

PLANAR R54

Vector Reflectometer



COPPER MOUNTAIN
TECHNOLOGIES



KEY FEATURES

- ▶ Frequency range: 85 MHz – 5.4 GHz
- ▶ Reflection coefficient magnitude and phase, cable loss, DTF
- ▶ Transmission coefficient magnitude when using two reflectometers
- ▶ Dynamic range: 87 dB, typ. at 1 kHz IF bandwidth
- ▶ Measurement time per point: 200 μ s
- ▶ Frequency setting resolution 10 Hz
- ▶ Time domain with gating standard
- ▶ Powered and operated via USB interface
- ▶ No test cable needed



COPPER MOUNTAIN TECHNOLOGIES

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Real Performance, Real Value.

Advanced

CMT analyzers take advantage of breakthrough advances in RF technology as well as the faster processing power, larger display, and more reliable performance of an external PC, while also simplifying maintenance of the analyzer.

Accurate

Our VNAs are made with high standards. Every instrument is lab-grade quality, with a low noise floor, high resolution sweep, and a variety of other advanced features. The metrology of the Planar R54 delivers real measurement accuracy and reliability.

Cost Effective

CMT VNAs are flexible, easy to maintain, and are well-suited for lab, production, field, and secure testing environments. With every bit of performance of traditional analyzers, but at a fraction of the cost, now every engineer and technician can have a highly accurate VNA.





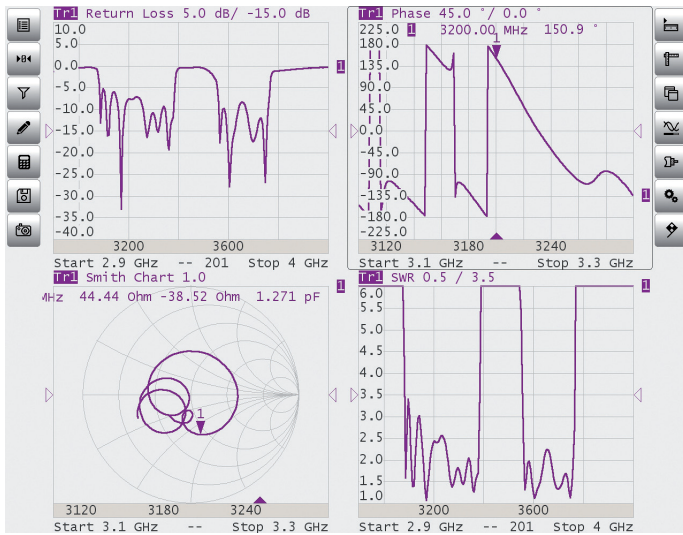
Planar R54 is a PC-driven vector reflectometer that operates in the frequency range from 85 MHz to 5.4 GHz. It is designed for use in the process of development, production, and field testing of various electronic devices in multiple environments, including operation as a component of an automated measurement system.

Planar R54 connects directly to the DUT without the use of a test cable, so there is higher calibration stability in the test setup and the cost of accessory replacement is significantly decreased. The device works with software on an external PC and is powered and operated by a USB interface.

This reflectometer is unique for its ultra compact dimensions. At just 8.8 oz, it is easily transported between workstations or used in applications requiring mobility. Planar R54 presents an excellent value solution for engineers and technicians: while it performs with the accuracy of a benchtop unit, it is equally well suited to field use or mass production environments.



Measurement Capabilities

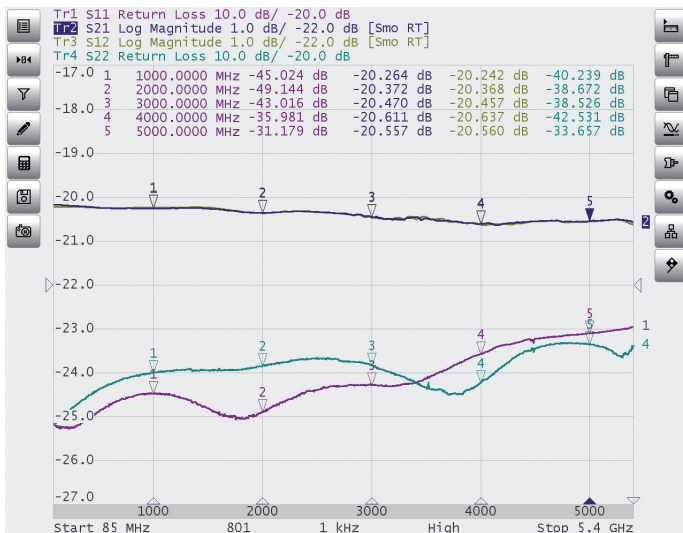


Measured parameters

S_{11} , cable loss
 S_{11} , $|S_{21}|$, $|S_{12}|$, S_{22} - using two Reflectometers.

