PicoVNA-R 6 GHZ VECTOR NETWORK ANALYZER & REFLECTOMETER

This Vector Network Analyzer is a 6 GHz (VNA-R06) USB-C controlled device that supports S11 and S21 measurements of both magnitude and phase. Compact and handheld, it provides accurate measurements at an affordable price.

Features

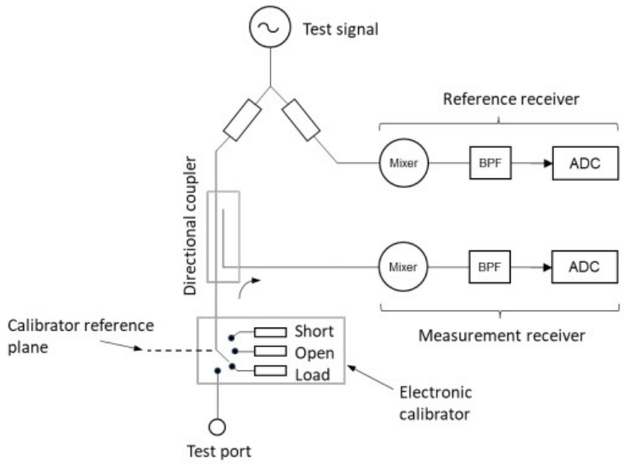
- Fast speed of 100 µs per frequency point for S11 measurements
- Compact USB powered design
- Network de-embedding and reference plane extension
- Unique on-board calibration storage helps to combat temperature drift
- Unique Save on Trigger facility allows capture over 1000 sweeps
- Time domain transmission and reflectometry
- Compatible with the PicoVNA electronic calibration module
- Control via user interface in PicoVNA 5 Software, SCPI or API
- Signal generator (CW and frequency sweep) utility

Precise, Single Board Design

The PicoVNA-R uses a single board design to provide an affordable solution which includes a unique, on-board electronic calibrator that stores calibrations and improves temperature performance. The device also offers low trace noise of 0.008 dB rms at its maximum receiver bandwidth of 140 kHz, and a max measurement speed of 100 µs per point for S11 measurements at 10 Hz IFBW. All of this in a compact, handheld design ideal for lab or field use.

Calibration Kit Compatibility

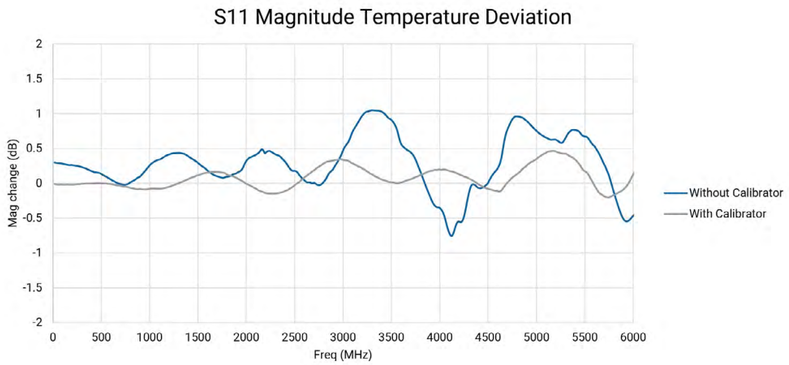
The PicoVNA-R is supported by most commercially available calibration kits as well as Pico's precision PC3.5 SOLT calibration kits and E-Cal automated electronic calibration module.

