Compact Series:

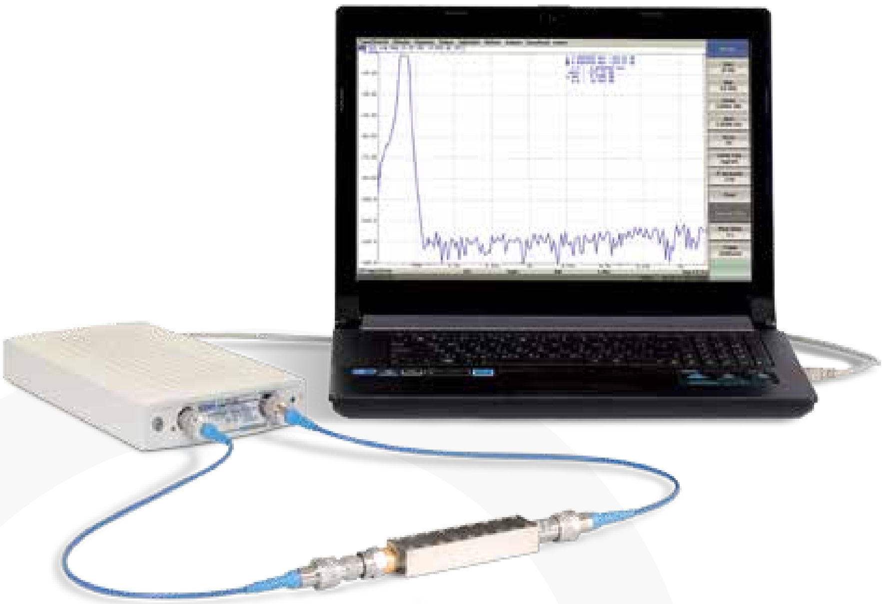
S5065 & S5085

Vector Network Analyzers

Telemeter Electronic

KEY FEATURES

- **Frequency range:** 9 kHz - 6.5 or 8.5 GHz
- **Measured parameters**: S11, S12, S21, S22
- **Wide output power adjustment range:** -50 dBm to +5 dBm
- **Dynamic Range:** 130 dB (1 Hz IF bandwidth) typ.
- **Measurement time per point:** 70 µs per point, min typ.
- Up to **16 logical channels with 16 traces** each
- **COM/DCOM compatible** for LabView, Python, MATLAB, .NET and automation programming
- **Time domain and gating** conversion included
- **Fixture simulation**
- **Frequency offset mode**, including vector mixer calibration measurements
- Up to **200,001 measurement points**
- Multiple **precision calibration** methods and automatic calibration



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 wide dynamic range, low noise floor, high resolution sweep, and a variety of other advanced features. The metrology of S5065 and S5085 deliver 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.

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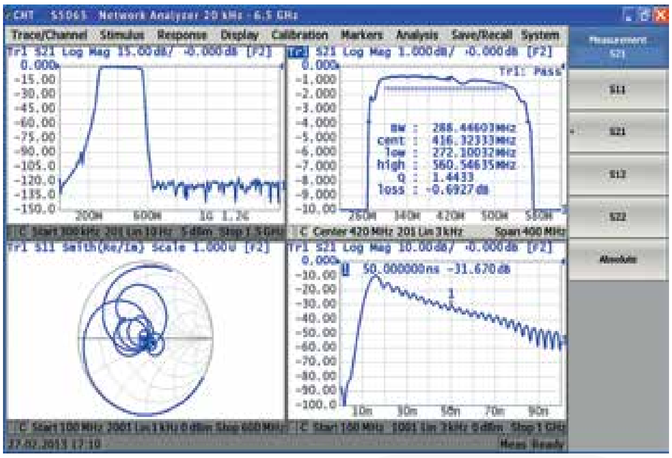
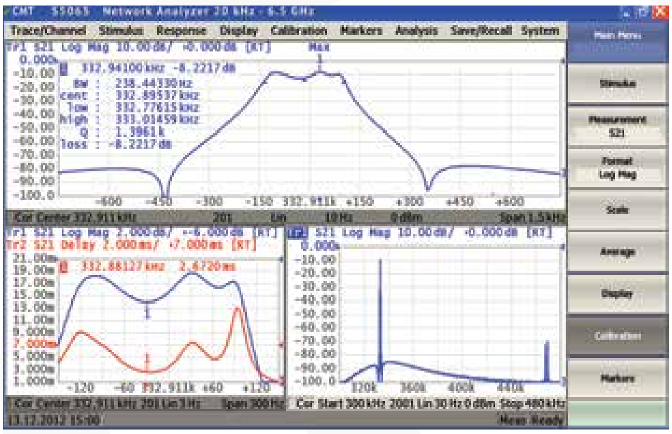
The S5065 and S5085 VNAs are S-parameter vector network analyzers designed for operation with an external PC. They connect to any Windows-based computer via USB and deliver accurate testing and measurement through a platform that can keep up with constant advancements as well as be remotely accessed.

S5065 and S5085 are designed for use in the process of development, adjustment and testing of various electronic devices in industrial and laboratory facilities, including operation as a component of an automated measurement system. S5065 and S5085 are designed for operation with an external PC (not supplied with the analyzer). The following product brochure outlines the various features that are standard on the device. To learn more about the software functions and capabilities, download our demo software from the CMT website.

Measurement Capabilities





Measured parameters
S5065/S5085: S_{11}, S_{21}, S_{12}, S_{22}

Both models also measure absolute power of the reference and received signals at the port.

Number of measurement channels
Up to 16 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, or power level.