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.

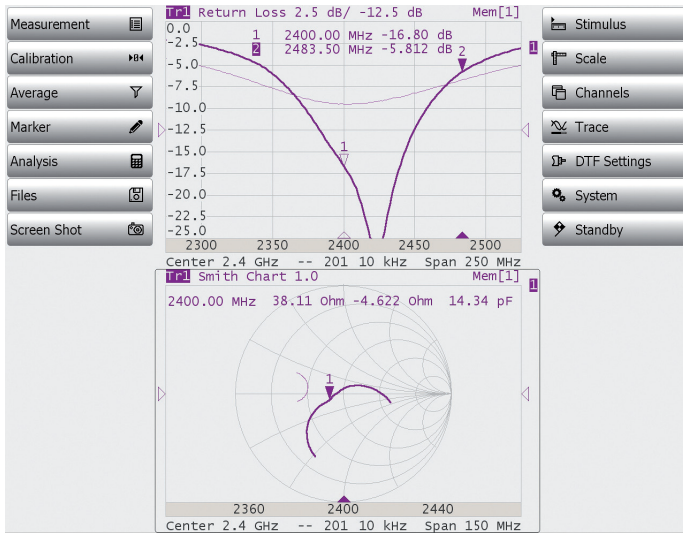


Data traces

Up to 4 data traces can be displayed in each channel window. A data trace represents one parameter of the DUT such as magnitude and phase of S_{11} , DTF, cable loss.

Memory traces

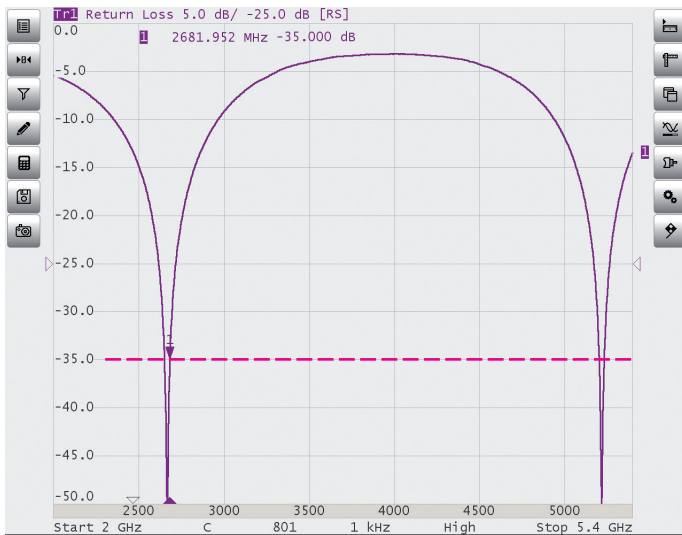
Each of the 4 data traces can be saved into memory for further comparison with the current values.



Data display formats

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

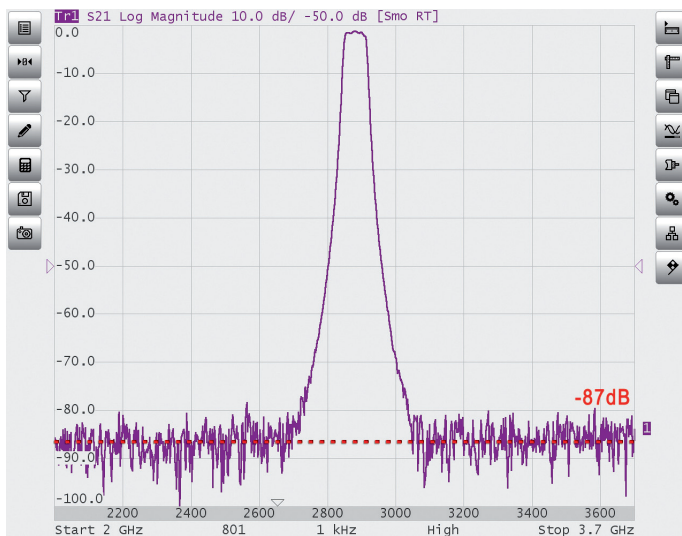
Measurement Range



Planar R54 has a high accuracy and can measure return loss up to 35 dB, which is a specification typical of benchtop instrumentation.