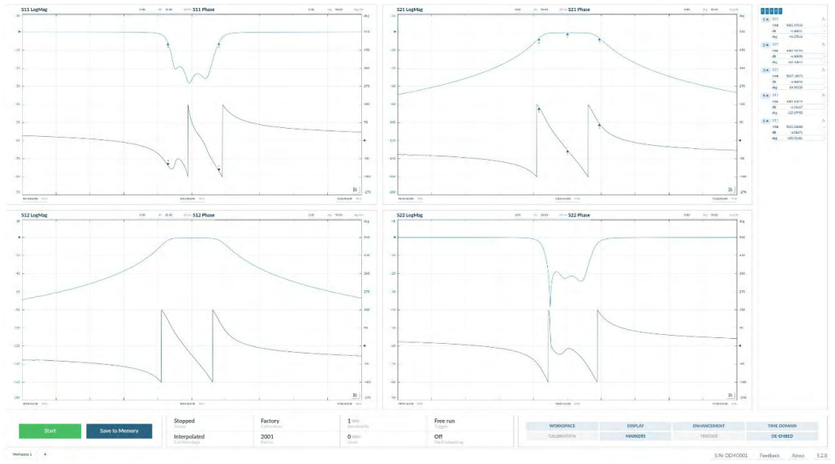


Internal Calibration Store Using A Built-in Electronic Calibrator

In the PicoVNA-R device, temperature drift in reflection coefficient (S11) measurements are significantly reduced thanks to a built-in electronic calibrator. This calibrator retrieves calibrations instantly by measuring and storing the reflection coefficient of built-in Short, Open and Load standards. Restoring a calibration works by re-measuring the same standards and computing the corresponding error terms. This technique is useful for field use where operation over a wide temperature range is likely, and indoor use, by providing near instant calibration after power on.

The built-in electronic calibrator helps to reduce S11 measurement temperature drift. An example of a -12 dB S11 measurement is shown below, with the maximum drift kept below 0.5 dB over a 22 °C case temperature change.

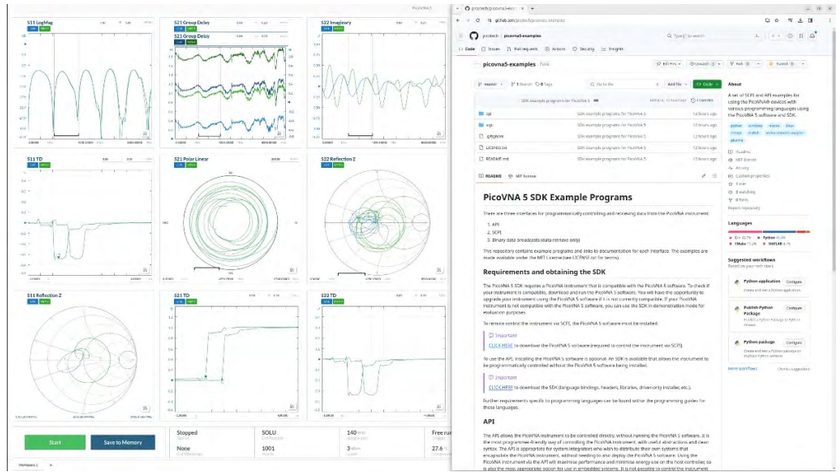




Easy-to-use Software

The PicoVNA 5 Software is developed by experienced VNA users, making it easy to use. Tasks, such as calibration, display set up and measured data saving are straightforward, allowing this device to have many applications including field service, installation, research and development, production and education. With its support for remote automation, this Vector Network Analyzer can also be used for Automatic Test Equipment (ATE). The software allows you to quickly create calibration kits from model or measured data and using the editor, you can also clone kits using low-cost parts.

Other useful tools include Data Compare, which compares measured data with reference data loaded from disk, and a signal generator function that can operate in CW or frequency sweep modes. Sweep plans of up to 10 001 points are allowed with adjustable dwell times of between 250 µs and 60 000 µs.



Test Automation

For automated field or production testing to pinpoint specific and repetitive measurements and faults, take advantage of the built-in API interface or use traditional SCPI commands. Use the API for direct, efficient integration between the PicoVNA-R and your test software or utilise the SCPI commands that are industry standard and easy to switch between existing products in your test set-up.

PicoVNA® 5 Software

Available on Windows®, macOS® and Linux®.

