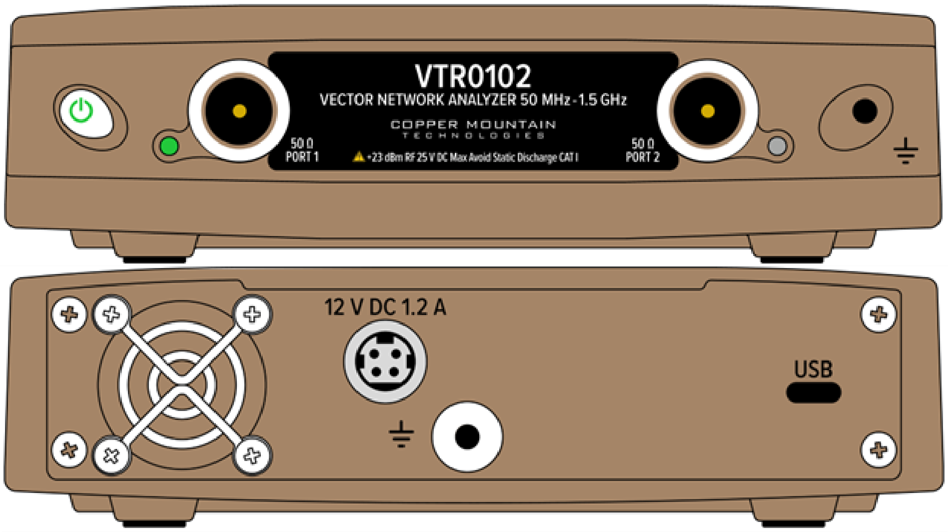
COPPER MOUNTAIN® TECHNOLOGIES
631 E New York Street | Indianapolis, IN 46202 USA
www.coppermountaintech.com

TR Series Vector Network Analyzer Datasheet and Specifications

VTR0102	50 MHz to 1.5 GHz
VTR0302	50 MHz to 3.5 GHz
Software	CMT VNA software, Windows and Linux, demo mode supported

Revision 25.00 31.10.2025

General Overview



VTR Vector Network Analyzer

Main Parameters

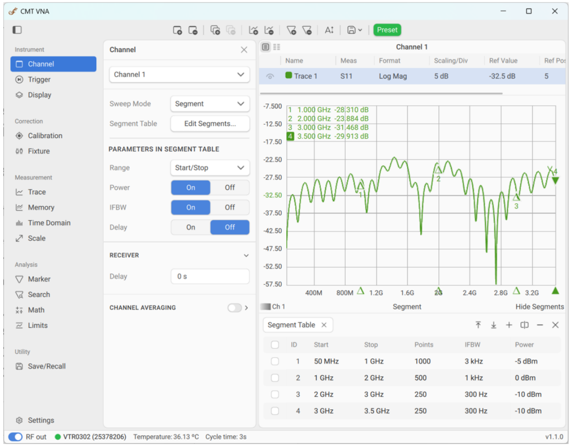
Configuration	2-port, 1-path, 50 Ohm
Measured parameters	S11, S21, RF Power
Frequency range	
VTR0102	50 MHz to 1.5 GHz
VTR0302	50 MHz to 3.5 GHz
Output power range	-25 dBm to 0 dBm
Receiver attenuator range	18 dB, 6 dB step
Dynamic range	110 dB at 10 Hz
Measurement bandwidths	1 Hz to 300 kHz
Measurement speed	35 μs typ.
Connection	USB
Software	CMT VNA, Windows or Linux
Demo mode	Free software option

CMT VNA software runs natively on Windows and Linux. It can also be used on x86 or ARM processors on PCs, tablets, or simple-board computers including Raspberry Pi.

Software Capabilities

Sweep Features

Sweep type	Sweep range, number of points, power level, CW frequency, segment sweep table, IF bandwidth, averaging, trigger mode, calibration, fixture simulator.
Trigger	Measured parameter along with conversions, display format, scale settings, electrical delay, phase offset, memory trace, math operation, smoothing, time domain, markers with search and math functions, limit test, ripple limit test, peak limit test.



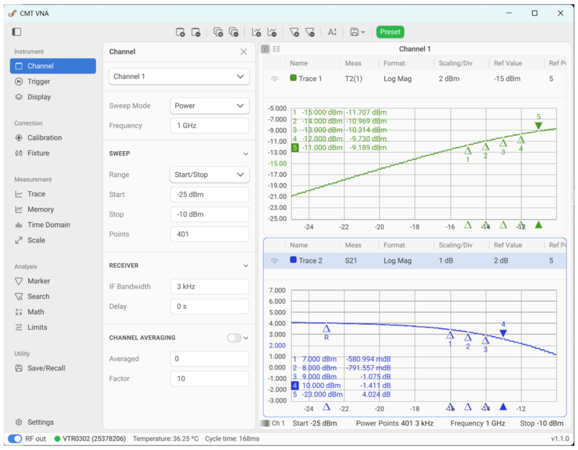
Segment Sweep Feature

Segment Sweep

In applications where a continuous sweep may be undesirable, this function allows the user to sweep frequency segments rather than the entire frequency span. This can lead to faster measurement results.

A frequency sweep can be made within several independent user-defined segments.

Frequency range, number of sweep points, IF bandwidth, source power, and delay can be set for each segment.



