1-Port VNA Series
(Reflectometers)

COPPER MOUNTAIN TECHNOLOGIES

- **Patent US 9,291,657** - No test cable needed
- **Frequency range:** 1 MHz - 18 GHz
- **Measurement time per point:** 100 or 200 µs min typ.
- **Automation programming** in LabView, Python, MATLAB, .NET, etc.
- Up to **100,001 measurement points**
- **Time domain and gating** included standard

EXTEND YOUR REACH

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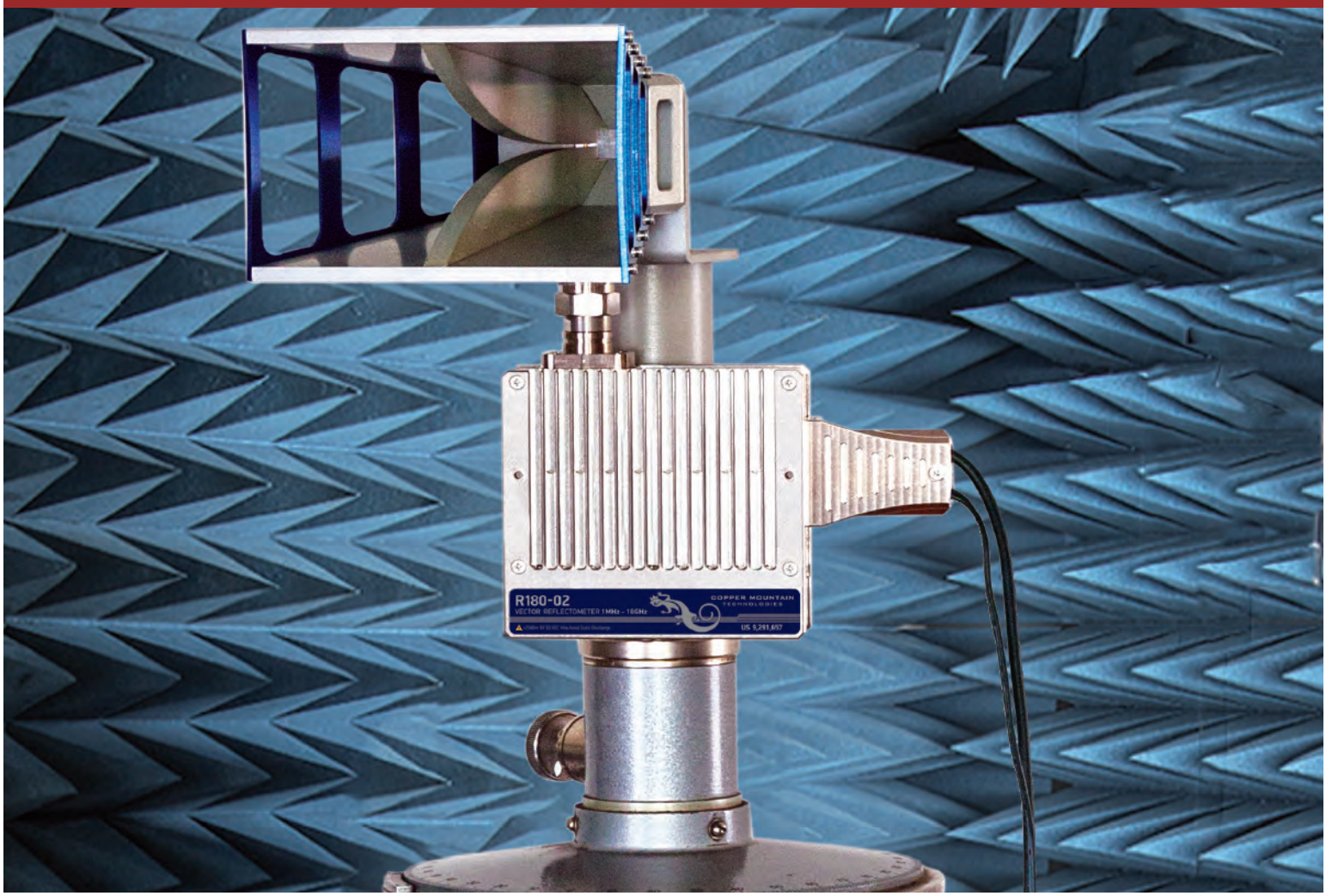
Lab grade performance in a handheld device



Our 1-port VNAs (cable and antenna analyzers) perform lab quality measurements connecting directly to the DUT without the need for a test cable, resulting in increased accuracy and quality of VNA measurements, specifically in cable and antenna analysis. In 2016 we were granted a US patent for Measurement Module of Virtual Vector Network Analyzer number US 9,291,657 for this innovation.

Due to their measurement accuracy, ultra-compact size and elimination of a test cable Copper Mountain Technologies' cable and antenna analyzers (reflectometers) provide a wide variety of analysis capabilities and are ideal for use by specialists working with antennas and antenna feeders in the field, as well as laboratory and production testing in a wide variety of industries including design and production of various IoT hardware components, materials testing, medical devices, aerospace applications, etc.

Copper Mountain Technologies' USB VNAs are next generation analyzers designed to meet the needs of 21st Century engineers. Our VNAs include an RF measurement module and a processing module, a software application which runs on a Windows PC, laptop or tablet, connecting to the measurement hardware via its USB interface.

This innovative approach delivers high measurement accuracy and enables users to take advantage of faster processors, newer computers and larger displays. USB VNAs have a lower Total Cost of Ownership and fewer potential failure points.

These instruments are smaller and lighter, can go almost anywhere, are very easy to share and eliminate the need for data purging or hard drive removal in secure environments.

The Whole Solution

Warranty, Service, & Repairs

All our products come with a standard three-year warranty from the date of shipment. During that time we will repair or replace any product malfunctioning due to defective parts or labor.

While we pride ourselves on quality of our instruments, should your VNA malfunction for any reason, we will gladly offer a loaner unit while we service yours. With our USB VNAs where all data is stored on your PC, a simple swap of the measurement module assures uninterrupted workflow and little or no downtime.

Our engineers are an extension of your team

Our team of applications engineers, service technicians, and metrology scientists are here to help you with technical support, application-specific recommendations, annual performance testing, and troubleshooting or repair of your CMT instruments.

Our engineers will work with your team to augment your in-house capabilities. We can write custom applications and test software, develop test automation scripts and help with integrated RF system testing. We can design and provide an RF switching network specific to your requirements; electro-mechanical, solid-state, or PIN diode-based. If the S-parameter measurement fixture involves challenging conditions for repeatability and accuracy we can assist with measurement uncertainty analysis.

An extensive library of technical materials including application notes, tips on performing VNA measurements, sample automation scripts, and how-to videos are available on our website www.coppermountaintech.com and YouTube channel/ CopperMountainTech.

Annual Calibration

Copper Mountain Technologies' Indianapolis calibration laboratory is accredited in accordance with the recognized international standard ISO/IEC 17025 (2005) and meets the requirements of ANSI/NCSL Z540-1994-1. All reference standards and equipment in the laboratory are traceable to National Institute of Standards and Technology (NIST) or international equivalents.

Should you prefer to perform annual testing yourself or use a third party, contact us for information or questions on performing these procedures. Additionally, the VNA Performance Test (VNAPT) software application is available for third party laboratories without restriction. Use of VNAPT to execute performance tests is optional, but the software is designed to automate and streamline VNA performance testing, including automatic generation of test reports. Please contact Copper Mountain Technologies or your local distributor for recommended calibration options.

"The small form factor of CMT's VNAs makes them particularly well suited for field applications, such as antenna testing, enabling customers to bring laboratory-grade instruments to hard-to-reach places. Their compactness and low weight also make them ideal for applications in the manufacturing industries, as they enable more machines to be deployed in plants."

