



# VNA Master™

## Handheld Vector Network Analyzer + Spectrum Analyzer

MS2026C	MS2027C	MS2028C	
5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz	Vector Network Analyzer

MS2036C	MS2037C	MS2038C	
5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz	Vector Network Analyzer
9 kHz to 9 GHz	9 kHz to 15 GHz	9 kHz to 20 GHz	Spectrum Analyzer

### The Ultimate Handheld Vector Network + Spectrum Analyzer



## VNA Master™ MS202xC/3xC Features

### Overview

#### Introduction

The VNA Master™ MS202xC/3xC series is made up of the industry's highest performance, fully reversing handheld vector network analyzers (VNA) with frequency coverage from practically DC (5 kHz) to either 6, 15, or 20 GHz. With an available high-performance spectrum analyzer covering 9 kHz to 9, 15, or 20 GHz, the VNA Master series transforms into a powerful multi-function instrument capable of enabling field technicians and engineers to accurately install, troubleshoot, and maintain complex communication systems with the highest degree of accuracy and reliability. Whether it's a mission critical military application or simply a consumer services type of application, the VNA Master series will provide accurate and dependable measurements – anytime, anywhere.



Global Communications

#### Vector Analyzer Key Features

- True 2-path 2-port fully-reversing VNA; measures and displays all S-parameters with a single connection
- 5 kHz to 6/15/20 GHz; the industry's first 20 GHz handheld VNA
- Ultra-fast 350  $\mu$ sec/data point sweep speed, ideal for filter tuning with ultimate flexibility in the number of points from 2 to 4001
- 12-term error correction algorithm
- Vector Voltmeter option, ideal for cable phase matching
- Time Domain option for precise Time or Distance Domain diagnostics, includes Gated Time Domain, LP Processing, and Phasor Impulse mode

#### + Spectrum Analyzer Key Features

- 9 kHz to 9/15/20 GHz
- Detectors: Peak, Negative, Sample, Quasi-peak, and RMS
- Markers: 6, each with a Delta Marker, or 1 Reference with 6 Deltas
- Interference Analyzer Option: Spectrogram, Signal Strength, RSSI
- AM/FM/PM Modulation Analyzer Option: Carrier Power, Center Frequency, Occupied Bandwidth, Audio Waveform & Spectrum, Deviation, SINAD, THD

#### Handheld VNA Master platform Key Features

- High-resolution, intuitive Graphical User Interface (GUI)
- Portable < 4.8 kg (10.5 lbs) and battery-powered – replaces bulky benchtop VNAs – no need for instrument carts or AC generators when working in the field!
- 8.4" daylight-viewable display offers hands-free operation while viewing measurement results
- Standard USB and Ethernet connectivity supports remote programming/control and data storage
- Available display selections of normal, high contrast, night vision, black & white, and invert colors
- Military-grade ESD protection
- Optional Secure Data Handling offers increased security features including Frequency Blanking capabilities

#### Standards Compliance

- MIL-PRF-28800F Class 2



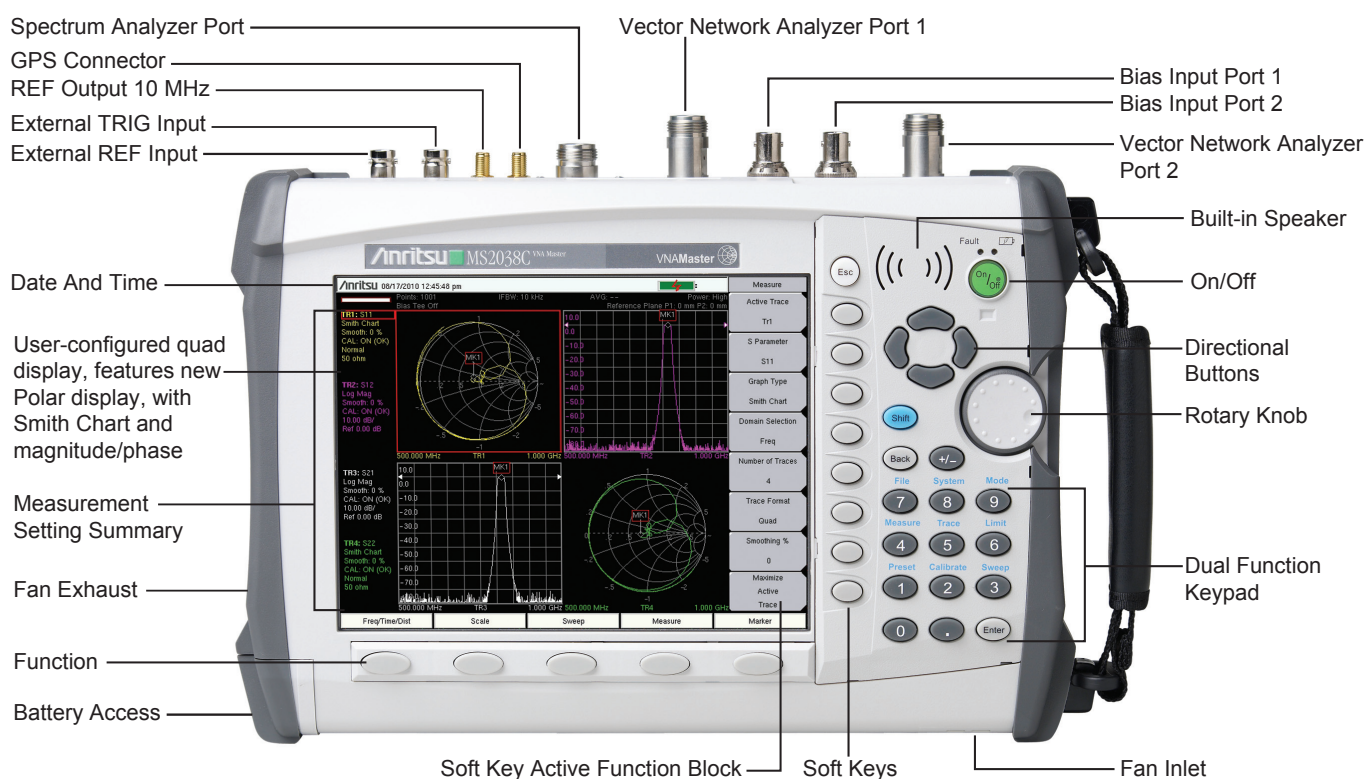
National Defense

## VNA Master™ MS202xC/3xC Features

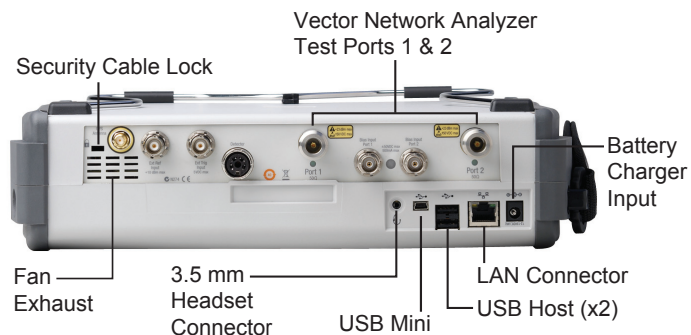
### Overview (continued)

The dynamic range, speed, accuracy and compact form factor of the VNA Master are ideal for demanding field use situations including aerospace & defense, SATCOM, commercial wireless backhaul, and research applications.

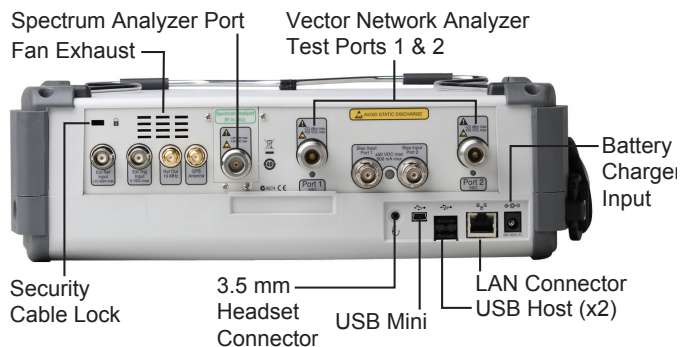
VNA Master Models Fully Reversing 2-Port	Vector Network Analyzer	Spectrum Analyzer
MS2026C	5 kHz to 6 GHz	
MS2027C	5 kHz to 15 GHz	
MS2028C	5 kHz to 20 GHz	
MS2036C	5 kHz to 6 GHz	9 kHz to 9 GHz
MS2037C	5 kHz to 15 GHz	9 kHz to 15 GHz
MS2038C	5 kHz to 20 GHz	9 kHz to 20 GHz



#### MS202xC VNA MASTER



#### MS203xC VNA MASTER + SPECTRUM ANALYZER



Handheld size: 211 mm x 315 mm x 78 mm (8.3 in x 12.4 in x 3.1 in) (MS202xC)  
 211 mm x 315 mm x 97 mm (8.3 in x 12.4 in x 3.8 in) (MS203xC)

Light weight: 4.5 kg (9.9 lbs) (MS202xC), 4.8 kg (10.5 lbs) (MS203xC)