Power Sweep

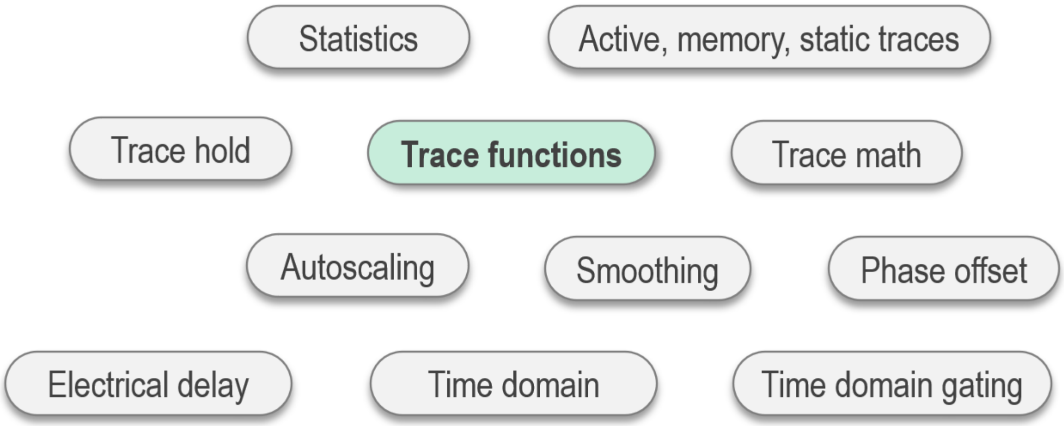
Power Sweep

The power sweep feature enables users to perform compression point recognition, one of the most fundamental and complex amplifier measurements, in a simple manner.

In this case, you can use either S21 transmission or the test receiver power measurements.

Trace Functions

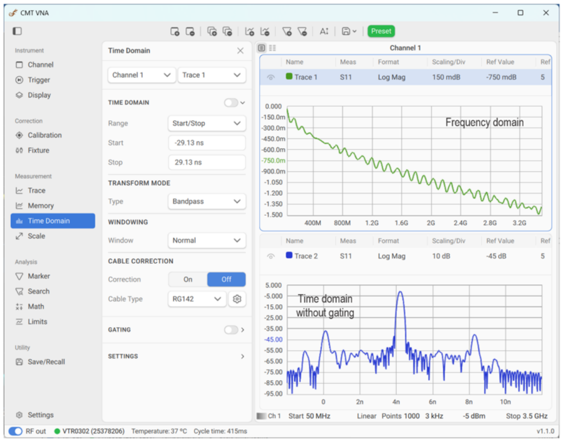
CMT VNA software incorporates many trace functions, such as:



Traces	Data trace, memory trace, or simultaneous indication of data and memory traces.
Static trace	You can recall data from a file and perform any calculation using the full range of functions available in the software.
Trace math	Data trace modification by math operations: addition, subtraction, multiplication or division (normalization) of measured complex values and memory data.
Smoothing	Smoothing averages the adjacent points of the trace by the moving window. Smoothing helps to reduce trace noises. Smoothing is set for each trace independently.
Statistics	The trace statistics feature allows to determine and view trace parameters, such as mean, standard deviation, and peak-to-peak.The range of trace statistics can be defined by two markers or band.
Trace hold	The trace hold function is used to hold the maximum or minimum values of the trace.
Autoscaling	Automatic selection of scale division and reference level value to have the trace most effectively displayed.
Electrical delay	The electrical delay function compensates for the delay of the trace measurement. This function is useful during measurements of phase deviations from linear.
Phase offset	The function applies a chosen constant phase offset to S-parameter measurements at all frequencies.

Time Domain Measurements

This function performs conversion of the DUT response from frequency domain to time domain.



Cable Measurement with Open at the End

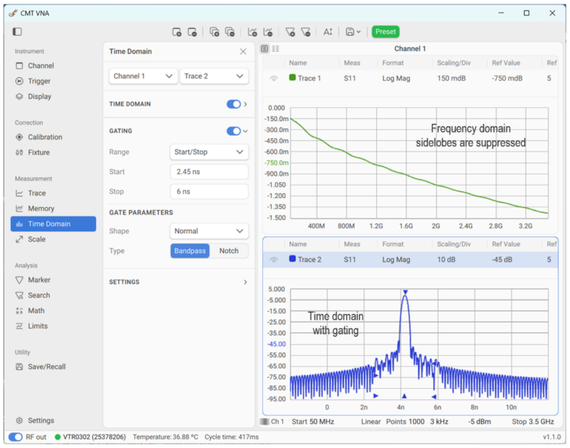
Modeled time domain stimulus types are bandpass, lowpass impulse, and lowpass step.

The time domain span is deter-mined by the frequency span and the number of measurement points.

Windowing functions of various shapes are used for tradeoff between resolution and levels of spurious sidelobes.

Time Domain Gating

This function mathematically removes unwanted responses in the time domain, allowing the user to obtain a frequency response without the effects of fixture elements.