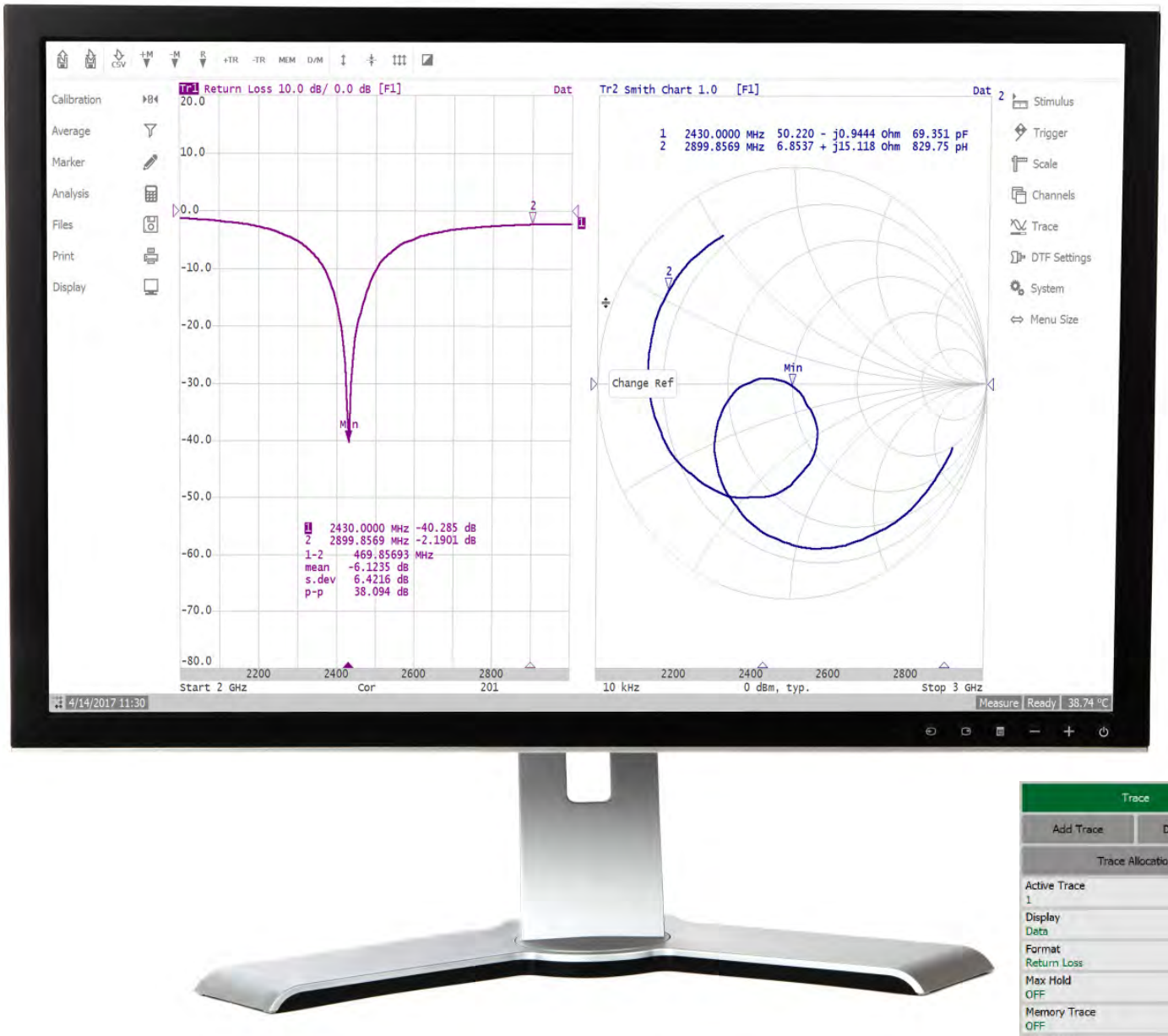
Jessy Cavazos
Industry Director, Frost & Sullivan

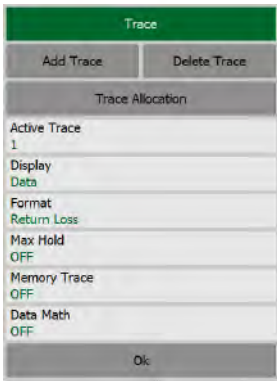
Software Application

Software application is part of the VNA

The software application takes raw measurement data from the data acquisition (measurement) module and recalculates into S-parameters in multiple presentation formats utilizing proprietary algorithms. These new and advanced calibration and other accuracy enhancing algorithms were developed by our metrology experts. Our software can be downloaded free from our website, used on an unlimited number of PCs, and enables easy VNA integration with other software applications and automation.

The software application features a fully functioning Demo Mode, which can be used for exploring VNAs' features and capabilities without an actual measurement module connected to your PC. States may be saved in RVNA directories by default and the two buttons on the top left of the RVNA screen can be used to save an unlimited amount of states to any directory on your PC.





Measurement Capabilities

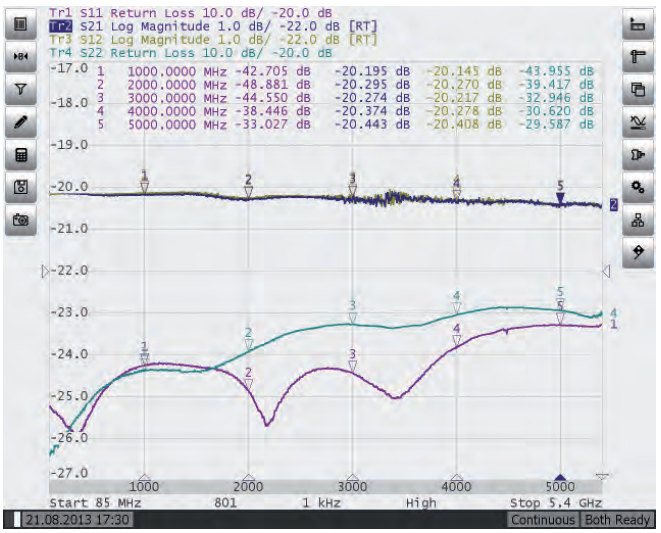
Measured parameters

S11, cable loss

S11, |S21|, |S12|, S22 - using two VNAs (cable and antenna analyzers).

Number of measurement channels

Up to 4 independent logical channels. Each logical channel is represented on the screen as an individual channel window. A logical channel is defined by such stimulus signal settings as frequency range, number of test points, etc.

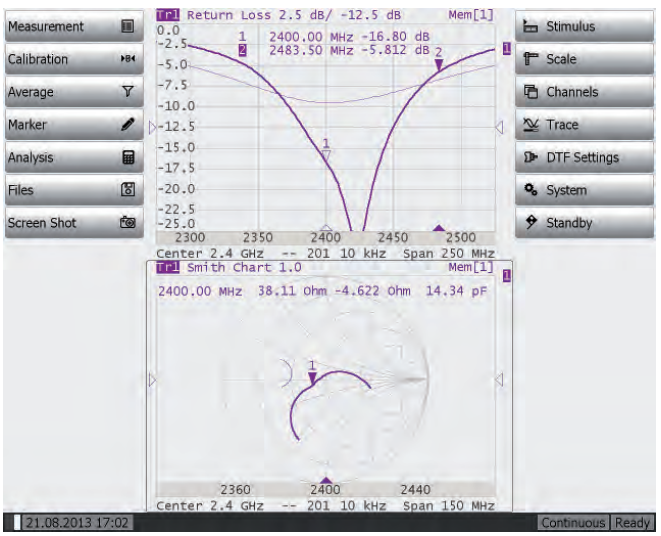


Data traces

Multiple data traces can be displayed in each channel window. A data trace represents one parameter of the DUT such as magnitude and phase of S11, DTF, cable loss.

Memory traces

Each of the multiple data traces can be saved into memory for further comparison with current values.

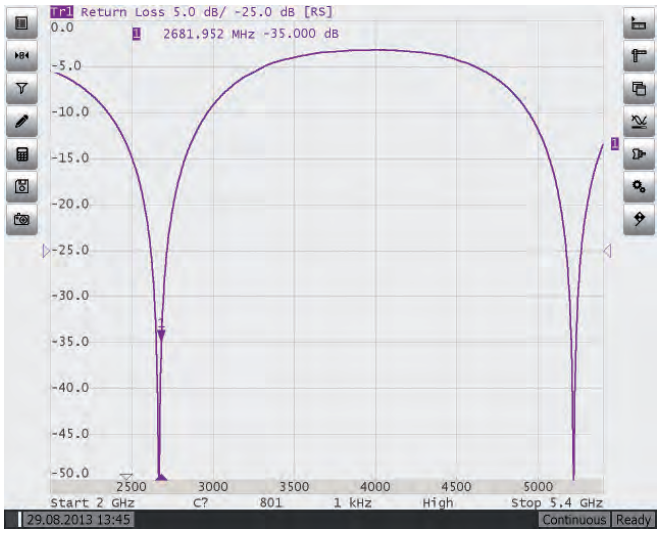


Data display formats

SWR, Return loss, Cable loss, Phase, Expand phase, Smith chart diagram, DTF SWR, DTF return loss, Group delay, Lin Magnitude.

Software Application

Measurement Range



CMT 1-port VNAs can measure return loss as low as 35 dB, across the full frequency range of each instrument. Consult the specifications of each instrument for more detail.

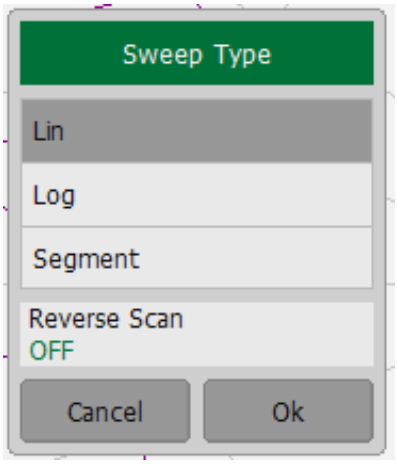
Pictured Above: R54 testing in the entire frequency range of 85 MHz to 5.4 GHz, the return loss is shown at 35 dB

Dynamic Range

Typical dynamic range of the |S21| and |S12| measurements using two 1-Port VNAs is as high as 100 dB, varying by frequency and model. Consult the specifications of each instrument for more detail.

Pictured Above: Two R54s are shown with a demo filter. Users can measure |S21| and |S12| of the DUT using two analyzers connected to the same USB hub.

Sweep Features



Sweep type: Linear frequency sweep, logarithmic frequency sweep, and segment frequency sweep.

Measured points per sweep: Set by the user from 2 to at least 100,001 (varies by model; consult the specifications of each instrument for more detail).