Data traces
Up to 16 data traces can be displayed in each channel window. A data trace represents one of such parameters of the DUT as S-parameters, response in time domain, or input power response.

Memory traces
Each of the 16 data traces can be saved into memory for further comparison with the current values.

Data display formats
Logarithmic magnitude, linear magnitude, phase, expanded phase, group delay, SWR, real part, imaginary part, Smith chart diagram and polar diagram display formats are available.

Dynamic Range

Typical dynamic range of 123 dB is achieved from 300 kHz through the top of the frequency range (at 10 Hz IF bandwidth). Seen here is the maximum dynamic range achieved when using IFBW 1 Hz and an output power level of 5 dBm.

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Sweep Features

Sweep type
Linear frequency sweep, logarithmic frequency sweep, and segment frequency sweep occur when the stimulus power is a fixed value. Linear power sweep occurs when frequency is a fixed value.

Measured points per sweep
Set by the user from 2 to 200,001.

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

Power
Source power from –50 dBm to +5 dBm with resolution of 0.05 dB. In frequency sweep mode, the power slope can be set to up to 2 dB/GHz for compensation of high frequency attenuation in connection wires.

Sweep trigger
Trigger modes: continuous, single, or hold.
Trigger sources: internal, manual, external, bus.

Trace Functions

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

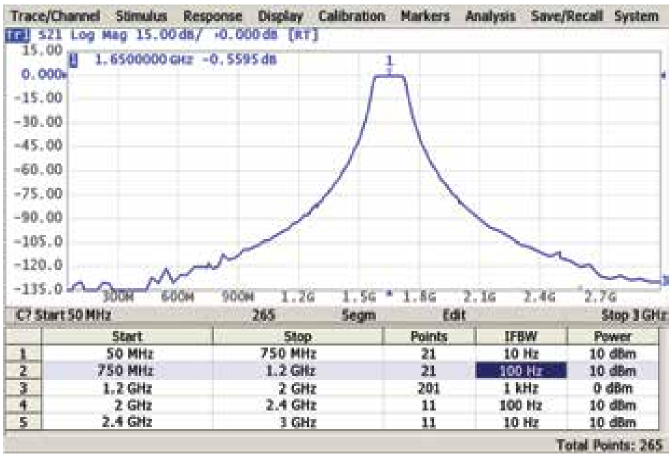
Trace math
Data trace modification by math operations: addition, subtraction, multiplication or division of measured complex values and memory data.

Autoscaling
Automatic selection of scale division and reference level value allow the most effective display of the trace.

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

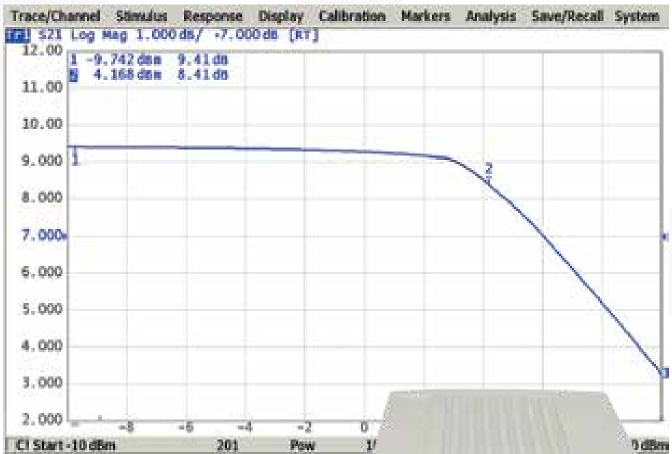
Phase offset
Phase offset is defined in degrees.

Frequency Scan Segmentation

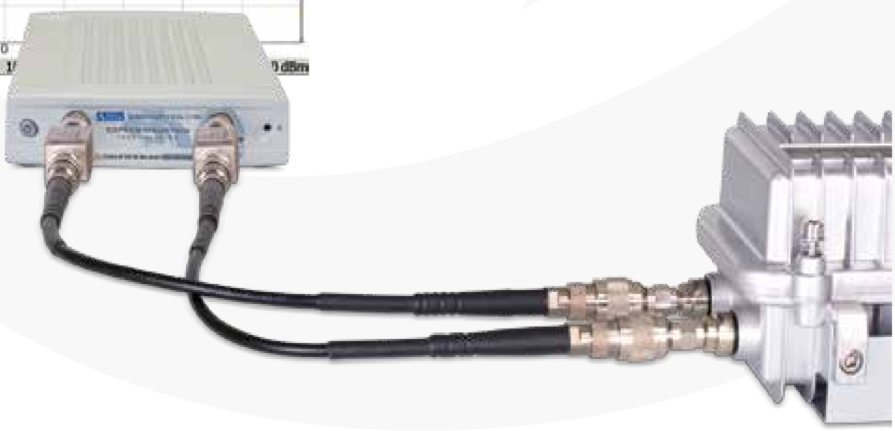


The VNA has a large frequency range with the option of frequency scan segmentation. This allows optimal use of the device, for example, to realize the maximum dynamic range while maintaining high measurement speed.

Power Scanning and Compression Point Recognition



The power sweep feature turns compression point recognition, one of the most fundamental and complex amplifier measurements, into a simple and accurate operation.



Pictured here is an S5085 VNA testing a 75 Ω amplifier with two CMT AP50NM75NF Impedance Matching Pads.