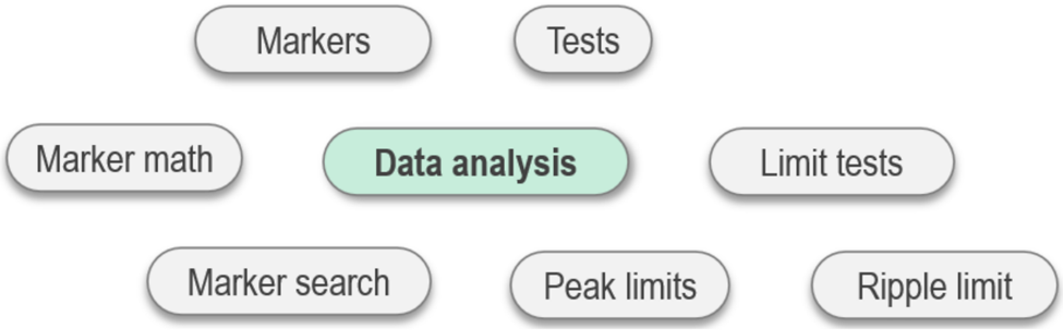


Cable Measurement with Open at the End

Reflections occurring within a chosen time span may be bandpass gated such that all other reflections are suppressed or notch gated such that reflections in the chosen time span are suppressed.

After time domain gating, the result with chosen reflections removed may be viewed in the frequency domain. Gating filter types are 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.

Data Analysis

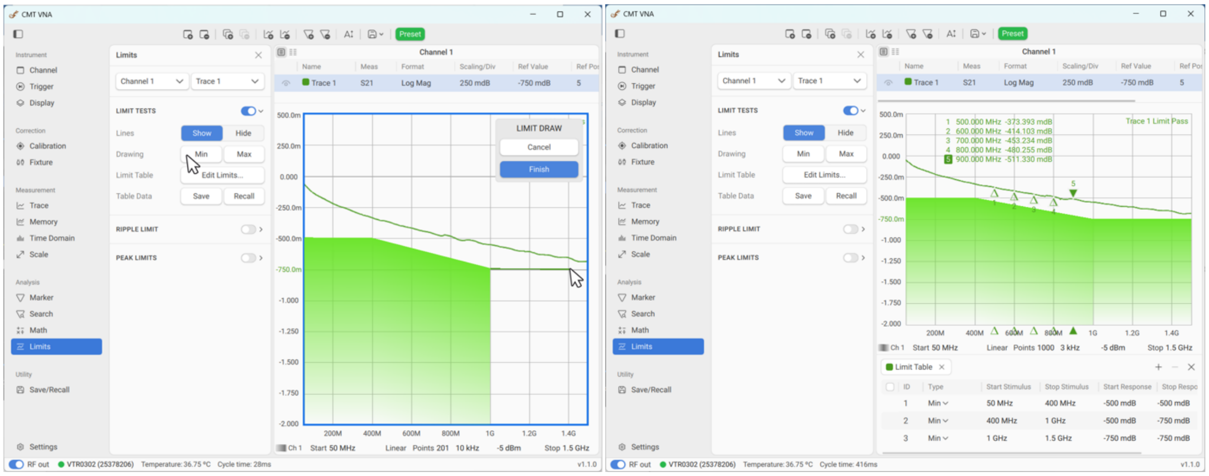


Markers	Marker tools are used to read and look up the numerical values of the stimulus and the measured value on selected points on the graph. The software has no limitations on the number of markers.
Marker search	The marker position search function allows the user to find the following values on a trace: maximum value, minimum value, peak value, target level.
Marker math	Marker math functions use markers to calculate various trace characteristics: trace statistics, bandwidth/notch search, flatness evaluation, RF filter statistics.
Limit tests	The limit test is a function of automatic pass/fail judgment for the trace of the measurement result.
Ripple limit	The ripple limit test is an automatic pass/fail check of the measured trace data. The trace is checked against the maximum ripple value. The ripple value is the difference between the maximum and minimum response of the trace in the trace frequency band.
Peak limits	The peak limits test function checks whether the trace point with the minimum or maximum value of the measured value falls within the specified limits of the frequency range and/or value range.

Limit Testing

Limit testing is a function that provides automatic pass/fail evaluation based on measurement results. The trace is compared against a user-defined limit line, which may consist of one or multiple segments. This function allow users to quickly verify compliance with specified requirements by comparing measurement traces against predefined thresholds. This ensures efficient quality control, accelerates testing, and reduces the risk of overlooking deviations from specifications.

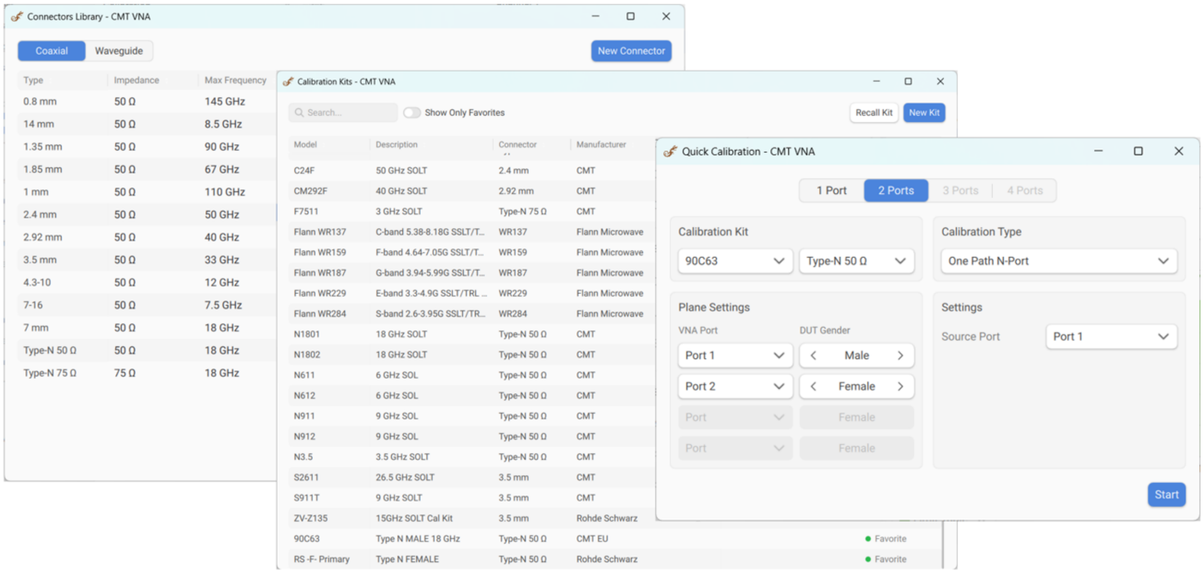
Each segment verifies whether the measurement value exceeds the upper limit, falls below the lower limit, or both. A limit line segment is defined by specifying the start coordinates (X0, Y0) and stop coordinates (X1, Y1), along with the limit type. The MAX and MIN limit types check whether the trace re-mains below or above the defined limit line, respectively.



