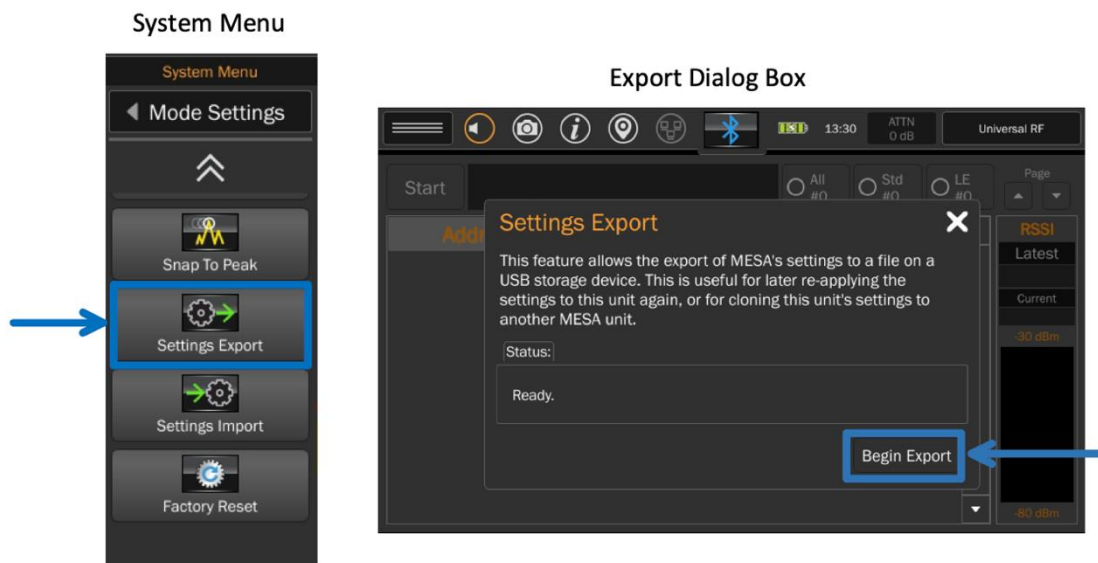
The MESA can save custom user settings to export to additional MESA devices. It can also be used to save these custom settings in case the device needs to be sent to REI for service. This requires a USB thumb drive to be inserted into either USB port.

There are certain settings that will not be exported for Save Settings. This is done for security and device function reasons. The following device settings will not be saved:

- Custom MAC address
- Passwords: VNC, API
- Current date and time
- GPS location
- Mobile Band Settings (exporting/importing mobile bands is a feature already available in Mobile Bands mode (page 58))

Exporting Device Settings

After inserting a USB thumb drive (see p. 116 for file system compatibility) into one of the USB ports, select “Settings Export” under the System Menu. The Export Dialog Box will appear, then select “Begin



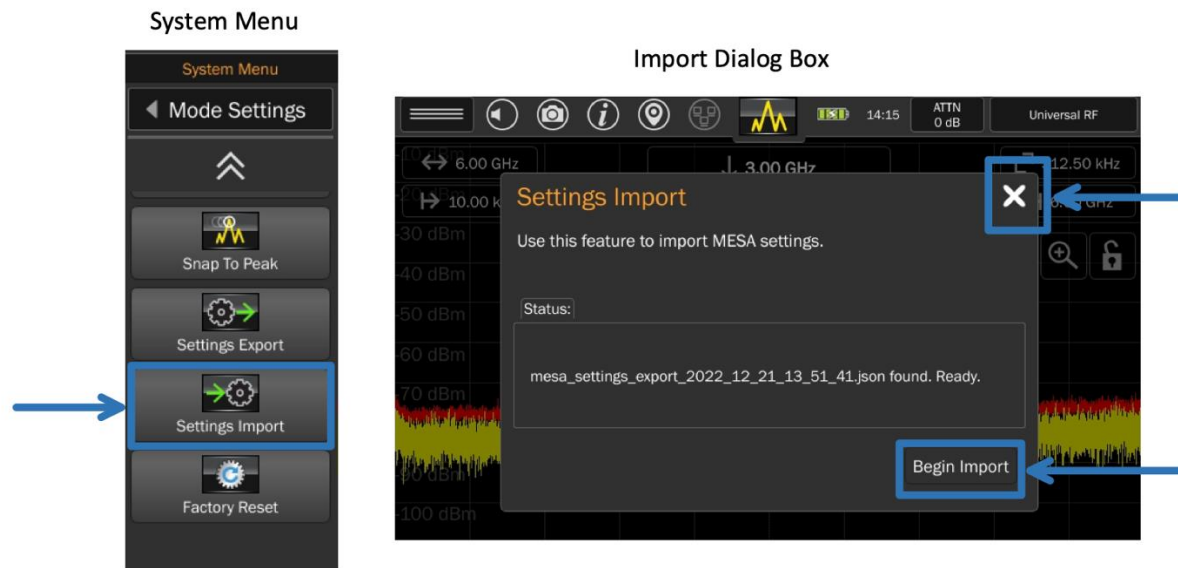
Export.”