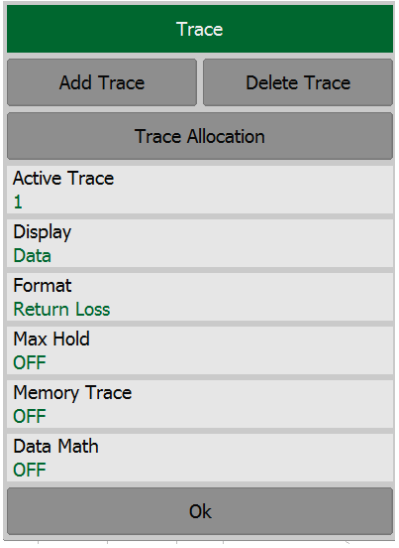
Segment sweep features: A frequency sweep within several independent user-defined segments. Frequency range, number of sweep points and IF bandwidth should be set for each segment.

Output Power: Output power of every 1-port VNA is adjustable. Typical output power and adjustment steps vary by model. Consult the specifications of each instrument for more detail.

Sweep Trigger:

Trigger modes: continuous, single, or hold.
Trigger sources: internal, bus.

Trace Functions



Trace display

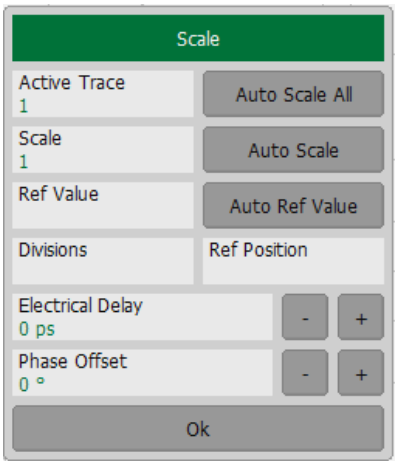
Data trace, memory trace, or simultaneous indication of data and memory traces.

Trace math

Data trace modification by math operations: addition, subtraction, multiplication or division of measured complex values and memory data.

S-parameters display

The program allows the user to load a Touchstone file (*.s1p and *.s2p) into data memory.



Autoscaling

Automatic selection of scale division and reference level value to have the trace most effectively displayed.

Electrical delay

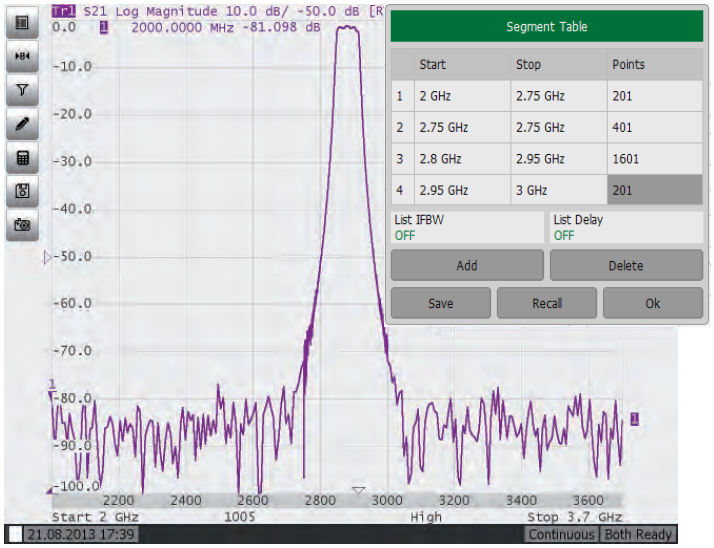
Calibration plane moving to compensate for the delay in test setup. Compensation for electrical delay in a DUT during measurements of deviation from linear phase.

Phase offset

Defined in degrees.

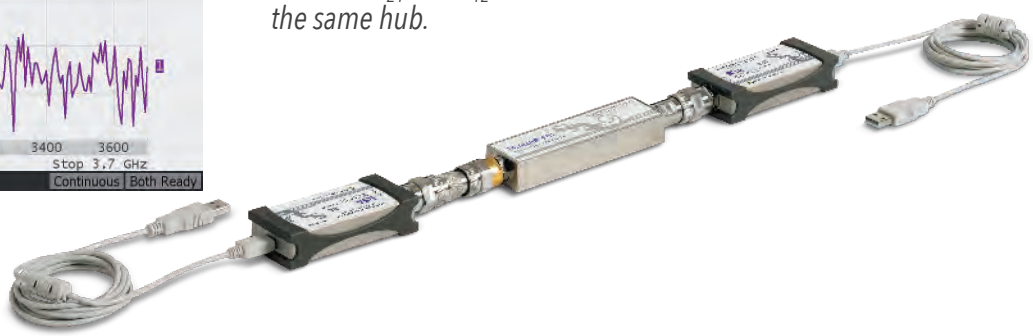
Software Application

Frequency Scan Segmentation

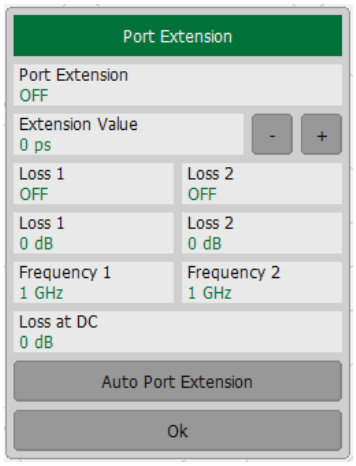


1-port VNAs (cable and antenna analyzers) have a large frequency range with the option of frequency scan segmentation. Among other benefits, this allows the user an opportunity to use the VNA, to realize the maximum dynamic range while maintaining high measurement speed.

Pictured Below: Two R54s are shown with a demo filter. Users can measure S_{21} and S_{12} of the DUT using two analyzers connected to the same hub.



Port Extension



Port Extension is a feature that allows for moving the calibration reference plane of the port by specifying the electrical delay to the new reference plane position. Additionally, it is possible to account for loss in the extended port.

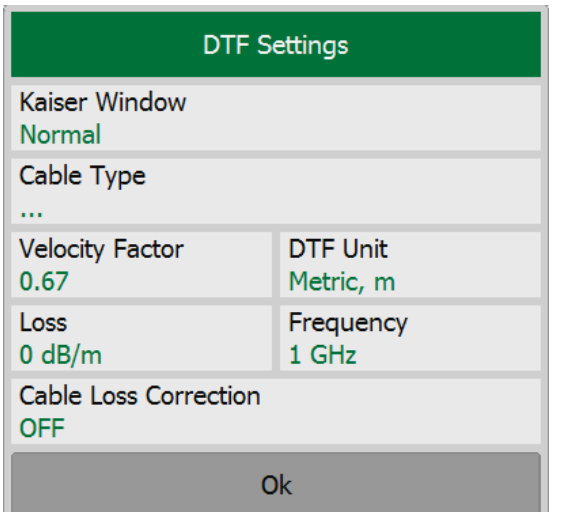
Automatic Port Extension is a feature that allows for automatic calculation of the electrical delay of the extended port and its loss by attaching an Open and/or a Short calibration standard at the new calibration reference plane position.

