MESA®

Mobility Enhanced Spectrum Analyzer

User Manual

Research Electronics International, LLC

455 Security Drive, Cookeville, TN 38506 U.S.A.

(800) 824-3190 (US Only) • +1 931-537-6032

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MESA®

Mobility Enhanced Spectrum Analyzer

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

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

Revision 1.4

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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 receiver.
- Connect the equipment into 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

- 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 its 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

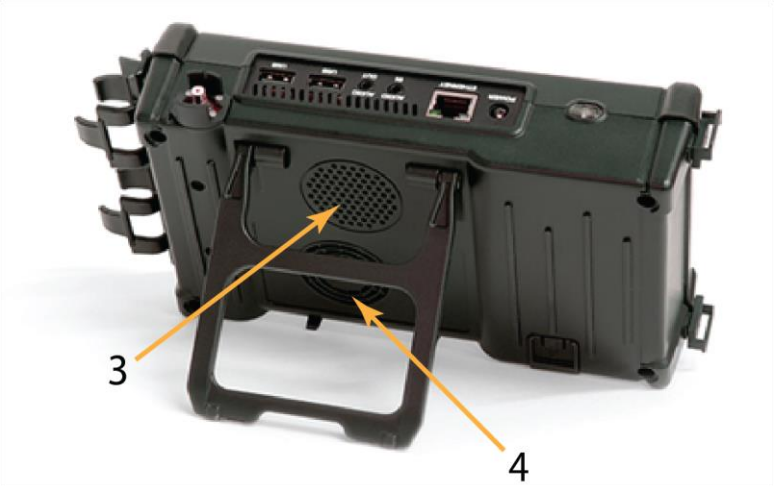
- CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.
- For your safety do not use any MESA battery if:
    - The battery case is cracked or otherwise damaged.
    - The battery is excessively hot or warm for any reason.
- Avoid 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.

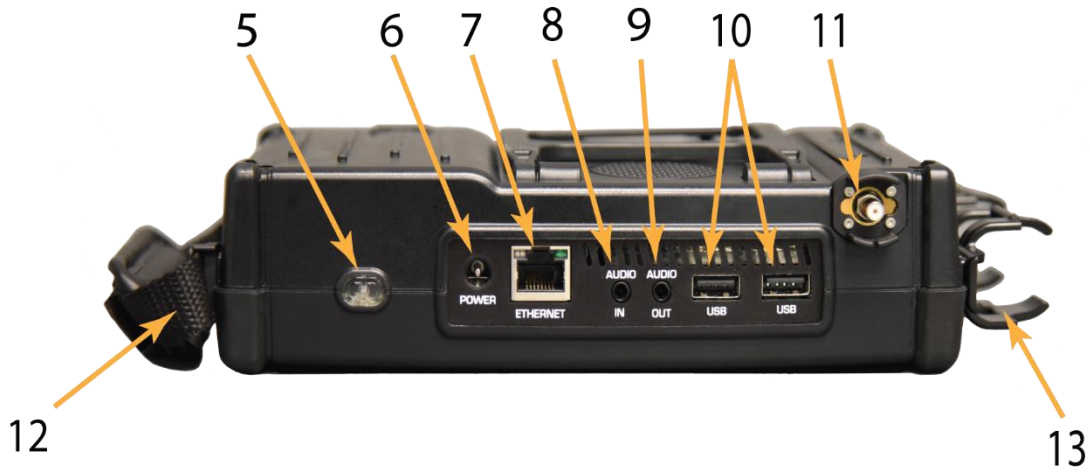
Equipment Description

MESA® 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 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 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) - 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 has been designed for quick and easy deployment. Depending on your application some adjustments to the default setting may be needed.

The MESA 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 your hand under the hand strap and gripping the side of the unit

A built-in stand is provided to allow for hands-free support on a table-top 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 your thumb under the edge of it and open it up fully.

5. Slide the battery into the battery slot observing proper contact alignment. Press firmly until the battery is fully seated.
6. Close the battery door until the edge lines up with the lip on the battery door latch. Then place a finger on both the battery door and the latch and press them close together.

Power Control and Charging

To turn on your 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 9) until it begins flashing. During operation, to turn off your MESA unit, press and hold the power button until the "Power Off" graphic appears on the screen.

Press and hold the power button 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® Packages

The MESA 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.

	MESA PACKAGES		
		BSC	DLX
Probes/Accessories	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
	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 21). 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

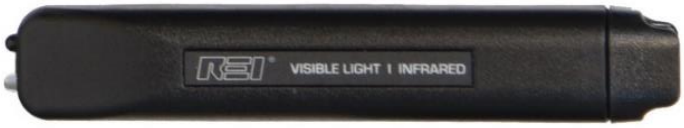
When using Band 2, the Down Converter Antenna converts signals occurring above the standard 6 GHz threshold so they can be detected and displayed on the MESA. For details on operation, see page77 .

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 20).

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 within a few inches.



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

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 20).

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 20).

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 25.

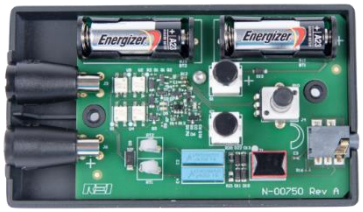
Audio Transformer Batteries

The audio transformer, which is an accessory probe included with the MESA 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 Basic and Deluxe packages include connector cables for connecting probes and antennas.

Powered Connector Cable (only included with the MESA Deluxe)

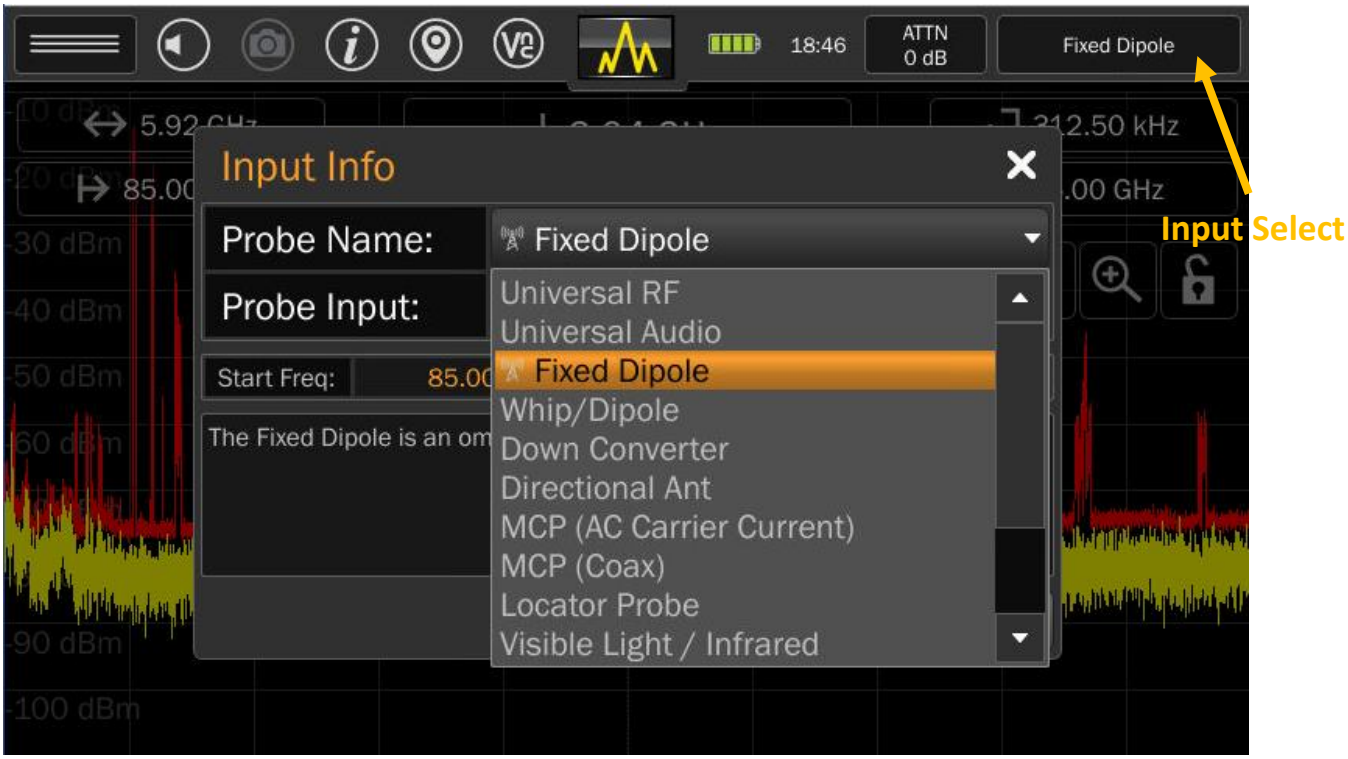
The powered connector cable is included with the MESA Deluxe package and is required to operate the flag-shaped Directional Antenna (70 MHz - 500 MHz), the Down Converter Antenna, the visible light / infrared probe, and the Ultrasonic probe. Other passive probes included with the MESA Deluxe will also 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, it is important to align the power pin on the cable with the power contact pad on the MESA 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 your cable. It is not necessary to power off the MESA when changing probes/antennas.

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 you to manually select 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.

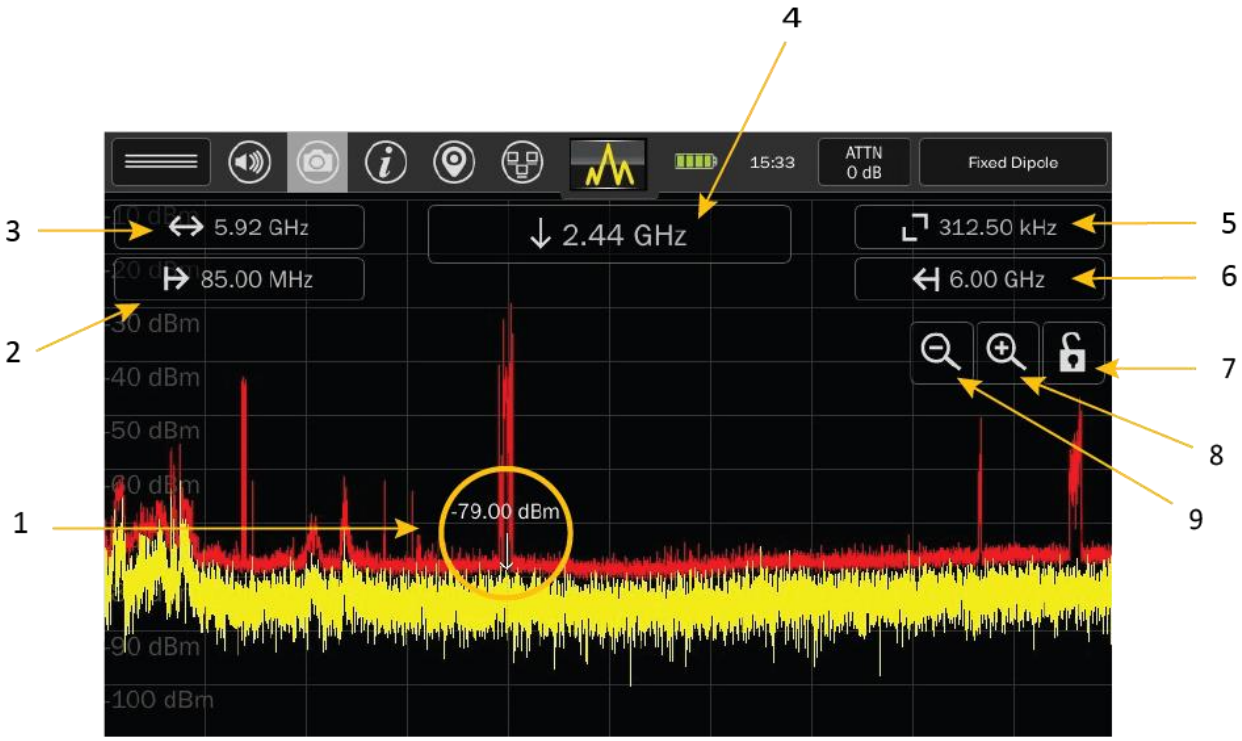
2) Select a probe/antenna from the Probe Name drop-down box.

3) Press "Select" at the bottom right of the Input Info dialog window.

Note: Not all probes and antennas listed in the Probe Name drop-down list may have shipped with your purchased MESA package.

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.

Display Screen Layout



1. Cursor - small downward arrow marking a position in the spectrum. The frequency of the cursor is indicated by the Cursor Frequency box at the top center of the screen. The power level at the current cursor position is indicated by the value just above the cursor.

2. Start Frequency - tapping the start frequency value will open a dialog box that allows you to set the start frequency for the spectrum. Allowable start frequencies will depend on the REI probe connected.

3. Frequency Span - tapping the frequency span value will open a dialog box that allows you to control the frequency span displayed on the screen. Enter a value using the keypad and then press one of the *unit* keys (kHz, MHz, GHz) to initiate the change. If no change is desired, pressing the "x" in the upper right-hand corner of the dialog box will close it. The smallest span that the MESA can display is 25 kHz. The largest span will depend on the range of the REI probe connected.

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 you to precisely set 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.

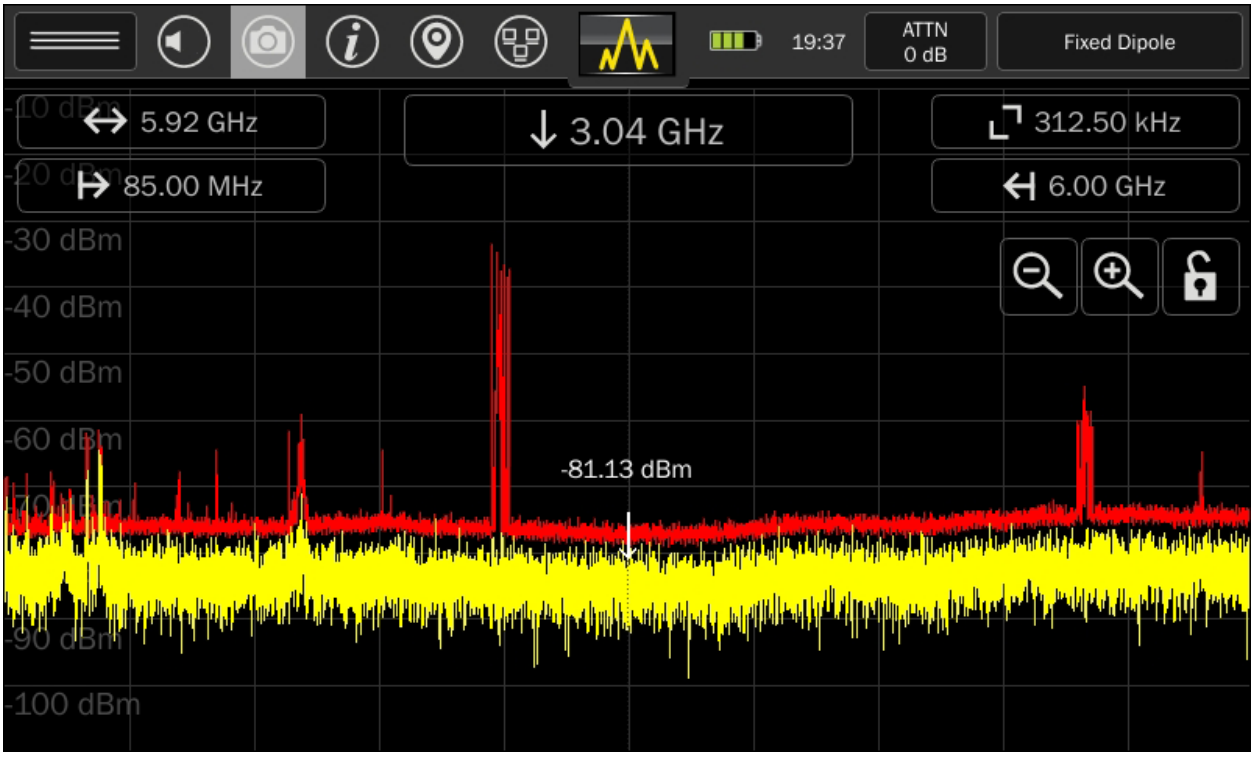
6. Stop Frequency - tapping the stop frequency value will open a dialog box that allows you to set the stop frequency of the spectrum. Allowable stop frequencies will depend on the REI probe connected.

7. Lock Screen - Press to lock the screen. Press again to unlock the screen. This feature locks the spectrum portion of the display. This will keep you from inadvertently moving the cursor or changing the span. All of the 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 you to lock the MESA for overnight or extended monitoring to keep others from tampering with the device or settings. For additional details on Locked Monitor Mode, see page 69.

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 your 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 you can tap the volume control icon again to make it go away.