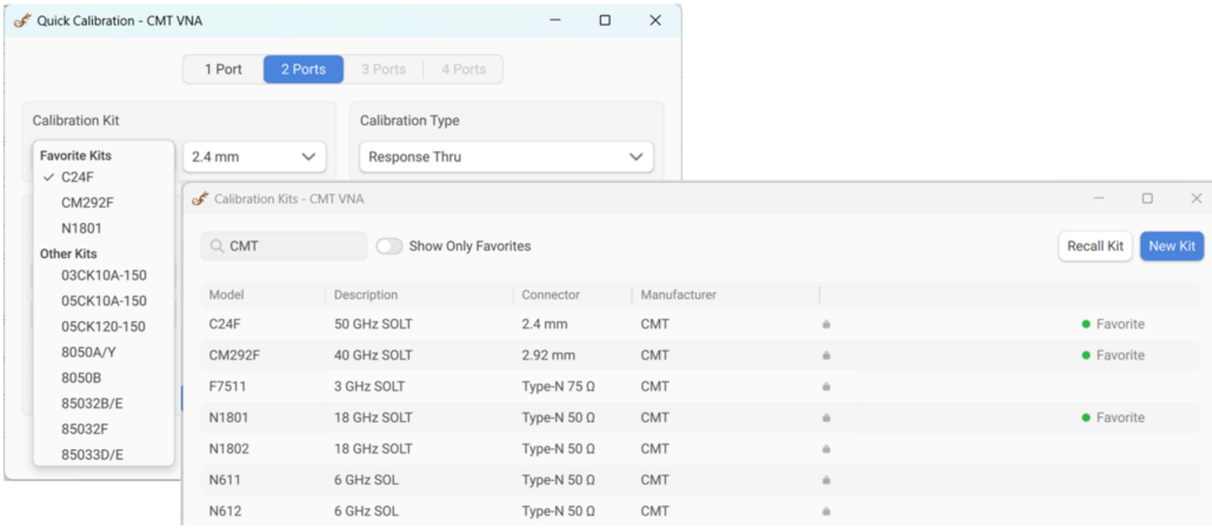
Limit lines can be created either interactively using the mouse or by entering values directly into the limit table. The limit line can be drawn in with more than two points. Alternatively, choose the limit table button and enter the limit line values.

Calibration

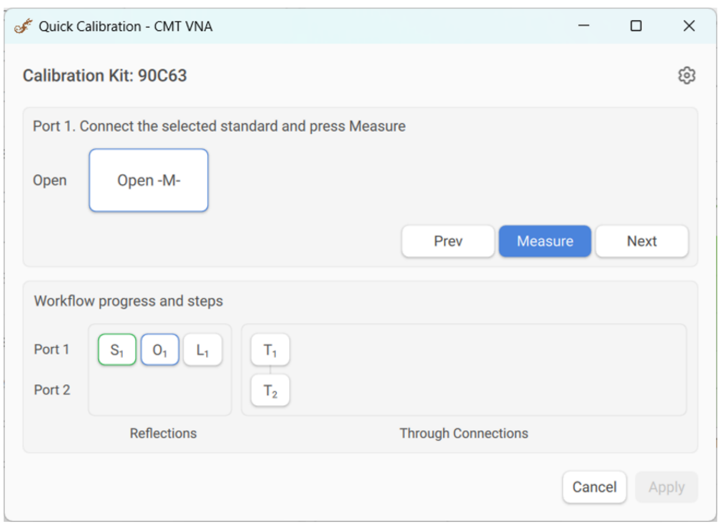
Calibration can be done using the new **Basic calibration wizard**, which allows for easy and intuitive calibration using enabled calibration kits.



Calibration wizard	The basic calibration wizard is a simple and intuitive tool for performing analyzer calibration. It guides the user through the calibration process, indicating which standards need to be connected and how many steps are required.
Calibration methods	The following calibration methods of various sophistication and accuracy are available: reflection (open, short, both open and short) and transmission response, full 1-port calibration, 1-path 2-port calibration.
Error correction interpolation	Interpolation or extrapolation of the calibration coefficients will be applied 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. Extrapolation is not recommended for accurate measurements.
Kit library	This library stores definitions of calibration kits, both predefined and user-created. A search function can be used to locate the required definition. Definitions can be saved to a file and later used at different workstations. Definitions marked as “Favorite” will appear first in the list of available kits during calibration.
Calibration standard definition	Different methods of calibration standard definition are available: standard definition by polynomial model and standard definition by Touchstone data file (S-parameters).
Connector library	This library is designed to store connectors, categorized into coaxial and waveguide types. By default, the library contains a comprehensive set of standardized connectors.