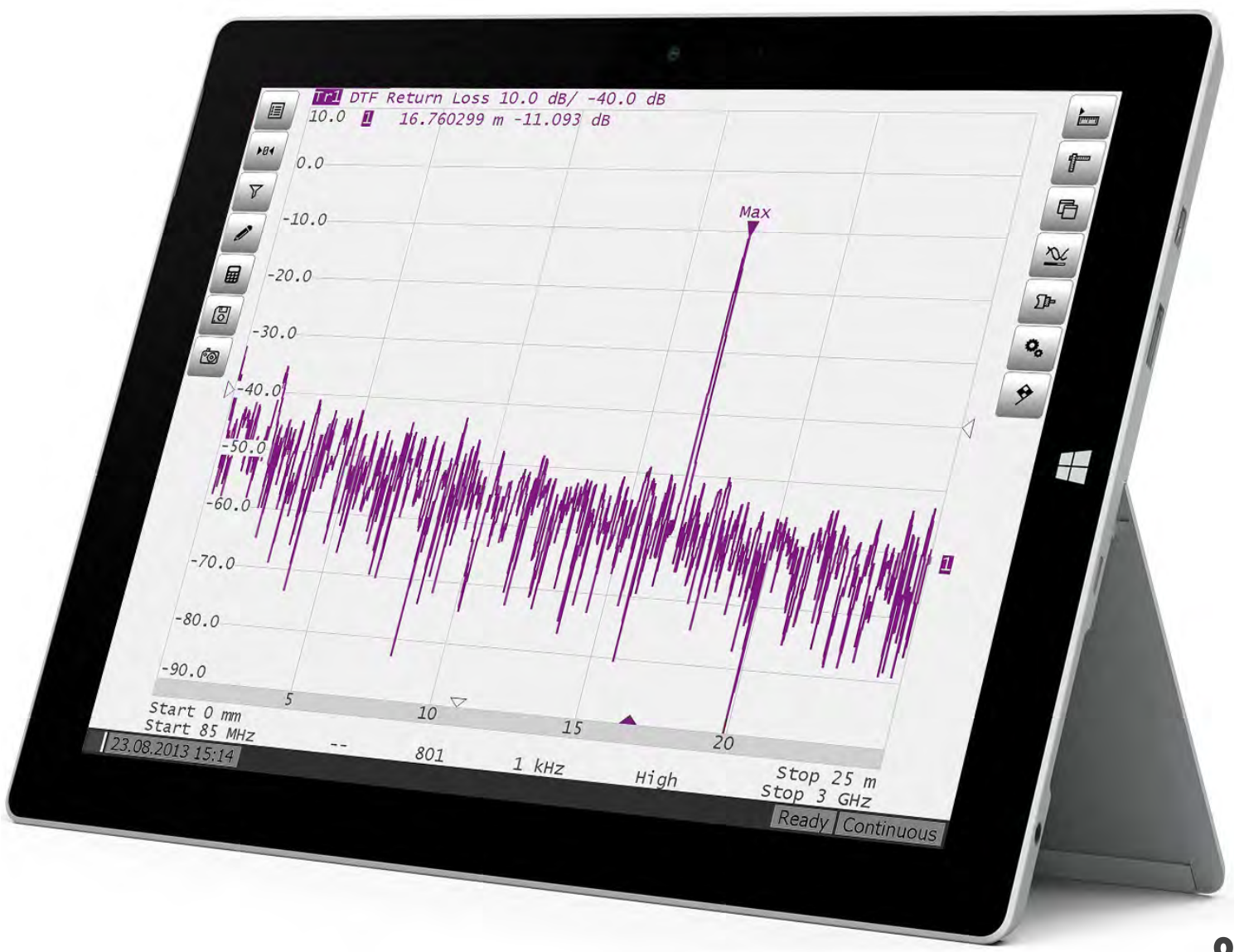
Time Domain Measurements

Distance to Fault (DTF)

DTF mode is enabled by selecting either the DTF SWR or DTF return loss format. The instrument will automatically transform measured data from frequency domain to time domain, and then to distance based on the velocity of propagation. DTF easily finds fault points in cables or connectors.

Distance resolution can be maximized by selecting a wide measurement frequency range. Likewise, the maximum measured distance is proportional to the number of stimulus points. Built-in DTF measurement allows the user to detect a physical impairment in the antenna feeder.





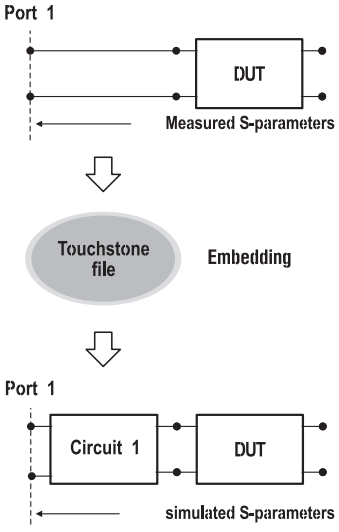
Software Application

Gating

This function mathematically removes unwanted responses in the time domain, which allows the user to obtain frequency response without influence from the fixture elements. The function applies reverse transformation back to frequency domain after cutting out the user-defined span in time domain.

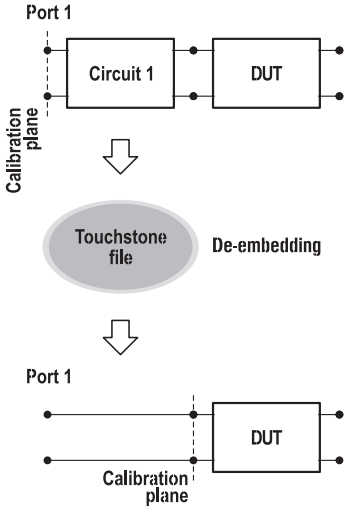
Gating filter types: bandpass or notch. For a better tradeoff between gate resolution and level of spurious sidelobes the following filter shapes are available: maximum, wide, normal and minimum.

Embedding



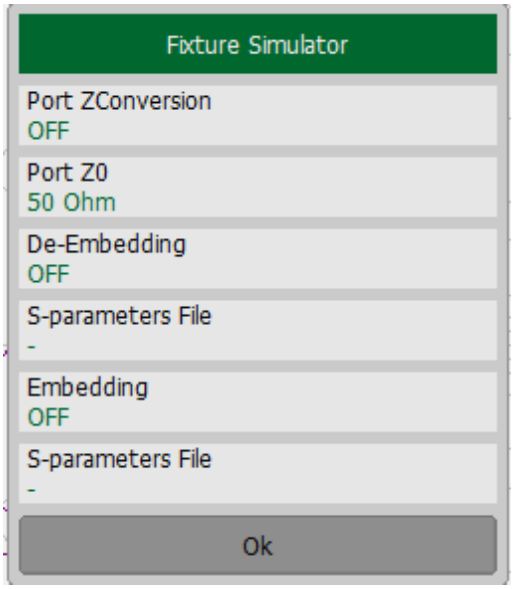
This function allows the user to mathematically simulate the DUT parameters after virtual integration of a fixture circuit between the calibration plane and the DUT. This circuit can be described by an S-parameter matrix in a Touchstone file.

De-Embedding



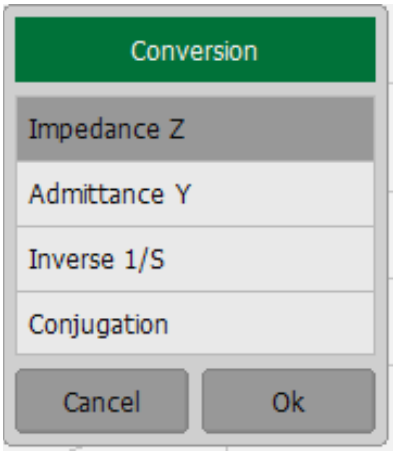
This function allows users to mathematically exclude from the measurement result the effect of the fixture circuit connected between the calibration plane and the DUT. This circuit should be described by an S-parameter matrix in a Touchstone file.

Port Impedance Conversion



This is the function that converts the S-parameters measured at 50 port into values, which could be determined if measured at a test port with arbitrary impedance.

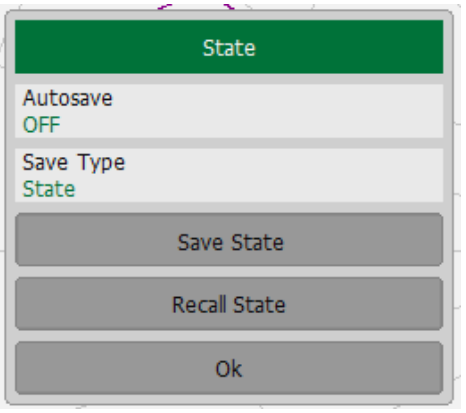
S-Parameter Conversion



The function allows conversion of the measured S-parameters to the following parameters: reflection impedance and admittance, inverse S-parameters and conjugation.

Software Application

Data Output

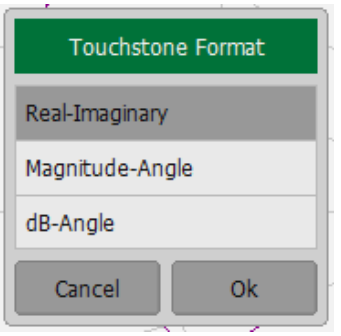


Analyzer State

All state, calibration and measurement data can be saved to an Analyzer state file on the hard disk and later uploaded back into the software program. The following four types of saving are available: State, State & Cal, State and Trace, and All.

Trace Data CSV File

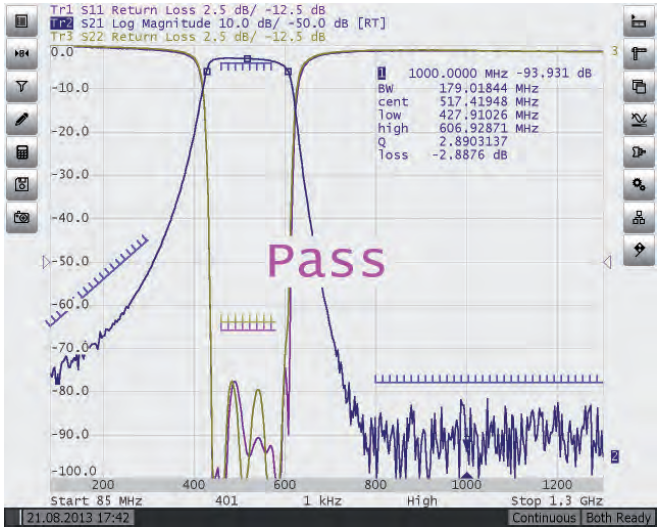
The VNA allows the user to save individual trace data as a CSV file (comma separated values). The active trace stimulus and response values in the current format are saved to *.CSV file for ease of importing into other applications.



Trace Data Touchstone File

Touchstone file saving allows the user to save frequencies and S-parameter results into an industry-standard .s1p file format. In addition, the software can be used as a Touchstone file viewer, which allows the user to graphically display and work with previously saved Touchstone files.

Limit Testing



Setting Pass-Fail Tests

Limit test automatically performs pass/fail analysis of the measured test result. The analysis is based on comparison of the trace to the limit as configured by the user.

The limit line can consist of one or several segments. Each segment checks the measurement value for failing either upper or lower limit.

The limit line segment is defined by specifying the coordinates of the beginning (X0, Y0) and the end (X1, Y1) of the segment, and type of the limit. The MAX or MIN limit types check if the trace falls outside of the upper or lower limit, respectively.