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 $|S_{21}|$ measurement using two reflectometers is 87 dB across the entire frequency range (at 1 kHz IF bandwidth)



Sweep Features

Sweep Type	
Lin	
Log	
Segment	
Cancel	Ok

Sweep type

Linear frequency sweep, logarithmic frequency sweep, and segment frequency sweep.

Measured points per sweep

Set by the user from 2 to 16,001.

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

High: -10 dBm and low: -30 dBm.

Sweep trigger

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

Trace Functions

Trace List	
Add Trace	Delete Trace
No	Format
1	Smith Chart
Memory Trace ON	
Data Math OFF	
Load S1P	Load S2P
Ok	

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 to load into data memory Touchstone file (*.s1p and *.s2p).

Autoscaling

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

Electrical delay

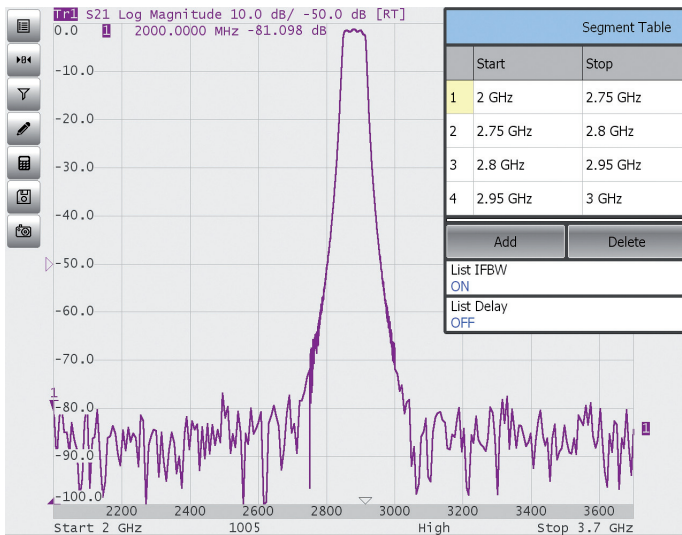
Calibration plane moving to compensate for the delay in the test setup. Compensation for electrical delay in a DUT during measurements of deviation from linear phase.

Phase offset

Phase offset is defined in degrees.

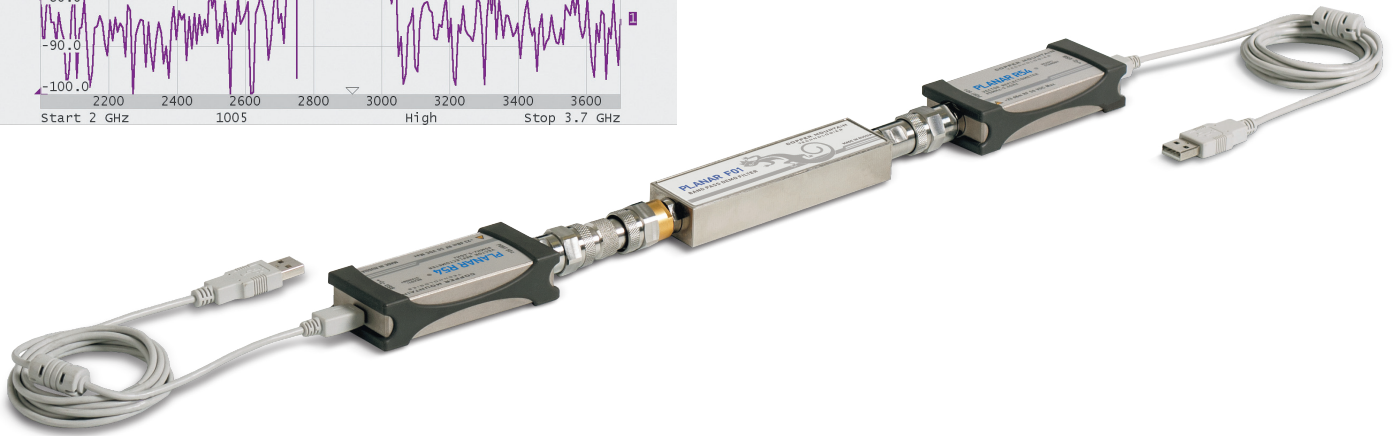
Scale	
Auto Scale	Auto Ref. Value
Scale 10 dB/div	
Reference Value -50 dB	
Divisions 10	
Ref. Position 5	
Electrical Delay 0 ps	- +
Phase Offset 0 °	- +
Ok	