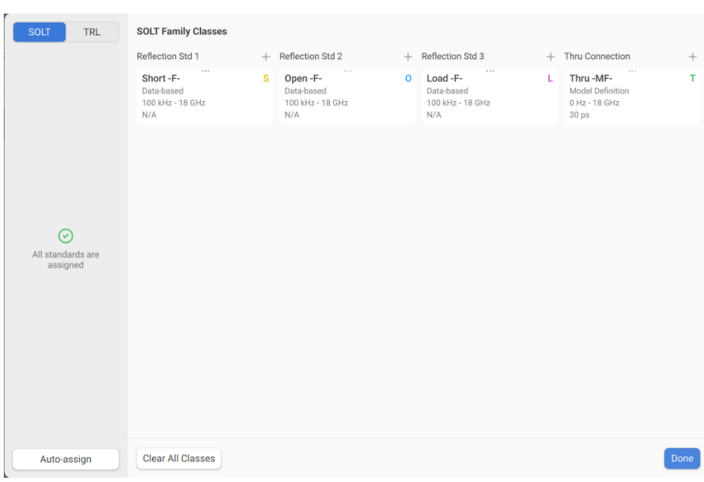


Kit Library with "Favorites" Marked



Basic Calibration Wizard

Calibration of a test setup (which includes the analyzers, cables, and adapters) significantly increases the accuracy of measurements.



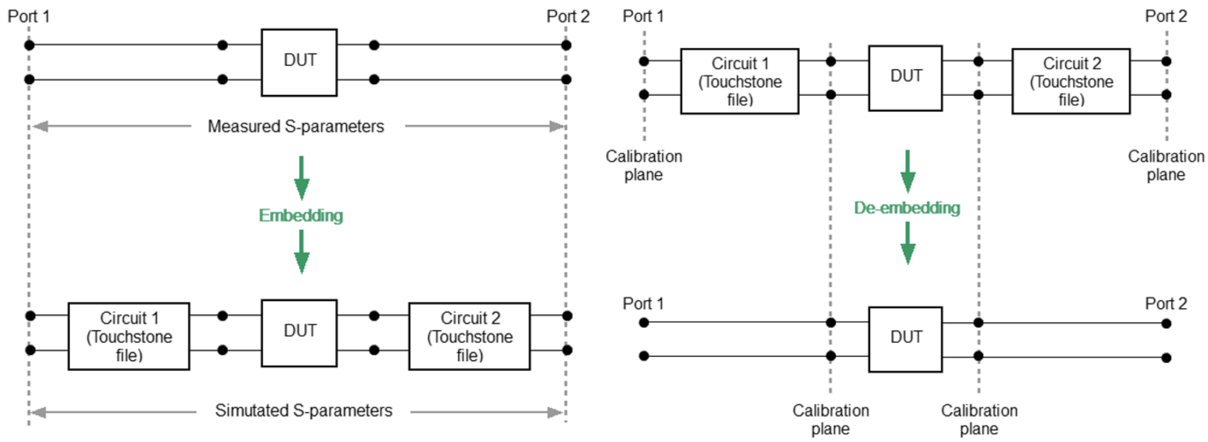
Creating the Kit Definition and Class Assignment

The software allows for class assignment to be done automatically to simplify user kit creation. The assignment is carried out after adding a new standard and selecting its type.

The standards are arranged in a sequence that makes it easy to identify which type of calibration they support. For example, in the figure, the letters SOLT are clearly visible, indicating that the Short, Open, Load, and Thru standards will need to be connected during calibration.

Fixture

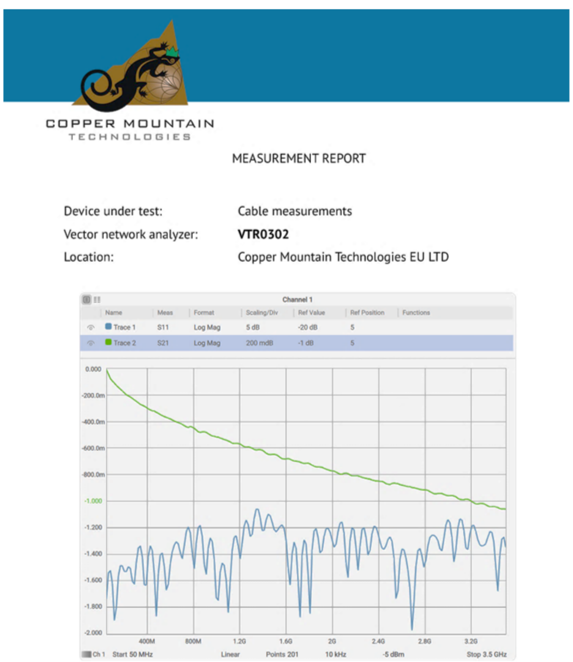
This section includes a set of functions that either modify the position of the calibration plane or recalculate the scattering matrix parameters.