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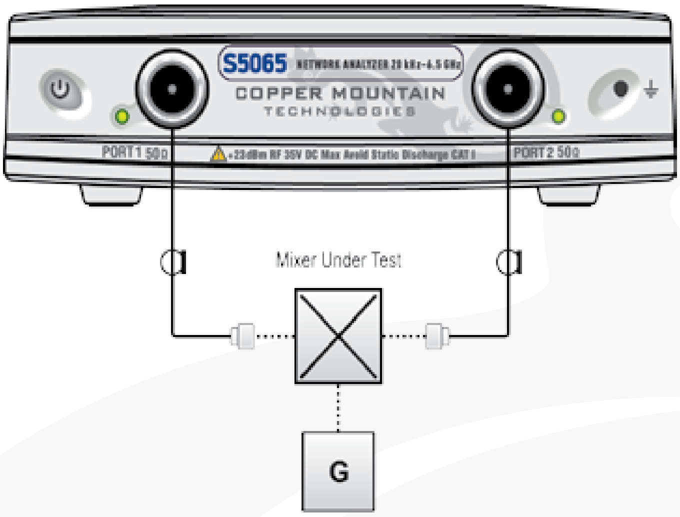
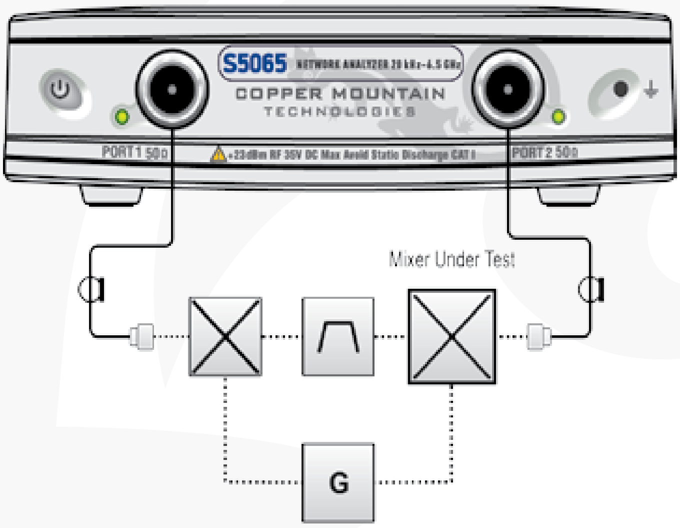
Mixer/Converter Measurements



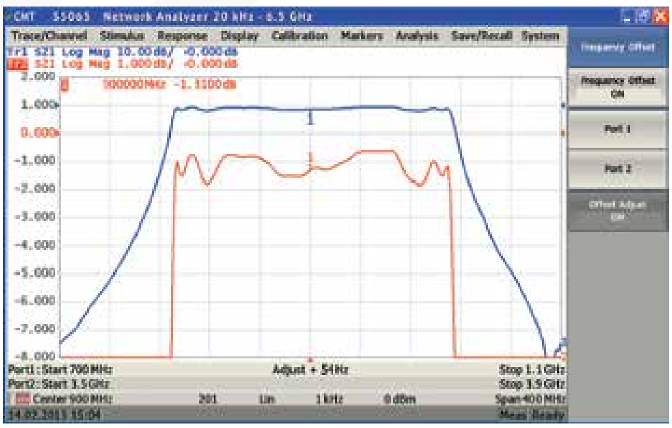
Scalar mixer / converter measurements
The scalar method allows the user to measure only the magnitude of the transmission coefficient of the mixer and other frequency translating devices. No external mixers or other devices are required. The scalar method employs port frequency offset when there is a difference between the source port frequency and the receiver port frequency.

Scalar mixer / converter calibration
This is the most accurate method of calibration applied for measurements of mixers in frequency offset mode. The OPEN, SHORT, and LOAD calibration standards are used. An external power meter should be connected to the USB port directly or via a USB/GPIB adapter.



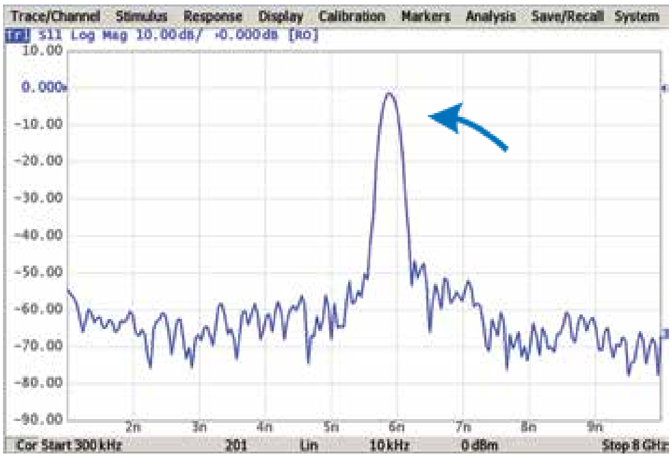
Vector mixer / converter measurements
The vector method allows the measurement of both the magnitude and phase of the mixer transmission coefficient. This method requires an external mixer and an LO common for both the external mixer and the mixer under test.

Vector mixer /converter calibration
This method of calibration is applied for vector mixer measurements. OPEN, SHORT and LOAD calibration standards are used.