Calibration

User Calibration

Calibration
Calibration of a test setup (which includes the VNA, cables, and adapters) significantly increases the accuracy of measurements. Calibration allows for correction of the errors caused by imperfections in the measurement system: system directivity, source match and tracking.

Calibration methods
The following calibration methods of various sophistication and accuracy enhancement level are available:

- Reflection normalization
- Transmission normalization (when using two 1-Port VNAs)
- Full one-port calibration

Reflection and transmission normalization
This is the simplest calibration method; however, it provides reasonably low accuracy compared to other methods.

Full one-port calibration
Method of calibration performed for one-port reflection measurements. It ensures high accuracy.

Mechanical Calibration Kits
The user can select one of the predefined calibration kits of various manufacturers or define a new calibration kit.

Electronic Calibration Modules
Electronic, or automatic, calibration modules offered by CMT make calibration faster and easier than traditional mechanical calibration.

Defining of calibration standards
Different methods of calibration standard definition are available: standard definition by polynomial model and standard definition by data (S-parameters).

Error correction interpolation
When the user changes any settings such as the start/stop frequencies or the number of sweep points, compared to the settings at the moment of calibration, interpolation or extrapolation of the calibration coefficients will be applied.

Automation

Automation Interfaces

- SCPI over TCP/IP (for automation over a network to the controlling PC)
- COM over USB, DCOM over TCP/IP and HTP (for automation from the controlling PC, except for DCOM which is a network interface)

Automation Languages

We maintain code examples in the following languages:

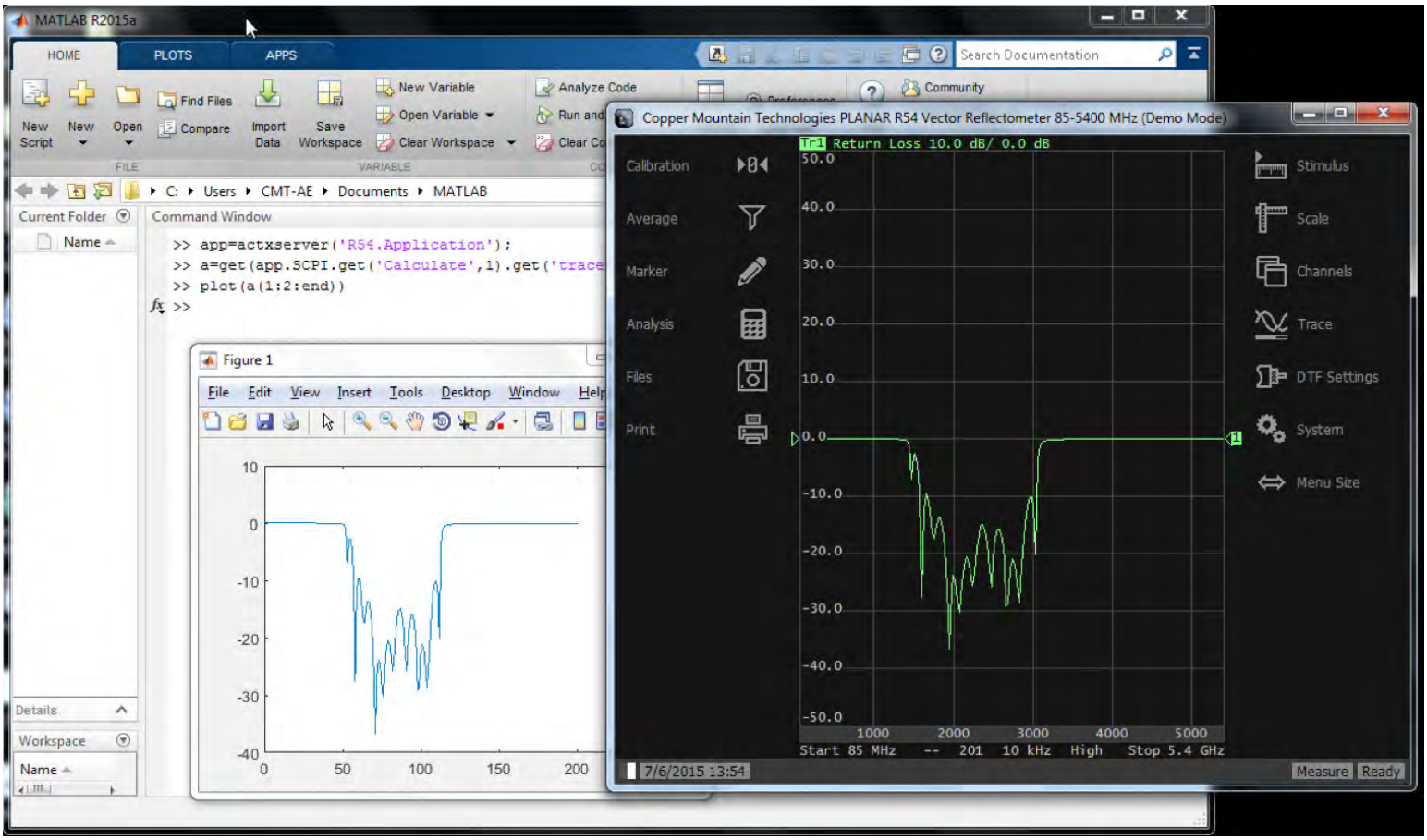
- MATLAB
- Visual Basic (Excel)
- C++
- Python
- LabVIEW

Measurement Automation

COM/DCOM interface
The VNA software provides a COM/DCOM (ActiveX) interface, allowing the instrument to be used as a part of a larger test system and in other specialized applications. The VNA program runs as a COM/DCOM server, while the user program runs as client.

SCPI over TCP socket interface
Optionally, a TCP socket can be enabled in the VNA software over which SCPI commands can be sent. Compared with the COM interface, SCPI over TCP can ease migration of legacy code when an existing test automation system is already in place.

LabView compatible
The device and its software are fully compatible with LabView applications, for ultimate flexibility in user-generated programming and automation.



Command set is modeled after industry-standard legacy equipment; porting code is straightforward and we can help.

Complete installation of any CMT software comes with multiple programming examples and guides installed in the C:\VNA\RVNA\ Programming Examples and Guides directory.

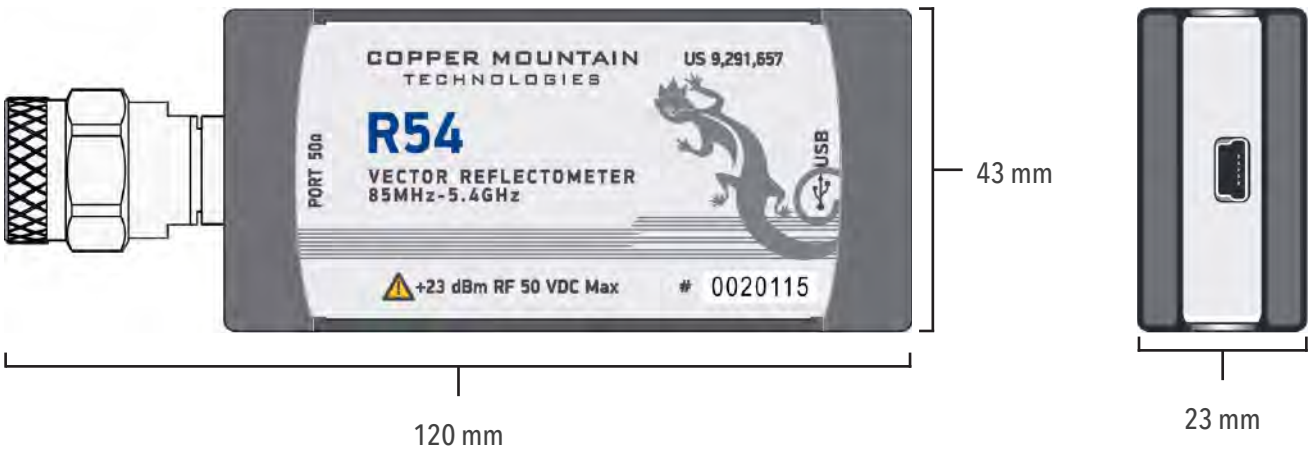
CMT software includes many features that other vendors offer as options: Time Domain capability, S-parameter Embedding and De-Embedding, Frequency Offset, and Vector Mixer Calibration functionality. No integrated PC means faster data processing turnaround and regular updates that are easy to install. Less complexity in the VNA case leads to less room for critical errors that cost you production/development time.

Software comes with all the features developers have come to expect: segmented frequency sweeps, linear/logarithmic sweeps, power sweeps, multiple trace formats, 4 channels max. with up to 4 traces each, marker math, and limit tests. These provide added value to production testing by simplifying measurement interpretation. Plugins can add wide ranges of functionality and can be developed upon request. Examples include streamlined production applications, functionality to trigger with external generators, and virtual circuit matching modeling.