Note: The USB thumb drive *should not contain* any previously exported device settings files, or the wrong file may be imported.

The exported filename will be: “mesa_settings_export_yyyy_MM_dd_hh_mm_ss.json”

Importing Device Settings

After inserting the USB thumb drive containing the settings file to be imported, select **Settings Import** under the System Menu. The Import Dialog Box will appear, then select **Begin Import**. The MESA unit



will not automatically ask the user if they wish to import settings, the user must initiate this. When the import is complete, the user must select “X” or the prompt to import settings will reappear.

Note: When the import is complete, a warning dialog box may appear if the settings file includes a manually configured IP address. This will give the user an opportunity to adjust the manual IP address setting to avoid potential conflicts if other MESA units are being configured with the exact same settings.

Again, please ensure there is only one settings file (.json) on the thumb drive before importing.

Factory Reset

Original factory user settings can be restored to the unit using the **Factory Reset** in the Systems Menu.

MESA 2.0 Specifications

Receiver

Sweep Speed	>200 GHz/second
Operating Freq. Range	10 kHz – 6 GHz /*12 GHz
Resolution Bandwidth	Variable depending on span: 0.0380 kHz to 312.5 kHz
Instantaneous Bandwidth	25 MHz
DANL - Noise Floor	312.5 kHz RBW with Pre-amp: -90 dBm 9.765 kHz RBW with Pre-amp: -110 dBm
Attenuation	0 dB, 10 dB, 20 dB, Auto
Preamplifier	+15 dB
Detection Types	RF, Carrier Current, Acoustic Leakage, IR/Visible Light, Ultrasonic
Spurious Free Dynamic Range	81.6 dB
Receiver Type	Swept-tuned Superheterodyne
Audio Demodulation	AM/FM demodulation with filter options: Auto, 200 kHz, 20 kHz, 5 kHz
Input Port	QMA connector (RF input) for included and auxiliary RF antennas

Features

Operation Modes	Spectrum Analyzer, SmartBars™, Mobile Bands, WiFi, Bluetooth
Alert Types	Haptic, audible, and visible alerts
Display/Controls	7in/18 cm capacitive touch screen, brightness control
Display Features	Zoom, screen lock, frequency span, start/stop frequencies, resolution bandwidth, center frequency, automatic probe recognition. Display types include RF spectral display, <i>Patented</i> SmartBars™ bar graph, <i>Patent Pending</i> Cached Peak, WiFi/Bluetooth Scanner, Waterfall display, Persistence display, RSSI, Average Trace
Remote Access	Ethernet port for VNC remote access
Signal List Generation	Manual or automatic depending on mode
GPS	Removable USB, captures and saves GPS data
Audio	Built-in speaker and external headphones with adjustable volume control.
Data Ports	2 USB 2.0 Type A ports for software upgrades, file storage, file transfer and GPS adapter; Gigabit Ethernet port
WiFi	802.11a/b/g/n/ac, 2.4 and 5 GHz
Bluetooth	Bluetooth v5.0 + HS backwards compatible with v1.x and v2.

Power

AC Adapter	Input: 100-240VAC/50-60 Hz, 1.5A; Output: 15 VDC, 3A
Battery	rechargeable Li-ion battery (+1 spare)
Run Time	~3 hours (typical) per battery
Charge time	~3 hours per battery (typical), external recharger included with Deluxe model

Mechanical

Unit Dimensions	5 x 8 x 2 in /13 x 20 x 5 cm
Unit Weight	2.4 lbs./1.1 kg including battery
Case Dimensions	6 x 15 x 18.5 in / 16 x 38 x 47 cm
Case /Contents Weight	15 lbs./ 6.8 kg

Environmental

Operating temperature	-10° to 53° C
Battery charging temperature	5° to 37° C
Storage temperature	-20° to 60° C
Environment	Indoor/Outdoor
Altitude	Less than 3000 m
Relative Humidity	85% Max for ≤ 40°C, < 85% RH for > 40°C, non-condensing
MAINS supply volt. Fluctuation	100 - 240V ± 10%
Pollution Degree	Pollution Degree 2 per IEC 61010-1

Note: extended storage at temperatures above 40° C could degrade battery performance and life.

**Down Converter antenna (Deluxe model)*