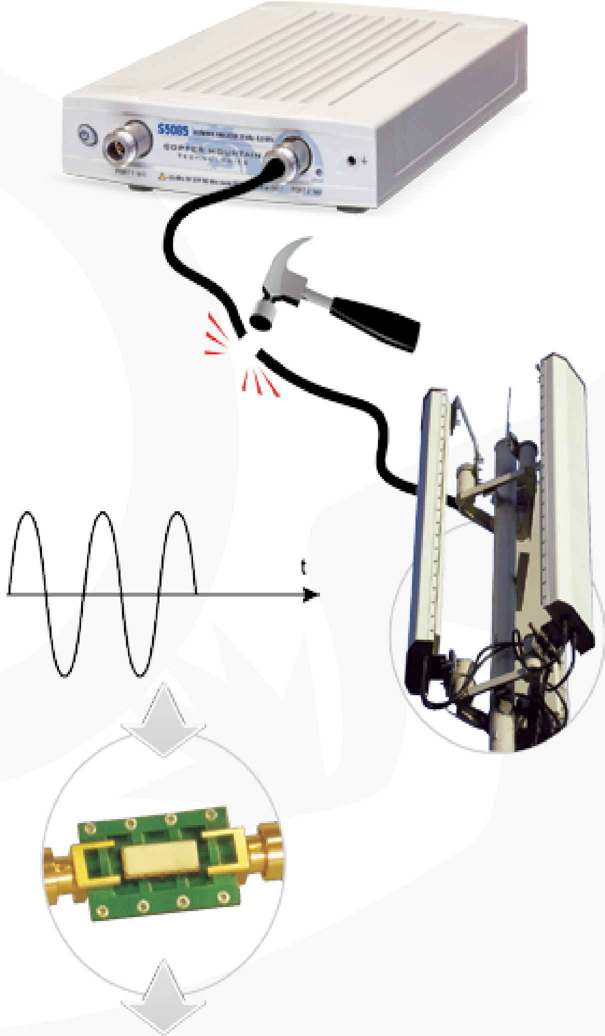
Automatic frequency offset adjustment
The function performs automatic frequency offset adjustment when the scalar mixer / converter measurements are performed to compensate for internal LO setting inaccuracy in the DUT.

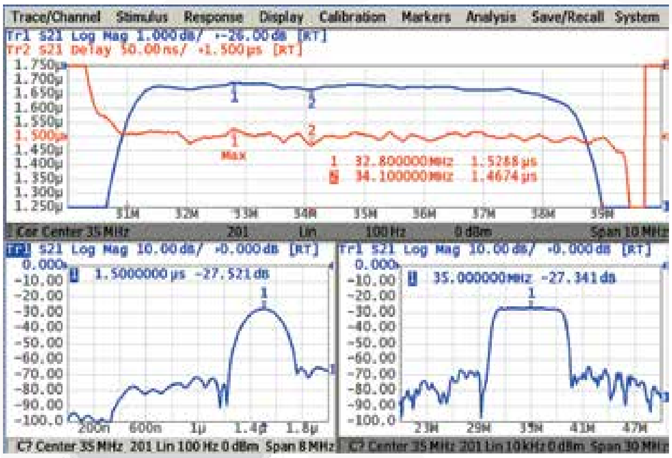
Time Domain Measurements



This function performs data transformation from frequency domain into response of the DUT to various stimulus types in time domain. Modeled stimulus types: bandpass, lowpass impulse, and lowpass step. Time domain span is set by the user arbitrarily from zero to maximum, which is determined by the frequency step. Windows of various forms are used for better tradeoff between resolution and level of spurious sidelobes.

Here, built-in time domain analysis allows the user to detect a physical impairment in the antenna feeder.





Time domain analysis allows measurement of parameters of SAW filters such as the signal time delay, feedthrough signal suppression.

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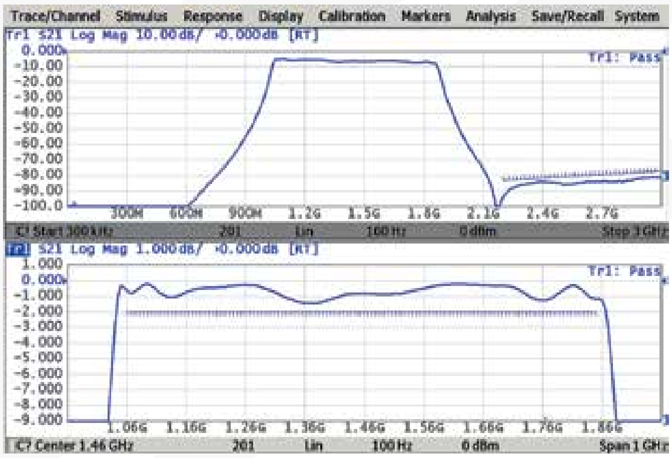
Time Domain Gating

This function mathematically removes unwanted responses in the time domain, which allows the user to obtain frequency response without influence from fixture elements.

This function applies reverse transformation back to the 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.

Applications of these features include, but are not limited to: measurement of SAW filter parameters, such as filter time delay or forward transmission attenuation.

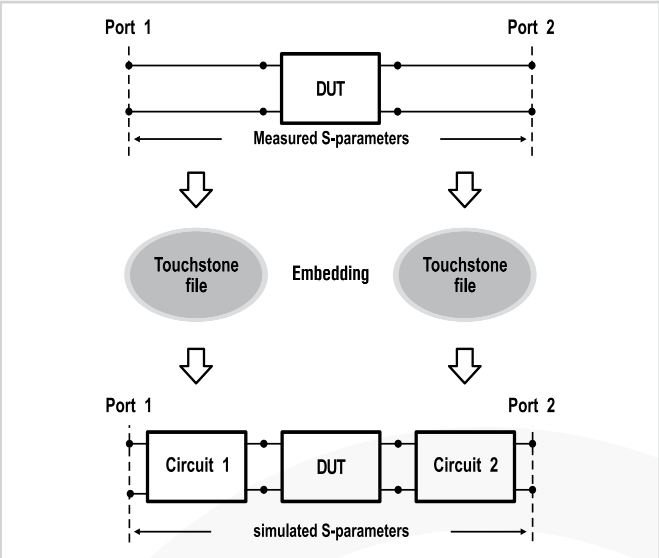
Limit Testing



Limit testing is a function of automatic pass/fail judgment for the trace of the measurement results. The judgment is based on the comparison of the trace to the limit line set by the user and can consist of one or several segments.