Screenshot

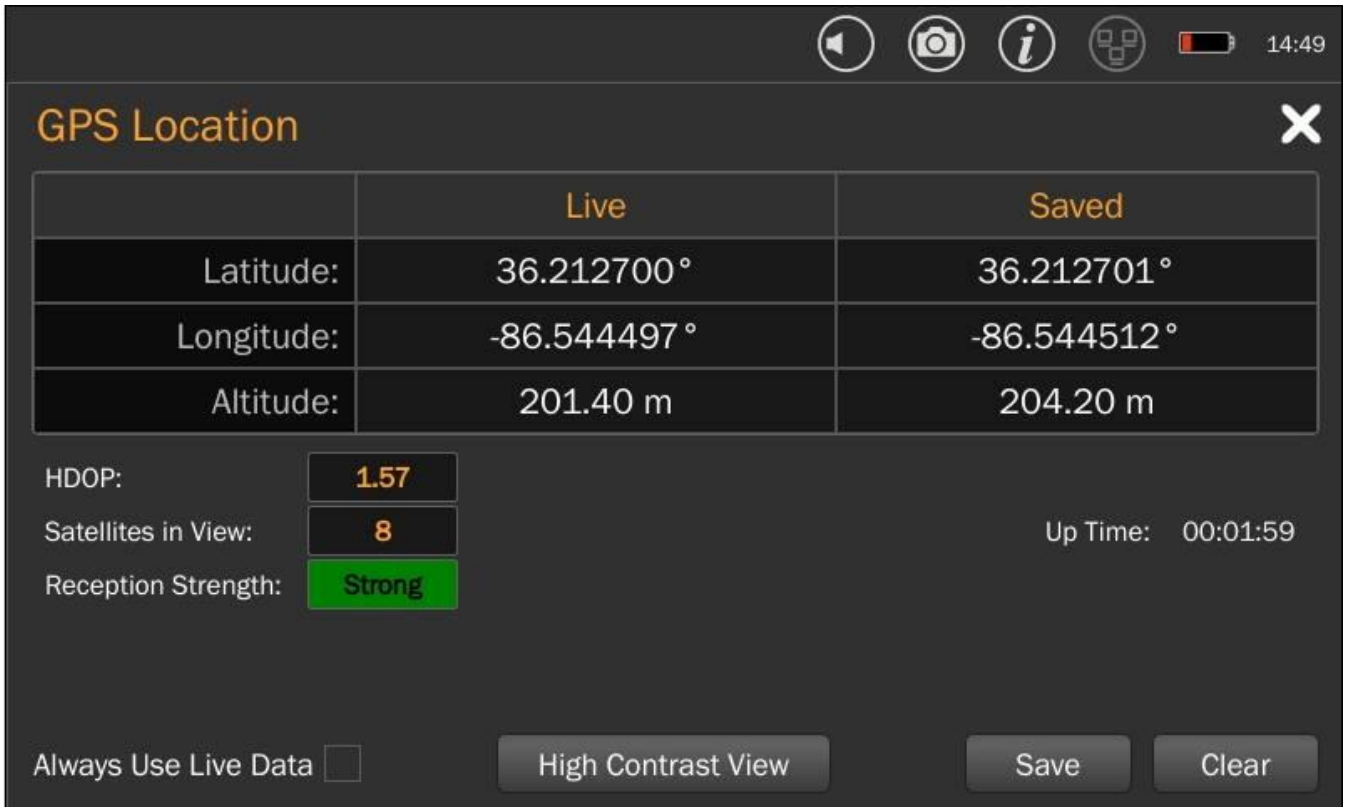
Tapping the camera icon in the status bar will take a screenshot and save it to the unit in .jpg format using an automatically generated file name based on a header specified by the user (see page 61. The captured screenshot can be viewed on the MESA using the Image Viewer (see page 63) or from any PC.

Help

Tap the Help icon to access information on operating the MESA. The Help feature displays information specific to the Mode that you are in.

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.



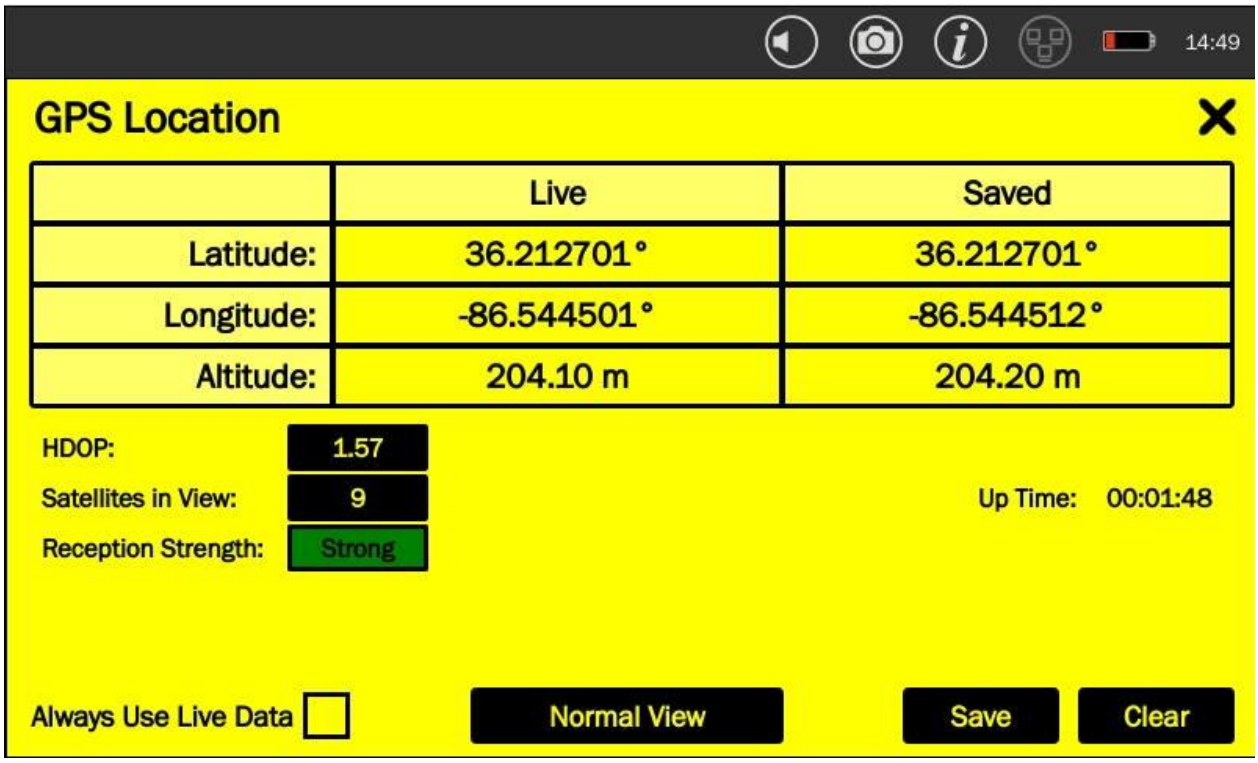
Note: In order to receive GPS coordinates, the GPS Adapter (see page 19) must be inserted into one of the MESA's USB ports. To improve GPS reception, especially on cloudy or overcast days, use a USB extender cable to physically locate the GPS adapter further from the MESA unit.

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



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 69.

Battery Life

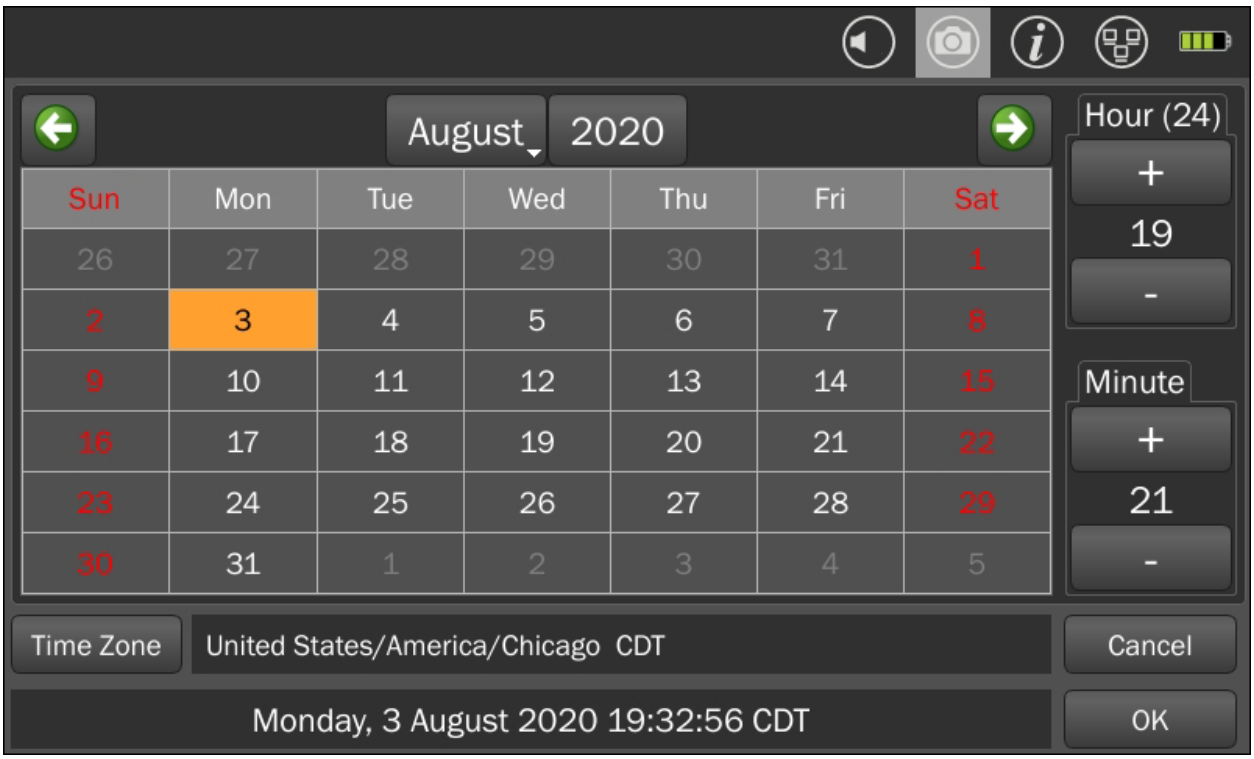
The battery icon provides a visual representation of the remaining battery life. Tap the icon for additional details.

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.



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.

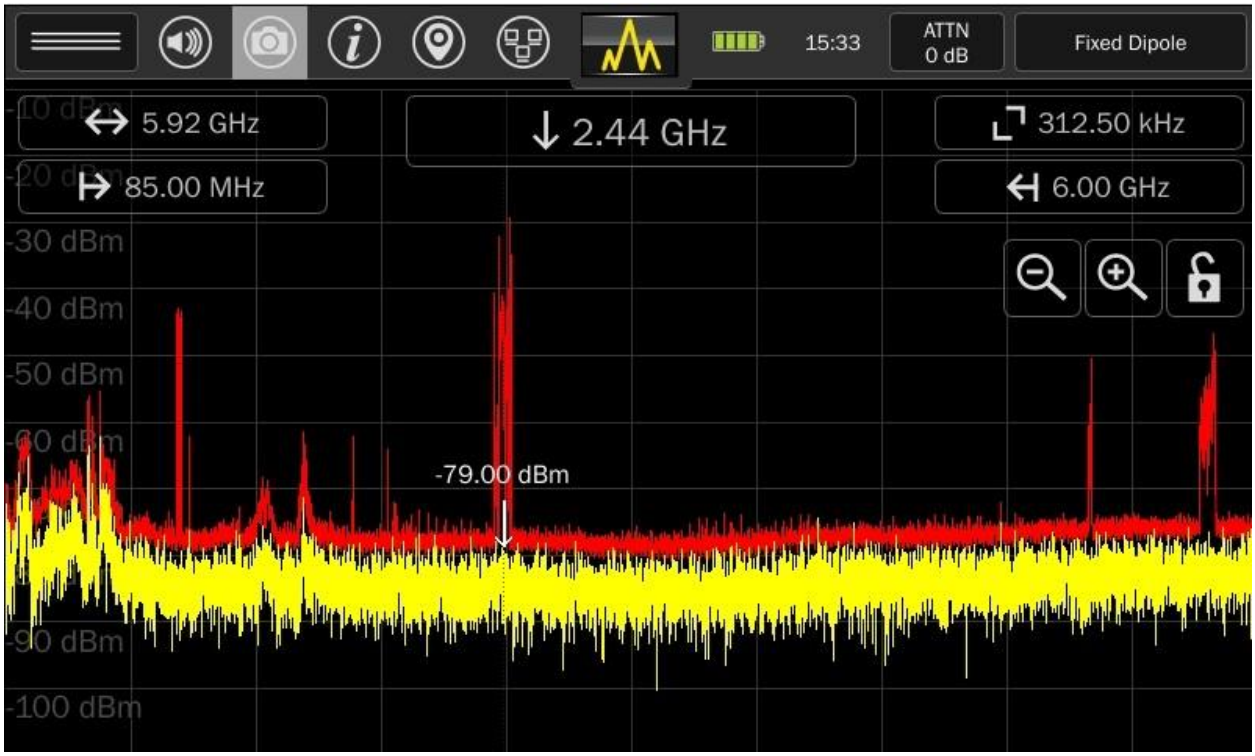
Modes

Mode Menu

The Mode Menu, located at the top center of the screen, enables you to switch between the five main operating modes of the MESA: Spectrum Mode (see below), SmartBars Mode (see page 42), Mobile Bands Mode (see page 51), WiFi Mode and Bluetooth Mode (page 55).

Spectrum Mode

Spectrum Mode on the MESA allows you to easily monitor the RF spectrum and analyze signals that are found. 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:

- Double-tap to Zoom In - Double-tap anywhere on the spectrum to zoom in with the spectrum centered around the frequency tapped on

- 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.

- 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.

- Click - Cursor Move: Tap 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 your finger from the screen, the cursor will again become a short, down-ward facing arrow.

- 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 your finger to the left or right to adjust the cursor. This method of adjusting the cursor is affected by the Snap to Peak feature.

- 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 you release the cursor 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 80).

- 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.

(Start Frequency Adjustment)

(Stop Frequency Adjustment)

(Span Frequency Adjustment)

- 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.

Cached Peaks

As you zoom in on the spectrum, the resolution bandwidth will change. It is not possible to maintain peaks as you zoom in due to the changes in resolution bandwidth. The MESA includes the feature, cached peaks, to enable you to see peaks obtained at previous resolution bandwidths.

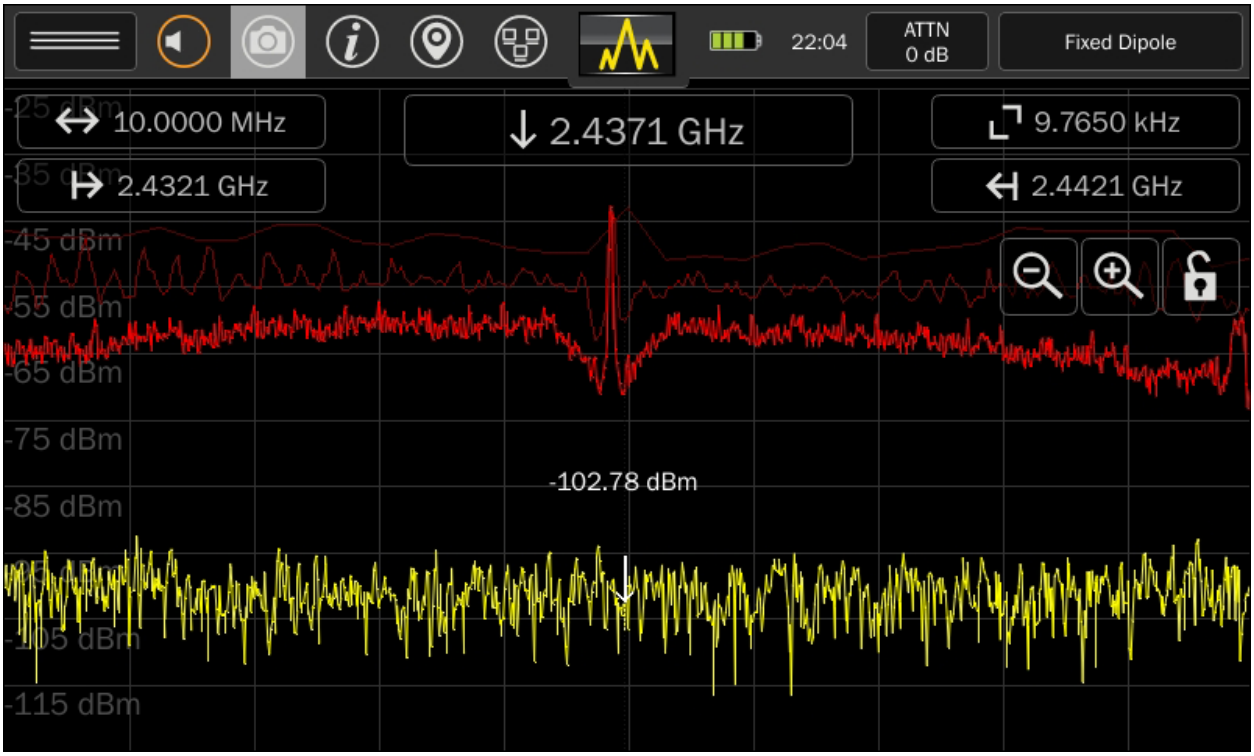
To enable cached peaks:

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. You will see a 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. Now you will see two faint red 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. If you continue zooming in, which 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 since 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, and factory reset. For additional information see page 79.

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

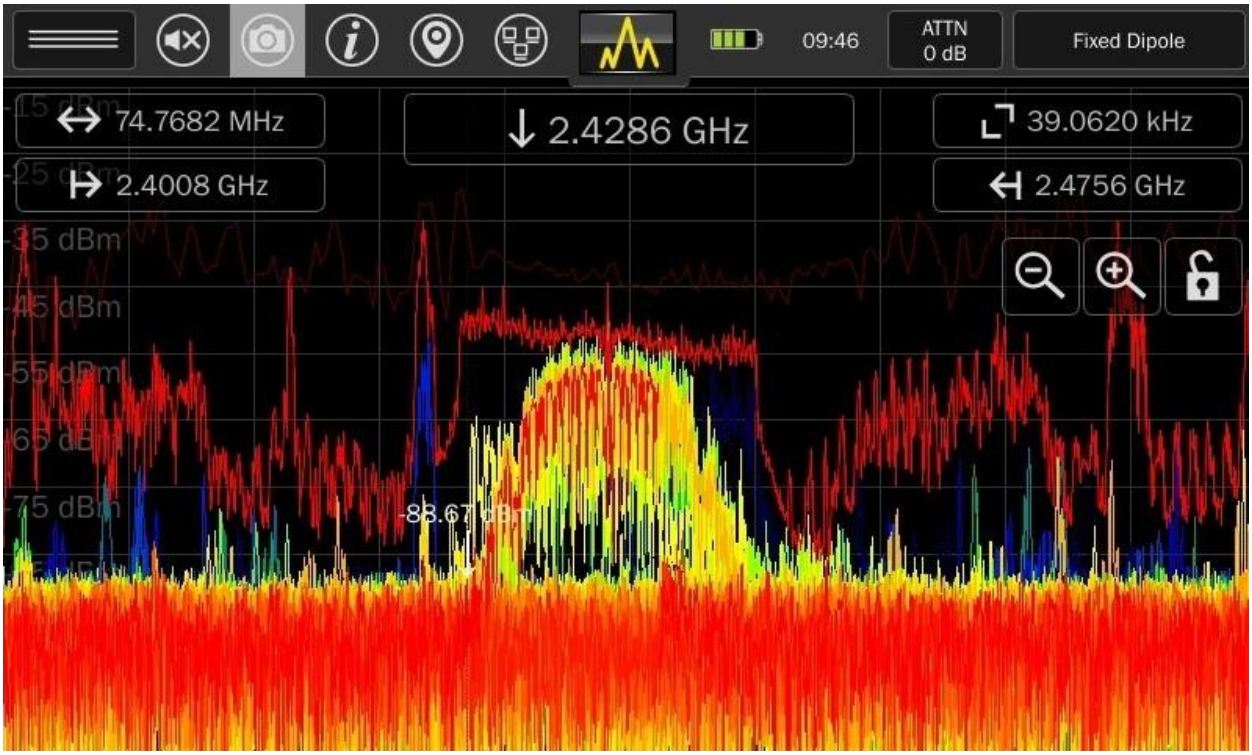
This option enables/disables the cached peak display as described above.