Frequency Scan Segmentation



Planar R54 has a large frequency range with the option of frequency scan segmentation. This allows the user an opportunity to use the reflectometer, for example, to realize the maximum dynamic range while maintaining high measurement speed.

Two reflectometers are shown with a demo filter. Users can measure $|S_{21}|$ and $|S_{12}|$ of the DUT using two reflectometers connected to the same USB hub.



Port Extension

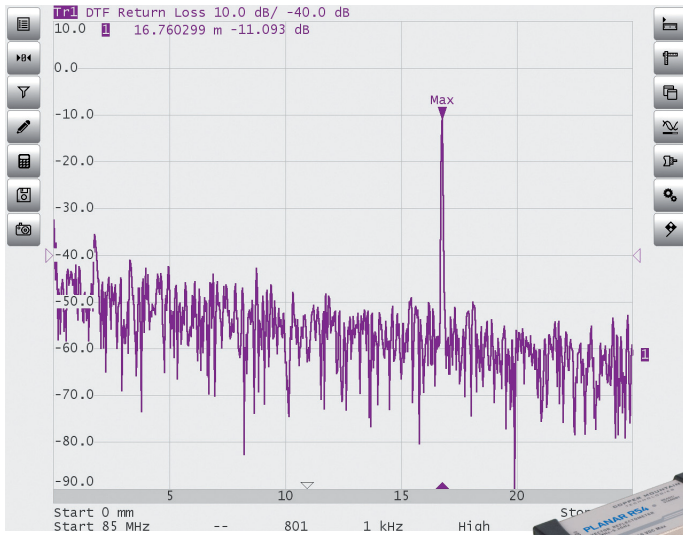
Port Extension	
Port Extension OFF	
Extension Port 0 ps	
Loss 1 OFF	Loss 2 OFF
Loss 1 0 dB	Loss 2 0 dB
Frequency 1 1 GHz	Frequency 2 1 GHz
Loss at DC 0 dB	
Auto Port Extension	
Ok	

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.