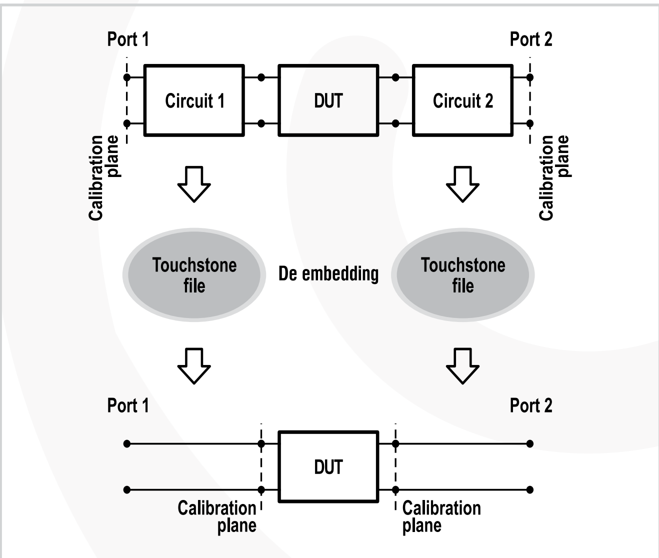
Each segment checks the measurement value for failing either the upper or lower limit, or both. The limit line segment is defined by specifying the coordinates of the beginning (X0, Y0) and the end (X1, Y1) of the segment, and type of the limit. The MAX or MIN limit types check if the trace falls outside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

Embedding



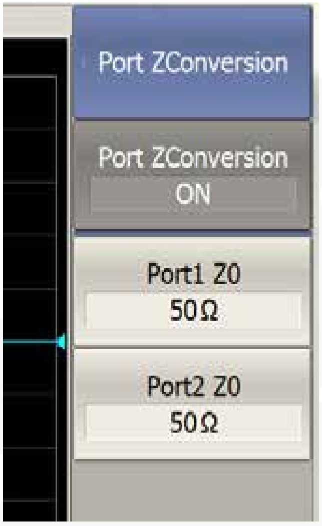
This function allows the user to mathematically simulate DUT parameters by virtually integrating a fixture circuit between the calibration plane and the DUT. This circuit should be described by an S-parameter matrix in a Touchstone file.

De-Embedding



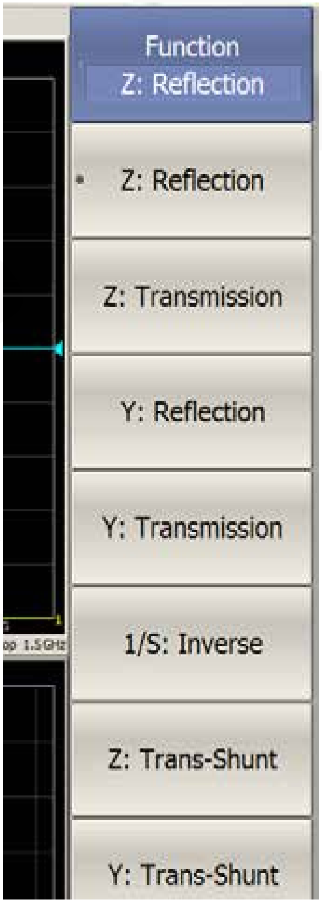
This function allows the user to mathematically exclude the effect of the fixture circuit connected between the calibration plane and the DUT from the measurement results. This circuit should be described by an S-parameter matrix in a Touchstone file.

Port Impedance Conversion



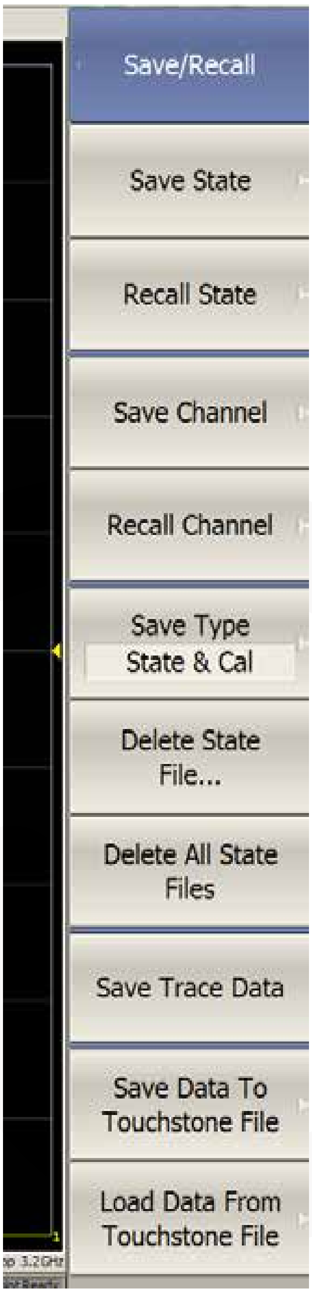
This function converts the S-parameters measured at the 50 port into values, which could be determined if measured at a test port with arbitrary impedance.