Automation Features

- Segmented frequency sweeps
- Linear/logarithmic sweeps
- Power sweeps
- Multiple trace formats
- 4 channels max. with up to 4 traces each
- Marker math
- Limit tests

R54 Specifications[1]



Primary Specifications

Impedance	50 Ohm
Test port connector	N-type male
Number of test ports	1
Frequency range	85 MHz to 5.4 GHz [2]
Full CW frequency	±5x10-6
Frequency setting resolution	10 Hz
Number of measurement points	2 to 100001
Measurement bandwidth	10 Hz to 30 kHz (with 1/3 step)
Cable loss measurement range	35 dB
Dynamic range (100 Hz IF BW)	97 dB, typ.

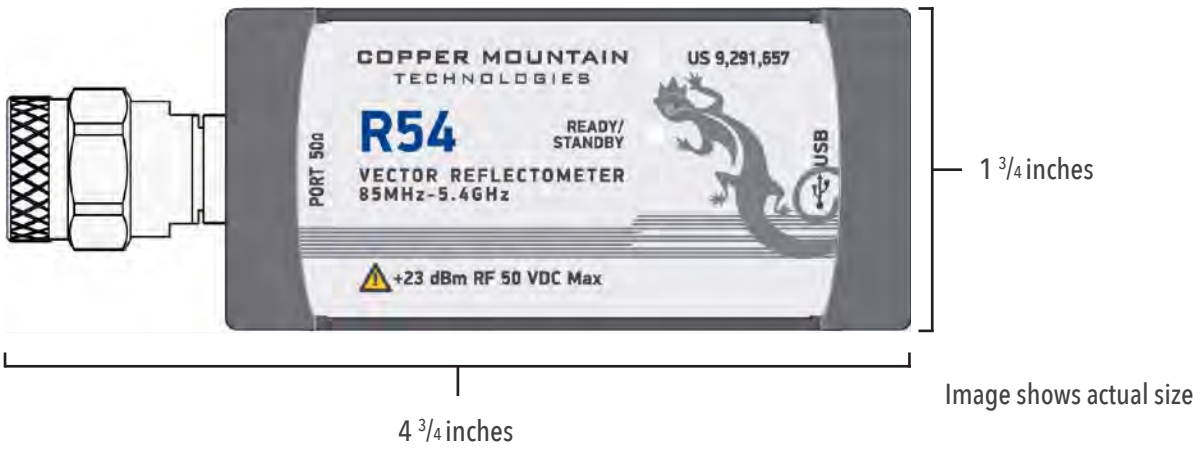
Effective System Data[3]

Effective directivity	45 dB
Effective source match	37 dB
Effective reflection tracking	0.10 dB
Effective directivity with factory calibration	
85 MHz to 4 GHz	36 dB
4 GHz to 5.4 GHz	32 dB

Measurement Accuracy

Reflection [3]	**(Magnitude/Phase)**
-15 to 0 dB	0.4 dB/4°
-25 to -15 dB	1.2 dB/8°
-35 to -25 dB	4.0 dB/22°
Transmission [4]	**(Magnitude)**
-40 to 0 dB; 100 Hz IF BW	1.0 dB
Trace noise magnitude (High Output Power, IF Bandwidth 1 kHz)	0.015 dB RMS
Temperature dependence	0.020 dB/°C

[1] All specifications subject to change without notice.
[2] All specifications in frequency range from 4.8 GHz to 5.4 GHz are typical.
[3] At 23 °C +/- 5 °C after 30 minutes of warming-up, with +/- 1°C ambient deviation from calibration temperature, at high output power and IF BW 100 Hz
[4] Measurement of $|S_{21}|$ and $|S_{12}|$ using two R54, both being connected to the same USB hub, applies over the temperature range of 23°C ± 5°C after 30 minutes of warming-up, with less than 1°C deviation from the calibration temperature at high output power and IF BW 100 Hz.



Test Port

Directivity (without system error correction)	18 dB
Match (without system error correction)	18 dB
Output Power	
High level	-10 dBm, typ.
Low level	-30 dBm, typ.
Interference immunity	+17 dBm
Damage level	+23 dBm
Damage DC voltage	50 V

Measurement Speed

Measurement time per point, min typ.	200 µs

Atmospheric Tolerances

Operating temperature range	-10°C to 50°C
Storage temperature range	-50°C to 70°C
Humidity	90% at 25°C
Atmospheric pressure	84.0 kPa to 106.7 kPa

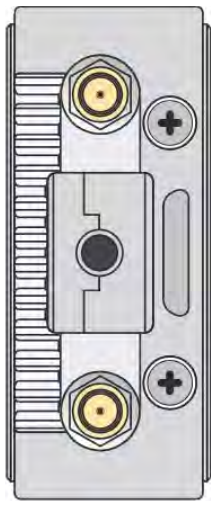
Factory Adjustment

Recommended factory adjustment interval	3 Years

System & Power

Operating systems	Windows XP/Vista/7/8/10
CPU frequency	1.0 GHz
RAM	2.0 GB
Power Consumption	2.0 W
USB Connector Type	Mini USB B
Weight	0.25 kg/8.8 oz

R60 Specifications[1]



Primary Specifications

Impedance	50 Ohm
Test port connector	N-type male
Number of test ports	1
Frequency range	1 MHz to 6.0 GHz
Full CW frequency	±2.5x10-6
Frequency setting resolution	20 Hz
Number of measurement points	2 to 100001
Measurement bandwidth	10 Hz to 100 kHz (with 1/3 step)
Cable loss measurement range	35 dB
Dynamic range (100 Hz IF BW)	109 dB, typ.

Measurement Accuracy

Reflection[2]	**(Magnitude/Phase)**
-15 to 0 dB	0.4 dB/3°
-25 to -15 dB	1.0 dB/6°
-35 to -25 dB	3.0 dB/20°
Transmission	**(Magnitude)**
-50 to 0 dB; 100 Hz IF BW	1.0 dB
Trace noise magnitude (0 dBm Output Power, IF Bandwidth 1 kHz)	0.005 dB RMS
Temperature dependence	0.015 dB/°C

Effective System Data[2]

Effective directivity	46 dB
Effective source match	40 dB
Effective reflection tracking	0.05 dB
Effective directivity with factory calibration	
1 MHz to 4 GHz	36 dB
4 GHz to 6 GHz	32 dB

[1] All specifications subject to change without notice.
[2] At 23 °C +/- 5 °C after 30 minutes of warming-up, with +/- 1°C ambient deviation from calibration temperature, at 0 dBm output power and IF BW 100 Hz

Image shows actual size

Test Port

Directivity (without system error correction)	15 dB, 18 dB typ.
Match (without system error correction)	15 dB, 18 dB typ.
Output Power	
Power range	-35 to -3 dBm, typ.
Power resolution	0.25 dB, typ.
Power accuracy	+1.5 dB
Interference immunity	+17 dBm
Damage level	+23 dBm
Damage DC voltage	50 V

Measurement Speed

Measurement time per point, min typ.	100 µs

General Data

External reference frequency	10 MHz
Input level	2 dBm ± 2 dB
Input impedance at Ref input	50 Ohm
Connector type	SMA, female
Output reference signal level at 50 Ohm impedance	3 dBm ± 2 dB
Ref connector type	SMA, female
External trigger	3.3 V CMOS, TLL compatible
Pulse width	More than 1 us
Input impedance at Ext Trig	At least 10 kOhm
Input connector type	SMA, female

Atmospheric Tolerances

Operating temperature range	-10°C to 50°C
Storage temperature range	-50°C to 70°C
Humidity	90% at 25°C
Atmospheric pressure	84.0 kPa to 106.7 kPa

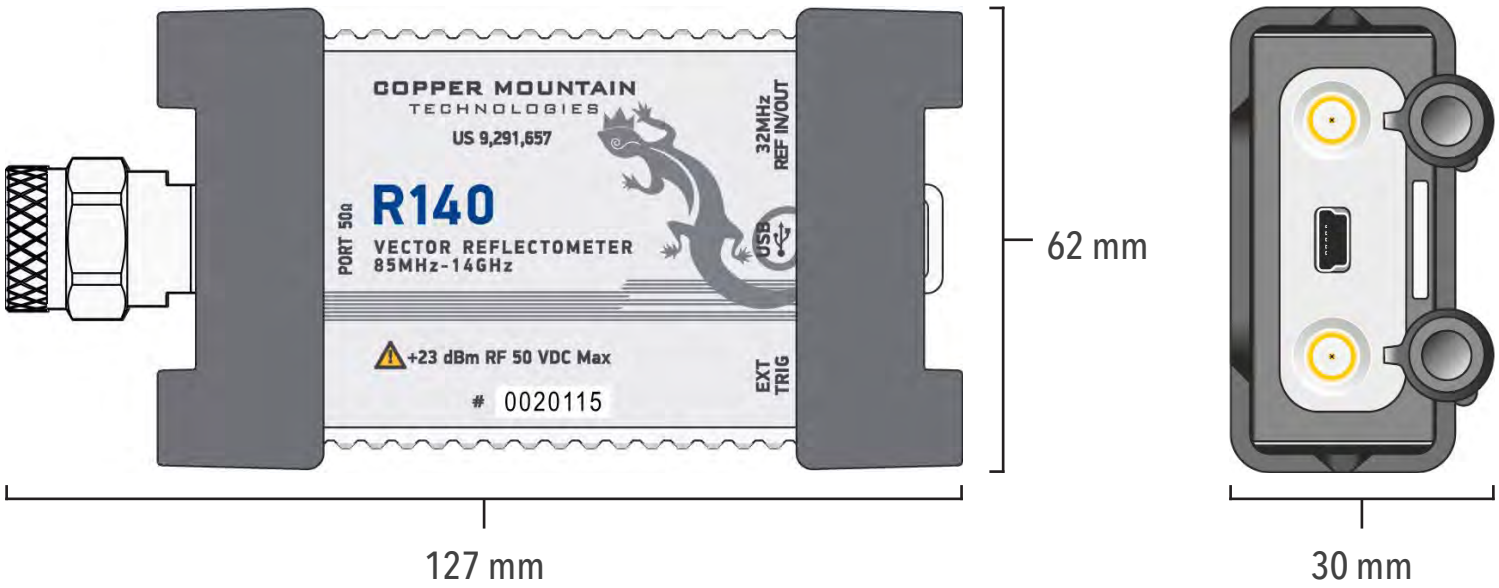
Factory Adjustment

Recommended factory adjustment interval	3 Years

System & Power

Operating systems	Windows XP/Vista/7/8/10
CPU frequency	1.0 GHz
RAM	2.0 GB
Power Consumption	3.5 W
USB Connector Type	Mini USB
Weight	0.35 kg/12.3 oz