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 turning on the average trace display, a slider bar will appear allowing you to specify the number of real-time traces included in the average.

Persistence Trace

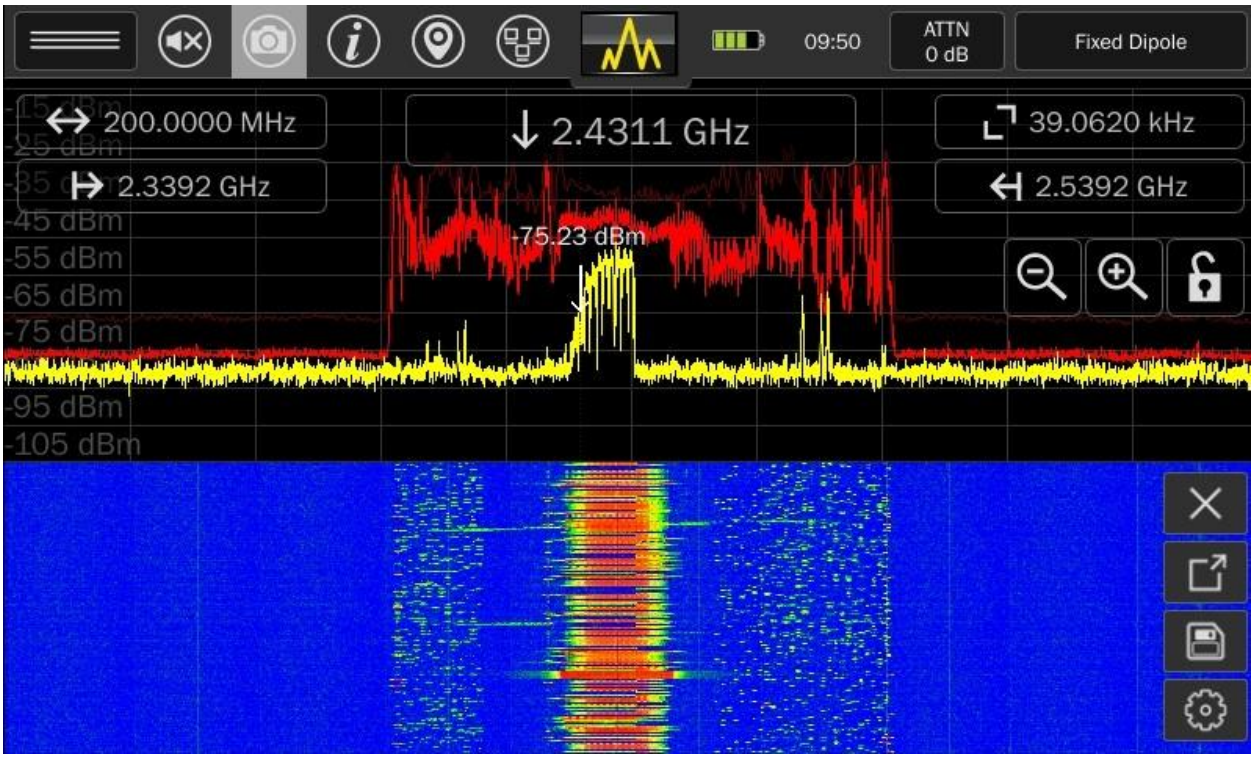


This option toggles the display of the persistence trace. The persistence trace displays the trace data from each sweep of the receiver using fading colors to indicate how frequently and recently each signal was encountered. Transient signals are displayed in darker colors (blues & greens) and fade quickly, 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



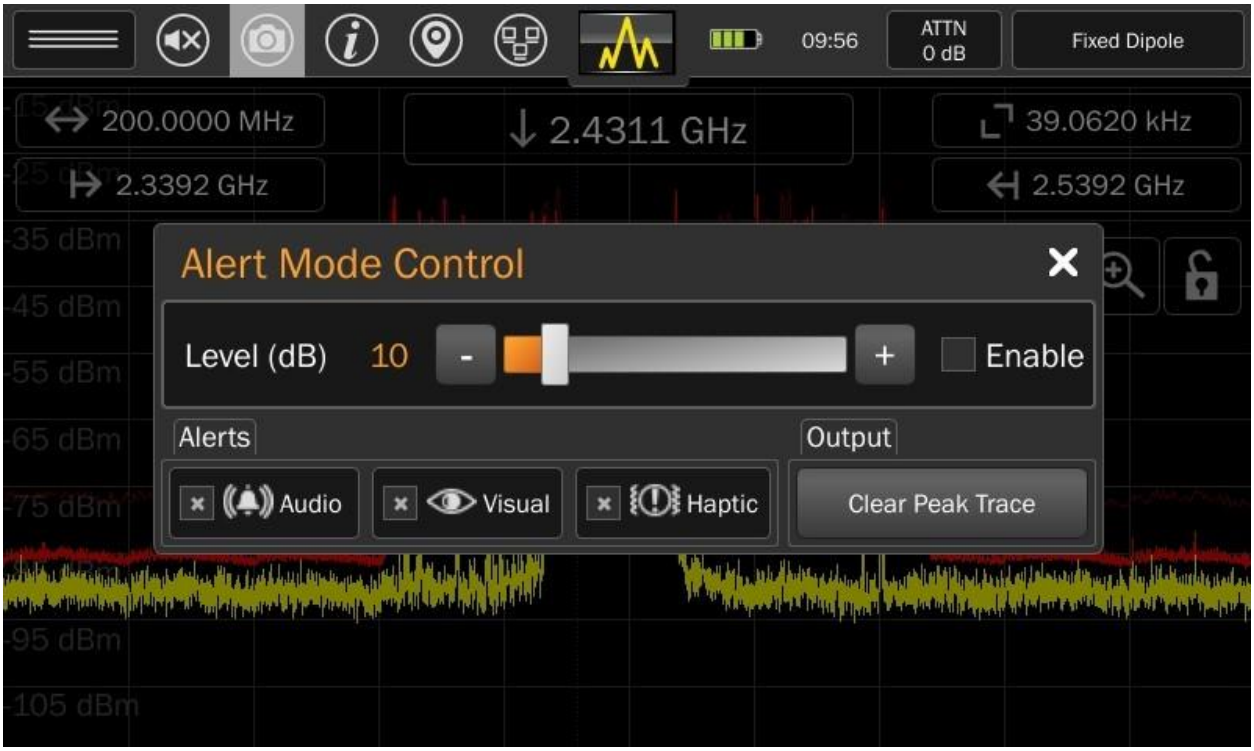
This option toggles the display of the waterfall. The waterfall captures a series of traces and displays them in a waterfall format. This is a quick way to observe the RF spectrum over a period of time and easily identify intermittent transmissions such as burst transmitters.

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
- 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 with your finger.

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, you must 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 you clear the peak trace 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.

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 portion of the screen represent the RSSI Window or the area of the spectrum whose relative signal strength is represented by the RSSI graph. You may pan the spectrum or zoom in/out to adjust the frequency span being monitored.

You may also adjust the RSSI Window. Tap the *Configuration* button in the RSSI graph. Use the slider bar to adjust the window.

You may also adjust the amount of time represented by the horizontal span of the graph. Tap the *Configuration* button in the RSSI graph. Choose one of the Timespan options.

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

Generate Signal List

This option will generate a signal list based on a reference peak trace. When selected from the menu, the user is presented with a dialog box. Set a threshold level using the slider control in the dialog box. Once you have the desired threshold set, press *Activate.*

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

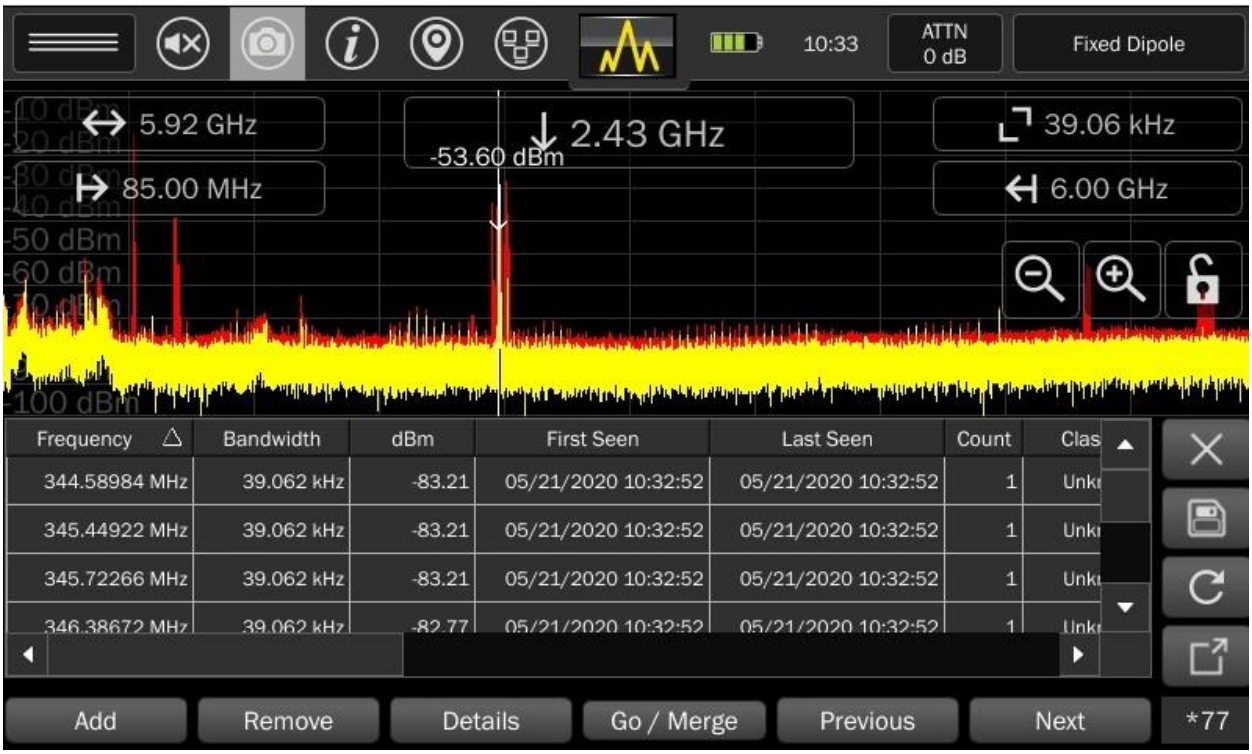
When ready, press *Generate Signal List*. The MESA will analyze the peak reference trace, establishing an average baseline. Any frequency that crosses the set threshold level will be added to the signal list.

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 48).

For additional details on the signal list window, see page 61.

Signal List



This option toggles the display of the signal list window. The spectrum portion of the graph will be compressed and displayed on the top half of the screen. The signal list window will be displayed 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 61.

Audio Demod

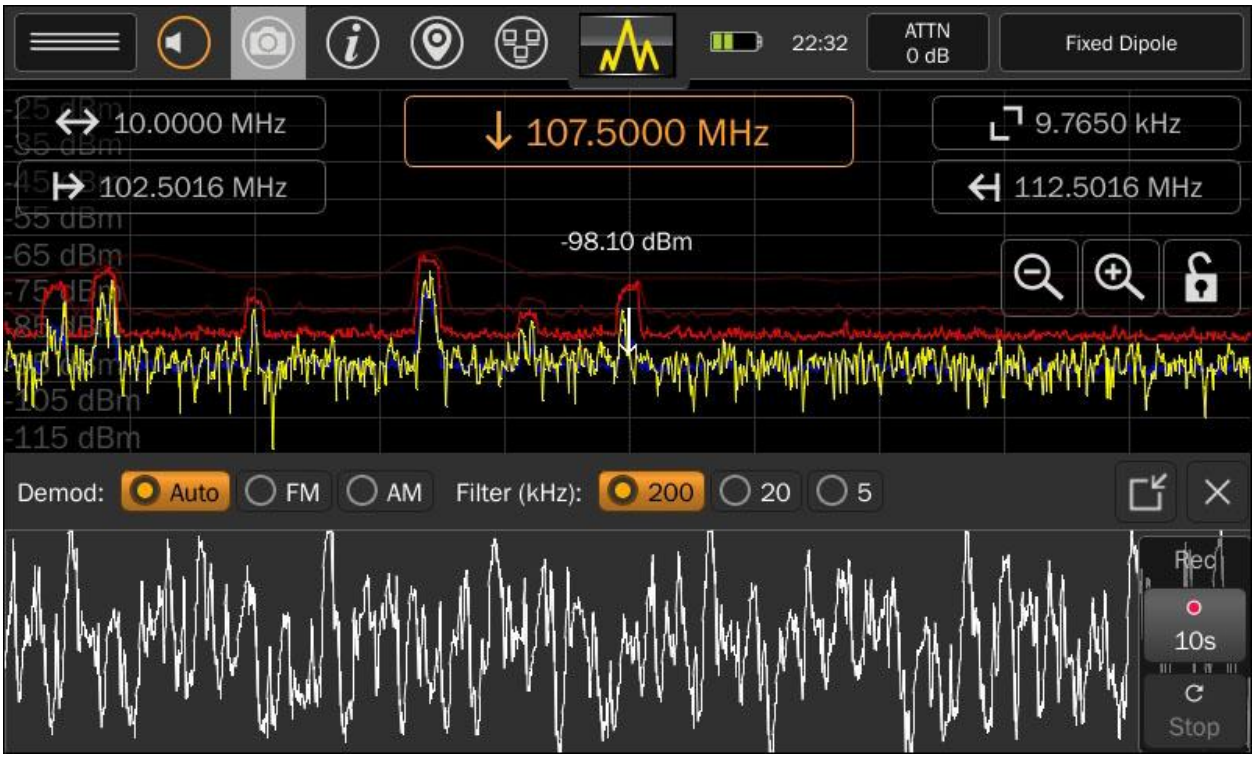
Demodulation of AM and FM signals is possible with the MESA:

1) With the cursor located at the signal, you wish to demodulate, 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, AM.
- Filter Bandwidth: Select from three different bandwidths - 200 kHz, 20 kHz, 5 kHz.

Audio Recording

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

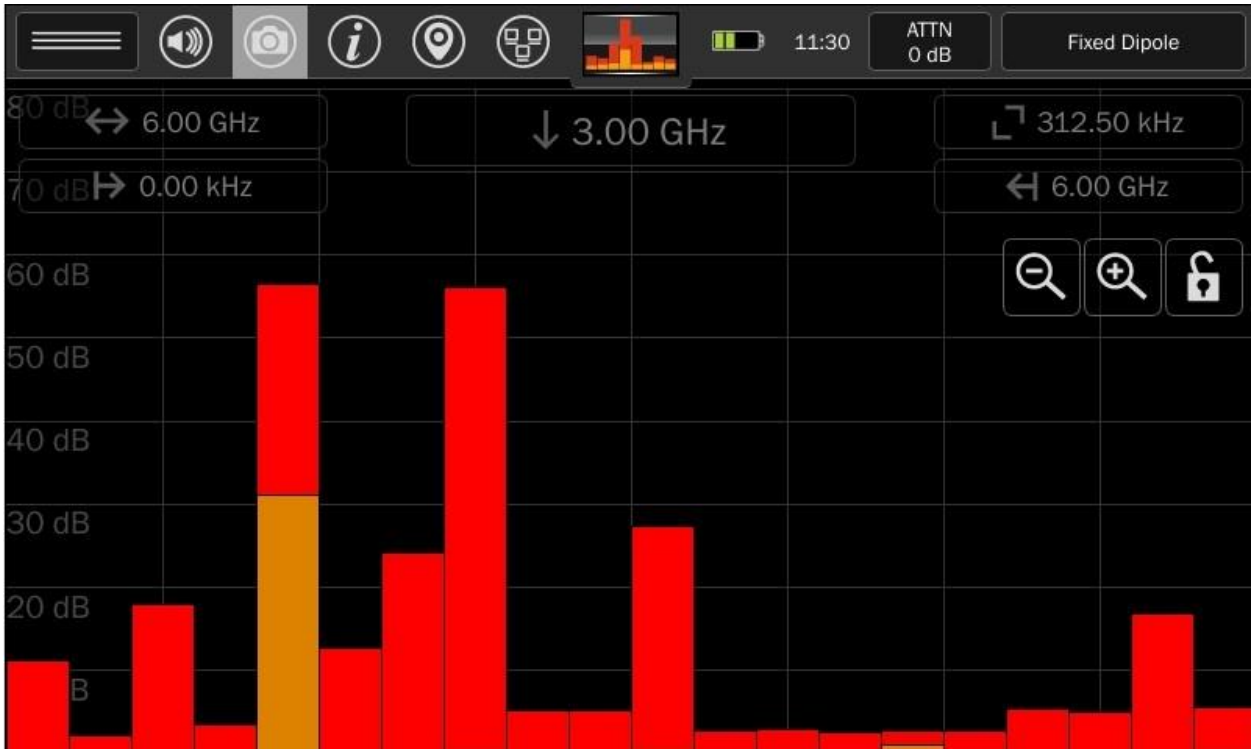
To Record Audio:

1) Insert a thumb drive into the USB connector on the MESA.
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, 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:

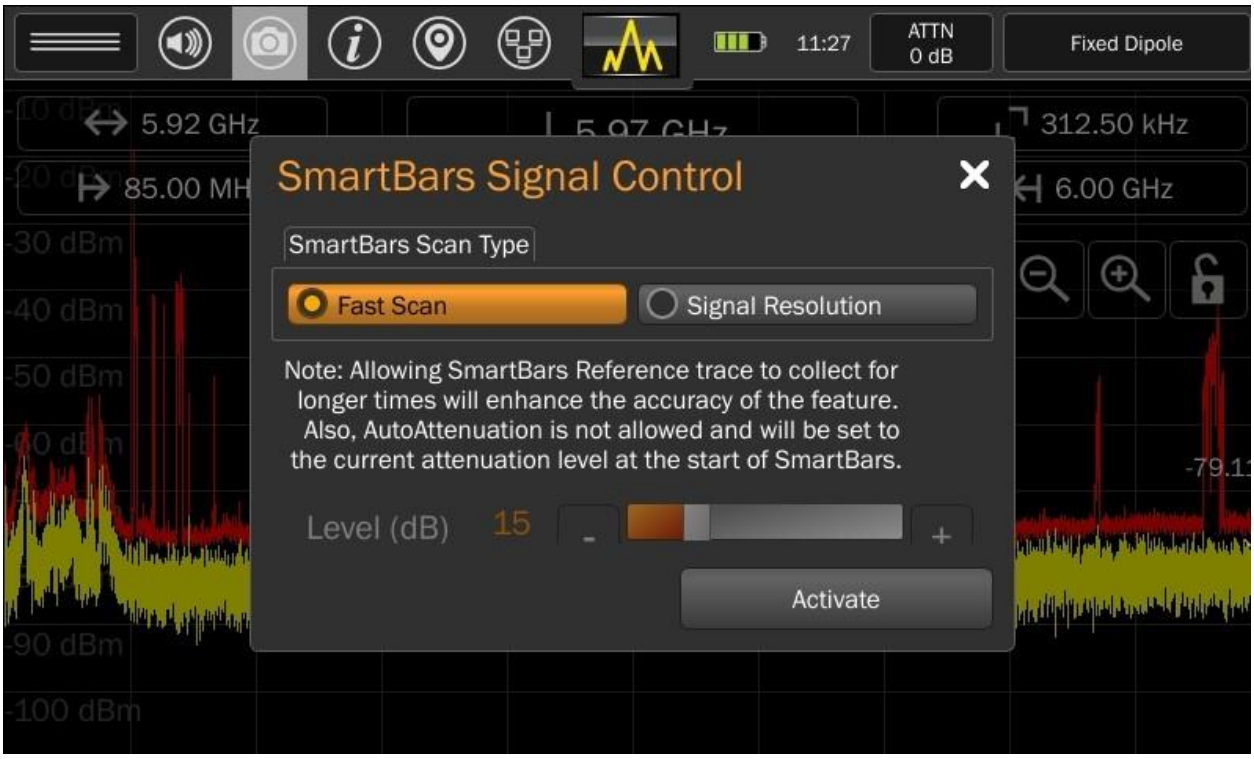
- Whip/Dipole
- Fixed Dipole
- Down Converter
- Locator Probe

It is possible to use any probe with SmartBars by manually selecting "Universal RF" from the Probe Selection Input (see page 21), 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™

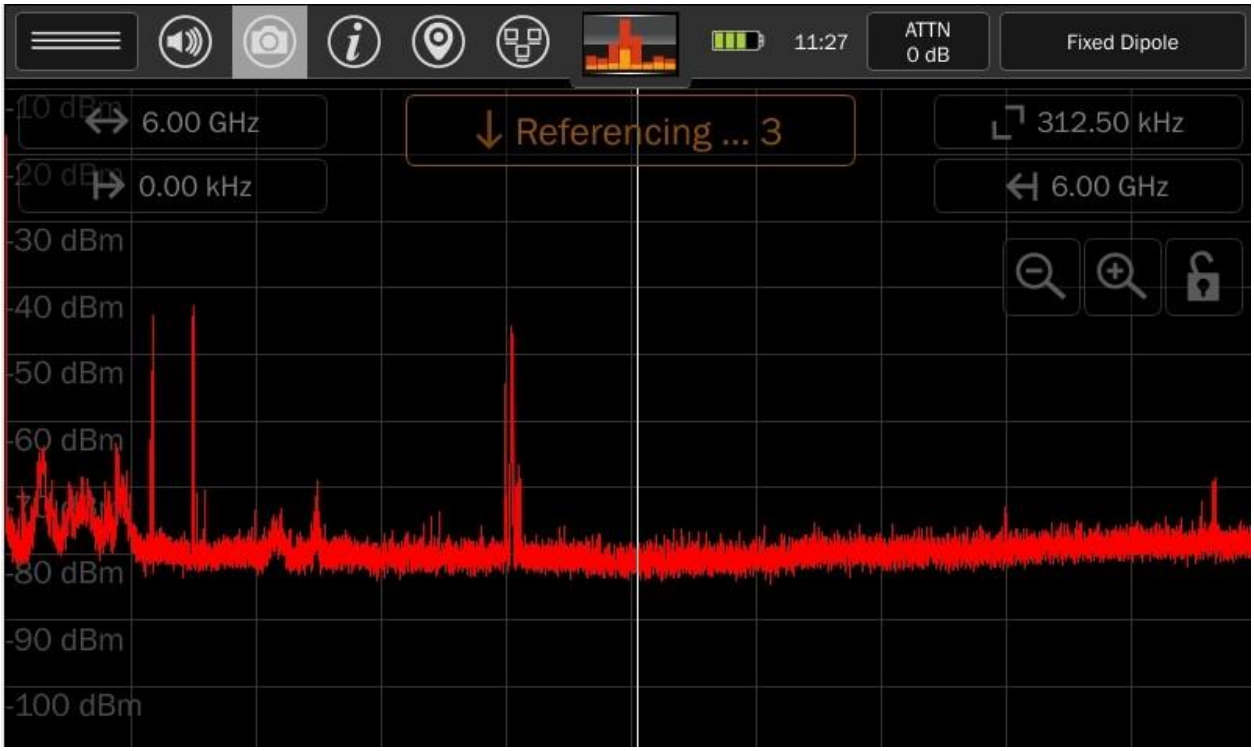
1. Select SmartBars from the Mode Menu at the top center of the screen.



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 you to set a threshold level and records any signal that crosses the threshold while you are in Signal Resolution mode in a signal list.

3. If you have chosen *Signal Resolution* mode in Step 2 above, adjust the Level (dB) slider bar to the desired threshold level.

4. Press *Activate.*

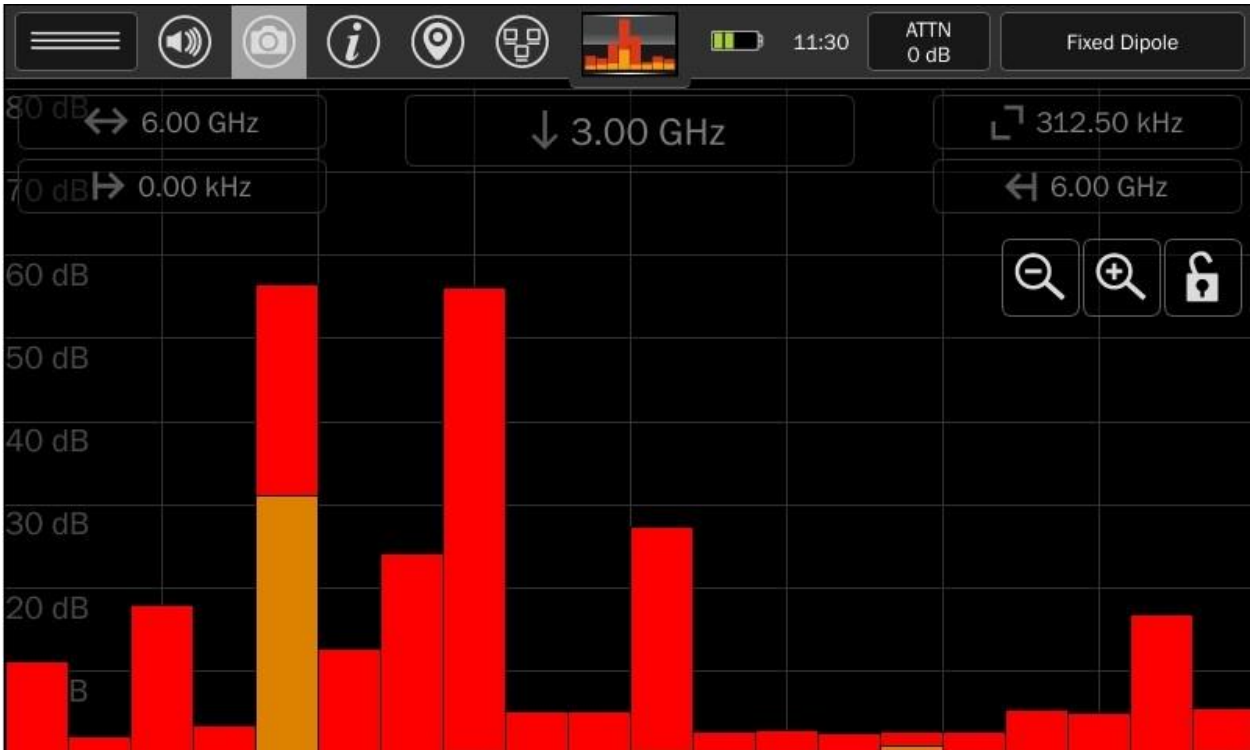


5. The MESA will begin collecting a reference trace for a minimum of 5 seconds. During this time, the top center of the screen will say "Referencing…" with a countdown. If desired, you may collect the reference trace for longer. Ideally, you would want to collect the reference trace outside of the area that you plan to sweep. The longer that you allow the reference trace 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 your sweep, press "Start SmartBars" and move into the area that you plan to sweep.

Navigating SmartBars™ Mode

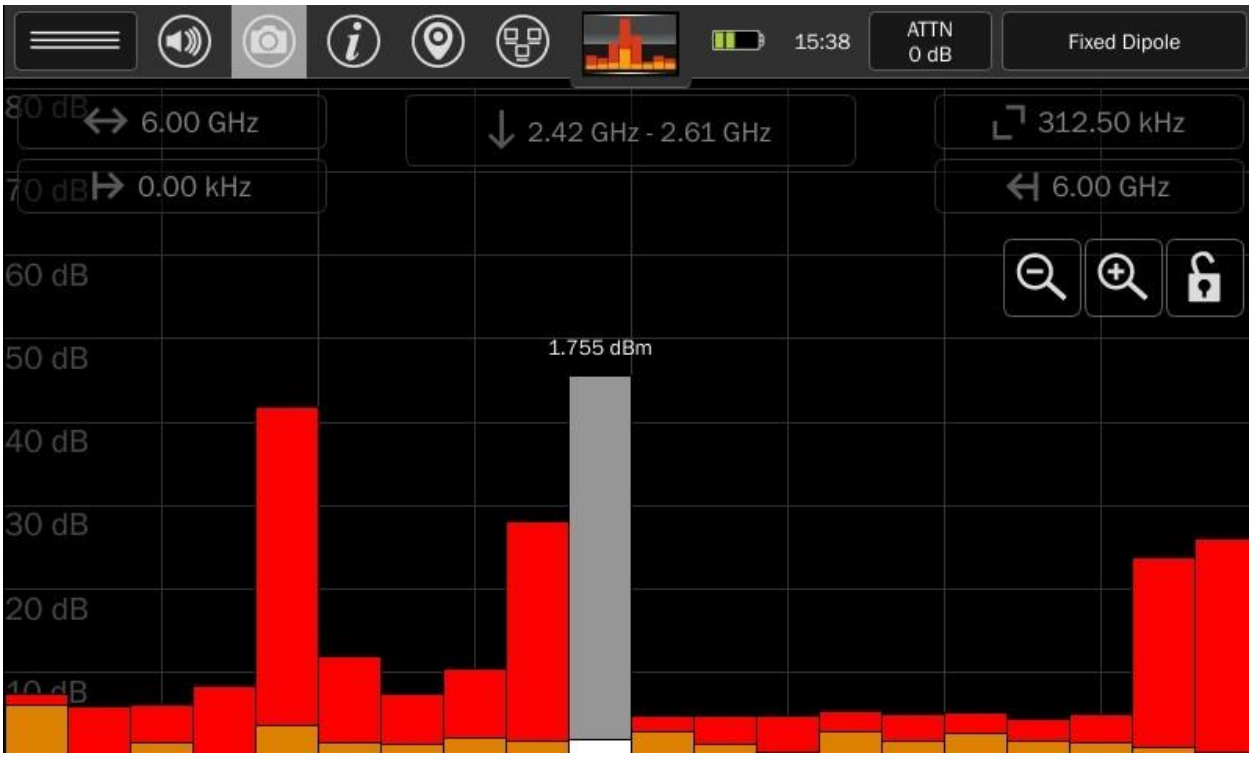
Note: The screenshots below show the *Fast Scan* version of SmartBars. However, navigation works the same in both modes.



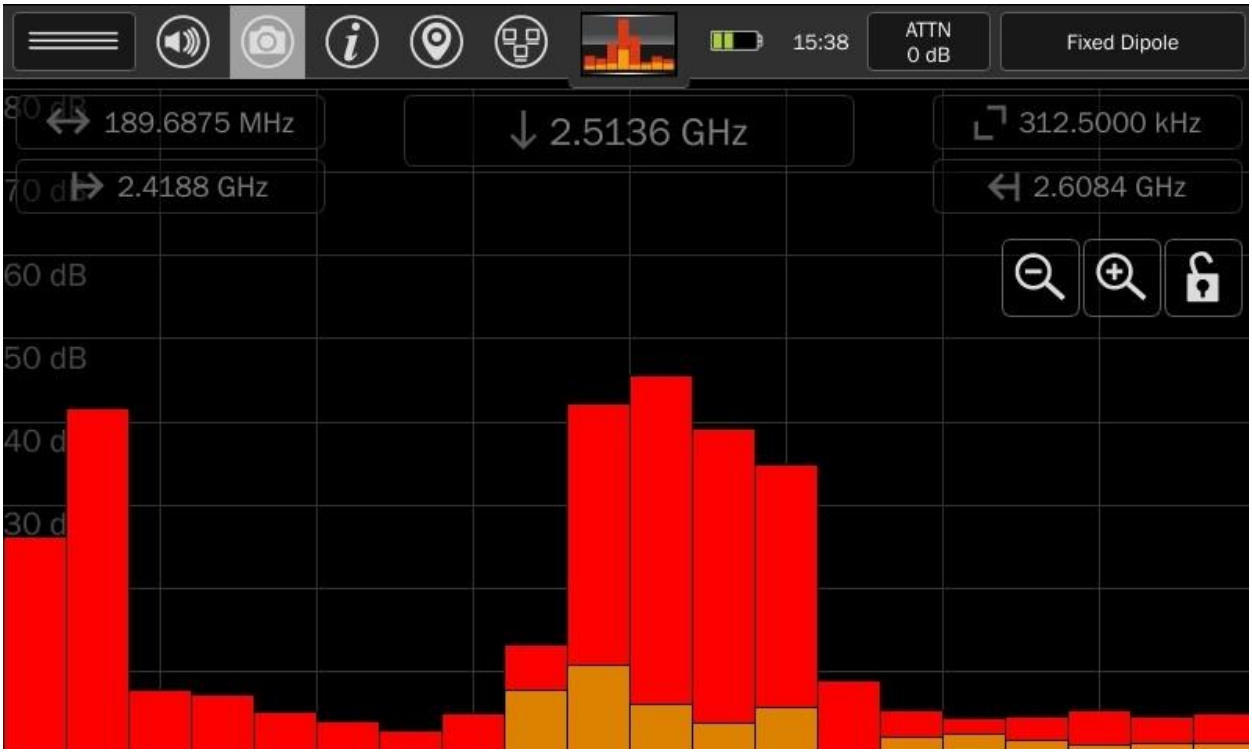
After starting SmartBars, the spectrum will be displayed as 20 SmartBars representing the full range of the connected probe with each SmartBar comprised of equal power normalized to the absolute power of the reference trace.

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.