Embedding	Embedding is a function of the S-parameter transformation via integration of some virtual circuit into the real network. The function allows the user to mathematically simulate the DUT parameters after adding the fixture circuits.
De-embedding	De-embedding is a function of transforming the S-parameter by eliminating some circuit effect from the measurement results. The function allows the user to mathematically exclude the effect of the fixture circuit existing between the calibration plane and the DUT in the real network from the measurement results.
Port impedance conversion	Port reference impedance conversion is a function that mathematically converts the matrix of S-parameters measured at the reference impedance of port Z0 to the matrix of S-parameters measured at an arbitrary impedance of port Z1.

Data Output

Analyzer state	All state, calibration and measurement data can be saved to a state file on the hard disk and later recalled into the software. The software supports the Quick Save to List function for storing analyzer settings and quickly switching between saved configurations.
Touchstone files	This selection allows users to save S-parameters to a Touchstone file, which contains frequency values along with the corresponding S-parameters. Touchstone files are an industry-standard format supported by most circuit simulation programs. The .s2p files are used to store all S-parameters of a device, while .s1p files are used to store either the S11 or S22 parameter of a one-port device. Additionally, the software can function as a Touchstone file viewer, enabling users to graphically display and analyze previously saved Touchstone files.
CSV files	This selection allows users to save an individual trace's data as a CSV file (comma separated values).



Template of a Report Generated by CMT VNA Software

Screenshot capture

Screenshots can be printed using three different applications: MS Word, Image viewer for Windows, or the Print wizard.

Each screenshot can be printed in color, grayscale, or inverted for visibility or to save ink.

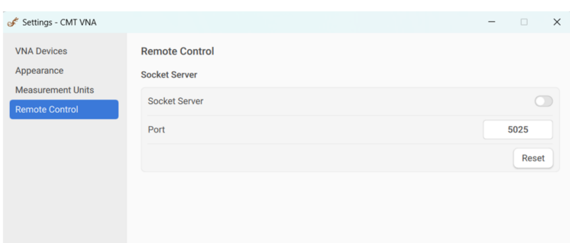
The current date and time can be added to each capture before it is transferred to the printing application, resulting in quick and easy test reporting.

A Word template file can be customized to change the appearance of the MS Word file output.

This function enables users to save measurement data in accordance with a predefined template, with the capability to incorporate supplementary information regarding the operator, the device under test (DUT), and the experimental conditions.

Automation

We maintain code examples and guides in the following languages:



Remote Control in the Settings

SCPI via TCP Socket

Alternatively a TCP socket is provided for automation from either localhost - the same machine running the analyzer software application - or from a second PC connected by an IP network. The SCPI commands are largely compatible with legacy instruments, maximizing code reuse for existing test automation platforms

SCPI via TCP Socket can be used with either Windows or Linux operating systems.

LabVIEW Compatible

The instrument and its software are fully compatible with LabVIEW applications, for ultimate flexibility in user-generated programming and automation. LabVIEW can be used with Windows OS only.

Hardware Specifications

VTR0102 and VTR0302

All specifications subject to change without notice.

Measurement Range

Impedance	50 Ohm
Test port connector	type N, female
Configuration	2-port, 1-path
Number of transmitter ports	1
Number of receiver ports	1
Frequency range	
VTR0102	50 MHz to 1.5 GHz
VTR0302	50 MHz to 3.5 GHz
Full frequency accuracy	$\pm 10 \cdot 10^{-6}$
Frequency resolution	1 Hz
Number of measurement points	2 to 200,001
Measurement bandwidths (with 1/1.5/2/3/5/7 steps)	1 Hz to 300 kHz
Dynamic range[2] (receiver att = 12dB)	110 dB (120 dB typ.)

[2] The dynamic range is defined as the difference between the specified maximum transmitter power level and the specified noise floor.

The specification applies at 10 Hz IF bandwidth.

Measurement Accuracy[3]

Accuracy of transmission measurements[4]	Magnitude / Phase ($S_{11} = S_{22} = 0$)	Magnitude / Phase ($S_{11} = S_{22} = 0.1$)
0 dB to 10 dB	±0.30 dB / ±2.5°	±0.40 dB / ±3.0°
-30 dB to 0 dB	±0.20 dB / ±2.0°	±0.30 dB / ±2.5°
-50 dB to -30 dB	±0.30 dB / ±2.5°	±0.40 dB / ±3.0°
-70 dB to -50 dB	±1.2 dB / ±8.0°	±1.3 dB / ±8.5°
Accuracy of reflection measurements[5]	Magnitude/Phase	
-10 dB to 0 dB	±0.5 dB / ±4.5°	
-20 dB to -10 dB	±1.1 dB / ±8.0°	
-30 dB to -20 dB	±3.5 dB / ±20.5°	
Trace noise magnitude	0.004 dB rms	
Temperature dependence	0.03 dB/°C	

[3] Reflection and transmission measurement accuracy applies over the temperature range of (73 ± 9) °F or (23 ± 5) °C after 60 minutes of warming-up,

with less than 1 °C deviation from the calibration temperature, at output power of -10 dBm. Frequency points have to be identical for measurement and

calibration (no interpolation allowed).

[4] Transmission specifications are based on a matched DUT and DUT with S11=S22=0.1, IF bandwidth of 10 Hz.

[5] Reflection specifications are based on an isolating DUT.