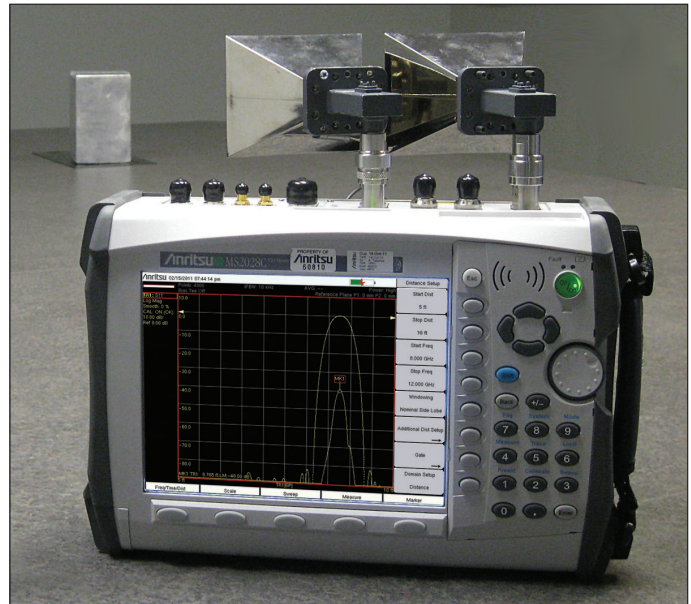
## VNA Master™ MS202xC/3xC Features

### Overview (continued)

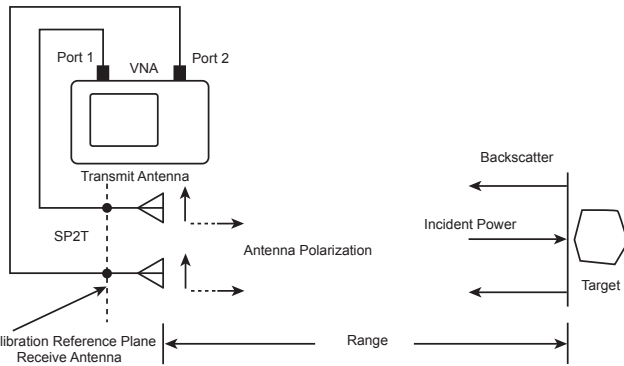
#### Application Spotlight: Measurement of Radar Cross Section (RCS) using the VNA Master MS202xC

Radar cross section (RCS) is the measure of an object's ability to reflect radar signals in the direction of the radar receiver. The VNA Master makes it easy to do RCS tests on the flight line or in the field.

A typical aircraft RCS measurement configuration using a VNA is shown here. The transmit antenna (connected to port 1 of the VNA) and receive antenna (connected to port 2 of the VNA) are positioned in the same plane as shown. The measurement target consists of the aircraft either mounted on a low reflection pedestal or a standalone on a flight line.

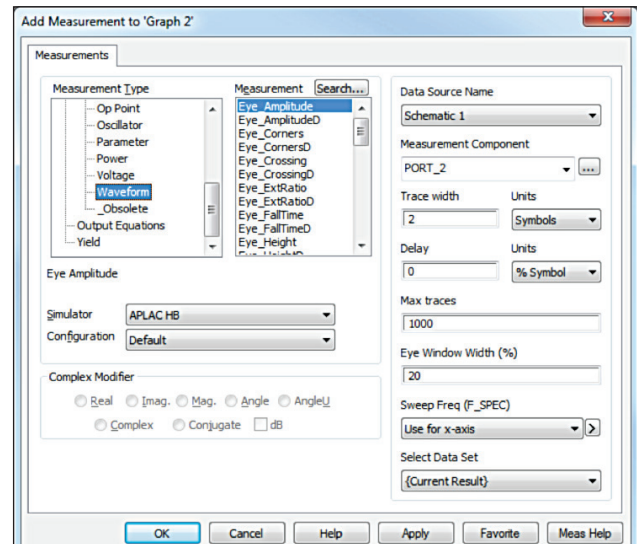


MS2028C with waveguide antenna



Block diagram for VNA measurement of RCS.

The target in this case is a known calibration standard which is positioned in the target area. The calibration standard reflection is identified and a range gate is placed on the calibration standard to remove all other reflections as shown here. The amplitude  $S_{21(tstd)}$  of the calibration standard reflection is measured. The  $S_{21}$  measurement in dB corresponds to the known RCS (in square meters).



Target reflection from a 6" Diameter Calibration Sphere (RCS = 0.018 m<sup>2</sup>).

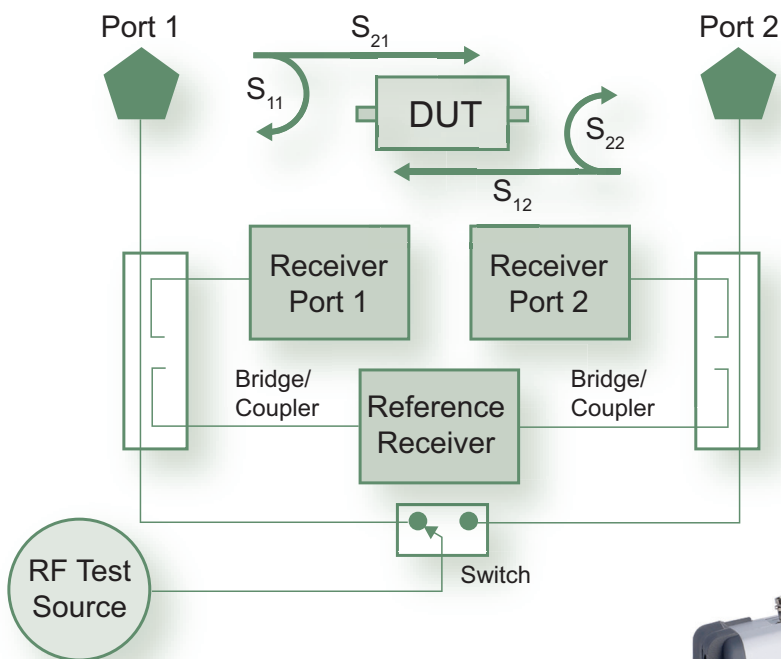
## VNA Master™ MS202xC/3xC Features

### Overview (continued)

#### MS202xC/3xC Highlights: Vector Network Analyzer

- The ultimate accuracy of a fully-reversing 2-port architecture
- Measures all four S-parameters with a single connection:  $S_{11}$ ,  $S_{21}$ ,  $S_{12}$  and  $S_{22}$
- Guaranteed 100 dB dynamic range to 3 GHz, 90 dB to 6 GHz, and 85 dB to 20 GHz for stop band filter rejection measurements
- World's fastest handheld display updates of 350  $\mu$ sec/data point for real-time filter tuning
- Polar and Smith Chart displays for added readout versatility
- Overlay screen formats for user-configured up to 4 trace display
- Selectable IF Bandwidths of 10 Hz to 100 kHz – one calibration satisfies both fast sweeps and best dynamic range
- Arbitrary selection of 2 to 4001 data points for more overall resolution instead of save/recall multiple calibrations
- Improved frequency resolution of 1 Hz to 375 MHz, 10 Hz to 6 GHz, and 100 Hz to 20 GHz
- Available options for Vector Voltmeter, Integrated Bias Tee, Differential S-parameters (for balanced lines, SERDES channels, SATA, etc.), and Time Domain analysis

The VNA Master has a 2-port, 2-path architecture that automatically measures four S-parameters with a single connection. There are three receivers, so the forward sweep from Port 1 simultaneously yields  $S_{11}$  and  $S_{21}$ , and the reverse sweep from Port 2 simultaneously yields  $S_{22}$  and  $S_{12}$ . The four S-parameters for a two-port DUT require only two sweeps, both forward and reverse transmission. With just one connection, the VNA Master provides both precision measurements and hands-free operation.



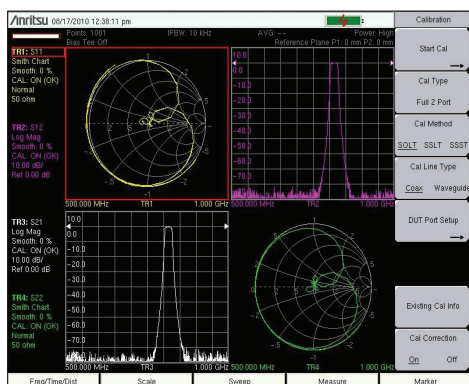
The functional block diagram of the VNA Master is shown in this illustration. The DUT is connected between Port 1 and Port 2 as shown. The switch alternates the source between forward and reverse transmission sweeps so all four S-parameters are measured within a single connection. With three receivers, the MS202xC/3xC only needs two sweeps to measure all 4 S-parameters so real-time display updates in excess of 350  $\mu$ sec/point are available for tuning filters and isolating faults in the field.