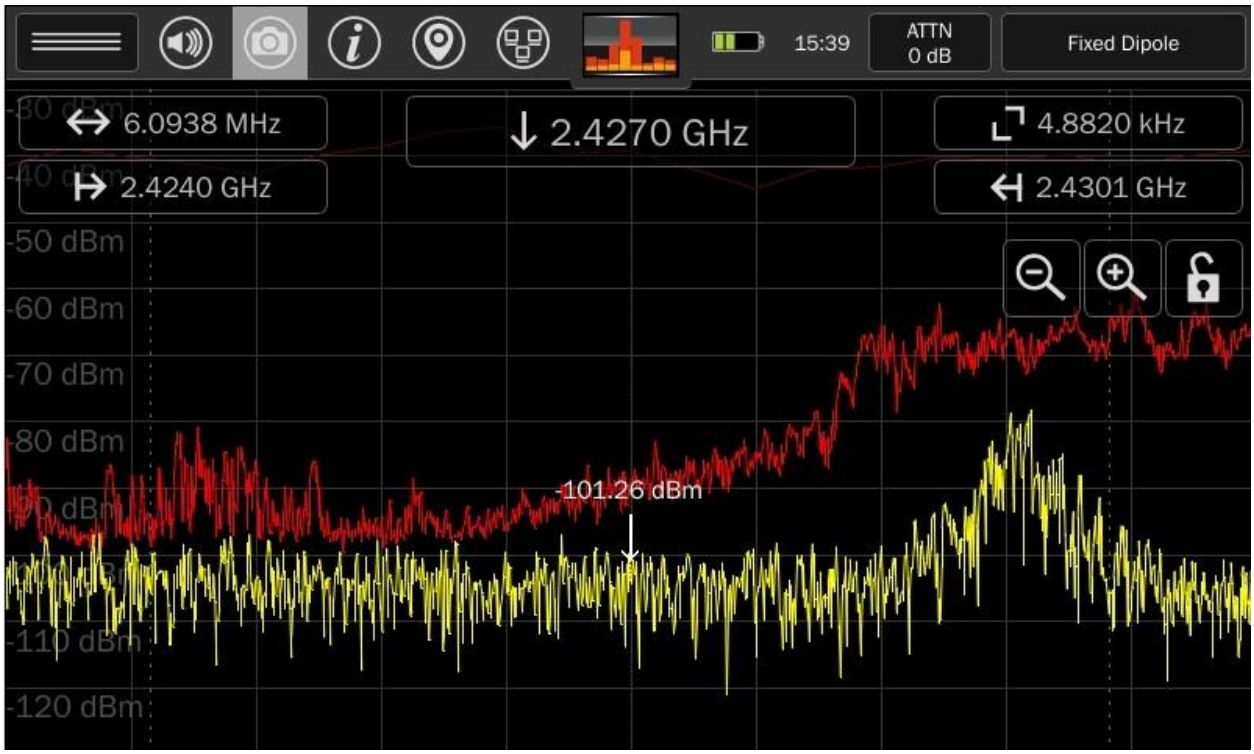


Tapping a SmartBar will select it. The selected peak trace bar will change to gray. The selected live trace bar will change to white.

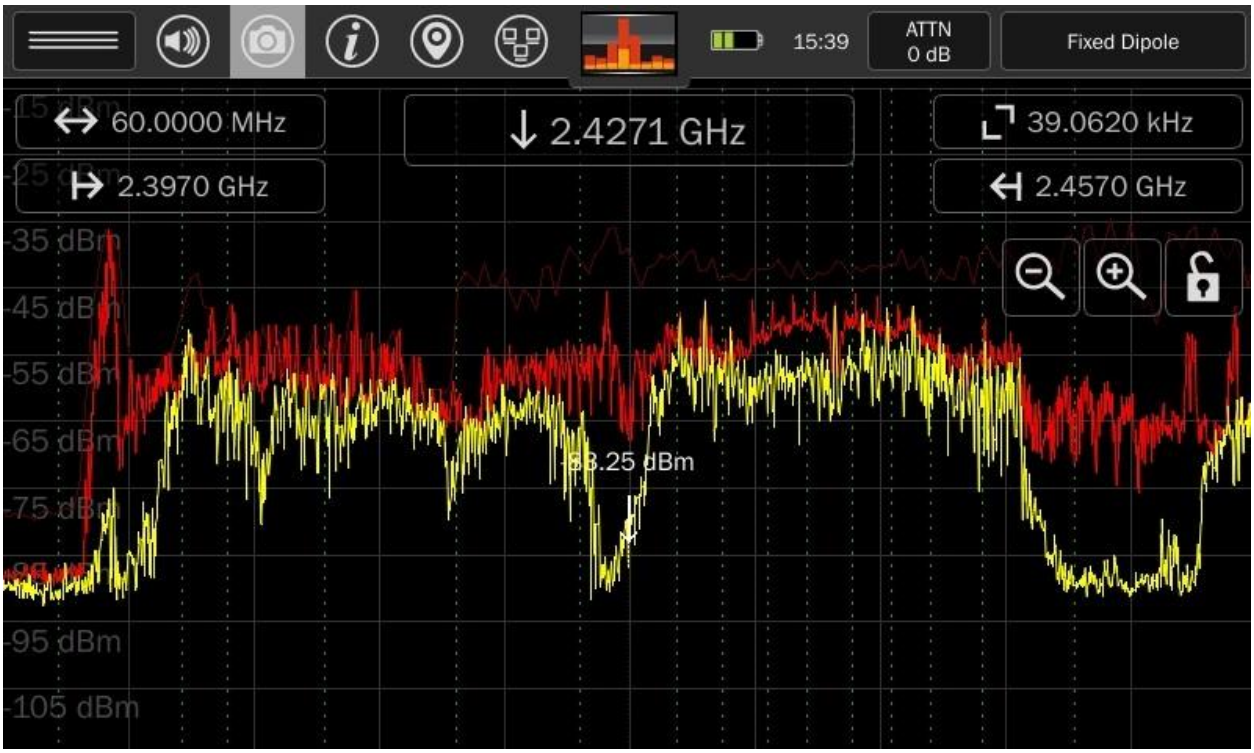


Tapping a selected SmartBar will zoom in to the portion of the spectrum represented by the span of the selected SmartBar. Again, the portion of the spectrum will be displayed as 20 sub-bars of equal power.

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



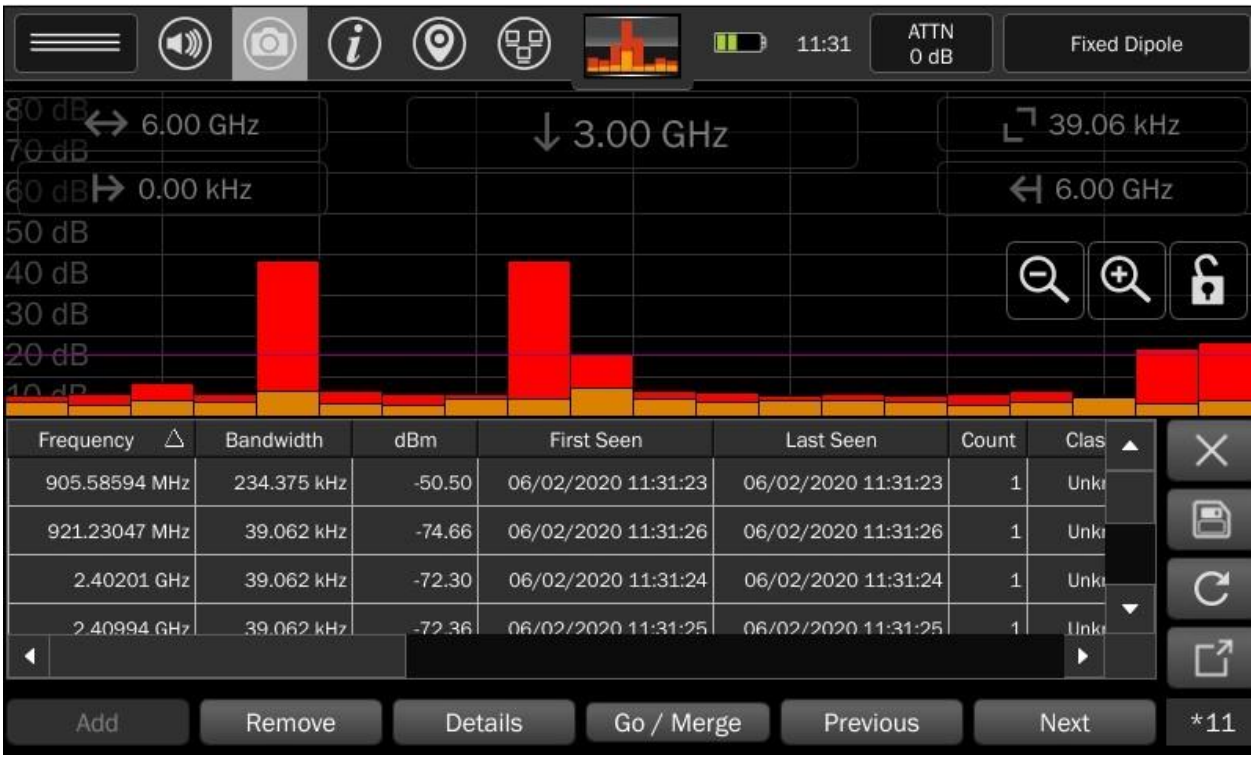
Tapping one of the sub-bars will select it. Tapping a selected sub-bar will zoom in to the portion of the spectrum represented by the span of the sub-bar displayed as a trace graph.



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 you zoom in to where the Spectrum mode is displayed or until you exit SmartBars Signal Resolution mode.

After you are finished collecting signals in the Signal Resolution SmartBars Mode, you should save the signal list. Be sure that 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 61.

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. Even within the SmartBars mode, the options available in the Mode Settings Menu will change depending on whether you have SmartBars showing or whether you have zoomed in far enough so that the spectrum traces are showing. 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, and factory reset. For additional information see page 79.

Restart SmartBars™

Selecting Restart SmartBars from the Mode Settings Menu starts the process of collecting a reference trace again. You will remain in either Fast Scan or Signal Resolution Mode, whichever one you initially started with. To switch to the other mode, select SmartBars again from the Mode Menu.

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, you must 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, if you zoom in to the point where trace graphs are shown, a marker will appear at each point that the threshold is crossed.

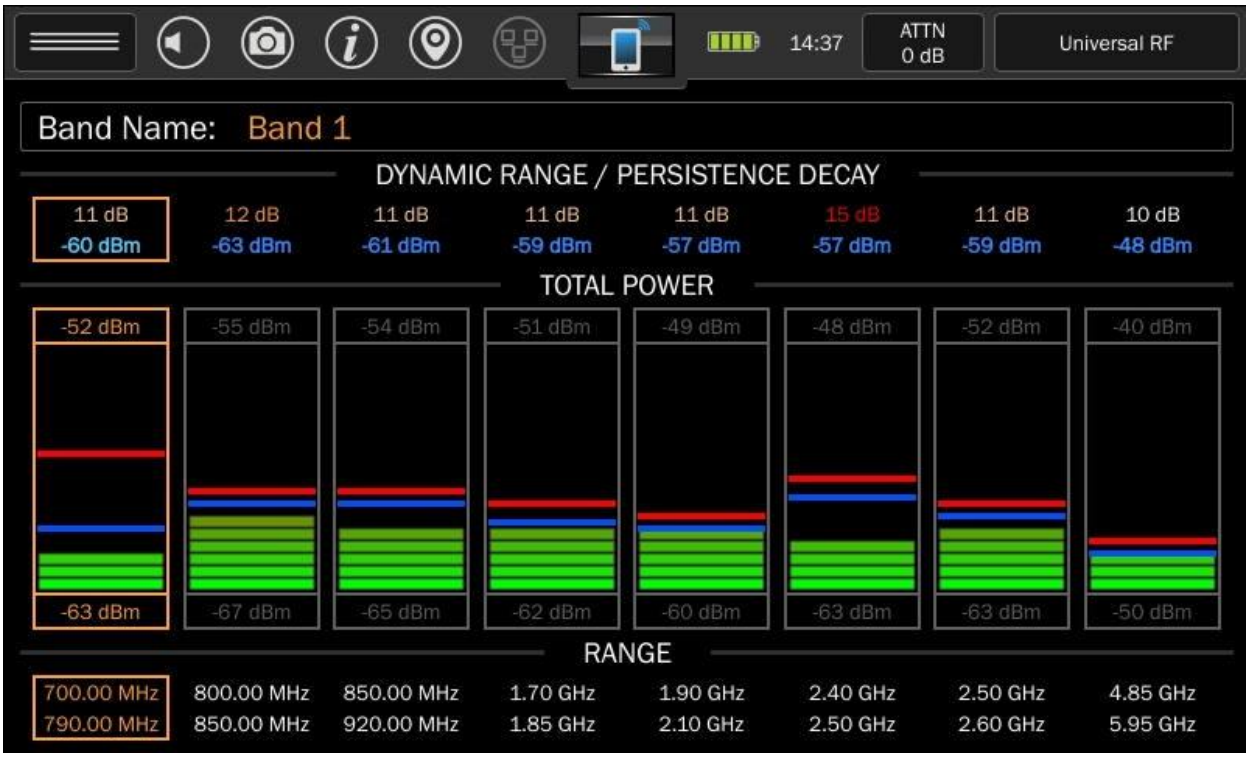
Haptic - Check the Haptic box to enable haptic alerts. Haptic feedback will be felt anytime that the threshold is crossed by the real-time trace.

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 you clear the peak trace before enabling

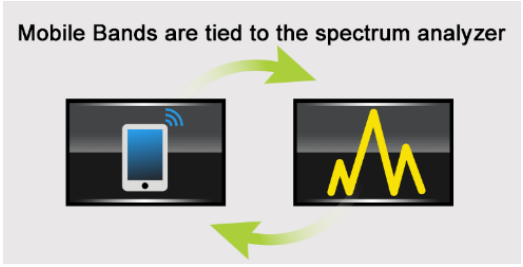
the threshold, the threshold level will be based on the cleared peak. It is best to allow a peak to collect for a while before enabling the threshold level.

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:

1. Select a bar graph to highlight it. The selected graph will be highlighted with an orange border.

2. Tap the selected graph again. 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.

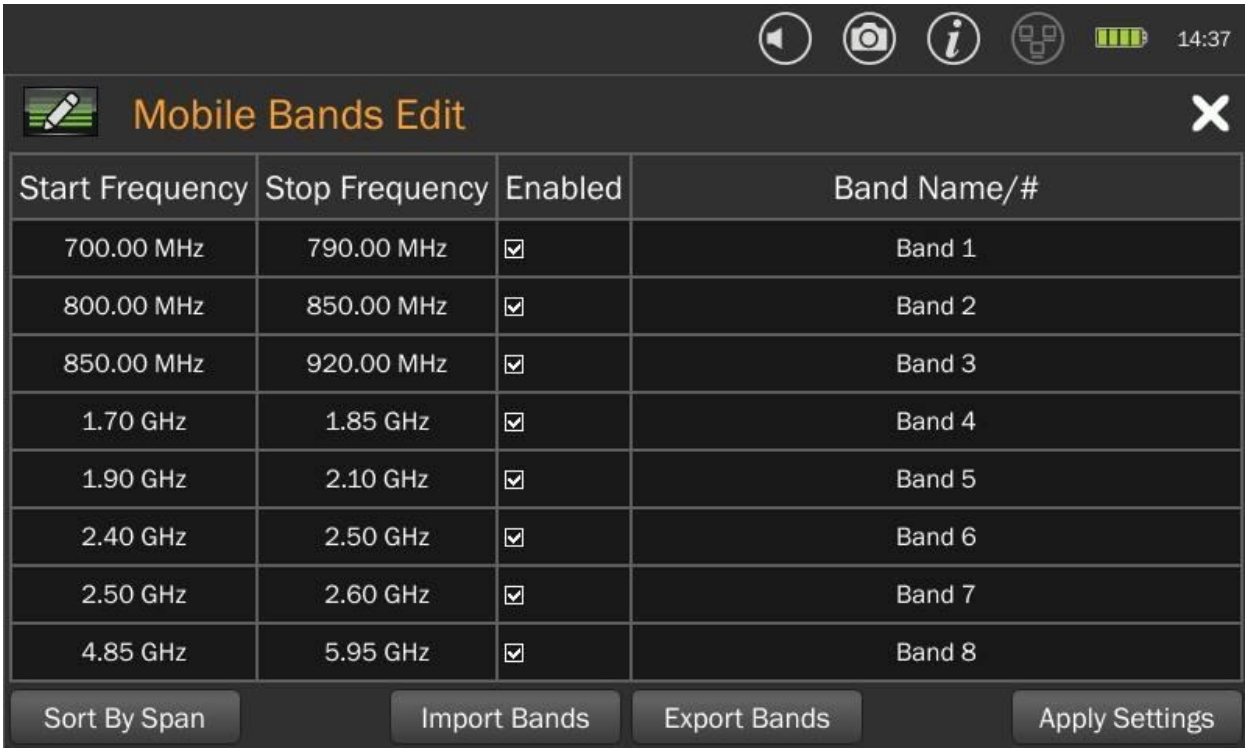
In the spectrum display, the normal functions are available such as peak, persistence, signal lists, etc. Pressing Zoom In will reduce the frequency span. Pressing Zoom Out will increase the frequency span. Zooming out beyond the bar graph frequency limits will return to the bar graph screen.

Editing Mobile Bands

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

Default Band	Frequency
1	700-790MHz
2	800-850MHz
3	850-920MHz
4	1700-1850MHz
5	1900-2100MHz
6	2400-2500MHz
7	2500-2600MHz
8	4850-5950MHz

But these frequencies 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 twice on the frequency range at the bottom of one of the bars (once to select and a second time to edit). The Mobile Bands Edit dialog will appear.
2. From this dialog, you can edit Start and Stop frequencies of each range. Double tap the frequency that you wish to edit. Frequency bands cannot overlap. If a Start or Stop frequency is selected that 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 at the top of the Mobile Bands screen for each band that is selected.
5. When you are finished making changes, select ***Apply Settings*** from the bottom right of the dialog.
6. To return to default values, select ***Restore Defaults*** from the Mode Settings Menu.

Saving / Recalling Mobile Band Configurations

The MESA allows you to save custom mobile band configurations and recall them at a later time.