Effective System Data

50 MHz to 3.5 GHz	
Directivity	40 dB
Source match	36 dB
Load match	20 dB
Reflection tracking	±0.15 dB
Transmission tracking	±0.20 dB

Uncorrected System Performance

50 MHz to 2.5 GHz	
Directivity	15 dB (18 dB typ.)
Source match	15 dB
Load match	20 dB (25 dB typ.)
2.5 GHz to 3.5 GHz	
Directivity	8 dB (10 dB typ.)
Source match	12 dB
Load match	20 dB (25 dB typ.)

Transmitter Output

Power range	-25 dBm to +0 dBm
Power accuracy	±2 dB
Harmonic distortion[6]	
50 MHz to 1.0 GHz	-9 dBc
1.0 GHz to 3.5 GHz	-15 dBc

[6] Specification applies over full frequency range, at max output power.

Receiver Input

Receiver max input power (receiver att = 12 dB)	0 dBm
Noise floor[7]	-120 dBm/Hz
Receiver attenuator range	18 dB
Damage level	+23 dBm
Damage DC voltage	25V

[7] Receiver noise floor specification includes crosstalk effect.

Measurement Speed

Time per point	35 μs typ.

System and Power

CMT VNA software:	
Operating system (min requirements)	Windows 10, Ubuntu 24.04
CPU	4 core 2.0 GHz (x64 or arm64)
RAM	8 GB
Interface	USB 2.0
Connector type	Type C
Input power	
Voltage range	9 V DC to 15 V DC
Power consumption	10 W
Connector designation	12 V DC 1.2 A
Connector type	KPJX-4S-S

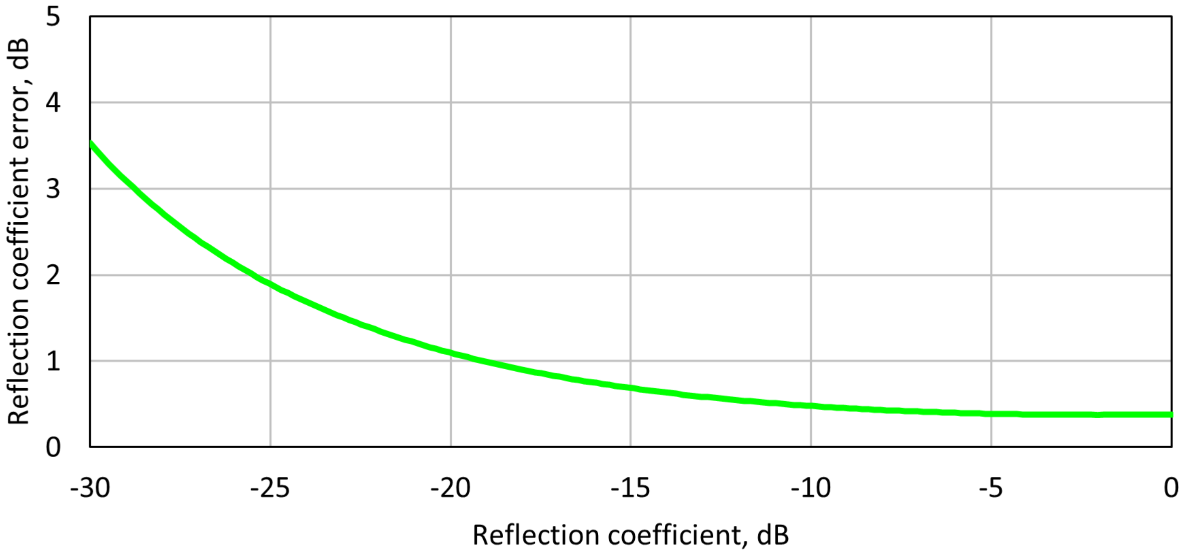
Dimensions

Length	160 mm
Width	297 mm
Height	44 mm
Weight	1.5 kg (53 oz)

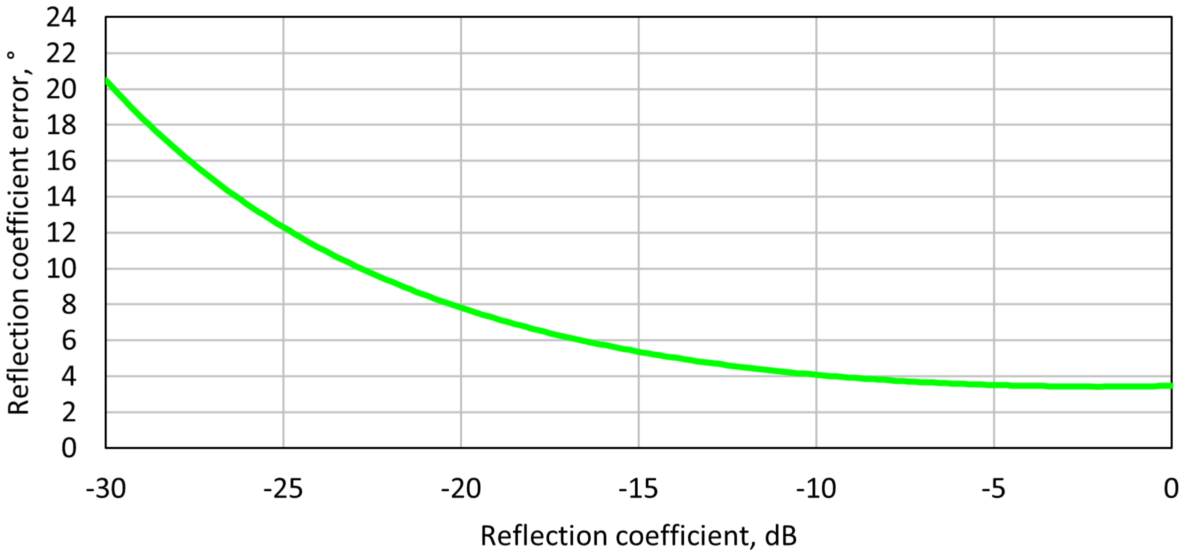
Environmental Specifications

Operating condition	
Temperature	+5 °C to +40 °C (41 °F to 104 °F)
Humidity	90 % at 25 °C (77 °F)
Storage	
Temperature	+0 °C to +40 °C (32 °F to 104 °F)
Humidity	80 % at 35 °C (95 °F)
Non-operating temperature	-50 °C to +70 °C (-58 °F to 158 °F)
Atmospheric pressure	70.0 kPa to 106.7 kPa