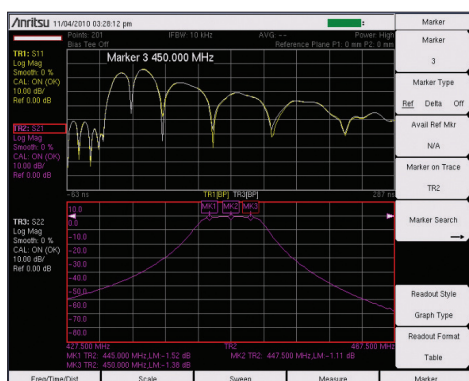
## VNA Master™ MS202xC/3xC Features



### 2 Port Vector Network Analyzer



The VNA Master's unique quadrature display provides simultaneous display of all S-parameters and allows you to mix frequency, time, and distance domain displays as needed.



The VNA Master MS202xC/3xC is the first handheld which offers Time Domain analysis for field alignment of cavity filters and combiners.

### 2 Port Vector Network Analyzer

VNA Master features a 2-port Vector Network Analyzer to be able to test and verify the performance of feedline, filtering, and antenna components. This includes:

- Connectors
- Cables/Jumpers
- Antenna Isolators
- Multicouplers/Diplexers/Duplexers
- Tower Mounted Amplifiers
- Waveguides/Couplers/Feedhorns

2-port Transmission Measurements can help identify poor filter adjustment, antenna isolation, and degraded tower mounted amplifiers. The goal of these measurements is to maximize the system coverage and capacity with problem-free base stations.

### Antenna System Failure Mechanisms

Maintenance is an on going requirement as antenna system performance can degrade at any point in time due to:

- Loose connectors
- Debris in waveguides
- Improperly weatherized connectors
- Pinched cables
- Poor grounding
- Corroded connectors
- Lightning strikes
- Strong winds misaligning antennas
- Water intrusion into cables and waveguides
- Bullet holes, nails, or rodent damage to the cable

### Making Measurements Easier

The VNA Master provides features for making measurements easier to perform and for analyzing test results such as:

- Fast sweep speed, measurement point selection, and flexible display formats make it easy to view and adjust base station RF system performance
- High RF Immunity mode for testing in harsh RF environments
- Trace Overlay compares reference traces to see changes over time
- Limit Lines and Alarming for providing reference standards
- High and Low Power output selection to test tower-top components without climbing the tower
- Internal Bias-Tee to power up TMAs for testing when off-line
- GPS tagging of data to verify location of tests

### Measurements

- VNA Measurements
  - Log Mag
  - SWR
  - Phase
  - Smith Chart
  - Group Delay
  - Linear Polar
  - Log Polar
  - Log Mag/2 (1 port cable loss)
  - Real
  - Imaginary
  - Real Impedance
  - Imaginary Impedance
- Windowing Functions in Distance Domain
  - Rectangular
  - Normal Side Lobe
  - Low Side Lobe
  - Minimum Side Lobe
- Domains
  - Frequency
  - Time
  - Distance
  - Frequency gated by time (FGT)
  - Frequency gated by distance (FGD)
- Low Pass Response
  - Impulse
  - Step
- Gate
  - Gate On/Off/Display
  - Start, Stop, Center, Span (Distance or Time)
  - Notch On/Off
  - Gate Shape Min/Nominal/Wide/Max

### Calibration

- User-variable Data Points from 2 to 4001
- Full 2-port ( $S_{11}$ ,  $S_{21}$ ,  $S_{12}$ ,  $S_{22}$ )
- Full  $S_{11}$  or  $S_{22}$  (Open, Short, Load)
- FlexCal and/or Reciprocal Through
- Full  $S_{11}$  &  $S_{22}$
- Reflection Response  $S_{11}$ ,  $S_{22}$ , or  $S_{11}$  &  $S_{22}$
- Transmission Response  $S_{21}$ ,  $S_{12}$ , or  $S_{21}$  &  $S_{12}$
- 1P2P  $S_{11}$  &  $S_{21}$  (Forward Path)
- 1P2P  $S_{22}$  &  $S_{12}$  (Reverse Path)

### Sweep Functions

- IFBW
- Run/Hold, Single/Continuous/External
- RF Immunity (High/Low)
- Averaging/Smoothing
- Port Power (High/Low)

### Trace Functions

- Save/Recall, Copy to Display Memory
- No Trace Math, Trace  $\pm$  Memory
- Trace Overlay

### Marker Functions

- 1-8 Markers each with a Delta Marker
- Marker to Peak/Valley
- Marker to/Peak Valley between Markers
- Marker Table

### Limit Line Functions

- Limit Lines
  - Single Limit
  - Multi-segment (41)
  - Limit Alarm
- Limit Line Edit
  - Frequency, Amplitude
  - Add/Delete Point
  - Next Point Left/Right
  - Move Limit

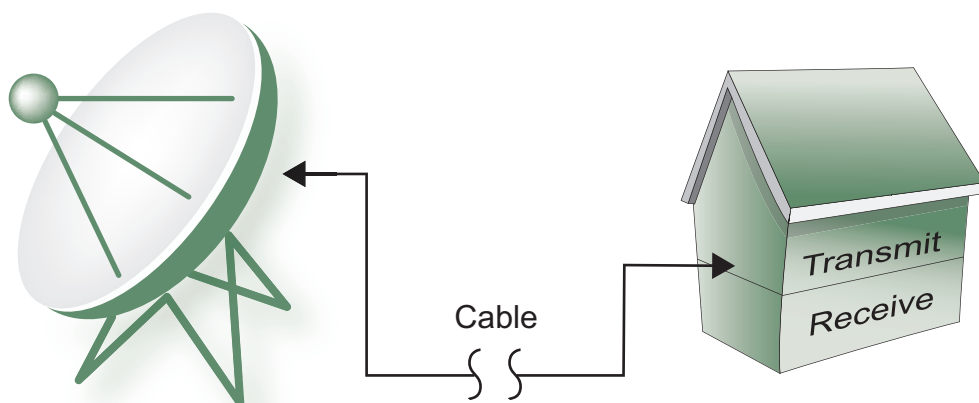
## VNA Master™ MS202xC/3xC Features

### Overview

#### MS203xC Highlights: VNA + Spectrum Analyzer

- Two-port vector network analysis to 6/15/20 GHz that supports both coaxial and waveguide connector types
- True 2-port, 12-term error correction calibrations — outstanding calibration stability
- Fully reversing architecture with three receivers support fast measurements of 350  $\mu$ sec/point
- Broadband Spectrum Analysis (9 kHz to 9/15/20 GHz - MS203xC models only)
- Optional Vector Voltmeter (VVM) mode
- Standard Distance Domain Analysis
- Available Options for Time Domain Analysis, Internal Bias Tee, Balanced/Differential Analysis, and Secure Data Storage
- Options for remote power sensors for higher accuracy power measurements
- Optional Interference Analysis
- Optional Indoor Coverage Mapping
- Optional Channel Scanner
- Optional AM/FM/PM Modulation Analyzer

The VNA Master™ MS202xC/3xC series is a compact handheld multi-function instrument that offers a portable yet powerful vector network analyzer, allowing you to do S-parameter analysis in the field — anytime, anywhere. The MS203xC models also offer a high-performance spectrum analyzer with industry-leading ultra-low noise floor. Based on Anritsu's 8th generation handheld platform, the VNA Master offers unmatched measurement breadth, depth, and precision; reducing the number of different tools needed to analyze modern communication systems in the field, on a tower, on a flightline, or in a vehicle.



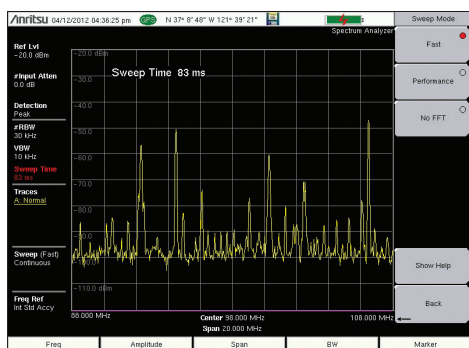
The RF and Microwave Spectrum is crowded with many wireless systems that provide critical services. In this illustration, a simplified block diagram of a typical wireless system is shown, which consists of antenna, cable, and transmit/receive capabilities.



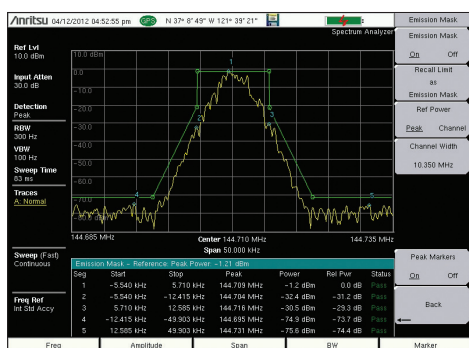
## VNA Master™ MS202xC/3xC Features



### MS203xC Highlights: VNA + Spectrum Analyzer



The spectrum analyzer mode in the VNA Master MS203xC offers fast sweep speeds for interference hunting intermittent signals.



The Spectrum Analyzer mode in the VNA Master MS203xC offers automated measurements including occupied bandwidth, adjacent channel power, and emission mask, as shown above. The mask can be quickly created using the standard limit line editor. The emission mask measurement function automatically moves the trace to match the peak of a modulated signal to conform to common mask standards.