S-Parameter Conversion



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

Data Output

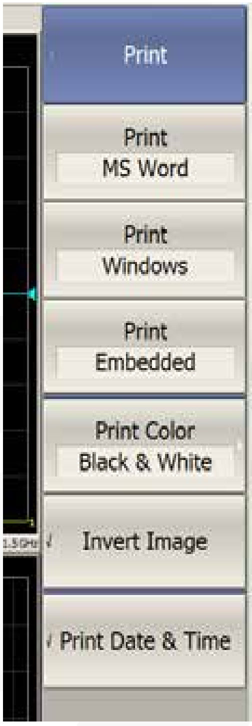


Analyzer State
All state, calibration and measurement data can be saved to an Analyzer state file on the hard disk and later uploaded back into the software program. The following four types of saving are available: State, State & Cal, Stat & Trace, or All.

Channel State
A channel state can be saved into the Analyzer memory. The channel state saving procedure is similar to saving of the Analyzer state saving, and the same saving types are applied to the channel state saving. Unlike the Analyzer state, the channel state is saved into the Analyzer inner volatile memory (not to the hard disk) and is cleared when the power to the Analyzer is turned off. For channel state storage, there are four memory registers A, B, C, D. The channel state saving allows the user to easily copy the settings of one channel to another one.

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

Trace Data Touchstone File
The Analyzer 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. The *.s2p files are used for saving all the four S-parameters of a 2-port device. The *.s1p files are used for saving S11 and S22 parameters of a 1-port device. Only one (active) trace data are saved to the file.
The Touchstone file saving function is applied to individual active channels.



Screenshot capture
The print function is provided with the preview feature, which allows the user to view the image to be printed on the screen, and/or save it to a file. Screenshots can be printed using three different applications: MS Word, Image Viewer for Windows, or the Print Wizard of the Analyzer.

Each screenshot can be printed in color, grayscale, black and white, or inverted for visibility or ink use. The current date and time can be added to each capture before it is transferred to the printing application, resulting in quick and easy test reporting.

Measurement Automation

COM/DCOM compatible
S5065 and S5085 software is COM/DCOM compatible, which allows the unit to be used as a part of an ATE station and other special applications. COM/DCOM automation is used for remote control and data exchange with the user software. The Analyzer program runs as COM/DCOM server. The user program runs as COM/DCOM client. The COM client runs on Analyzer PC. The DCOM client runs on a separate PC connected via LAN.

LabView compatible
The device and its software are fully compatible with LabView, MATLAB, and Python 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 and load match, tracking and isolation.

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

- reflection and transmission normalization
- full one-port calibration
- one-path two-port calibration
- full two-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.

One-path two-port calibration
Method of calibration performed for reflection and one-way transmission measurements, for example for measuring S11 and S21 only. It ensures high accuracy for reflection measurements, and mean accuracy for transmission measurements.

Full two-port calibration
This method of calibration is performed for full S-parameter matrix measurement of a two-port DUT, ensuring high accuracy.

TRL calibration
Method of calibration performed for full S-parameter matrix measurement of a two-port DUT. It ensures higher accuracy than two-port calibration. LRL and LRM modifications of this calibration method are available.

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

Automatic Calibration Modules (ACMs)
Electronic, or automatic, calibration modules offered by CMT make the analyzer calibration faster and easier than traditional mechanical calibration.

Sliding load calibration standard
The use of sliding load calibration standard allows significant increase in calibration accuracy at high frequencies compared to the fixed load calibration standard.

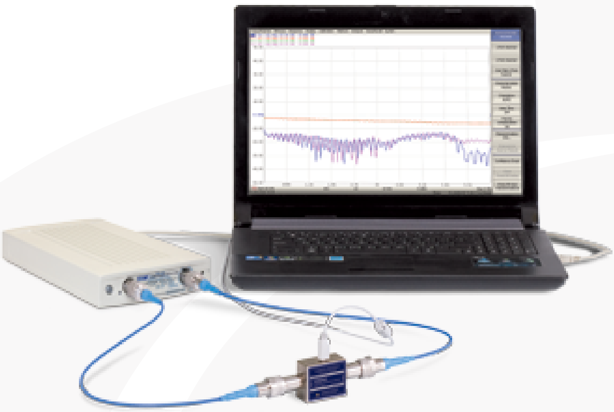
"Unknown" Thru calibration standard*
The use of a generic two-port reciprocal circuit instead of a Thru in full two-port calibration allows the user to calibrate the VNA for measurement of "non-insertable" devices.

Defining of calibration standards
Different methods of calibration standard defining are available:

- standard defining by polynomial model
- standard defining by data (S-parameters)

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

Supplemental Calibration Methods



Power calibration
Power calibration allows more stable maintainance of the power level setting at the DUT input. An external power meter should be connected to the USB port directly or via USB/GPIB adapter.

Receiver calibration
This method calibrates the receiver gain at the absolute signal power measurement.