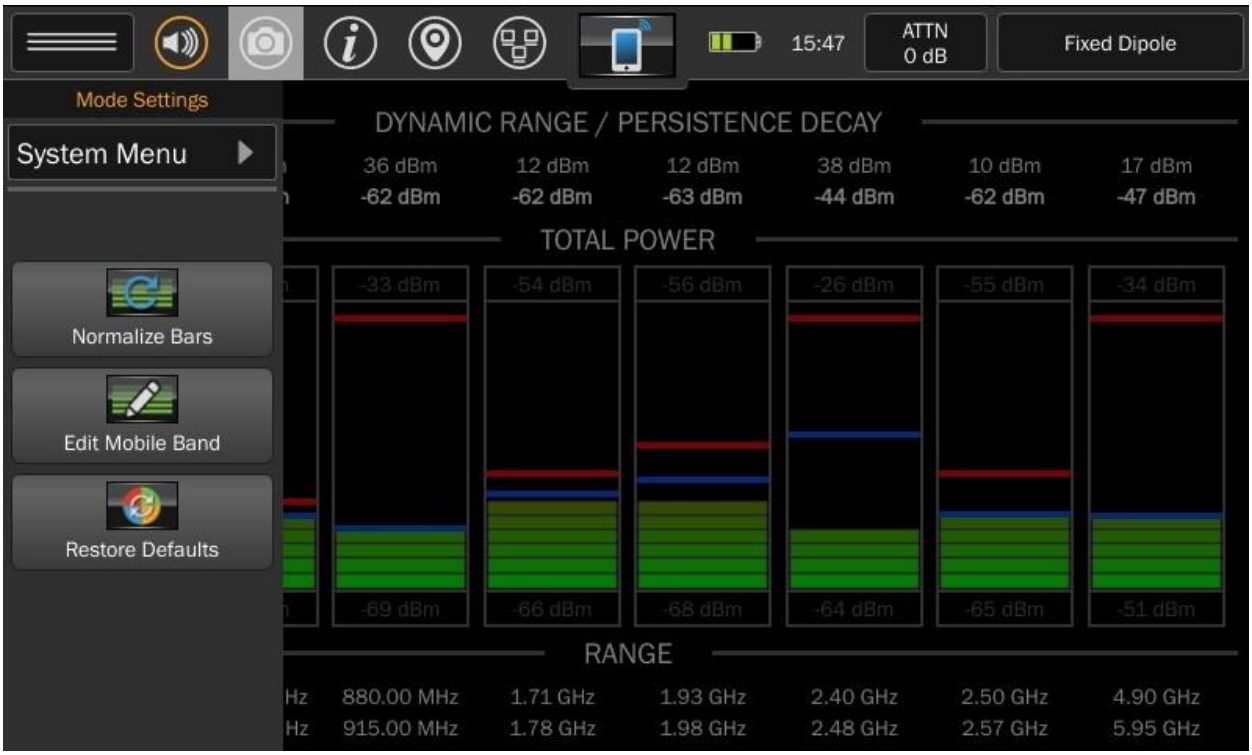
To save a custom mobile band configuration:

1. Select ***Edit Mobile Band*** from the Mode Settings Menu *or* tap twice on the frequency range at the bottom of one of the bars to enter the Mobile Bands Edit dialog.
2. Configure the settings as you wish to save them.
3. Ensure that a thumb drive is in one of the USB ports.
4. Select ***Export Bands*** from the bottom of the Mobile Bands Edit dialog.

To recall a previously saved mobile band configuration:

1. Ensure that a 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. Select ***Apply Settings*** from the bottom right of the dialog.

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, and factory reset. For additional information see page 79.

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.

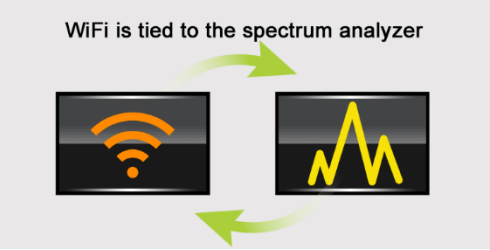
Edit Mobile Band

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.

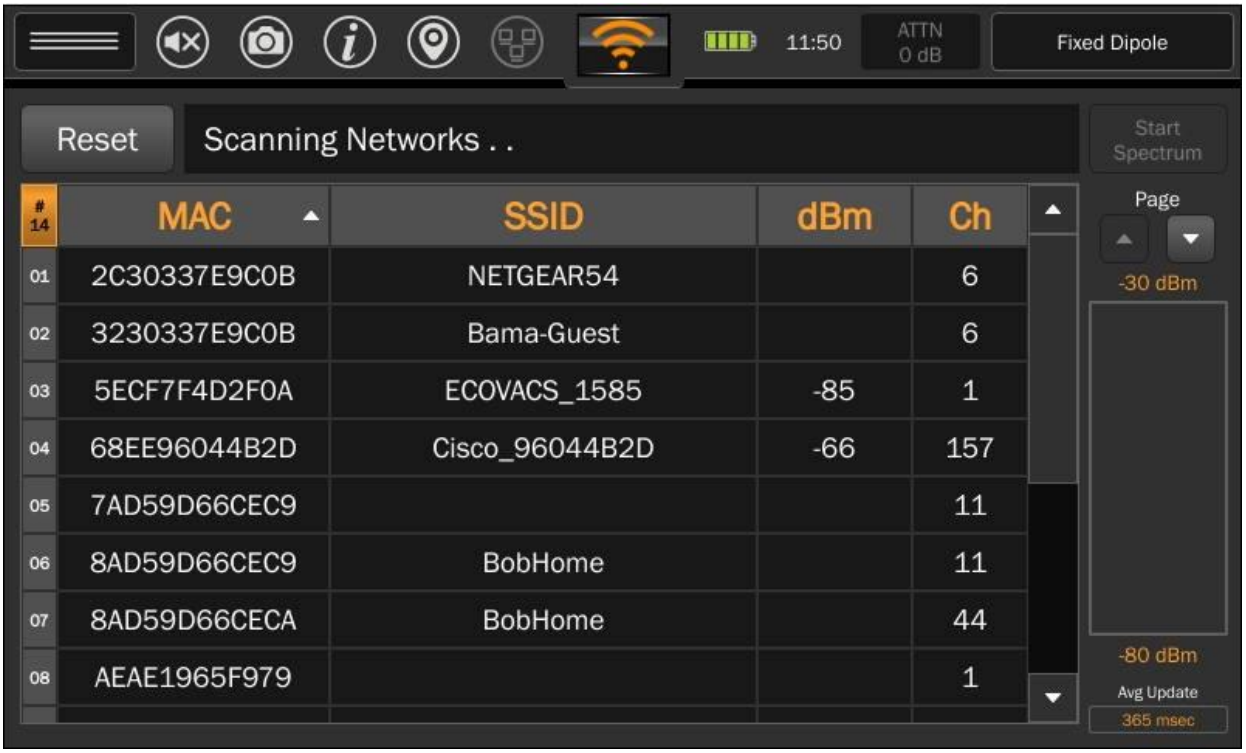
Restore Defaults

This option restores the 8 default mobile bands at 700-790MHz, 800-850MHz, 850-920MHz, 1700-1850MHz, 1900-2100MHz, 2400-2500MHz, 2500-2600MHz, 4850-5950MHz.

Wi-Fi & Bluetooth



The MESA combines both a Wi-Fi/Bluetooth module and a spectrum analyzer. The module identifies a list of signals that are automatically tied to the spectrum analyzer. The module scans the wireless networks in your area and displays a list of addresses, network names, power levels, and channel numbers.



The MESA begins scanning for WiFi networks as soon as WiFi mode is entered. Any network found is added to the list. The MESA will continue scanning for WiFi networks until WiFi mode is exited, until a device in the list is selected, or until the ***Start Spectrum*** button is pressed to view the spectrum of a selected device.

To View RSSI Data for a device/network in the list:

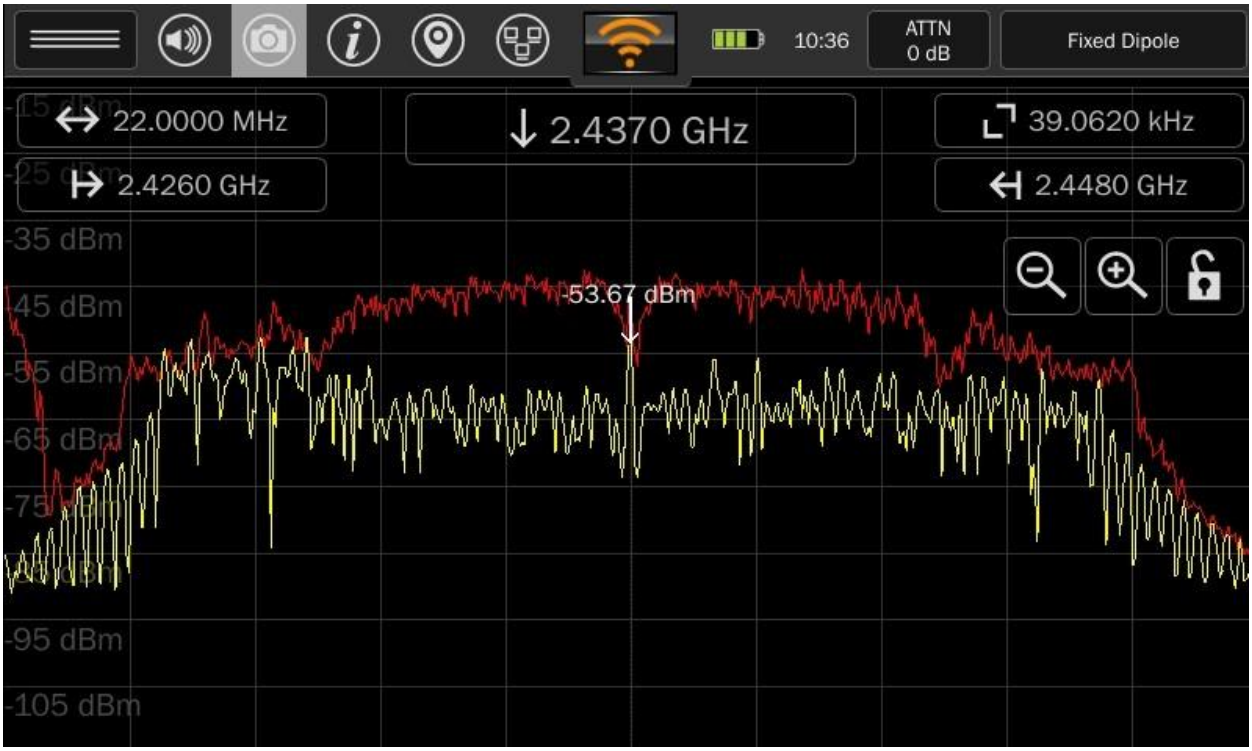
1. Select the device/network in the list.
2. The MESA will change to the channel of the selected device and begin scanning just for that device. The bar graph on the right side of the WiFi screen will begin displaying RSSI levels for the selected device.

Note: If you have moved out of range of the selected device, there may not be any RSSI data.

Note: If the selected device moves channels, the MESA will not detect this change until you return to scanning for devices.

To View the Spectrum for a device/network in the list:

1. Select the device/network in the list.
2. Press the ***Start Spectrum*** button in the top right of the WiFi screen.
3. The MESA will begin displaying the RF Spectrum for the selected device/network.



4. While in spectrum mode, the span is limited but the normal options are available (peak, average, persistence, etc.)
5. By pressing zoom out the unit returns to the table with the relative power bar showing.

To Return to WiFi Scanning after scanning a single device:

1. Deselect the device in the list.
2. The MESA will begin scanning for devices/networks again.

To Restart a Scan:

1. Press the ***Reset*** button at the top right of the WiFi screen.
2. The current list of devices will be cleared and the MESA will immediately begin scanning again

Some scans may result in a large number of devices in the list. Several methods are available for managing large lists:

- The total number of devices is located in the top left cell of the table.
- For lists that span several pages, a scroll bar will appear.
- Page up and down buttons are also provided to quickly scroll through lists.
- The list may be sorted by any of the column headings either ascending or descending. Tap the column heading to sort by that column. Tap again to reverse the order.

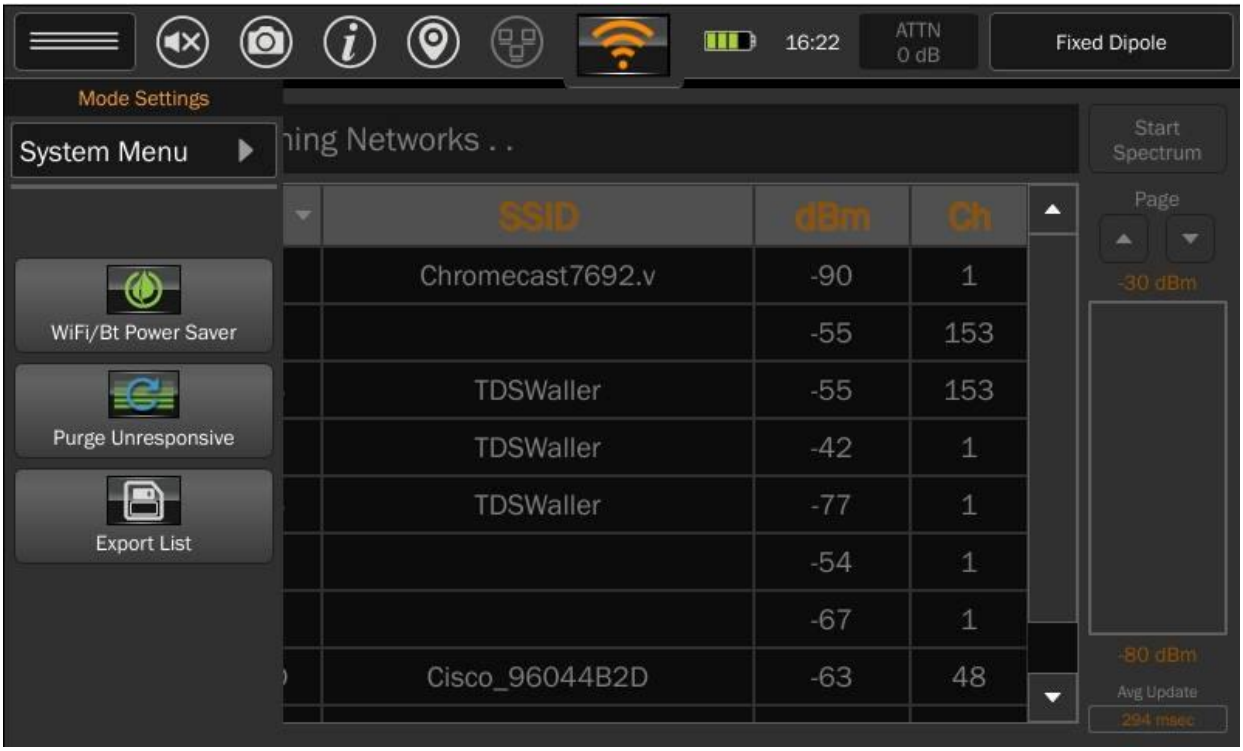
To remove devices in the list that are no longer active or that are out of range:

1. While the MESA is scanning for WiFi networks, select ***Purge Unresponsive*** from the Mode Settings Menu.
2. Devices/Networks that are no longer active or that have moved out of range will be removed from the list.
3. The MESA will continue scanning for devices.

To save a device list:

1. Ensure that a thumb drive is inserted into one of the USB ports on the MESA.
2. Select ***Export List*** from the Mode Settings Menu. Note: This option will not appear unless there is a thumb drive inserted into one of the USB ports.
3. The list is saved as a comma separated text file with a file extension of .wifi. This file can be opened with Excel or other spreadsheet programs.

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 the WiFi & Bluetooth Modes.

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, factory reset. For additional information see page 79.

WiFi/Bt Power Saver

To save power and reduce its RF signature, the MESA offers a low power option. ***Wi-Fi/BT Power Saver*** holds the WiFi/Bluetooth module in reset when not in use. This slows the initial scan, but saves power when not in use and reduces the RF signature. Since the WiFi/Bluetooth module requires 8-10 seconds to start after coming out of reset, you may prefer turning this feature off if you are planning to scan Wi-Fi/BT frequently. If reducing the RF signature while in other modes is important, then you may want to turn this feature on.

Purge Unresponsive

This option will remove devices from the list that are no longer active or that have moved out of range of the MESA. This option will not appear in the Mode Settings Menu if one of the devices in the list is selected.

Export List

This option is for saving the list of devices/networks. This option will only appear in the Mode Settings Menu if a thumb drive is inserted in one of the USB ports on the MESA.

Bluetooth Mode Operation

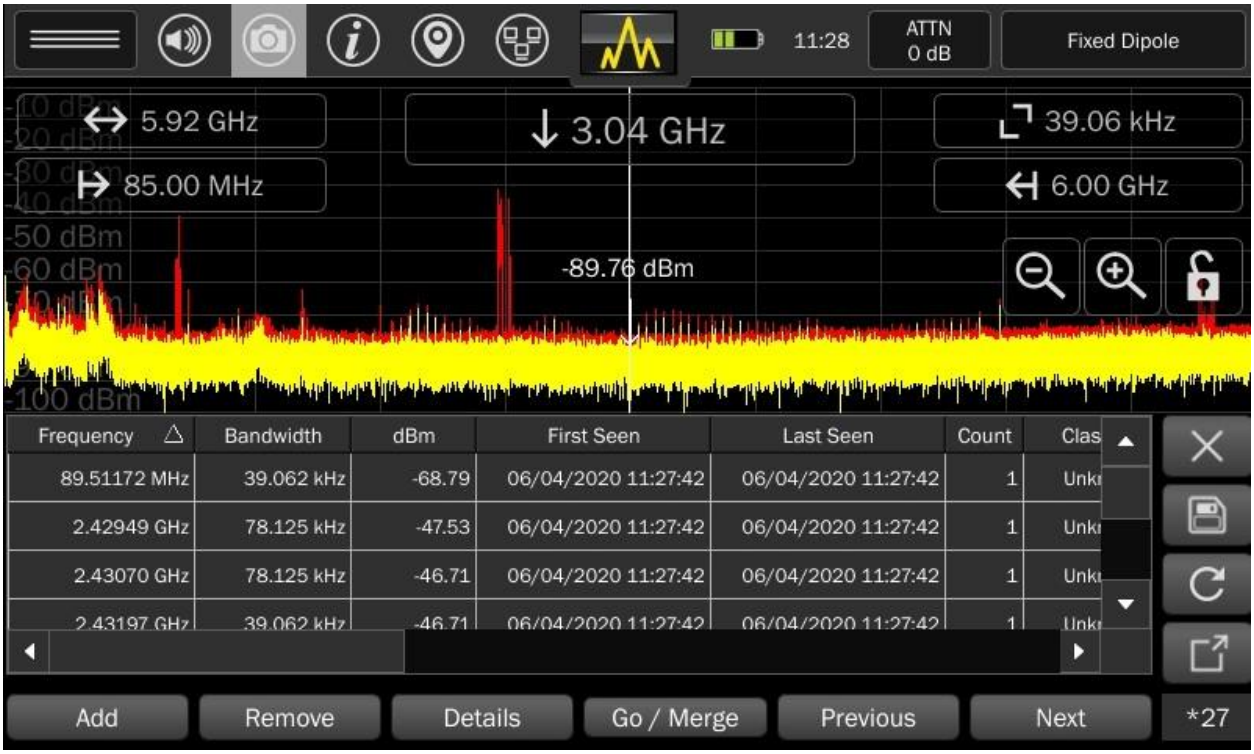
In Bluetooth mode, the unit scans for Bluetooth Classic and Bluetooth LE devices. When entering Bluetooth Mode for the first time after powering on, the unit scans for BT classic (or Standard) devices such as cell phones.