R140 Specifications[1]



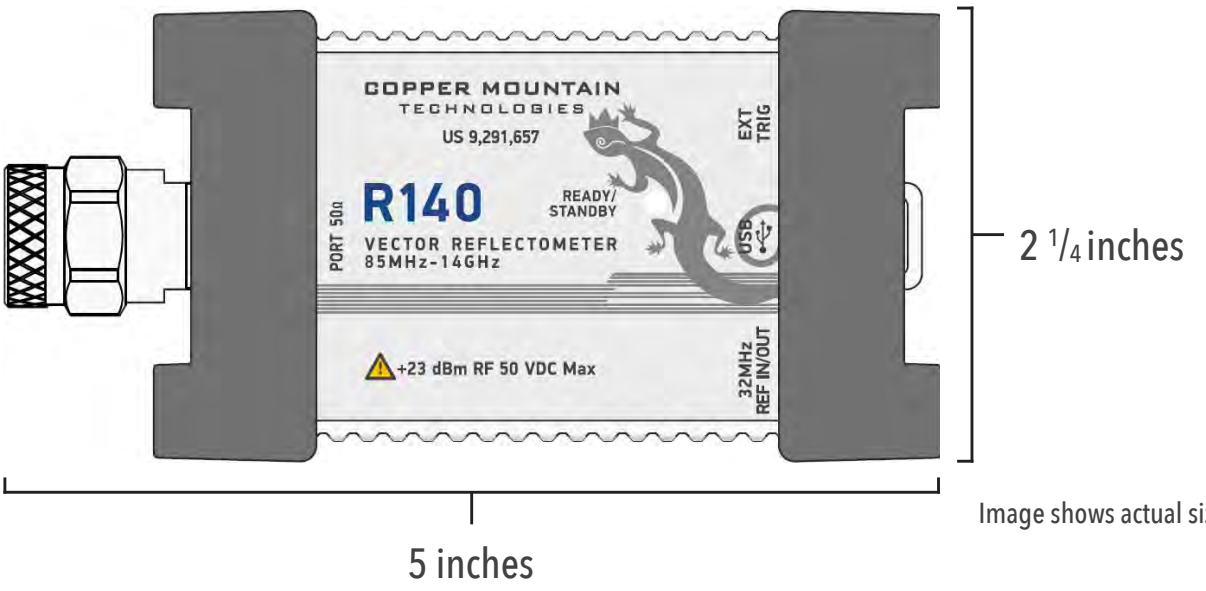
Primary Specifications

Impedance	50 Ohm
Test port connector	N-type male
Number of test ports	1
Frequency range	85.0 MHz to 14.0 GHz[2]
Full CW frequency	±2.5x10-6
Frequency setting resolution	25 Hz
Number of measurement points	2 to 100,001
Measurement bandwidth	10 Hz to 30 kHz (with 1/3 step)
Cable loss measurement range	
85 MHz to 4.8 GHz	35 dB
4.8 GHz to 14 GHz	30 dB
Dynamic range (100 Hz IF BW)	
85 MHz to 4.8 GHz	107 dB, typ.
4.8 GHz to 14 GHz	74 dB, typ.

Measurement Accuracy

Reflection[2]	**(Magnitude/Phase)**
85 MHz to 4.8 GHz	
-15 to 0 dB	0.4 dB/4°
-25 to -15 dB	1.2 dB/8°
-35 to -25 dB	4.0 dB/22°
4.8 GHz to 14 GHz	
-15 to 0 dB	1.0 dB/5°
-25 to -15 dB	1.5 dB/10°
-35 to -25 dB	5.5 dB/30°
Transmission	**(Magnitude)**
-50 to 0 dB; 85 MHz to 4.8 GHz	1.0 dB
-25 to 0 dB; 4.8 GHz to 14 GHz	1.0 dB
Trace noise magnitude (High Output Power, IF Bandwidth 1 kHz)	
85 MHz to 4.8 GHz	0.005 dB RMS
4.8 GHz to 14 GHz	0.05 dB RMS
Temperature dependence	
85 MHz to 4.8 GHz	0.015 dB/°C
4.8 GHz to 14 GHz	0.030 dB/°C

[1] All specifications subject to change without notice.
[2] At 23 ° C +/- 5 ° C after 30 minutes warmup time, with +/- 1°C ambient deviation from calibration temperature, at high output power and IF BW 100 Hz
[3] Measurement of $|S_{21}|$ and $|S_{12}|$ using two R140, 32 MHz Ref Out, one of which is connected to 32 MHz Ref In of the other, both connected to the same USB hub. Applies over the temperature range 23°C ±5°C after 30 minutes of warming-up, with less than 1°C deviation from the calibration temperature at high output power and IF BW 100 Hz.



Effective System Data[2]

Effective directivity	
85 MHz to 4.8 GHz	45 dB
4.8 GHz to 14 GHz	42 dB
Effective source match	
85 MHz to 4.8 GHz	37 dB
4.8 GHz to 14 GHz	35 dB
Effective reflection tracking	
85 MHz to 4.8 GHz	0.10 dB
4.8 GHz to 14 GHz	0.20 dB

Test Port

Directivity (without system error correction)	10 dB, 15 dB typ.
Match (without system error correction)	10 dB, 15 dB typ.
Output Power	
High level (85 MHz to 4.8 GHz)	0 dBm, typ.
High level (4.8 GHz to 14 GHz)	-10 dBm, typ.
Low level	-35 dBm, typ.
Interference immunity	+17 dBm
Damage level	+23 dBm
Damage DC voltage	50 V

Measurement Speed

Measurement time per point, min typ.	200 µs

General Data

External reference frequency	32 MHz
Input level	2 dBm ± 2 dB
Input impedance at Ref input	50 Ohm
Connector type	SMA, female
Output reference signal level at 50 Ohm impedance	3 dBm ± 2 dB
Ref connector type	SMA, female
External trigger	3.3 V CMOS, TLL compatible
Pulse width	More than 1 us
Input impedance at Ext Trig	At least 10 kOhm
Input connector type	SMA, female

Atmospheric Tolerances

Operating temperature range	-10°C to 50°C
Storage temperature range	-50°C to 70°C
Humidity	90% at 25°C
Atmospheric pressure	84.0 kPa to 106.7 kPa

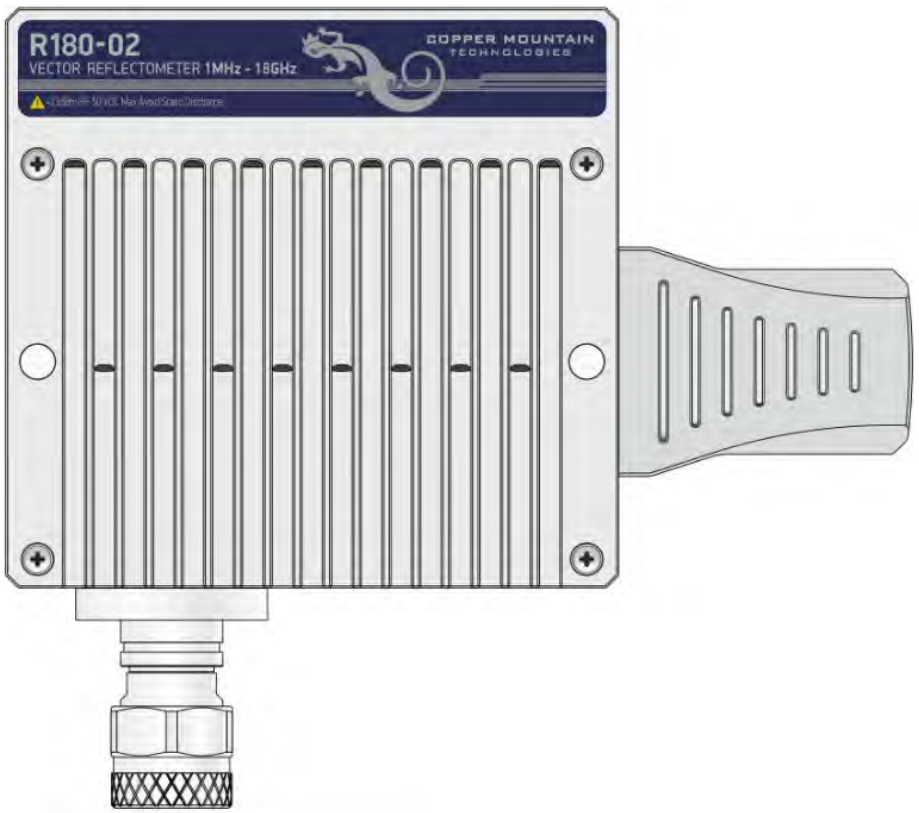
Factory Adjustment

Recommended factory adjustment interval	3 Years

System & Power

Operating systems	Windows XP/Vista/7/8/10
CPU frequency	1.0 GHz
RAM	2.0 GB
Power Consumption	3.0 W
USB Connector Type	Mini USB B
Weight	0.3 kg/10.6 oz