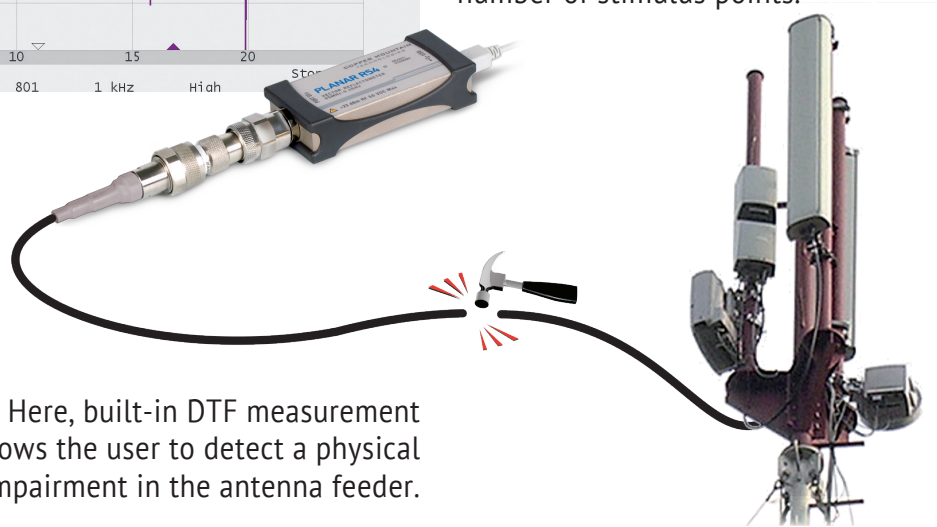
Time Domain Measurements



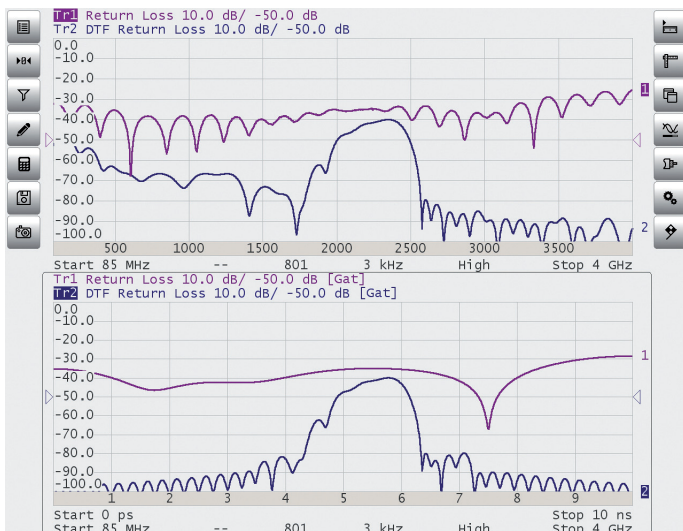
Distance to Fault (DTF)

DTF mode is enabled by selecting either the DTF SWR or DTF return loss format. The instrument will automatically transform measured data from the 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.



Here, built-in DTF measurement allows the user to detect a physical impairment in the antenna feeder.

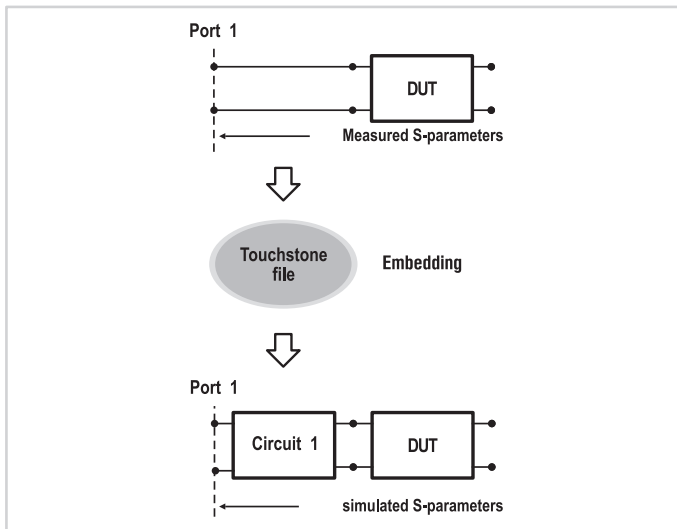


Gating

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.

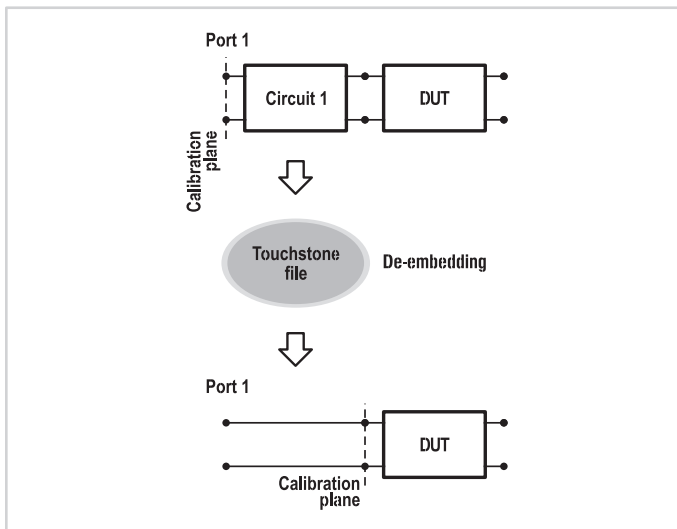
Gating filter types: bandpass or notch. For a better tradeoff between gate resolution and level of spurious sidelobes the following filter shapes are available: maximum, wide, normal and minimum.

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



The function allows 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

Port ZConversion

OFF

Port Z0

50 Ohm

This is the function 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

Conversion	
Impedance Z	
Admittance Y	
Inverse 1/S	
Conjugation	
Cancel	Ok

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

Data Output

Files	
Autosave OFF	
Save Type State	
Save State	Recall State
Format S1P Real-Imaginary	
Save S1P	Save Data
Save Image	Ok

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.