SUPPORTS ALL PICO TECHNOLOGY VECTOR NETWORK ANALYZERS AND IS AVAILABLE TO DOWNLOAD WITH FREE SOFTWARE UPDATES AND LIFETIME SUPPORT*.

* Upgrades may be required for some VNA models

DEFINE MEASUREMENT:

Click here to configure the measurement for each plot window using these settings:

Measurement Parameter: choose the S-parameter (S11, S21, S12, S22)

Plot Domain: select either the frequency or time domain

Plot Type: choose from Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, VSWR, Polar Linear, or Smith Chart

Reference Position: select either Top, Centre, or Bottom.

ADJUST HORIZONTAL AXIS:

Click on the upper or lower limits of the horizontal axis on any plot to adjust the range. Values can be typed in directly, or adjusted via a context-sensitive popup – opened by clicking into the input – using touch-friendly controls or mouse-wheel scroll.

REFERENCE POSITION:

Click and drag this arrow on each plot to set the reference position.

WORKSPACES:

Add and define multiple workspaces, each with their own settings, spans, views, measurements and calibrations.

VERTICAL AXIS SETTINGS:

The scaling and reference level can be adjusted using the inputs shown at the top of each plot. Values can be typed in directly, or adjusted via a context-sensitive popup – opened by clicking into the input – using touch-friendly controls or mouse-wheel scroll.

MEASUREMENT CHANNELS:

Select the measurement channels to display on a plot by clicking on each channel to toggle it on/off.

MARKER SIDEBAR:

View all markers across all plots in the workspace. Click or double-click to hide/ unhide a marker readout.

MARKER GROUPS:

Used to compare measurements at different frequencies (or times) across different channels and S-parameters. One marker must first be converted to a reference; other markers are then added to the group to show delta readouts.

MARKERS:

Individual markers can be added to a plot by CTRL + Click and then adjusted using the settings in the Marker sidebar.

MARKER READOUT:

Each marker has a readout visible in the marker sidebar. These can be configured using the marker panel to adjust the marker position and parameters shown.

TIME DOMAIN:

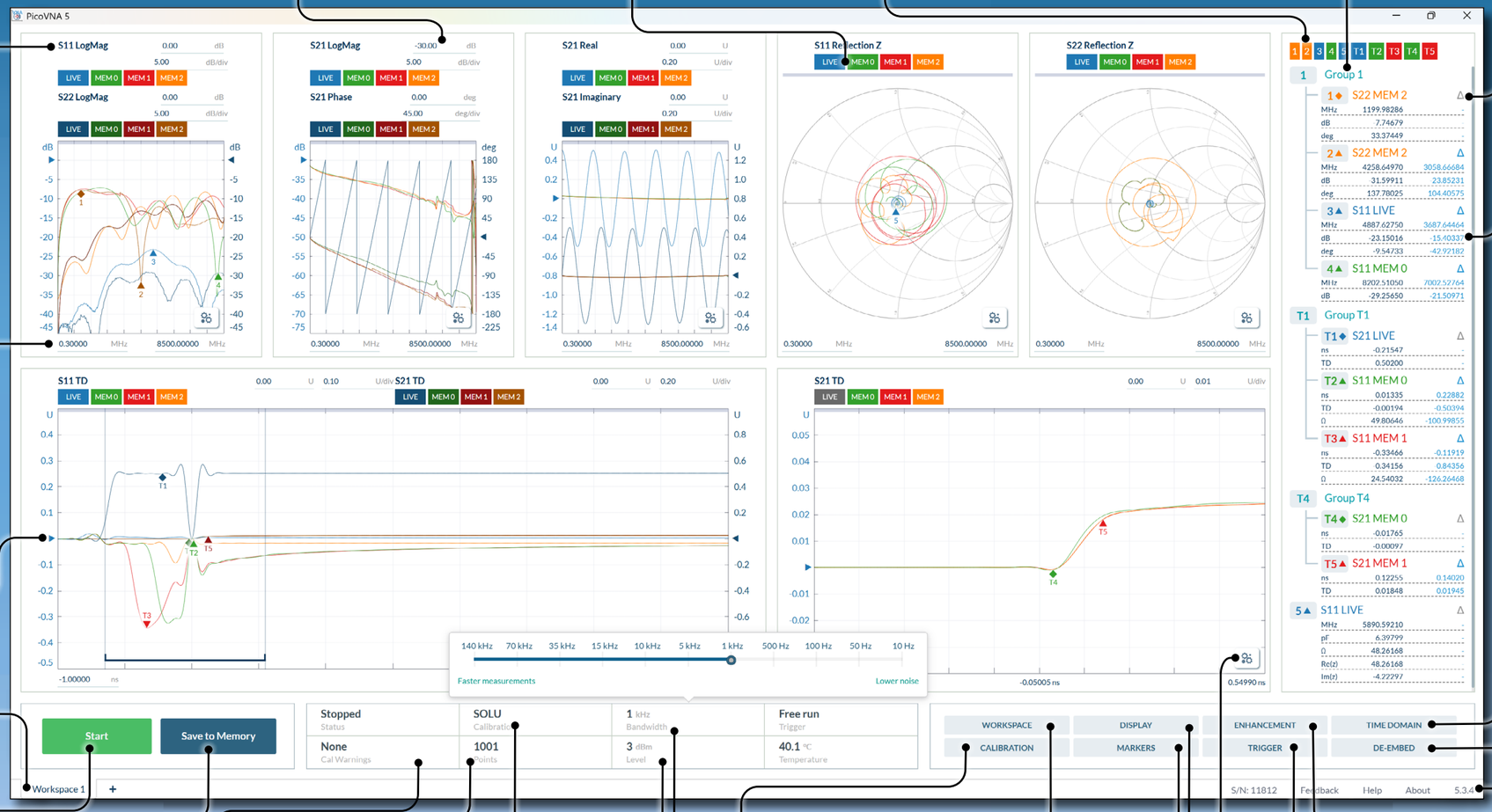
Adjust the settings for a time-domain measurement which has been processed using an inverse FFT from the frequency sweep. Choose lowpass (best resolution) or bandpass mode, and configure windowing, DC termination, and the time/ distance axis.

DE-EMBED:

Shift the reference plane using the de-embed sidebar – or load Touchstone files to remove the effects of a network section on ports 1 and 2.

HELP & INFO BAR:

This menu section provides VNA and software version details, a link to the user manual, and space to give feedback or report an issue.



MEASUREMENT START/ STOP CONTROL:

Click to start displaying measurements and click again to stop. The keyboard spacebar also has the same function.

SAVE TO MEMORY:

Click to add the current live measurement trace to the memory. PicoVNA 5 supports an unlimited number of memory traces.

POINT COUNT:

Click here to set the number of measurement points on a sliding-scale popup, in increments.

CALIBRATION:

Check the settings for the loaded calibration. There are further options to load the factory calibration or run a new calibration.

CALIBRATION MENU:

Start a new S11, S11+S21, or full 2-port calibration using SOLT, TRL/ TRM, E-Cal, or custom standards. Define multiple calibration kits, or load a previous calibration.

WORKSPACE:

Click here to load or save a workspace session, or to import/export measurement data within the current workspace.

TRIGGER:

Sets the VNA's trigger mode – free run (default), rising edge, falling edge, or manual. Both rising and falling edge require an external trigger.

ENHANCEMENT:

Enhance measurements with smoothing, averaging, extra synthesiser settling time, or a configurable group delay aperture.

CAL WARNINGS:

Checks that your measurement settings still match the loaded calibration.

POWER LEVEL:

Click here to set the signal power level on a sliding-scale popup, in increments. Best practice is to measure a DUT at the same power level that the calibration was carried out.