R180 Specifications[1]



Additional Model Sizes

Listed in mm

R180-02	126 x 142 x 36
R180-01	128 x 142 x 36
R180-11	121 x 142 x 36
R180-12	121 x 142 x 36

Primary Specifications

Impedance	50 Ohm
R180-02 - Test port connector	N-type male
R180-01 - Test port connector	N-type female*
R180-11 - Test port connector	3.5 mm female*
R180-12 - Test port connector	3.5 mm male*
Number of test ports	1
Frequency range	1.0 MHz to 18.0 GHz [2]
Full CW frequency	±2.5x10-6
Frequency setting resolution	50 Hz
Number of measurement points	2 to 100,001
Measurement bandwidth	10 Hz to 100 kHz (with 1/3 step)
Cable loss measurement range	35 dB
Dynamic range (100 Hz IF BW)	
1 MHz to 6 GHz	110 dB, typ.
6 GHz to 18 GHz	94 dB, typ.

*Special Order

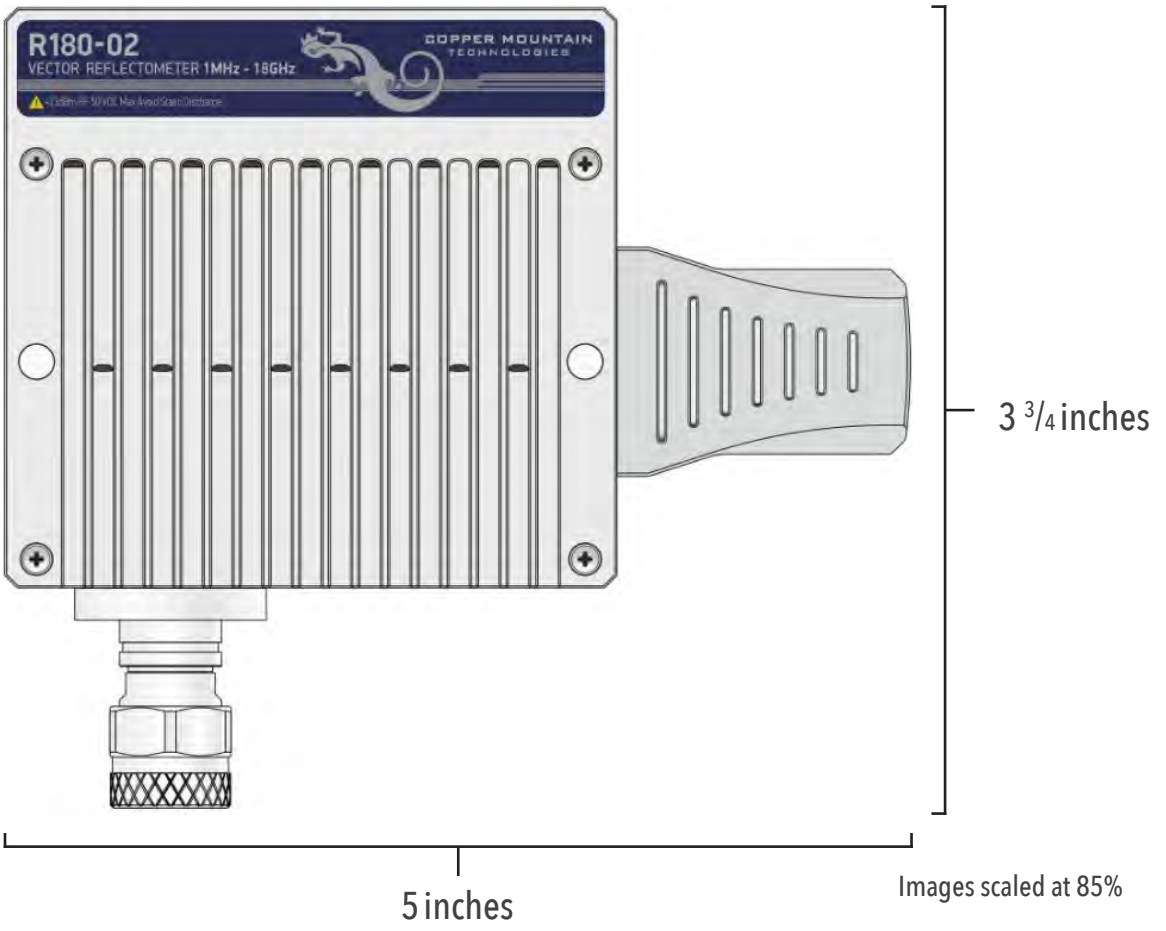
Measurement Accuracy

Reflection[2]	**(Magnitude/Phase)**
-15 to 0 dB	0.5 dB/5°
-25 to -15 dB	1.5 dB/10°
-35 to -25 dB	5.5 dB/30°
Transmission	**(Magnitude)**
1 MHz to 6 GHz; -50 to 0 dB	1.0 dB
6 GHz to 18 GHz; -25 to 0 dB	1.0 dB
Trace noise magnitude (0 dBm Output Power, IF Bandwidth 3 kHz)	0.01 dB RMS
Temperature dependence	0.020 dB/°C

Effective System Data[2]

Effective directivity	45 dB
Effective source match	37 dB
Effective reflection tracking	0.10 dB

[1] All specifications subject to change without notice.
[2] At 23 °C +/- 5 °C after 30 minutes of warming-up, with +/- 1°C ambient deviation from calibration temperature, at 0 dBm output power and IF BW 100 Hz



Test Port

Directivity (without system error correction)	10 dB, 15 dB typ.
Match (without system error correction)	10 dB, 15 dB typ.
Output Power	
Power range	-15 to 0 dBm
Power resolution	0.05 dB, typ.
Power accuracy	±1.5 dB, typ.
Interference immunity	+17 dBm
Damage level	+23 dBm
Damage DC voltage	50 V

Measurement Speed

Measurement time per point, min typ.	100 µs

General Data

External reference frequency	10 MHz
Input level	2 dBm ± 2 dB
Input impedance at Ref input	50 Ohm
Connector type	SMA, female
Output reference signal level at 50 Ohm impedance	3 dBm ± 2 dB
Ref connector type	SMA, female
External trigger	3.3 V CMOS, TLL compatible
Pulse width	More than 1 us
Input impedance at Ext Trig	At least 10 kOhm
Input connector type	SMA, female

Atmospheric Tolerances

Operating temperature range	-10°C to 50°C
Storage temperature range	-50°C to 70°C
Humidity	90% at 25°C
Atmospheric pressure	84.0 kPa to 106.7 kPa

Factory Adjustment

Recommended factory adjustment interval	3 Years

System & Power

Operating systems	Windows XP/Vista/7/8/10
CPU frequency	1.0 GHz
RAM	2.0 GB
External Power Supply	+5DVC±5%
Power Consumption	8.0 W
USB Connector Type	USB type-C, female
Weight	0.5 kg/17.6 oz

Technology is supposed to move. It's supposed to change and update and progress. It's not meant to sit stagnant year after year simply because that's how things have always been done.

The engineers at Copper Mountain Technologies are creative problem solvers. They know the people using VNAs don't just need one giant machine in a lab. They know that VNAs are needed in the field, requiring portability and flexibility. Data needs to be quickly transferred, and a test setup needs to be easily automated and recalled for various applications. The engineers at Copper Mountain Technologies are rethinking the way VNAs are developed and used.

Copper Mountain Technologies' VNAs are designed to work with the Windows PC you already use via USB interface. After installing the test software, you have a top-quality VNA at a fraction of the cost of a traditional analyzer. The result is a faster, more effective test process that fits into the modern workspace. This is the creativity that makes Copper Mountain Technologies stand out above the crowd.

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	R54	R60	R140	R180
Frequency Range	85 MHz to 5.4 GHz	1 MHz to 6 GHz	85 MHz to 14 GHz	1 MHz to 18 GHz
External frequency reference	No	10 MHz	32 MHz	10 MHz
External trigger	No	Input/Output	Input/Output	Input/Output
Power connector	USB mini-B	Reinforced (rugged) USB mini-B	USB mini-B	Reinforced (rugged) USB-C or +5V external
Adjustable output power	Hi/Low/Off	0.25 dB steps	Hi/Low/Off	0.05 dB steps
S21, S12 measurements	Scalar, with specialized software (available upon request)		Scalar, with specialized software (available upon request)	