Trace Data CSV File

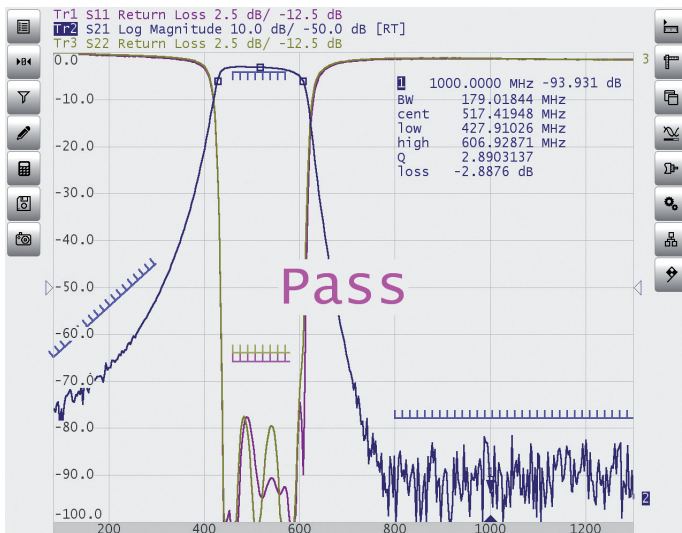
The VNA allows the user to save an individual trace data as a CSV file (comma separated values). The active trace stimulus and response values in the current format are saved to *.CSV file. Only one trace data are saved to the file.

Touchstone Format	
Real-Imaginary	
Magnitude-Angle	
dB-Angle	
Cancel	Ok

Trace Data Touchstone File

Planar R54 allows the user to save S-parameters to a Touchstone file. The Touchstone file contains the frequency values and S-parameters. The files of this format are typical for most of circuit simulator programs. S_{11} parameters are saved using *.s1p files. Only one (active) trace data are saved to the file.

Limit Testing



Setting Pass-Fail Tests

The limit test is a function of automatic pass/fail judgment for the trace of the measurement result. The judgment is based on the comparison of the trace to the limit line set by the user.

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

Measurement Automation



COM/DCOM compatible

Planar R54 software is COM/DCOM compatible allowing the unit to be used as a part of measuring stands and different special applications. COM/DCOM automation is used for remote control and data exchange with the user software.

The Planar R54 program runs as a COM/DCOM server, while the user program runs as COM/DCOM client. The COM client runs on the VNA PC, and the DCOM client runs on a separate PC connected via LAN.

LabView compatible

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

Accuracy Enhancement



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 reflectometers)
- ▶ 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 defining are available: standard definition by polynomial model 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.

Technical Specifications

MEASUREMENT RANGE

Impedance	50 Ω (75 Ω connectors via adapters)
Test port connector	N-type, male
Number of test ports	1
Frequency range	85 MHz to 5.4 GHz ¹
Full CW frequency accuracy	$\pm 5 \times 10^{-6}$
Frequency setting resolution	10 Hz
Number of measurement points	2 to 16,001
Measurement bandwidths	100 Hz to 30 kHz (with 1/3 step)
Cable loss measurement range	35 dB
Dynamic range of $ S_{21} ^2$ (IF bandwidth 1 kHz)	87 dB, typ.

MEASUREMENT ACCURACY

Accuracy of reflection measurements (magnitude / phase)³

-15 dB to 0 dB	0.4 dB / 4°
-25 dB to -15 dB	1.5 dB / 7°
-35 dB to -25 dB	4.0 dB / 22°

Accuracy of transmission magnitude measurements²

-40 dB to 0 dB	1.0 dB
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Trace stability

Trace noise magnitude (high output power, IF bandwidth 1 kHz)	0.015 dB rms
Temperature dependence (per one degree of temperature variation)	0.02 dB

EFFECTIVE SYSTEM DATA

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

¹ All specifications in the frequency range from 4.8 to 5.4 GHz are typical.

² Measurement of $|S_{21}|$ using two reflectometers connected to the same USB hub. Applies at high output power and 1 kHz IF bandwidth.