### Simple but Powerful

The goal of Spectrum Analyzer measurements is to accurately monitor, measure, and analyze RF signals and their environments. It finds rouge signals, measures carriers and distortion, and verifies base stations' signal performance. It validates carrier frequency and identifies desired and undesired signals.

The VNA Master MS203xC models feature the most powerful handheld spectrum analyzer in their class with unmatched performance in:

- Sensitivity
- Dynamic Range
- Phase Noise
- Frequency Accuracy
- Sweep Speed

The VNA Master offers full control over bandwidth and sweep settings, or can be set to automatically optimize for best possible trade-off between accuracy and speed.

### GPS-Enhanced Frequency Accuracy

With GPS Option 31 the spectrum analyzer frequency accuracy (for MS203xC models) is improved to < 25 ppb (parts per billion) while the GPS is locked. After 3 minutes of GPS lock, the GPS antenna can be removed and the MS203xC will maintain 50 ppb frequency accuracy for up to 72 hours.

### Rx Noise Floor Testing

The VNA Master can measure the receive noise floor on a base station's uplink channel using the channel power measurement. An elevated noise floor indicates interference that can lead to call blocking, denial of service, call drops, low data rates, and lowered system capacity.

### Measurements

- One Button Measurements
  - Field Strength – in dBm/m<sup>2</sup> or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
  - Emission Mask
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB Demodulation - audio out only
  - C/I - carrier-to-interference ratio

### Sweep Functions

- Sweep
  - Single/Continuous, Manual Trigger, Reset, Minimum Sweep Time
- Detection
  - Peak, RMS, Negative, Sample, Quasi-peak
- Triggers
  - Free Run, External, Video, Change Position, Manual

### Trace Functions

- Traces
  - 1-3 Traces (A, B, C), View/Blank, Write/Hold
- Trace A Operations
  - Normal, Max Hold, Min Hold, Average, Number of Averages, (always the live trace)
- Trace B Operations
  - A → B, B ← C, Max Hold, Min Hold
- Trace C Operations
  - A → C, B ← C, Max Hold, Min Hold, A - B → C,
  - B - A → C, Relative Reference (dB), Scale

### Marker Functions

- Markers
  - 1-6 Markers each with a Delta Marker, or Marker 1 Reference with 6 Delta Markers
- Marker Types
  - Fixed, Tracking, Noise, Frequency Counter
- Marker Auto-Position
  - Peak Search, Sequential Peak (Right/Left), Peak Threshold %, To Channel, To Center, To Reference Level, Delta Marker to Span
- Marker Table
  - 1-6 markers' frequency & amplitude plus delta markers' frequency offset & amplitude

### Limit Line Functions

- Limit Lines
  - Upper/Lower, Limit Alarm, Default Limit
- Limit Line Edit
  - Frequency, Amplitude, Add/Delete Point, Add Vertical, Next Point Left/Right
- Limit Line Move
  - To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
- Limit Line Envelope
  - Create, Update Amplitude, Number of Points (41), Offset, Shape Square/Slope
- Limit Line Advanced
  - Absolute/Relative, Mirror, Save/Recall



## VNA Master™ MS202xC/3xC Features

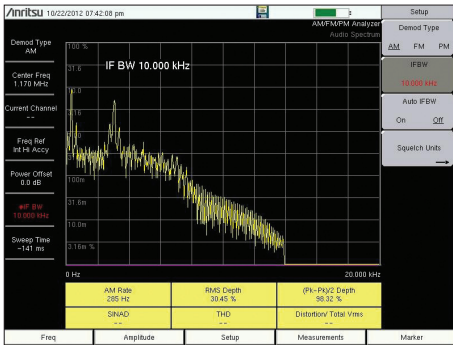


### AM/FM/PM Analyzer (Option 0509)

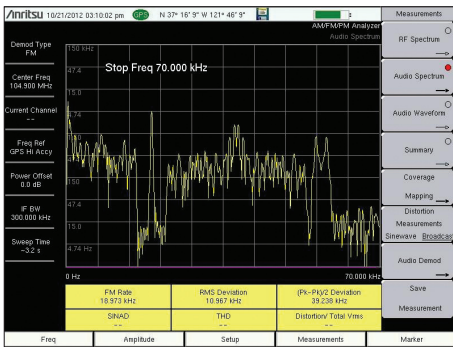
#### AM/FM/PM Analyzer

VNA Master comes with AM/FM/SSB audio demodulation as standard. By adding Option 509, the instrument becomes capable of measuring, analyzing, and displaying key modulation parameters of the RF Spectrum, Audio Spectrum, Audio Waveform and even includes a demodulation summary. Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM) are fully supported.

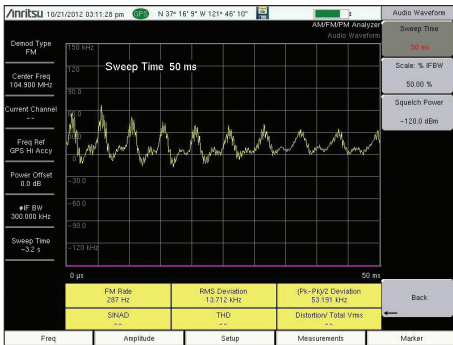
- The **RF Spectrum View** displays the spectrum with carrier power, frequency, and occupied BW.
- **Audio Spectrum** shows the demodulated audio spectrum along with the Rate, RMS deviation, Pk-Pk/2 deviation, SINAD, Total Harmonic Distortion (THD), and Distortion/Total.
- An **Audio Waveform** oscilloscope display is included with all three modulation formats that shows the time-domain demodulated waveform.
- The **Modulation Summary** display shows all of the RF and modulation parameters for each modulation format on one screen.



AM audio spectrum



FM with sub carriers



Demodulated audio waveform

FM DEMOD	RESULT
RMS Deviation	13.276 kHz
Peak Deviation	35.726 kHz
Peak Deviation	-30.491 kHz
(Pk-Pk)/2 Deviation	35.109 kHz
Carrier Power	-69.6 dBm
Center Frequency	104.899 756 MHz
Occ. BW	70.780 kHz
FM Rate	5.380 kHz
SINAD	--
THD	--
Distortion Total Vrms	--

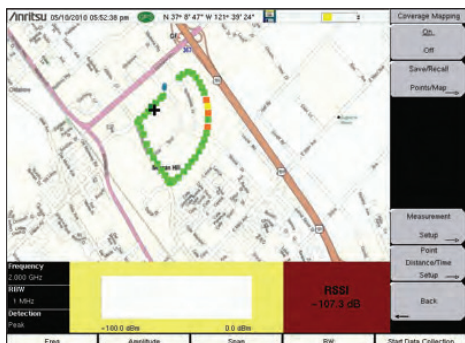
Modulation Summary

## VNA Master™ MS202xC/3xC Features



### Coverage Mapping (Option 431)

There is a growing demand for coverage mapping solutions. Anritsu's Coverage Mapping measurements option provides wireless service providers, public safety users, land mobile radio operators, and government officials with indoor and outdoor mapping capabilities

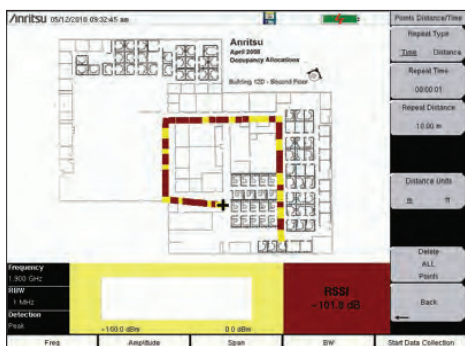


Outdoor Mapping

#### Outdoor Mapping

With a GPS antenna connected to the instrument and a valid GPS signal, the instrument monitors RSSI and ACPR levels automatically. Using a map created with Map Master, the instrument displays maps, the location of the measurement, and a special color code for the power level. The refresh rate can be set up in time (1 sec, minimum) or distance.

The overall amplitude accuracy coupled with the GPS update rate ensures accurate and reliable mapping results.



Indoor Mapping

#### Indoor Mapping

When there is no GPS signal valid, the Spectrum Master uses a start-walk-stop approach to record RSSI and ACPR levels. You can set the update rate, start location, and end location and the interpolated points will be displayed on the map.



Saved KML File

#### Export KML Files

Save files as KML or JPEG. Open kml files with Google Earth™. When opening up a pin in Google Earth, center frequency, detection method, measurement type, and RBW are shown on screen.



Create maps with Map Master

#### Map Master

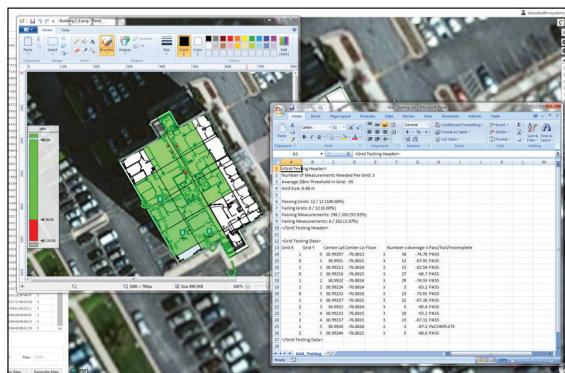
When there is no GPS signal valid, the Spectrum Master uses a start-walk-stop approach to record RSSI and ACPR levels. You can set the update rate, start location, and end location and the interpolated points will be displayed on the map.