RECEIVER BANDWIDTH:

Click here to set the receiver bandwidth on a sliding-scale popup, in increments.

MARKERS:

Click here to open the marker sidebar, add a new marker or adjust the settings for each marker.

DISPLAY:

The layout of plots in a workspace can be updated using this sidebar. Choose from standard layouts or create a custom layout for your use case.

PLOT FORMATTING:

Click here to format the plot to add a second axis, move it to a new window, maximise to full screen, or magnify a region to open it in a new plot window.

TOUCHSCREEN FRIENDLY:

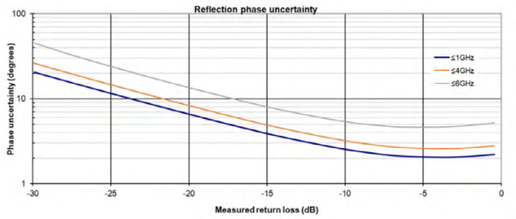
Easily interact with the software using a touchscreen or mouse.

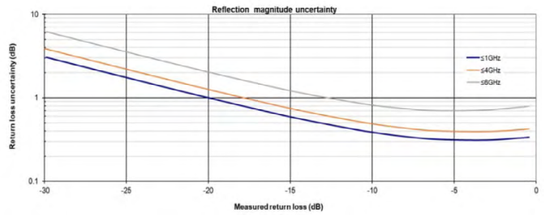
Technical Specifications

Unless otherwise stated, the figures apply with a 1 kHz resolution bandwidth, at -3 dBm test power using an S11+S21 calibration (including isolation calibration), with no averaging or interpolation, and at an ambient temperature of between 15°C and 30°C within 1°C of the calibration temperature and at least 30 minutes after power up.

Where applicable, the figures apply with a Dual E-Cal 8.5 GHz or a Standard/Premium 8.5 GHz SOLT calibration kit.

In addition to the conditions outlined in this section, the S11 figures below apply for a single-port DUT and the S21 figures apply for a DUT having S11 and S22 = 0.





Parameter	Value			Conditions
Measurement bandwidth	140 kHz, 70 kHz, 35 kHz, 15 kHz, 10 kHz, 5 kHz, 1 kHz, 500 Hz, 100 Hz, 50 Hz, 10 Hz			
S21 noise floor (dynamic range)	Band (MHz)	Typical (dB)	Max (dB)	Measured after an S11 and S21 calibration (with 0 dBm level) with ports terminated in 50 Ω. The table shows the S21 noise floor in dB. Dynamic range is limited by crosstalk.
	0.3 – 2000	80	66	
	2000 – 6000	70	50	
Temperature stability	Frequency Range	Temperture Coefficient		Measured after an S11 calibration and with test port shorted
	Below 4 GHz	0.03 dB/°C		
	4 GHz to 6 GHz	0.05 dB/°C		
Trace noise (dB rms)	Typical	Max	Bandwidth	Measured using a 201 points sweep plan covering 0.3 MHz to 6 GHz and test power set to 0 dBm
	0.002	0.004	10 kHz	
	0.004	0.008	70 kHz	
	0.008	0.012	140 kHz	
Transmission uncertainty	Magnitude: 1.0 dB, Phase: 8°			Power: −20 dBm to +3 dBm Frequency: < 2 MHz
	Magnitude: 0.6 dB, Phase: 6°			Power: −20 dBm to +3 dBm Frequency: 2 MHz to 6000 MHz
	Magnitude: 1.2 dB, Phase: 10°			Power: −40 dBm to −20 dBm Frequency: < 2 MHz
	Magnitude: 1.8 dB, Phase: 14°			Power: −40 dBm to −20 dBm Frequency: 2 MHz to 6000 MHz