Similar to Wi-Fi mode the Bluetooth mode lists device addresses, names, and power levels. If you select a table entry, the MESA will stop scanning the spectrum for new Bluetooth devices and will only scan the selected device. The MESA will display a power bar on the right. To return back to scanning for new devices, tap the selected device again in the list to deselect it.

When viewing the display, notice that there is a ***Mode: Standard*** button in the upper right-hand corner. Press this button once and it will change to ***Mode: Low Energy*** and begin scanning for Bluetooth LE devices. Press the button again and it will change to ***Mode: Both*** and begin scanning for both Bluetooth Standard & Bluetooth LE devices.

Additional Features

Signal List Window



A signal list allows you to store and recall 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 48).

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 your given location, be sure to set the ITU region (see page 79).
- Wireless - Specific Band Information for known wireless protocols (GSM, CDMA, LTE, etc.) To ensure accuracy for your given location, be sure to set the ITU regions (see page 80).
- 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 80).
- 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 80).
- Atten/Gain - Indicates the attenuation or gain setting (see page 29) 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 25) for this information to be present.
- UTC Offset - Represents the time difference between local time and UTC. This field depends on the time zone that your 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 that you want to add.
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 looks good, 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 of the details can be viewed in one concise screen:

1) Highlight the signal for which you want to view details.

2) Press the "Detail" button at the bottom of the signal list.

From the details screen you may edit the Frequency, displayed power level, or displayed bandwidth of the signal. You may also categorize each signal 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 that you would like 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 in 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 together so that 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 you have a keyboard and mouse connected to the USB port, you may also use Shift+Click and Ctrl+Click operations to highlight the signals.

2) Press the "Go/Merge" button.

3) A dialog box will appear asking if you are sure you want 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 full screen.

With the signal list open and displayed on the bottom half of the screen:

1) 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:

1) 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 if you are sure you want to clear 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 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. To change this, see File Prefix Settings on page 65.

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 which 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.

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 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 CSV file that you wish to open.
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 display. If you try to power off the unit, it will still ask if you want to save the signal list.

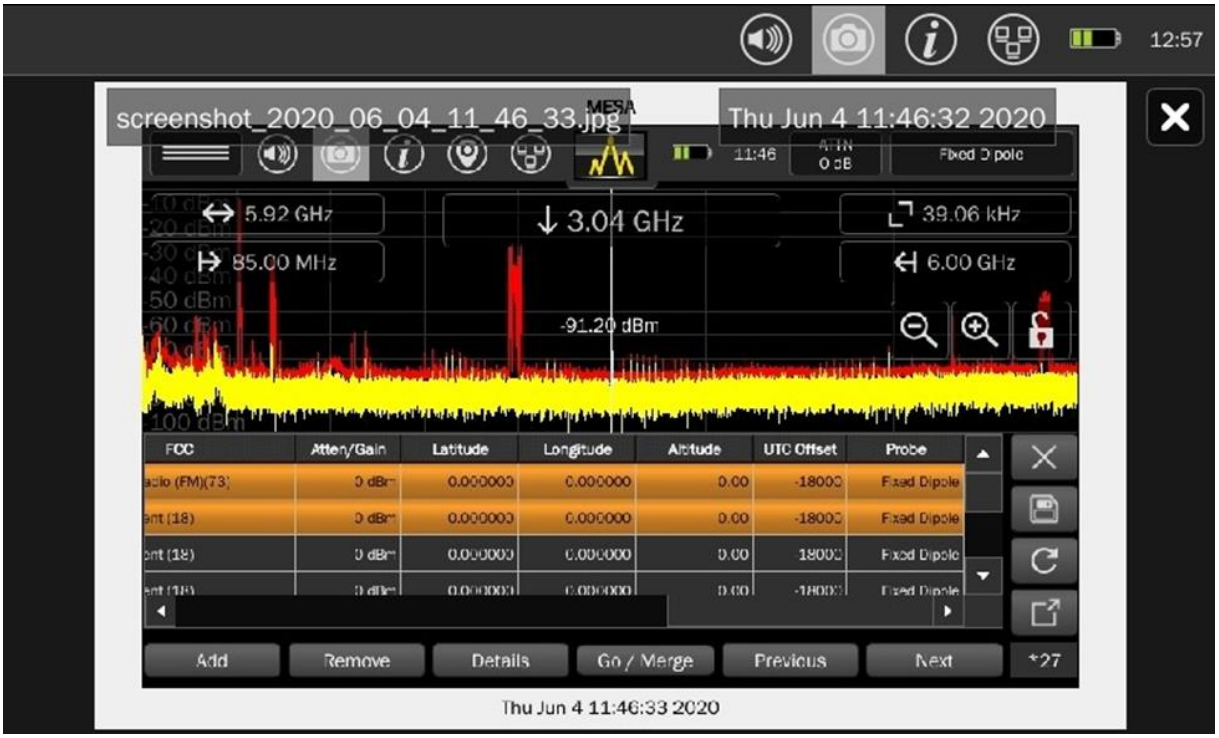
Image Viewer & Audio Player

The Image Viewer and Audio Player are located in 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, Wi-Fi, Bluetooth).

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

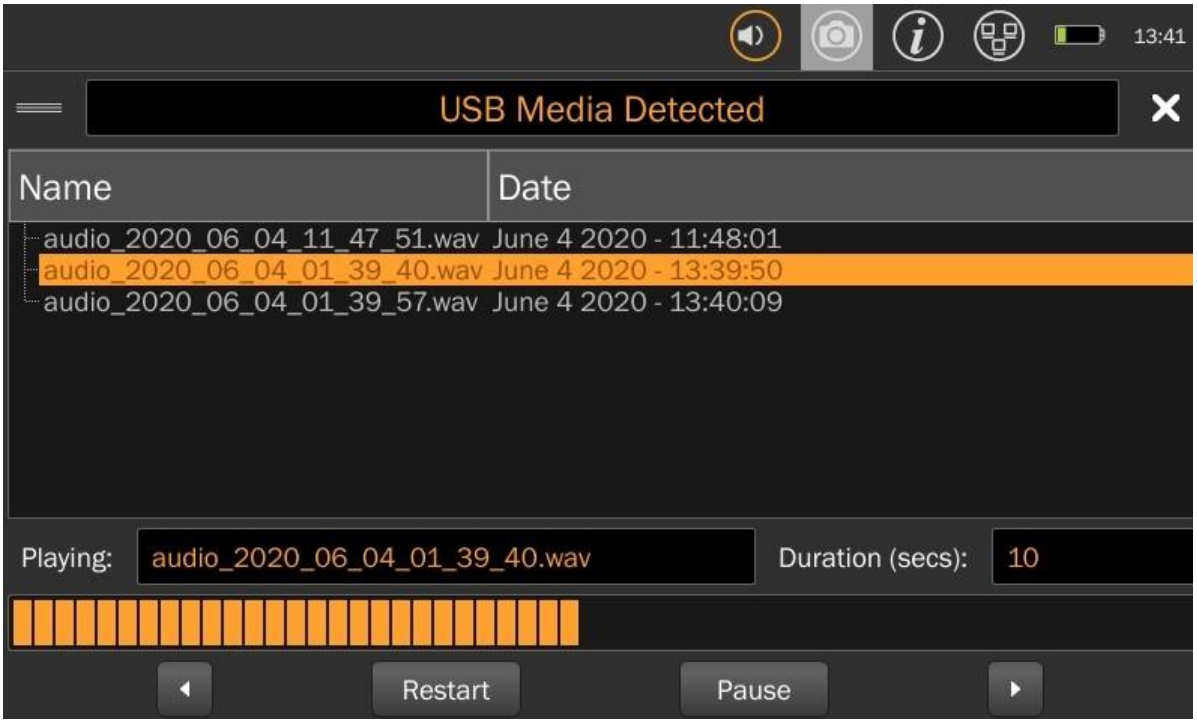
The Image Viewer opens up with a list of thumbnail images for any image stored on an inserted USB thumb drive.

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



Tap the "x" in the upper right-hand 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 you to lock the MESA 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 attemped.

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 you are not able to successfully unlock your device, email support@reiusa.net, or call (931-537-6032) during REI's normal business hours (M-F 8:00am-4:30pm CST)

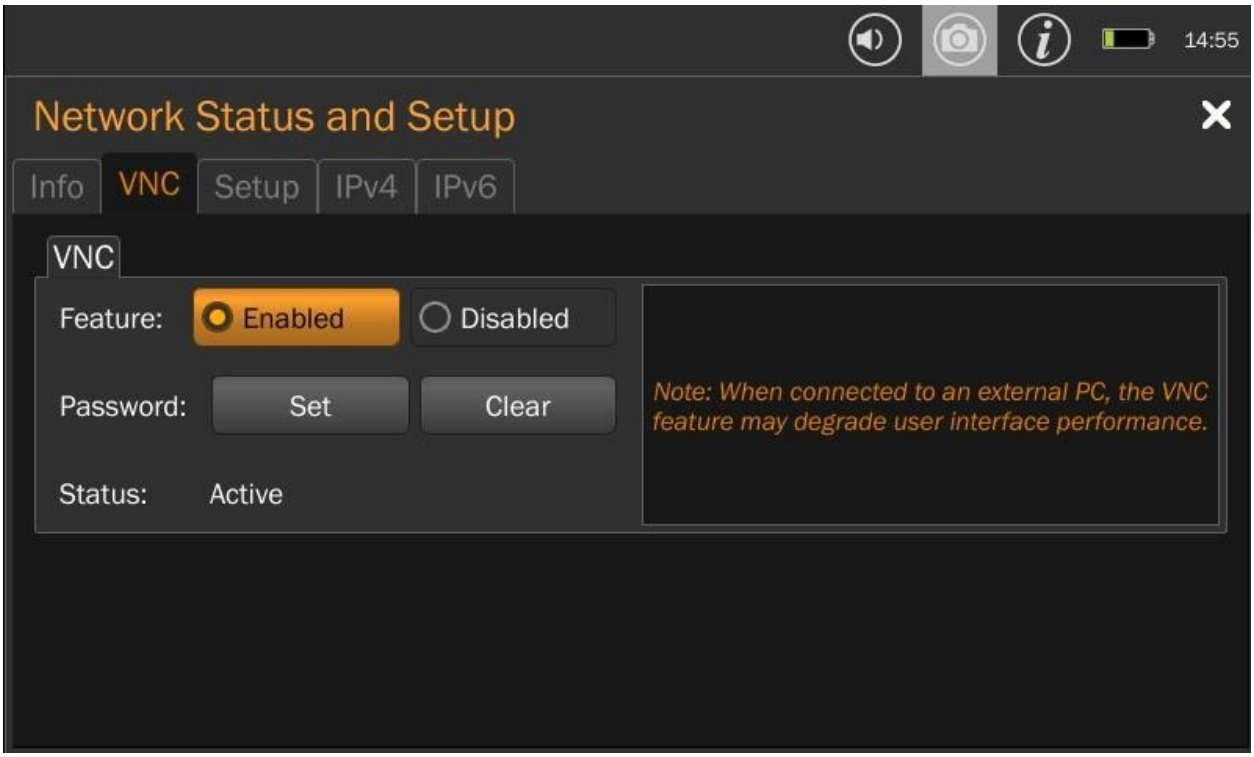
Network Configuration

The network settings can be accessed from the network icon at top of the screen and the System Menu.

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.

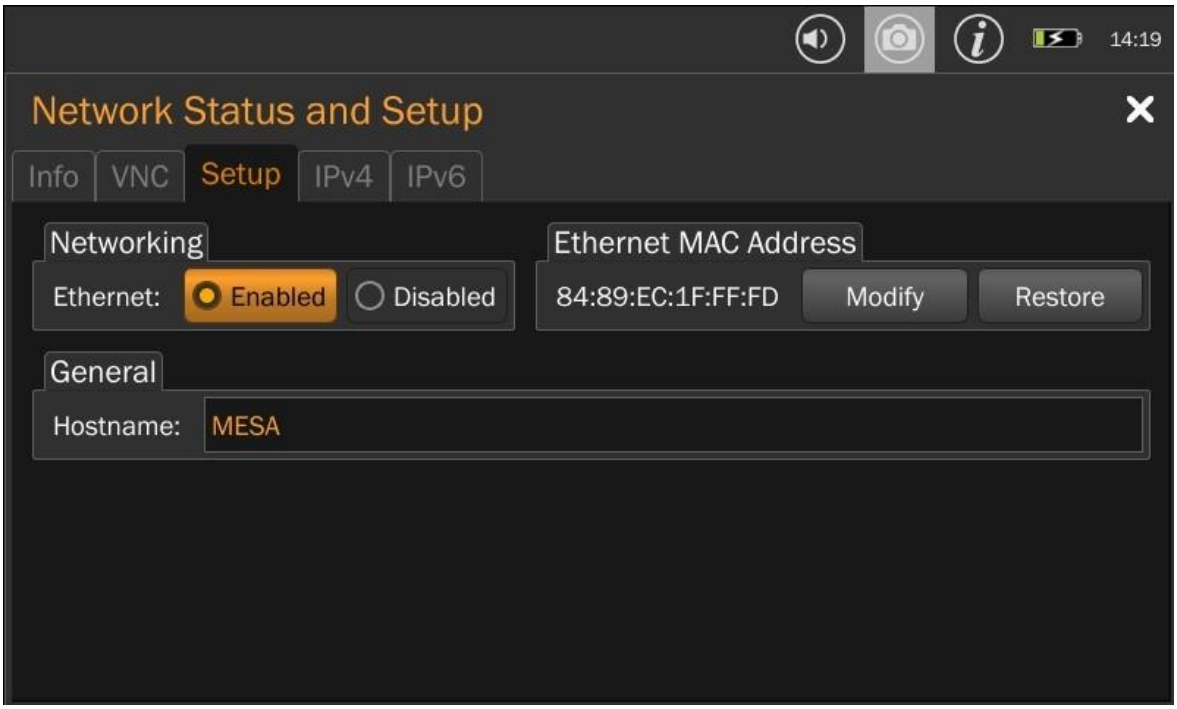


VNC:
The VNC subtab allows users to enable a VNC server. The VNC server allows users to view and control a MESA from a remote location. You must set a password before you can enable VNC. This password will be required at the remote viewer. After enabling the VNC server, the MESA can be controlled by 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, TightVNC and VNC Viewer have been tested.
https://www.tightvnc.com/
https://play.google.com/store/apps/details?id=com.realvnc.viewer.android&hl=en_US)

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.

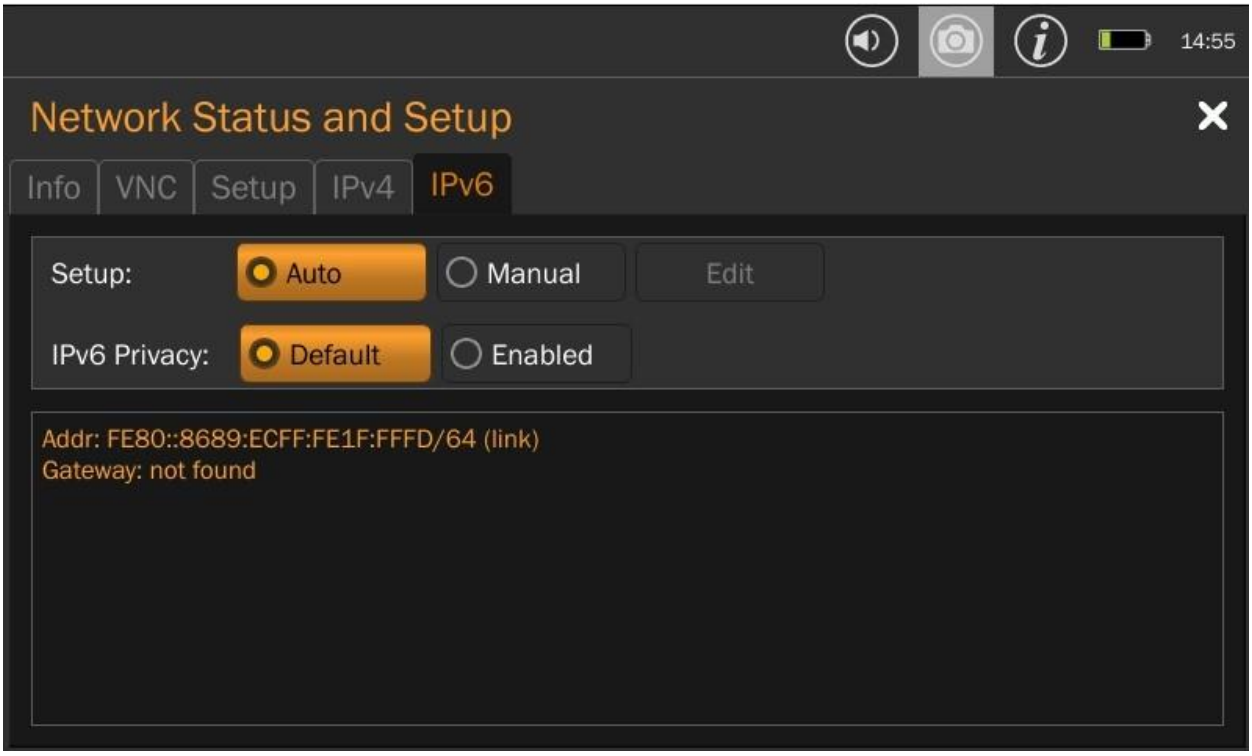


Setup:

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.