## VNA Master™ MS202xC/3xC Features

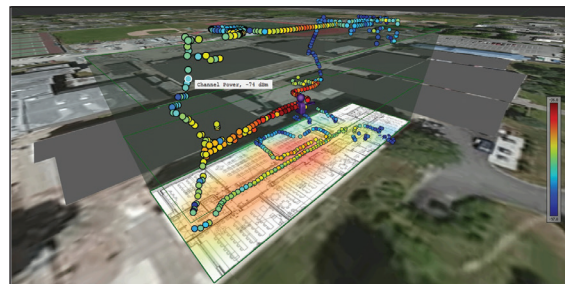
### MA8100A Series TRX NEON Signal Mapper



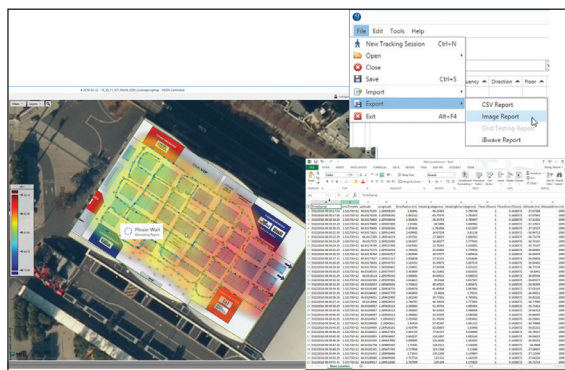
NEON Signal Mapping with Anritsu Handhelds



Support for NFPA Gridding Requirements



Automatically generate 3-D Heatmaps



Automatic Report Generation

#### MA8100A Series TRX NEON® Signal Mapper\*

The most powerful 3D in-building coverage mapping tool specially for Anritsu Handheld Spectrum Analyzers

Anritsu's TRX NEON Signal Mapper, a 3D in-building coverage mapping solution, is compatible with all Anritsu handheld instruments with spectrum analyzer mode. Instruments supported include Spectrum Master, LMR Master, Site Master, BTS Master, Cell Master, and VNA Master.

The MA8100A-xxx consists of both hardware and software from TRX Systems, a 3rd party partner. The MA8100A-xxx consists of a TRX Systems NEON Tracking Unit, NEON Signal Mapper Software for Android devices, and NEON Command Software for a PC.

The TRX NEON Tracking Unit supports collection and processing of sensor data that delivers 3D location information. The Tracking Unit connects to the TRX NEON Signal Mapper application which is run on an Android device via a Bluetooth connection.

The TRX NEON Signal Mapper application provides an intuitive Android user interface enabling lightly trained users to map RF signals within buildings. Users can initialize their location, start/stop mapping and save mapping data to the cloud. RF data is captured by an Anritsu Handheld spectrum analyzer product and the data is sent to the Android device via a USB connection.

The TRX NEON Command Software, run on a PC, enables creation and visualization of 3D building maps and provides centralized access to the TRX NEON Cloud Service to access stored maps and measurement data.

#### Key Features and Benefits

Integrating NEON's capability to automatically collect geo-referenced test data with Anritsu handheld spectrum analyzer products saves valuable time and money by:

- Eliminating the need to manually perform "check-ins" at each test point by automatically calculating indoor location
- Providing vastly more data than is possible with manual processes by recording data with every step
- Removing typical data recording errors caused by "guesstimating" locations in large buildings through automatic indoor location and path estimation
- Delivering actionable data in areas not easily analyzed such as stairways and elevators by recording and referencing measurements in 3D
- Enabling quick analysis of signal coverage and faster problem resolution by delivering the industry's only geo-referenced 3D visualization
- Provides color-graded measurement results in 2D and 3D views. Measurement values can be seen by clicking on each point. A .csv file of all measurements is also provided.

\*Android device and PC are NOT included in the MA8100A-xxx. Customers must purchase their own Android device and PC.

## VNA Master™ MS202xC/3xC Features

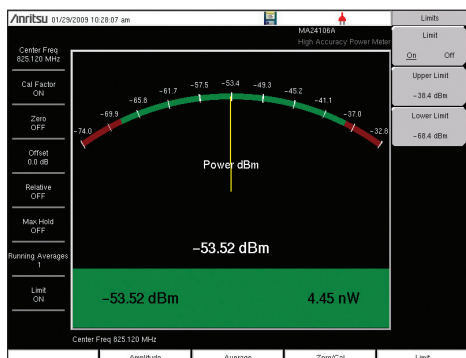


### Power Meter

### High Accuracy Power Meter (Option 19)



The VNA Master supports many different power measurements, including the channel scanner, high accuracy power meter, and channel power measurement.



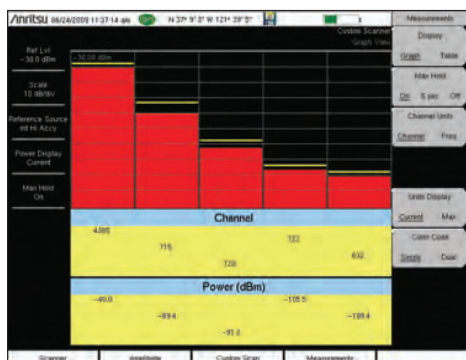
High Accuracy Power Meter

### PC Power Meter

These power sensors can be used with a PC running Microsoft Windows® via USB. They come with PowerXpert™ application, a data analysis, and control software. The application has abundant features, such as data logging, power versus time graph, big numerical display, and many more, that enable quick and accurate measurements.

### High Accuracy Power Meter (Option 19)

Anritsu's high accuracy power meter option enables you to make high accuracy RMS measurements. This capability is perfect for measuring both CW and digitally modulated signals such as CDMA/EV-DO, GSM/EDGE, and W-CDMA/HSPA+. You can select from a wide range of USB sensors delivering better than  $\pm 0.16$  dB accuracy. An additional benefit of using the USB connection is that a separate DC supply (or battery) is not needed because the necessary power is supplied by the USB port.



Channel Scanner

### Channel Scanner (Option 27)

The channel scanner option measures the power of multiple transmitted signals, making it very useful for simultaneously measuring channel power of up to 20 channels in GSM, TDMA, CDMA, W-CDMA, HSDPA, and public safety networks. You can select the frequencies or the scanned data to be displayed, either by frequencies or the channel number. And in the custom setup menu, each channel can be custom built with different frequency bandwidth, or with channels from different signal standards. With Script Master, scans can be automated for up to 1200 channels.

- MA24105A Inline High Power Sensor, 350 MHz to 4 GHz, +3 dBm to +51.76 dBm, True-RMS
- MA24106A High Accuracy RF Power Sensor, 50 MHz to 6 GHz, -40 dBm to +23 dBm, True-RMS
- MA24108A/18A/26A Microwave USB Power Sensor, 10 MHz to 8/18/26 GHz, -40 dBm to +20 dBm, True-RMS, Slot Power, Burst Average Power
- MA24208A/18A, Microwave Universal USB Power Sensor, 10 MHz to 8/18 GHz, -60 dBm to +20 dBm, True-RMS, Slot Power, Burst Average Power
- MA24330A/40A/50A, Microwave CW USB Power Sensor, 10 MHz to 33/40/50 GHz, -70 dBm to +20 dBm, Average Power



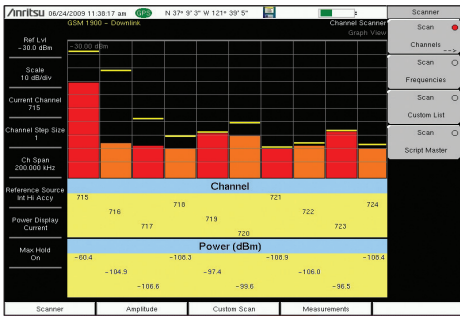
High Accuracy Power Sensors

## VNA Master™ MS202xC/3xC Features



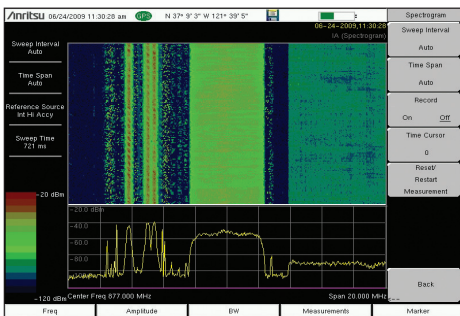
### Interference Analyzer (Option 25)

### Channel Scanner (Option 27)



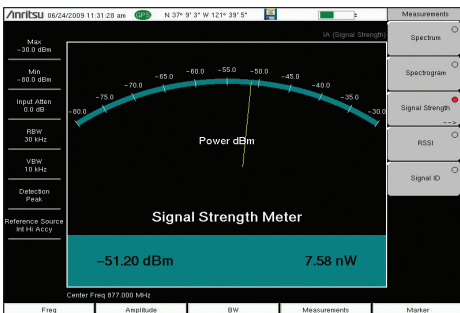
#### Channel Scanner

Works on any signal and is useful when looking for IM or harmonics. Can help spot signals widely separated in frequency that turn on and off together.