Reflection Magnitude Errors

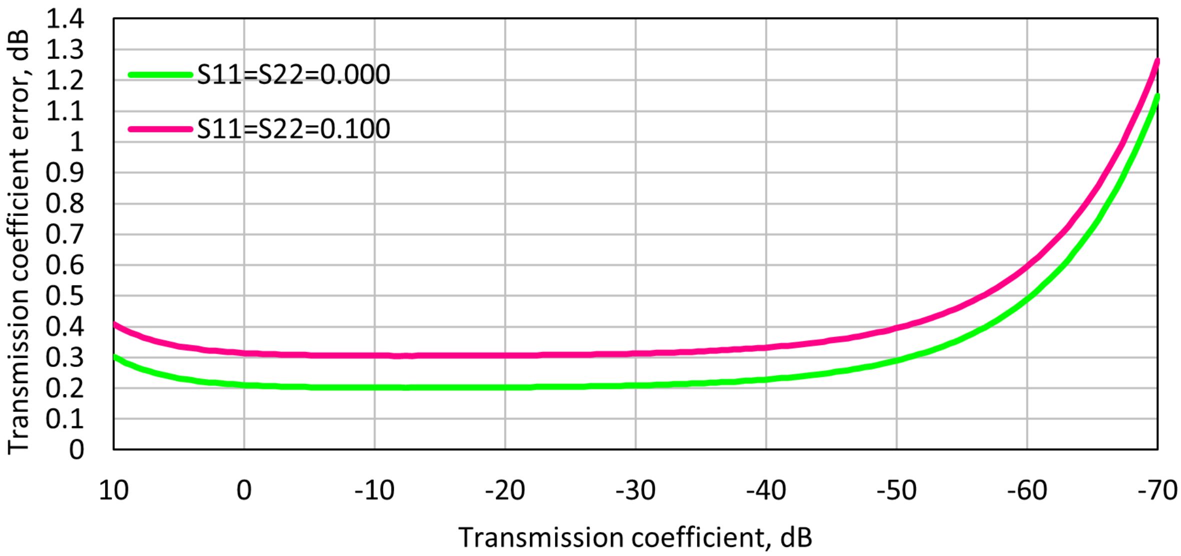


Reflection Phase Errors

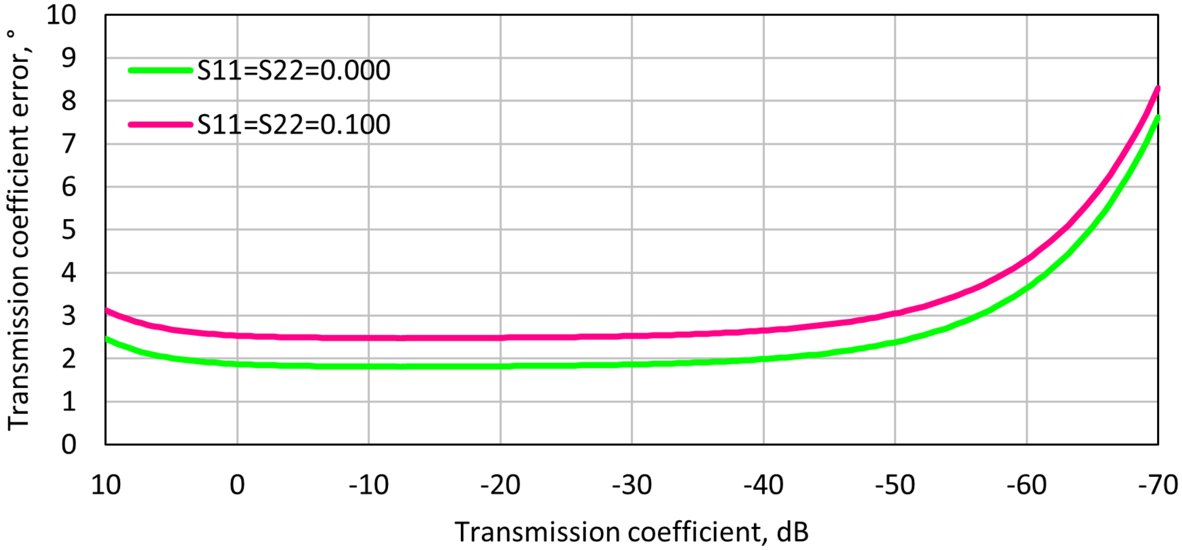


Specifications are based on isolating DUT (S21 = S12 = 0)

Transmission Magnitude Errors



Transmission Phase Errors



Specifications are based on a matched DUT and DUT with S11=S22=0.1, IF bandwidth of 10 Hz