TECHNICAL SPECIFICATIONS[1]

Measurement Range

	S5065	S5085
Impedance	50 Ω	50 Ω
Test port connector	N-type female	N-type female
Number of test ports	2	2
Frequency Range	9 kHz to 6.5 GHz	9 kHz to 8.5 GHz
Full CW Frequency	$\pm 5 \times 10^{-6}$	$\pm 5 \times 10^{-6}$
Frequency Setting Resolution	1 Hz	1 Hz
Number of Measurement Points	1 to 200,001	1 to 200,001
Measurement Bandwidths (with 1/1.5/2/3/5/7 steps)	1 Hz to 100 kHz	1 Hz to 100 kHz
Dynamic Range (IF bandwidth 10 Hz)		
9 kHz to 300 kHz	75 dB, typ. 100 dB	75 dB, typ. 100 dB
300 kHz to 4.8 GHz	125 dB, typ. 130 dB	125 dB, typ. 130 dB
4.8 GHz to 6.5/8.5 GHz	120 dB, typ. 123 dB	120 dB, typ. 123 dB

Measurement Accuracy

	S5065	S5085
Accuracy of transmission measurements (magnitude/phase)		
From 9 kHz to 300 kHz		
-20 dB to +10 dB	0.2 dB / 2°	0.2 dB / 2°
-40 dB to -20 dB	1.0 dB / 6°	1.0 dB / 6°
From 300 kHz to 6.5/8.5 GHz		
+5 dB to +10 dB	0.2 dB / 2°	0.2 dB / 2°
-50 dB to +5 dB	0.1 dB / 1°	0.1 dB / 1°
-70 dB to -50 dB	0.5 dB / 3°	0.5 dB / 3°
-90 dB to -70 dB	2.5 dB / 11°	2.5 dB / 11°
Accuracy of reflection measurements (magnitude/phase)		
-15 dB to 0 dB	0.4 dB / 3°	0.4 dB / 3°
-25 dB to -15 dB	1.0 dB / 6°	1.0 dB / 6°
-35 dB to -25 dB	3.0 dB / 20°	3.0 dB / 20°
Trace Stability		
Trace noise magnitude		
9 kHz to 300 kHz	50 mdB RMS	50 mdB RMS
300 kHz to 6.5/8.5 GHz	2 mdB RMS	2 mdB RMS
Temperature dependence	0.02 dB	0.02 dB

[1] All technical specifications subject to change without notice.

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TECHNICAL SPECIFICATIONS

Effective System Data[2]

	S5065	S5085
Effective directivity	46 dB	46 dB
Effective source match	40 dB	40 dB
Effective load match	46 dB	46 dB

Test Port

Directivity (without system error correction)		
9 kHz to 300 kHz	12 dB	12 dB
300 kHz to 6.5 GHz	18 dB	18 dB
6.5 GHz to 8.5GHz	-	12 dB

Test Port Output

Match (without system error correction)		
9 kHz to 300 kHz	12 dB	12 dB
300 kHz to 6.5 GHz	18 dB	18 dB
6.5 GHz to 8.5GHz	-	15 dB
Power Range	-50 dBm to +5 dBm	-50 dBm to +5 dBm
Power Accuracy	±1.5 dB	±1.5 dB
Power Resolution	0.05 dB	0.05 dB
Harmonics Distortion	-20 dBc	-20 dBc
Non-harmonic Spurious	-25 dBc	-25 dBc

Test Port Input

	S5065	S5085
Match (without system error correction)		
9 kHz to 300 kHz	12 dB	12 dB
300 kHz to 6.5 GHz	18 dB	18 dB
6.5 GHz to 8.5GHz	-	15 dB
Damage Level	+23 dBm	+23 dBm
Damage DC Voltage	35 V	35 V
Noise Level *(defined as the rms value of the specified noise floor, IF bandwidth 10 Hz)*		
20 kHz to 300 kHz	-80 dBm	-80 dBm
300 kHz to 4.8 GHz	-130 dBm	-130 dBm
4.8 GHz to 6.5/8.5 GHz	-125 dBm	-125 dBm

Measurement Speed

Measurement time per point, typ.	70 µs	70 µs
Source to receiver port switchover time	1 ms	1 ms

[2] Applies over the temperature range of 73°F ± 9 °F (23°C ± 5 °C) after 40 minutes of warming-up, with less than 1 °C deviation from the one-path two-port calibration temperature, at output power of -5 dBm, and 10 Hz IF bandwidth.

General Data

	S5065	S5085
External reference frequency	10 MHz	10 MHz
Input level	2 dBm ± 3 dB	2 dBm ± 3 dB
Input impedance at «10 MHz»	50 Ω	50 Ω
Connector type	BNC female	BNC female
Output reference signal level at 50 Ω impedance	3 dBm ± 2 dB	3 dBm ± 2 dB
«OUT 10 MHz» connector type	BNC female	BNC female

External Trigger Input Connector

Type	BNC, Female	BNC, Female
Input Level	Low threshold voltage: 0.5 V High threshold voltage: 2.7 V	Low threshold voltage: 0.5 V High threshold voltage: 2.7 V
Input level range	0 to + 5 V	0 to + 5 V
Pulse Width	⩾2 µsec	⩾2 µsec
Polarity	Positive or Negative	Positive or Negative

External Trigger Output Connector

Type	BNC, Female	BNC, Female
Maximum output current	20 mA	20 mA
Output level	Low level voltage: 0 V High level voltage: 3.5 V	Low level voltage: 0 V High level voltage: 3.5 V
Polarity	Positive or Negative	Positive or Negative

Atmostpheric Tolerances

Operating temperature range	+41 °F to +104 °F (+5 °C to +40 °C)	+41 °F to +104 °F (+5 °C to +40 °C)
Storage temperature range	-49 °F to +131 °F (-45 °C to +55 °C)	-49 °F to +131 °F (-45 °C to +55 °C)
Humidity	90% at 77 °F (25 °C)	90% at 77 °F (25 °C)
Atmospheric pressure	84 to 106.7 kPa	84 to 106.7 kPa

Calibration Frequency

Calibration interval	3 years	3 years

External PC System Requirements

Operating system	Windows XP, Vista, 7, 8, 10	Windows XP, Vista, 7, 8, 10
CPU frequency	1 GHz	1 GHz
RAM	512 MB	512 MB