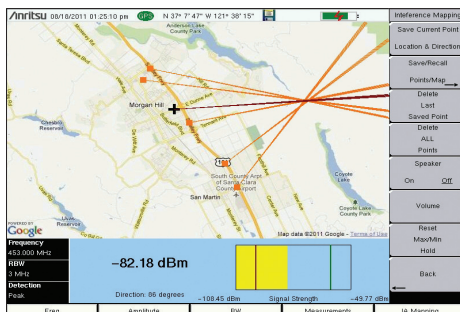
#### Spectrogram

For identifying intermittent interference and tracking signal levels over time for up to 72 hours with an external USB flash drive.



#### Signal Strength Meter

Can locate an interfering signal, by using a directional antenna and measuring the signal strength and by an audible beep proportional to its strength.



#### Interference Mapping

Eliminates the need to use printed maps and draw lines to triangulate location. Use on-screen maps generated with GPS coordinates with Map Master™.

### Interference Analyzer (Option 25) Channel Scanner (Option 27)

Interference is a continuously growing problem for wireless network operators. Compounding the problem are the many sources that can generate interference such as:

- Intentional Radiators
- Unintentional Radiators
- Interference

Interference causes Carrier-to-Interference degradation, robbing the network of capacity. In many instances, interference can cause an outage to a sector, a cell, and/or neighboring cells. The goal of these measurements is to resolve interference issues as quickly as possible.

#### Monitoring Interference

The VNA Master offers many tools for monitoring intermittent interferers over time to determine patterns:

- Spectrogram
- Received Signal Strength Indicator
- Remote Monitoring over the Internet
- Save-on-Event – crossing a limit line

Master Software Tools for your PC features diagnostic tools for efficient analysis of the data collected during interference monitoring. These features include:

- Folder Spectrogram – creates a composite file of multiple traces for quick review
- Movie playback – playback data in the familiar frequency domain view
- Histogram – filter data and search for number of occurrences and time of day
- 3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control

#### Identifying Interference

The VNA Master provides several tools to identify the interference – either from a neighboring wireless operator, illegal repeater or jammer, or self-interference:

- Signal ID (up to 12 signals at once)
- Signal Analyzer Over-the-Air Scanners
- Channel Scanner (up to 1200 channels, 20 at a time)

#### Locating Interference

Once interference has been identified, the Signal Strength Meter with its audible output beep coupled with a directional antenna makes finding the interference easier.

#### Interference Analyzer Measurements

- Spectrogram
- Signal Strength Meter
- Received Signal Strength Indicator (RSSI)
- Signal ID (up to 12 signals)
  - FM
  - GSM/GPRS/EDGE
  - W-CDMA/HSPA+
  - CDMA/EV-DO
  - Wi-Fi
- Spectrum
  - Field Strength – in dBm/m2 or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB audio monitor
  - C/I - carrier-to-interference ratio

#### Channel Scanner

- Scan
  - 20 channels at once, by frequency or channel
  - Noncontiguous channels
  - Different channel bandwidths in one scan
- Display
  - Current plus Max hold display
  - Graph View
  - Table View
- Script Master™
  - Up to 1200 Channels
  - Auto-repeat sets of 20 channels and total
  - Auto-save with GPS tagging

#### Interference Mapping

- Save Current Point with Location and Direction
- Save/Recall Points & Map
- Audible Output of RSSI
- Reset Max/Min Hold

## VNA Master™ MS202xC/3xC Features



### Distance Domain Analysis (Now Standard, formerly Option 501)

#### Distance Domain

Distance-to-Fault Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the VNA Master sweeps a user-specified band of full power operational frequencies (instead of fast narrow pulses from TDR-type approaches) to more precisely identify discontinuities. The VNA Master converts S-parameters from frequency domain into distance (or time) domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable and the

discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar time domain analysis is available on transmission ( $S_{21}$ ) measurements.

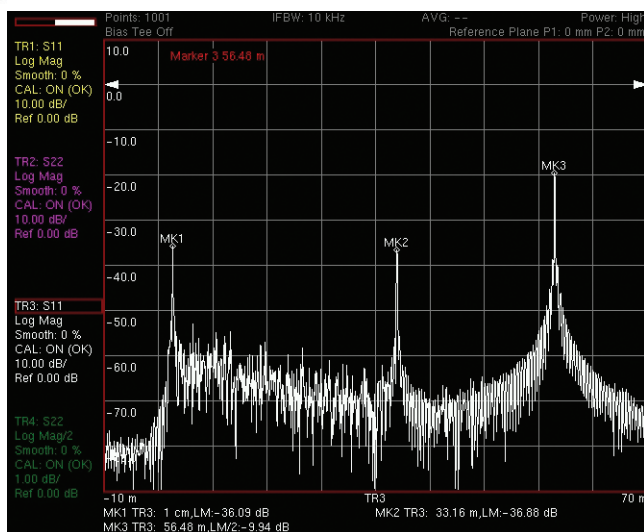
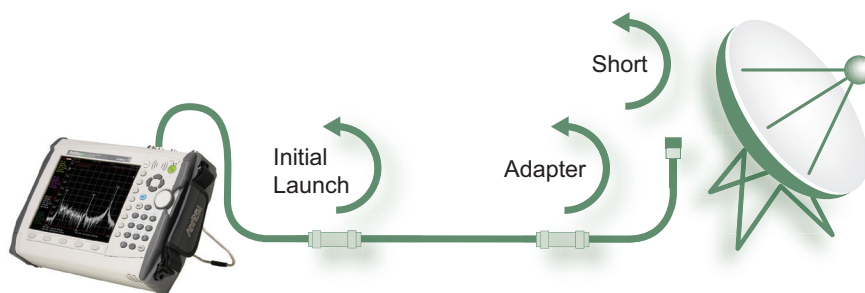
Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

#### Measurements

- DTF Return Loss
- DTF Insertion Loss

#### Setup Parameters

- Start Distance
- Stop Distance
- Start Frequency (FDR)
- Stop Frequency (FDR)
- Windowing: Rectangular, Nominal Side Lobe, Low Side Lobe, Minimum Side Lobe
- Propagation Velocity
- Cable Loss
- Units: meters or feet
- Distance Info display



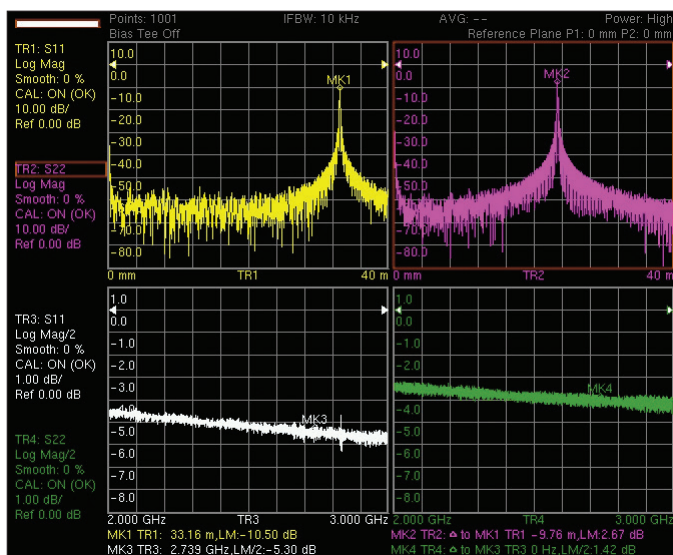
#### Distance-to-Fault Analysis

This illustration shows a typical cable measurement scenario with an adapter between the near and far end of the cable. With a short on the far end, the VNA Master can convert frequency domain results into corresponding distance-domain readout. Moving left to right, we can see the initial launch (MK1), the intermediate adapter (MK2), and the short at the far end of the cable (MK3). It is easy to interpret the discontinuities as normal or faults by simply looking at the location and amplitude of the peaks. Since the short shows as -20 dB, this means that the one-way cable loss must be 10 dB.

## VNA Master™ MS202xC/3xC Features



### Time Domain (Option 2)



Optional time domain analysis offers trace selections for the horizontal axis in frequency, distance, or time scales. This screen simultaneously shows distance-to-fault and cable loss (Log Mag|S<sub>11</sub>| / 2) for S<sub>11</sub> and S<sub>22</sub>.

### Time Domain Analysis (Option 0002)

The VNA Master can display the S-parameter measurements in the time or distance domain using this popular analysis mode. The broadband frequency coverage coupled with 4001 data points means you can measure discontinuities both near and far with clarity unprecedented in a hand held tool. With this option, you can simultaneously view S-parameters in frequency, time, and distance domain to quickly identify faults in the field. Further enhance the Distance-to-Fault (DTF) results by compensating for loss and relative propagation velocity (for cables) or cutoff frequency and dispersion (for waveguides).