Parameter	Value			Conditions
Test Port Connectors				
Load match (port 2)	< -26 dB (typical)			
Source match (port 1, f ≤ 6 GHz)	15 dB (typical)			Uncorrected
	45 dB (typical), 30 dB (min)			Corrected
Directivity	47 dB (typical), 36 dB (min)			Corrected
Crosstalk	Band	Typical	Max	Corrected, measured with both calibrated ports terminated in short circuits after isolation calibration over band specified.
	0.3 MHz to 2 GHz	−80	−60	
	2 GHz to 6 GHz	−70	-50	
Maximum input level	+23 dBm (No damage)			
Compression point	0.1 dB compression: 0 dBm (Typical)			
Test port connectors	Port 1 (Type N male - front) Port 2 (SMA male - rear)			
Sweep trigger output voltage	Low		High	
	0 V to 0.8 V		2.2 V to 3.6 V	
Sweep trigger input voltage	Low		High	
	−0.1 V to 1 V		2.0 V to 4 V	
Sweep trigger input voltage	±6 V			No damage
Sweep trigger in/out connectors	SMB, female on back panel			The rear panel carries two SMB connectors, REF/TRIG OUT and REF/TRIG IN, each shared between the 10 MHz reference and the sweep trigger.
Measuring Functions				
Measuring parameters	S11, S21			
Error correction	S11 (1 port correction), S21 (source match correction + normalise + isolation), Averaging, smoothing, Hanning and Kaiser-Bessel filtering on time domain measurements, electrical length compensation (manual), electrical length compensation (auto), effective dielectric constant correction			
Display channels	4 channels			
Traces	2 traces per display channel			
Display formats	Amplitude (logarithmic and linear), Phase, Group Delay, VSWR, Real, Imaginary, Smith Chart, Polar, Time Domain			
Memory trace	One per display channel			
Limit lines	6 segments per channel (overlap allowed)			
Markers	8 markers			
Marker functions	Normal, Δ (Delta) Marker, Fixed Marker, Peak / Min Hold, 3 dB and 6 dB bandwidth			

Parameter	Value	Conditions
Sweep Functions		
Sweep type	Linear sweep, CW sweep (timed sweep)	
Sweep times	140 kHz bandwidth 10 MHz to 6.4 GHz sweep 201 points (S11): 20.2 ms 201 points (S11 + S21): 33.1 ms	
Number of sweep points	51, 101, 201, 401, 801, 1 024, 2 001, 4 001, 9 001, 10 001	
Signal Source Characteristics		
Frequency range	300 kHz to 6.4 GHz	6 GHz specified, usable to 6.4 GHz
Frequency setting resolution	10 Hz	
Frequency accuracy	10 ppm (max)	Ambient of 23 °C ±3 °C
Frequency temperature stability	±0.5 ppm/°C max over the range +15 °C to +35 °C	
Harmonics	−20 dBc (max)	Test power set to < −3 dBm
Non-harmonic spurious	−40 dBc (typical)	
Phase noise (10 kHz offset, typical)	Typical	Band
	−80 dBc/Hz	0.3 MHz to 1 GHz
	−60 dBc/Hz	1 GHz to 4 GHz
	−57 dBc/Hz	> 4 GHz
Test signal power	−20 to 0 dBm	
Power setting resolution	0.1 dB	
Power setting accuracy	±1.5 dB	
Reference input frequency	10 MHz ±6 ppm	
Reference input level	0 ±3 dBm	
Reference output level	0 ±3 dBm	
Controller PC data interface	USB-C®	
Support for third party test software	• Standalone API with examples in C, C++ and Python • SCPI remote interface (via PicoVNA 5)	
External dimensions (mm)	187 x 81 x 41 mm (L x W x H)	Excluding connectors
Weight	0.47 kg	
Temperature range (operating)	0 °C to +40 °C	
Temperature range (storage)	−20 °C to +50 °C	
Humidity	80% max, non-condensing	
Vibration (storage)	0.5 G, 5 Hz to 300 Hz	