VNC Operation

How to start VNC Server

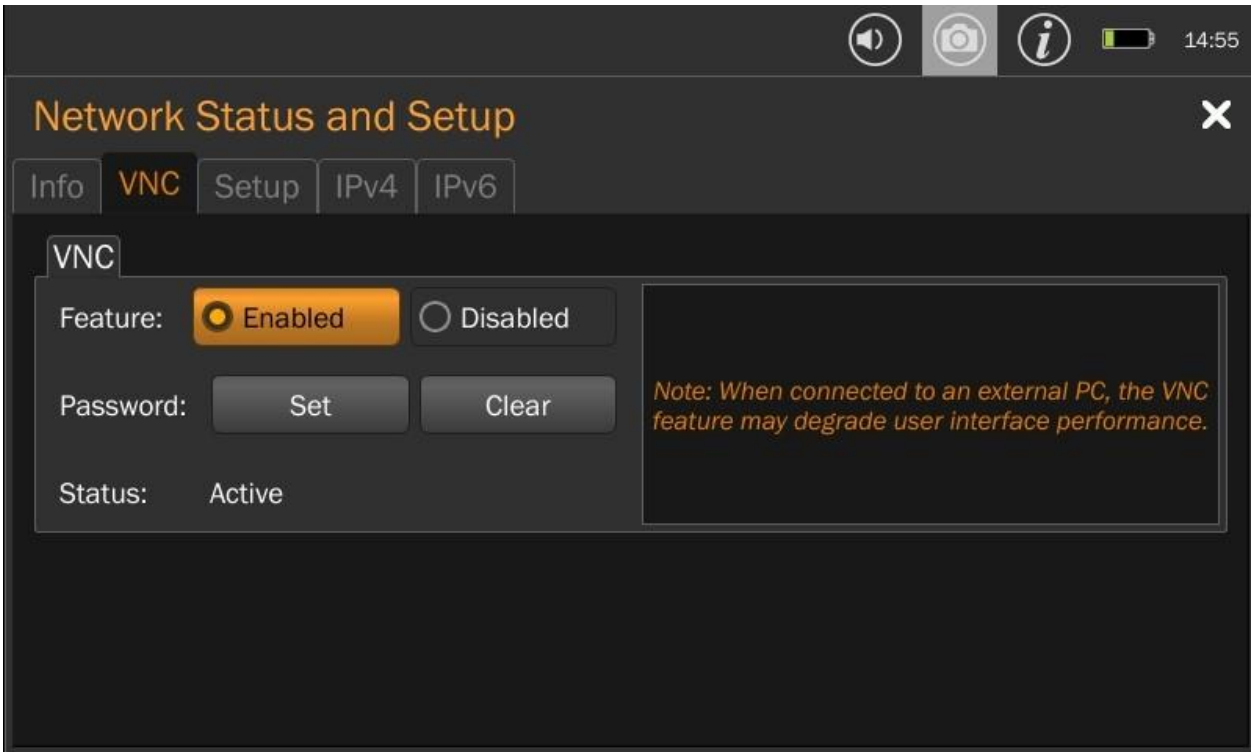
Users can remotely access the MESA using the built-in Ethernet port. Third-party Virtual Network Computing (VNC) software is a commercially available tool for connecting to a device such as the MESA.

Starting the MESA VNC server:

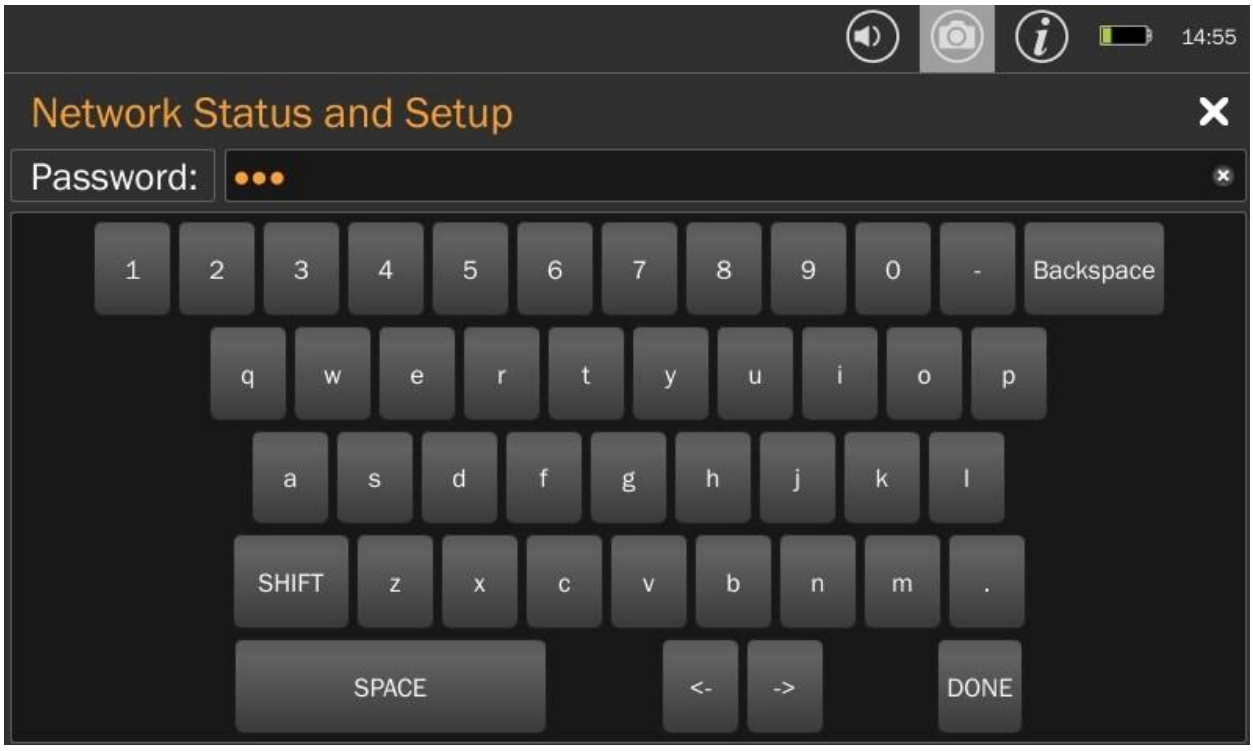
1. Connect the MESA to a network using the Ethernet Jack located at the top of the unit.
2. Open MESA Network Settings menus by selecting the Network Icon from the status bar.

3. Record the IP address.

4. Select VNC Tab.



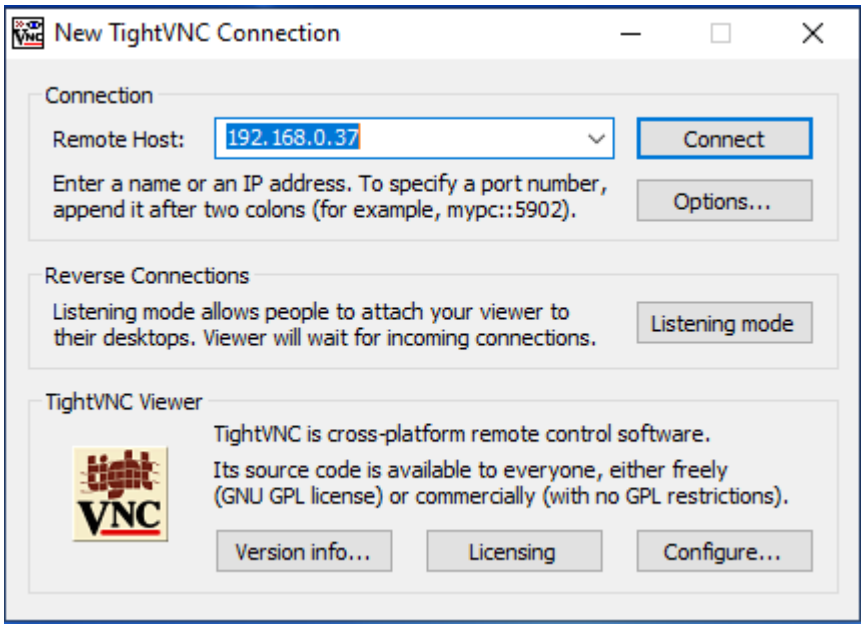
5. Set a VNC password.



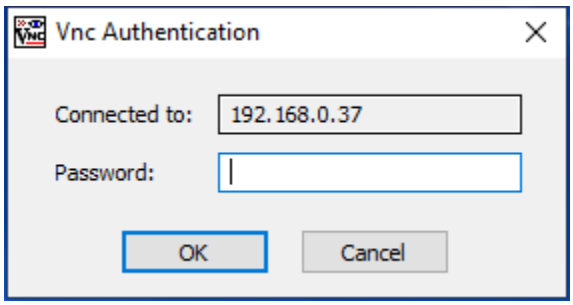
6. Return to the VNC tab and enable the server. A VNC status Update window should appear and display a "VNC Server Running …" message.

How to start VNC Viewer

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

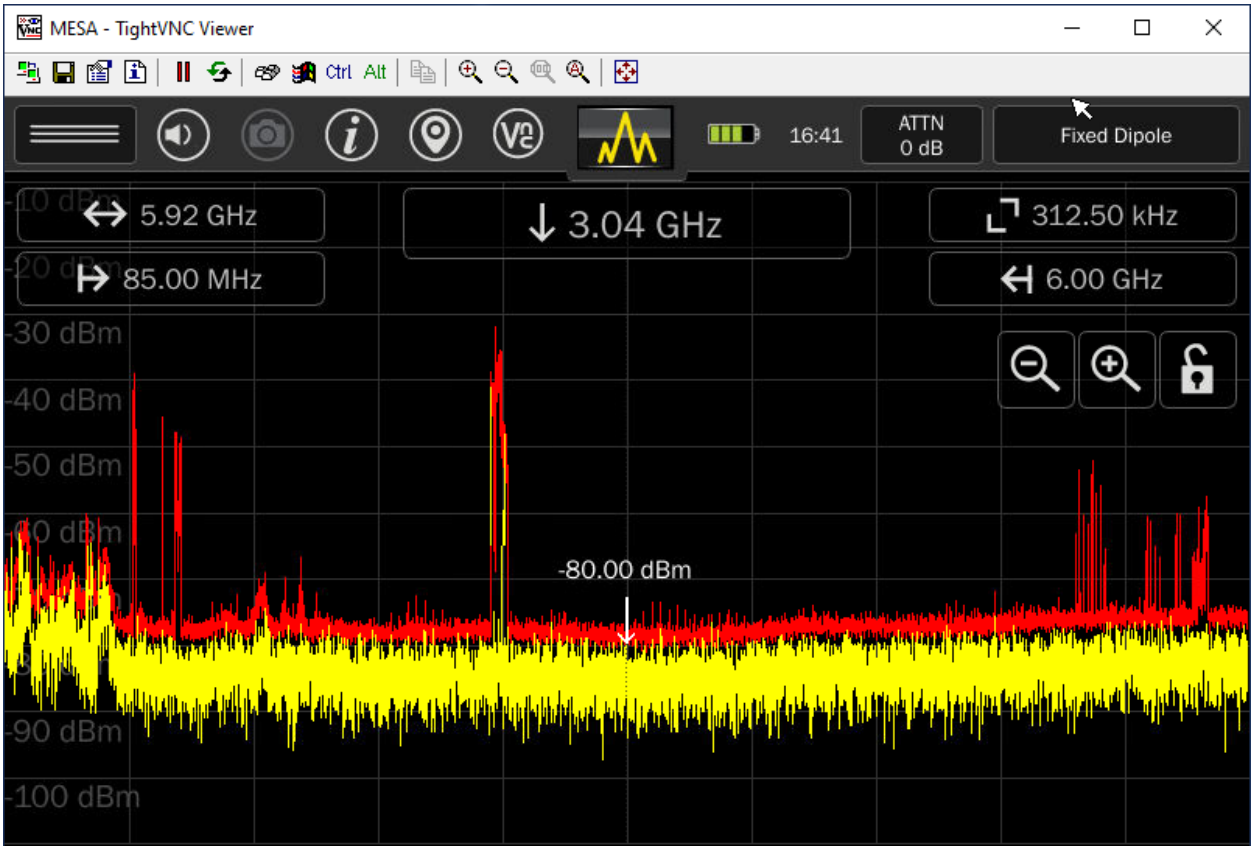


The viewer will request the password set in the VNC server.



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.

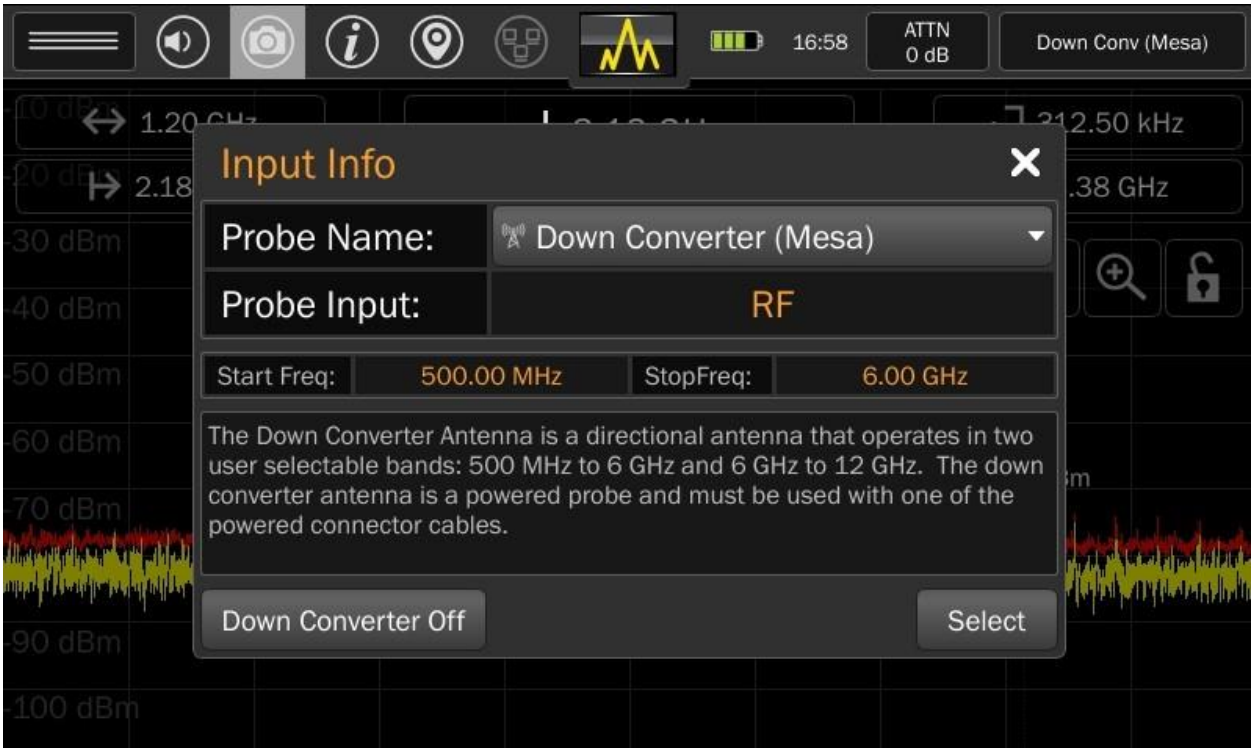


Down Converter Directional Antenna Operation

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-hand corner of the MESA display. In the drop-down menu select Down Converter, if the Down Converter is not already selected.



In the lower bottom of the Down Converter screen, the Down Converter On/Off button selects between bands. The start and stop frequencies change depending upon the down converter state. After turning the Down Converter on, press the "x" to close the Input Info dialog box.

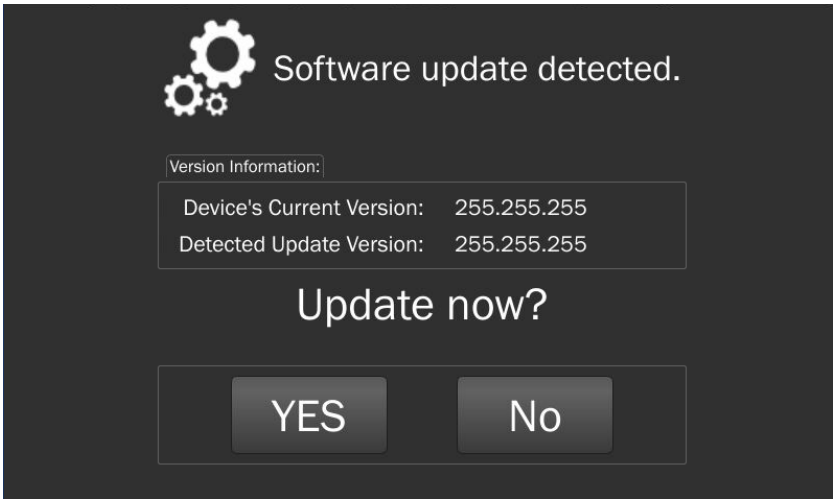
Note: The MESA Down Converter is available in the MESA Deluxe Package.

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 (FAT32 partition).
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. At this point remove the USB thumb drive. If the thumb drive is not removed, the MESA will attempt to update again, however, the version numbers displayed will match. Select "NO" and remove the thumb drive.



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 from this dialog.

Image Viewer

Screenshots taken with the MESA can be viewed on the MESA in the Image Viewer. See pg 67 for additional details.

Audio Player

Audio recordings made with the MESA can be played on the MESA in the Audio Player. See pg 67 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")

ITU Region

To ensure accurate Band ID information you will need to confirm that the ITU Region is set correctly for your 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, you are running low on battery power and need to swap the batteries.

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 you to enable or disable this feature. 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 your finger off the screen to release the cursor. It will snap to the nearest peak.

Note: If after using the snap to peak feature you immediately begin dragging the cursor again, the MESA will assume that you want more "exact" behavior and will not use the snap to peak feature when you release the cursor the second time. If you wait a longer period of time after releasing the cursor (approximately 3 seconds), the MESA will continue using the snap to peak feature.

Factory Reset

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

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
Preamp	+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, *Patented* SmartBars™ bar graph, *Patent Pending* 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

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)*