Side lobes are inherent by-products of time domain analysis. They can distort DTF results, especially when simultaneously measuring both small and large discontinuities in close proximity to each other. To more easily interpret DTF results, the VNA Master offers the following windowing selections to help optimize results (in increasing side lobe reduction order): rectangular, nominal, low, and minimum side lobe. These windowing selections trade-off side lobe level with resolution by smoothing out sharp transitions caused by the selected start and stop frequencies. LP Processing and Gated Time Domain functions have been added to offer more user choice on display clarity.

## VNA Master™ MS202xC/3xC Features

### Secure Data Operation (Option 7)



For secure environments, VNA Master will only use external USB memory as an external drive for storage when configured with Option 0007. Internal memory is disabled for data storage.

### K(f) Test Port Connectors (Option 11)

#### Secure Data Operation (Option 0007)

For highly secure data handling requirements, this software option prevents the storing of measurement setup or data information onto any internal file storage location. Instead, setup and measurement information is stored ONLY to the external USB memory location. A simple factory preset prepares the VNA Master for transportation while the USB memory remains behind in the secure environment. Once configured for secure data operation, the VNA Master cannot be switched between secure and non-secure operation by the user.

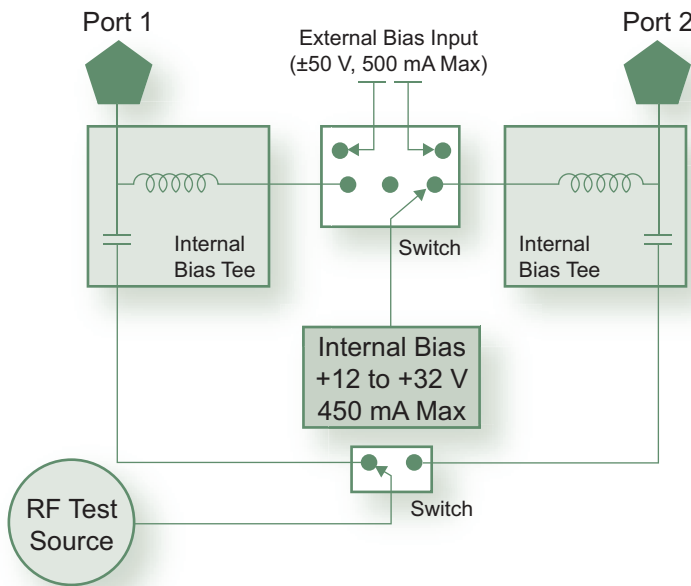
#### Bias Tee (Option 0010)

For tower mounted amplifier tests, the MS202xC/3xC series (when configured with the optional internal bias tees) can supply both DC and RF test signals on the center conductor of the cable during measurements. In addition, the VNA Master can supply internal voltage control from +12V to +32V in 0.1V steps up to 450 mA. To extend battery life, an external power supply can substitute for the internal supply by using the external bias inputs instead. Both test ports can be configured to supply voltage via this integrated bias tees option.

#### K(f) Test Port Connectors (Option 0011)



Optional K(f) test port connectors are available for precision measurements to 20 GHz.



The VNA Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in the simplified block diagram. Connectivity is also provided for external supply (instead of internal) to preserve battery consumption.

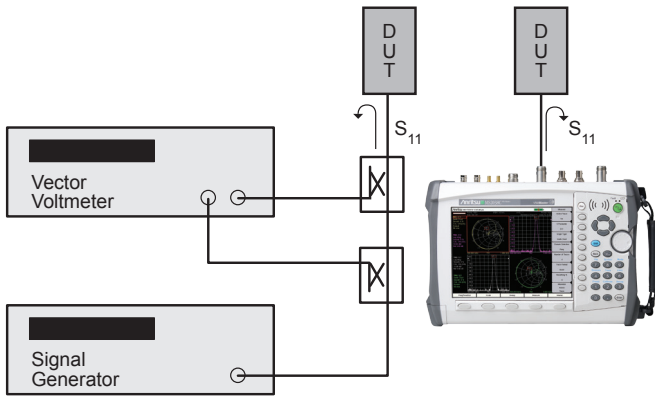


## VNA Master™ MS202xC/3xC Features

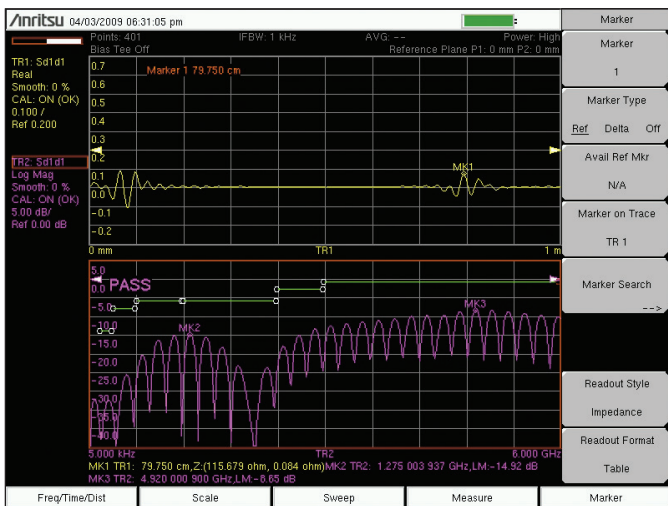


### Vector Voltmeter (Option 15)

### GPS Receiver (Option 31)



Compared to the Vector Voltmeter setup, this side-by-side illustration shows how VNA Master is a completely self-contained turnkey solution with integrated source, receivers, and couplers for phase matching cables.



This display shows a full 6 GHz sweep of a balanced pair of coax lines. If you add the Time Domain Option 0002, you can get DTF diagnostics too. Use a full 2-port calibration to conduct one-port differential measurements of  $S_{d1d1}$ . Similar to other S-parameters, you can view  $S_{d1d1}$  in the frequency, time, or distance domain for signal integrity measurements anytime, anywhere.

### Vector Voltmeter (Option 0015)

A phased array system relies on phase matched cables for required performance. For this class of application, the VNA Master offers this special software mode to simplify phase matching cables at a single frequency.

The similarity between the popular vector voltmeter method (using bench instruments) and the VNA Master's Vector Voltmeter application will ensure minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements. The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF omnidirectional range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables.

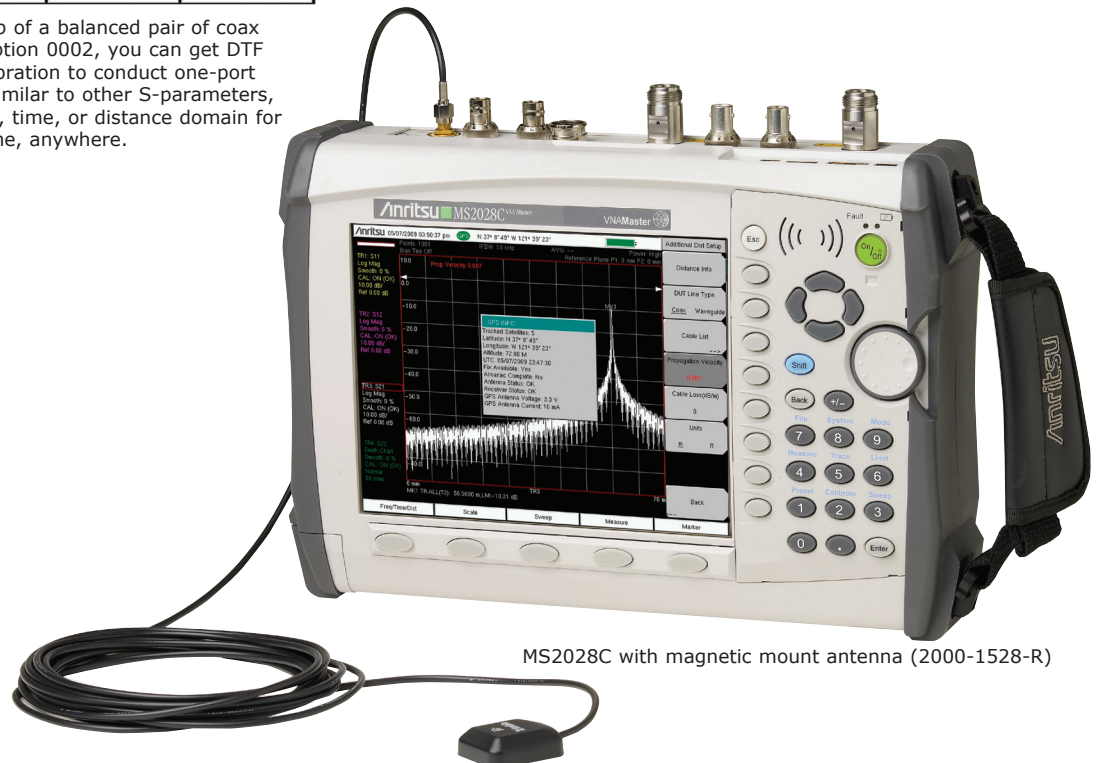
The MS202xC/3xC VVM solution is superior because the signal source is included internally, precluding the need for an external signal generator.