Parameter	Value	Conditions
Power source and current	USB-C powered via USB power delivery, with optional DC input for hosts that cannot supply enough power. USB-C power profile is 5V at 3A.	DC input: +12 Vdc to +15 Vdc, 1.9 A max with +15 Vdc supply
Power source connector	5.5 mm diameter hole, 2.1 mm diameter centre contact pin. Centre pin is positive	
Host OS Requirements	Linux, Windows® 10 or later, macOS 11 (Big Sur) or later, Raspberry Pi OS or later	
RAM	2 GB or more	
Screen Resolution	1680 x 1050 or higher	
GPU	High performance graphics card is recommended for larger (>1001 points) sweep points	
Warranty	3 years	
Compliance	EN IEC 61326-1:2021 with emissions to EN 55011 Group 1 Class A, EN 61000-3-2:2019, EN 61000-3-3:2013 +A1:2019, immunity to EN 61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8 and -4-11, plus FCC 47 CFR Part 15 Subpart B Class A and ICES-003 Issue 7 Class A	

PicoVNA-R Product Kit Ordering Information:

SKU	Description
PQ466	PicoVNA-R06 6 GHz 1 port VNA - Lite kit
PQ467	PicoVNA-R06 6 GHz 1 port VNA - Advanced kit
TA589	N (f) to SMA (f) adaptor
TA590	N (f) to N (f) adaptor
TA591	N (f) to SMA (m) adaptor
TA343	SMA (f) to SMA (f) adaptor
TA342	SMA (m) to SMA (m) adaptor
TA312	Precision sleeved coaxial cable SMA (60 cm)
TA336	Standard 8.5 GHz flexible test lead, male port, N(m)-SMA(m)
TA337	Standard 8.5 GHz flexible test lead, female port, N(m)-SMA(f)
TA338	Premium 8.5 GHz flexible test lead, male port, N(m)-PC3.5(m)
TA339	Premium 8.5 GHz flexible test lead, female port, N(m)-PC3.5(f)
TA357	ADA-STD-FM Standard within series adaptor SMA(f-m)
TA340	ADA-PREM-MM Premium test port adaptor PC3.5(m-m)
TA341	ADA-PREM-FF Premium test port adaptor PC3.5(f-f)
TA354	ADA-PREM-FM Premium within series adaptor PC3.5(f-m)
TA344	SOLT-STD-M Standard 8.5 GHz SOLT calibration kit SMA(m)
TA345	SOLT-STD-F Standard 8.5 GHz SOLT calibration kit SMA(f)
TA346	SOLT-PREM-M Premium 8.5 GHz SOLT calibration kit PC3.5(m)
TA347	SOLT-PREM-F Premium 8.5 GHz SOLT calibration kit PC3.5(f)
TA518	SOLT-AUTO-M 8.5 GHz automated calibration kit SMA(m)
TA519	SOLT-AUTO-F 8.5 GHz automated calibration kit SMA(f)
TA520	Dual 8.5 GHz automated calibration kit SMA(f) and SMA(m)
TA430	CHK-INS-MF insertable check standard SMA(m-f)
TA431	CHK-NON-F noninsertable check standard SMA(f-f)
TA314	Adaptor 18 GHz 50 Ω SMA(f)-N(m)
TA265	Precision sleeved coaxial cable 30 cm 1.3 dB at 13 GHz
TA358	Dual-break torque wrench N-type 1 N·m (8.85 in·lb)
TA356	Dual-break torque wrench SMA/PC3.5/K, 1 N·m (8.85 in·lb)

SKU	Description
CC047	Calibration for SOLT-STD-M or SOLT-STD-F
CC048	Calibration for SOLT-PREM-M or SOLT-PREM-F
CC050	Calibration for CHK-INS-MF or CHK-NON-F
CC057	Calibration for SOLT-AUTO-M or SOLT-AUTO-F
PQ186	Network Metrology Training Kit
PQ189	Network Metrology Training PCA (only)
PQ187	Network Metrology Leader Standard Kit
PQ188	Network Metrology Leader Premium Kit

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