³ Applies over the temperature range 23°C \pm 5°C after 5 minutes of warming up, with less than 1°C deviation from the full one-port calibration temperature at high output power and 100 Hz IF bandwidth.

EFFECTIVE FACTORY CALIBRATED DATA

	From 85 MHz to 4.0 GHz	From 4.0 GHz to 5.4 GHz
Effective directivity	36 dB	32 dB

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	200 μ s
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GENERAL DATA

Operating temperature range	-10°C to +50°C
Storage temperature range	-40°C to +55°C
Humidity	90% at 25°C
Atmospheric pressure	84 to 106.7 kPa
Calibration interval	3 years

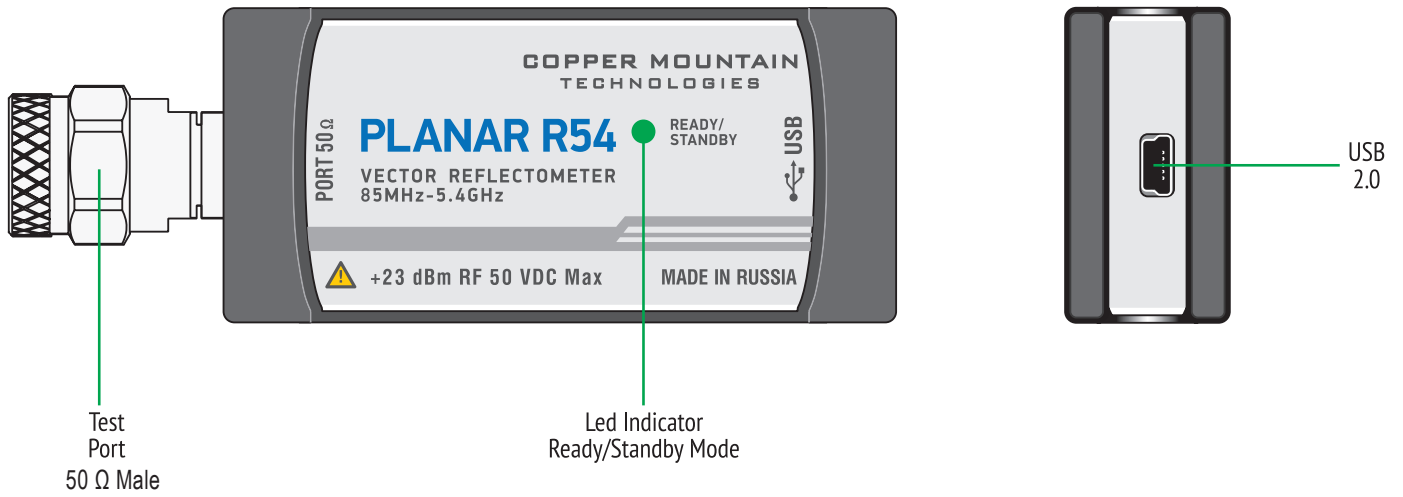
External PC system requirements:

Operating system	WINDOWS XP, VISTA, 7, 8
CPU frequency	1 GHz
RAM	1 GB

Connection to PC

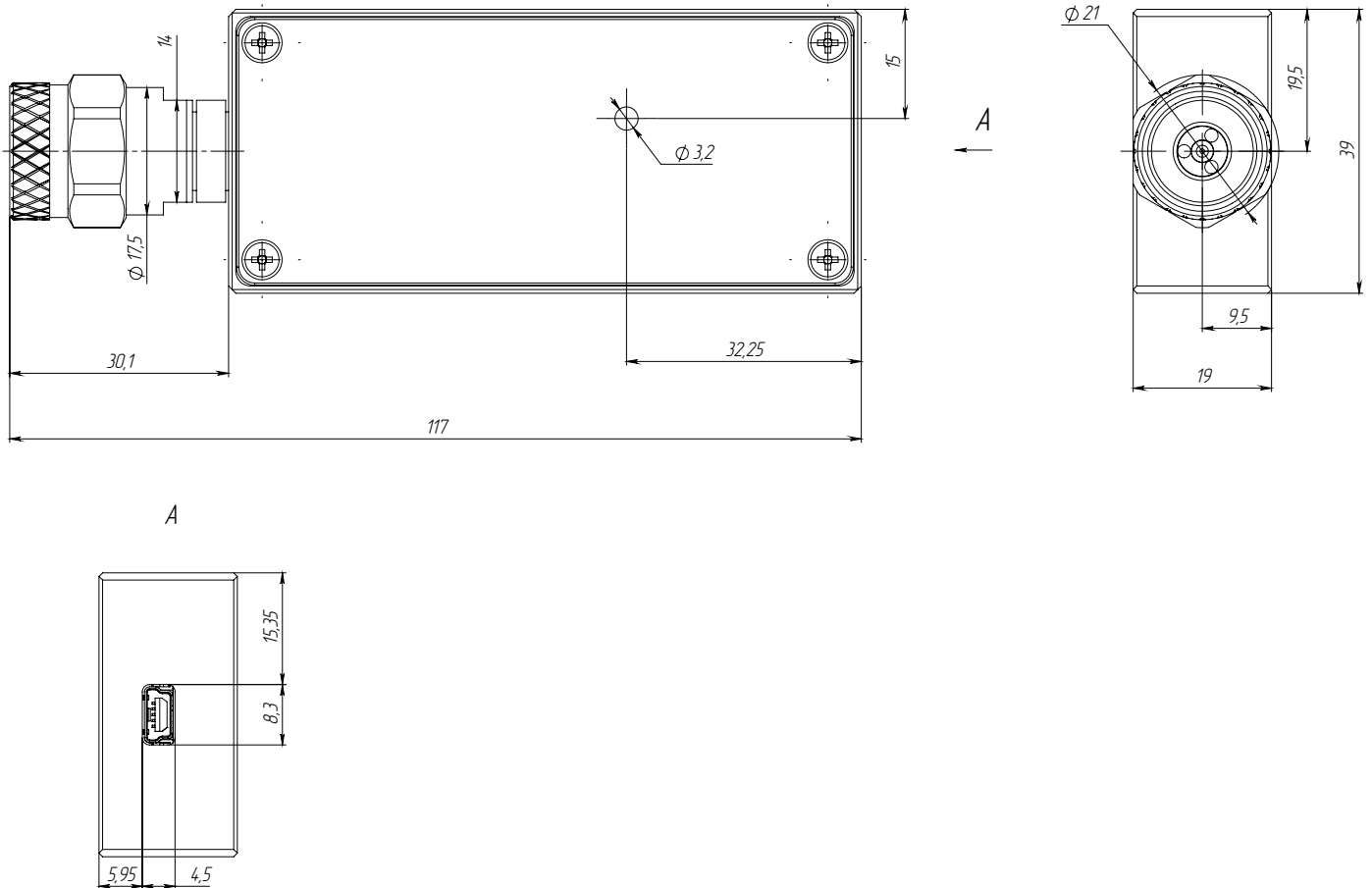
Connector type	Mini USB B
Interface	USB 2.0
Power consumption	2 W
Dimensions (L x W x H)	4.7 x 1.7 x 0.9 in
Weight	8.8 oz

Planar R54 Device Overview



Planar R54 Mechanical Dimensions

All mechanical measurements in millimeters



Applications



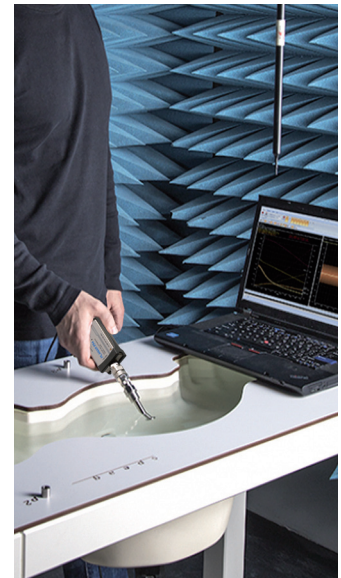
Antenna testing

Planar R54 easily fits into many field test applications. It can be used with a ruggedized laptop to perform critical measurements in the field, such as antenna feeder systems. Because no test cable is needed, calibration stability is higher in the test setup and the cost of accessory replacement is significantly decreased.



Materials Test

The Planar R54 allows the user perform measurement of material properties, such as dielectric constant and dielectric loss tangent. Its compact size and lack of test cables allowed SPEAG to use a reflectometer with a probe to perform materials testing.



Other Applications

For more information on the uses of our devices, view the videos on our web site, www.coppermountaintech.com.



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