Power Supply

Power supply AC circuit (via adapter)	110-240 V, 50/60 Hz	110-240 V, 50/60 Hz
Power consumption AC circuit	14 W	14 W
Power supply, external	DC 9-15 V	DC 9-15 V
Dimensions (L x W x H)	297 x 160 x 44 mm	297 x 160 x 44 mm
Weight	1.7 kg	1.7 kg

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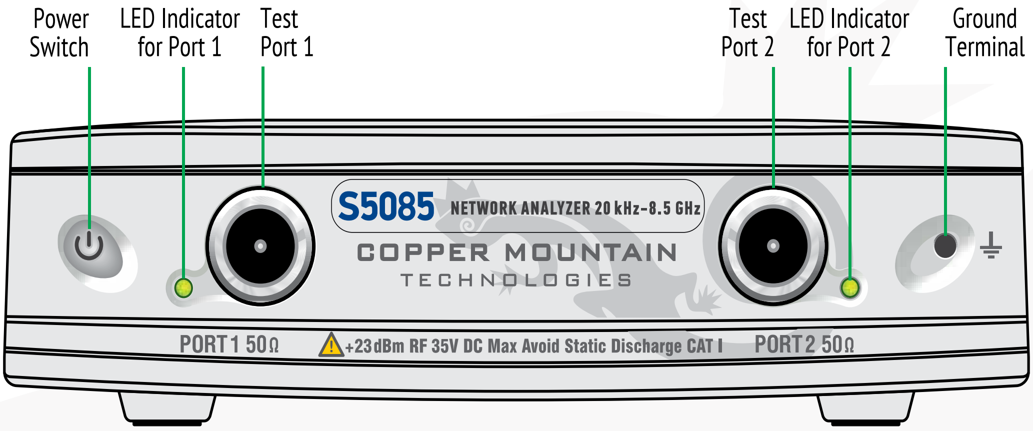
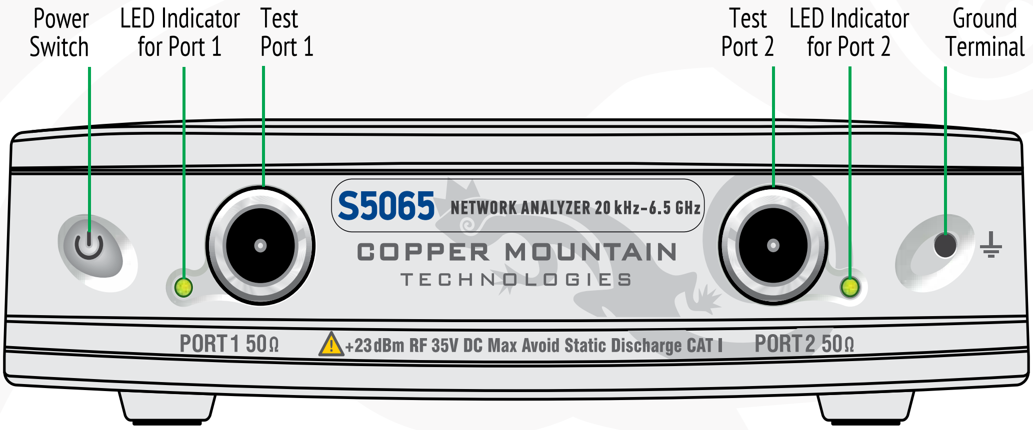
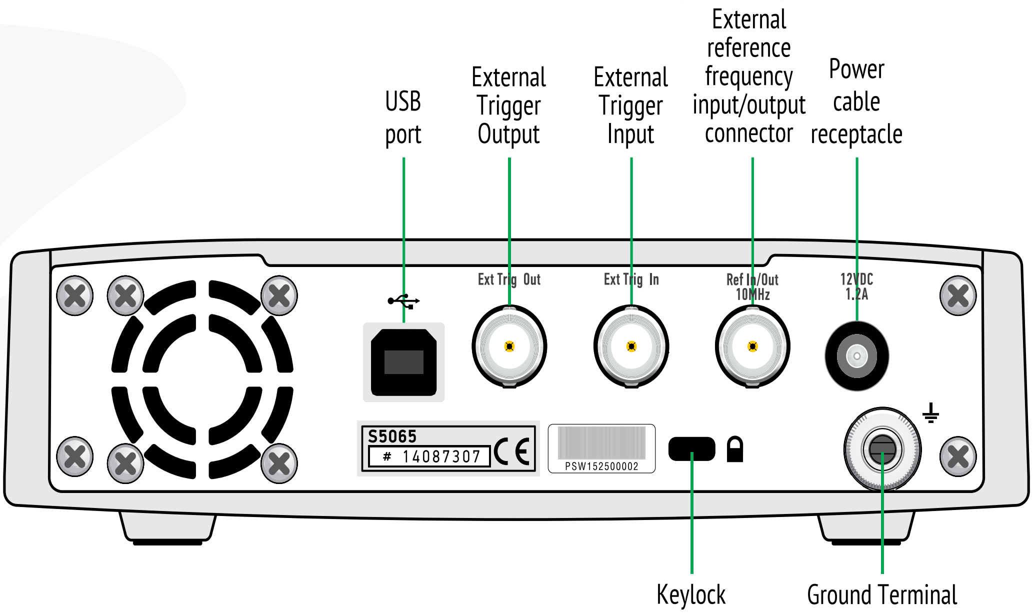
Front and Back Panels







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