### Balanced/Differential S-Parameters, 1-Port (Option 0077)

Verifying the performance and identifying discontinuities in differential cables is now possible with the VNA Master. After a full two-port calibration, connect your differential cable directly to the two test ports and reveal the  $S_{d1d1}$  performance, which is essentially differential return loss. With optional time domain, you can convert frequency sweeps to distance. This capability is especially valuable for applications in high data rate cables where balanced data formats are used to isolate noise and interference.

### GPS Receiver (Option 0031)

Built-in GPS provides location information (latitude, longitude, altitude) and Universal Time (UT) information for storage along with trace data so you can later verify that measurements were taken at the right location. The GPS option requires a separately ordered magnetic mount antenna (2000-1528-R) with a 15 foot (~ 5m) cable to mount outside on a metallic surface.



MS2028C with magnetic mount antenna (2000-1528-R)

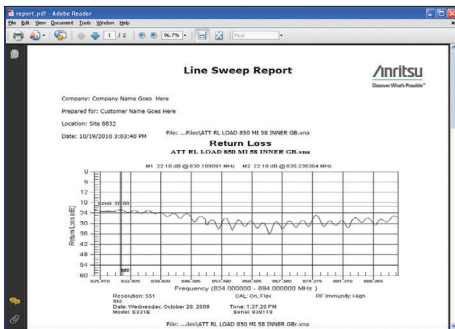
## VNA Master™ MS202xC/3xC Features

### Line Sweep Tools and Master Software Tools (for your PC)



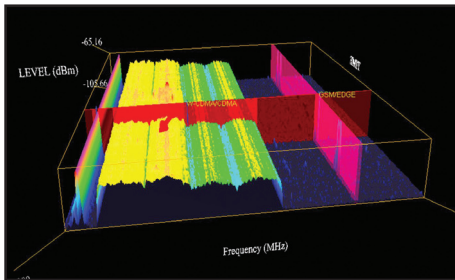
#### Trace Validation

Marker and Limit Line presets allow quick checks of traces for limit violations.



#### Report Generation

Create reports with company logo, GPS tagging information, calibration status, and serial number of the instrument for complete reporting.



#### 3D Spectrogram

For in-depth analysis with 3-axis rotation viewing, threshold, reference level, and marker control. Turn on Signal ID to see the types of signals.

#### Line Sweep Tools™

Line Sweep Tools increases productivity for people who deal with dozens of Cable and Antenna traces, or Passive Inter-Modulation (PIM) traces, every day.

#### User Interface

Line Sweep Tools has a user interface that will be familiar to users of Anritsu's Hand Held Software Tools. This will lead to a short learning curve.

#### Marker and Limit Line Presets

Presets make applying markers and a limit line to similar traces, as well as validating traces, a quick task.

#### Renaming Grid

A renaming grid makes changing file names, trace titles, and trace subtitles from field values to those required for a report much quicker than manual typing and is less prone to error.

#### Report Generator

The report generator will generate a professional looking PDF of all open traces with additional information such as contractor logos and contact information.

#### Master Software Tools™

Master Software Tools (MST) is a powerful PC software post-processing tool designed to enhance the productivity of technicians using spectrum analyzers.

#### Folder Spectrogram

Folder Spectrogram – creates a composite file of up to 15,000 multiple traces for quick review, also create:

- Peak Power, Total Power, and Peak Frequency plotted over time
- Histogram – filter data and plot number of occurrences over time
- Minimum, Maximum, and Average Power plotted over frequency
- Movie playback – playback data in the familiar frequency domain view
- 3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control

#### Line Sweep Features

##### Presets

7 sets of 8 markers and 1 limit line  
Next trace capability

##### File Types

Input: HHST DAT, VNA, and some MNA measurements.  
Return Loss (VSWR), Cable Loss, DTF-RL, DTF-VSWR, PIM  
Output: LS DAT, MNA, VNA, CSV, PNG, BMP, JPG, PDF

##### Report Generator

Logo, title, company name, customer name, location, date and time, filename, PDF, HTML, all open traces

##### Tools

Cable Editor  
Distance to Fault  
Measurement calculator  
Signal Standard Editor  
Renaming Grid

##### Interfaces

Serial, Ethernet, USB

##### Capture Plots to

Screen, Database, DAT files, JPEG, Instrument

#### Master Software Tools Features

##### Spectrum Analyzer Database Management

Full Trace Retrieval  
Trace Catalog  
Group Edit  
Trace Editor

##### Data Analysis

Trace Math and Smoothing  
Data Converter  
Measurement Calculator

##### Folder Spectrogram

Folder Spectrogram – 2D View  
Video Folder Spectrogram – 2D View  
Folder Spectrogram – 3D View

##### List/Parameter Editors

Traces  
Antennas, Cables, Signal Standards  
Pass/Fail  
Languages

## VNA Master™ MS202xC/3xC Ordering Information

### Ordering Information

**VNA Master™ Handheld Vector Network Analyzer + Spectrum Analyzer**

Includes standard three-year warranty (one year on battery) and Certificate of Calibration and Conformance.

MS2026C	MS2027C	MS2028C	MS2036C	MS2037C	MS2038C	Description
5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz	5 kHz to 6 GHz 9 kHz to 9 GHz	5 kHz to 15 GHz 9 kHz to 15 GHz	5 kHz to 20 GHz 9 kHz to 20 GHz	Vector Network Analyzer Spectrum Analyzer
MS2026C-0002	MS2027C-0002	MS2028C-0002	MS2036C-0002	MS2037C-0002	MS2038C-0002	Time Domain (includes Distance Domain capabilities)
MS2026C-0007	MS2027C-0007	MS2028C-0007	MS2036C-0007	MS2037C-0007	MS2038C-0007	Secure Data Operation
MS2026C-0010	MS2027C-0010	MS2028C-0010	MS2036C-0010	MS2037C-0010	MS2038C-0010	Built-in Bias-Tee
	MS2027C-0011	MS2028C-0011		MS2037C-0011	MS2038C-0011	K(f) Test Port Connectors (MS20x7C & MS20x8C only)
MS2026C-0015	MS2027C-0015	MS2028C-0015	MS2036C-0015	MS2037C-0015	MS2038C-0015	Vector Voltmeter
MS2026C-0019	MS2027C-0019	MS2028C-0019	MS2036C-0019	MS2037C-0019	MS2038C-0019	High-Accuracy Power Meter (requires external USB sensor)
			MS2036C-0025	MS2037C-0025	MS2038C-0025	Interference Analysis, <sup>a</sup> 9 kHz to 9/15/20 GHz
			MS2036C-0027	MS2037C-0027	MS2038C-0027	Channel Scanner, <sup>a</sup> 9 kHz to 9/15/20 GHz
MS2026C-0031	MS2027C-0031	MS2028C-0031	MS2036C-0031	MS2037C-0031	MS2038C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2026C-0077	MS2027C-0077	MS2028C-0077	MS2036C-0077	MS2037C-0077	MS2038C-0077	Balanced/Differential S-Parameters, 1-Port
			MS2036C-0431	MS2037C-0431	MS2038C-0431	Coverage Mapping <sup>b</sup>
MS2026C-0098	MS2027C-0098	MS2028C-0098	MS2036C-0098	MS2037C-0098	MS2038C-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate
MS2026C-0099	MS2027C-0099	MS2028C-0099	MS2036C-0099	MS2037C-0099	MS2038C-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data
			MS2036C-0509	MS2037C-0509	MS2038C-0509	AM/FM/PM Analyzer <sup>c</sup>

a. Option 31 (GPS) is recommended.

b. Requires Option 31 (GPS) for full functionality.

c. Requires Option 431 (Coverage Mapping) for full functionality.

### Standard Accessories (included with instrument)



Part Number	Description
2000-1685-R	Soft Carrying Case (supplied with MS202xC only)
2000-1686-R	Soft Carrying Case (supplied with MS203xC only)
633-75	Rechargeable Li-Ion Battery
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin Mini-B Cable, 3.05 m (10 ft)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft) Certificate of Calibration and Conformance

### Related Literature, Application Notes, Manuals

Part Number	Description
10100-00065	Product Information, Compliance, and Safety
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00289	VNA Measurement Guide
10580-00305	VNA Master User Guide
10580-00306	VNA Master Programming Manual
10580-00307	VNA Master Maintenance Manual
11410-00387	Primer on Vector Network Analysis
11410-00424	USB Power Sensor MA24106A
11410-00472	Measuring Interference
11410-00504	Microwave USB Power Sensor MA241x8A
11410-00531	Practical Tips on Making "Vector Voltmeter (VVM)" Phase Measurements using VNA Master (Option 15)
11410-00545	VNA Master + Spectrum Analyzer Brochure
11410-00549	VNA Master + Spectrum Analyzer Technical Data Sheet
11410-00565	Troubleshoot Wire Cable Assemblies with Frequency-Domain Reflectometry
11410-00700	Evaluation of RF Network Testing



Specifications are subject to change without notice.

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Anritsu utilizes recycled paper and environmentally conscious inks and toner.



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