pico® Technology

PicoVNA-R

Vector Network Analyzer - Reflectometer

Quick Start Guide

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English

1. Introduction

Thank you for purchasing a PicoVNA-R Vector Network Analyzer - Reflectometer.

For further setup information following basic installation, see the *User's Guide* supplied with the PicoVNA5 software.

For detailed specifications see the *PicoVNA-R Data Sheet*.

2. Safety information

To prevent possible electrical shock, fire, personal injury, or damage to the product, carefully read this safety information before attempting to install or use the product. In addition, follow all generally accepted safety practices and procedures for working with and near electricity.

This instrument and its accessories have been designed to meet the requirements of EN 61010-1 (*Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use*).

The following safety descriptions are found throughout this guide:

A **WARNING** identifies conditions or practices that could result in injury or death.

A **CAUTION** identifies conditions or practices that could result in damage to the product or equipment to which it is connected.

WARNING
This product is for professional use by trained and qualified technicians only. To prevent injury or death, use the product only as instructed and use only accessories that have been supplied or recommended by Pico Technology. Protection provided by the product may be impaired if used in a manner not specified by the manufacturer.

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2.1 Symbols

These safety and electrical symbols may appear on the product or in this guide.

Symbols	Description
	Earth (ground) terminal
	Chassis terminal
	Possibility of electric shock
	Caution
	Do not dispose of this product as unsorted municipal waste

This terminal can be used to make a measurement ground connection. It is NOT a safety or protective earth.

Appearance on the product indicates a need to read this safety and operation manual.

2.2 Maximum input and output ranges

WARNING
To prevent electric shock, do not attempt to measure or apply signal levels outside the specified maxima below.

The table below indicates the maximum voltage of the outputs and the overvoltage protection range for input on the VNA and its calibration accessories. The overvoltage protection ranges are the maximum voltages that can be applied without damaging the instrument or accessory.

Instrument connectors	Maximum operating voltage (output or input)	Overvoltage or overcurrent protection
Port 1	15 V DC or +23 dBm (about 710 mV RMS)	+27 dBm (about 5 V RMS)
Port 2	±10 V DC	
Trigger and reference in		±6 V pk
Trigger and reference out	0 V to +5 V	Do not apply a voltage
Calibration accessory connector/ overvoltage protection	N/A	SOLT-AUTO Ports A/B, SOLTPREM and SOLT-STD Ports = +20 dBm

WARNING
Signals exceeding the voltage limits in the table below are defined as “hazardous live” by EN 61010.

Signal voltage limits of EN 61010		
±60 V DC	30 V AC RMS	± 42.4 V pk max.

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WARNING
To prevent electric shock, take all necessary safety precautions when working on equipment where hazardous live voltages may be present.

WARNING
To avoid equipment damage and possible injury, do not operate the instrument or an accessory outside its rated supply voltages or environmental range.

CAUTION
Exceeding the overvoltage protection range on any connector can cause permanent damage to the instrument and other connected equipment.

To prevent permanent damage, do not apply an input voltage to the trigger or reference output of the VNA.

2.3 Grounding

WARNING
The instrument's or SOLT-AUTO E-Cal module's ground connection through the USB cable is for functional purposes only. The instrument and accessories do not have protective safety grounds.

WARNING
To prevent injury or death, or permanent damage to the instrument, never connect the ground of an input or output (chassis) to any electrical power source. To prevent personal injury or death, use a voltmeter to check that there is no significant AC or DC voltage between the instrument's ground and the point to which you intend to connect it.

CAUTION
To prevent signal degradation caused by poor grounding, always use the high-quality USB cable supplied with the instrument.

2.4 External connections

WARNING
To prevent injury or death, use only the power adaptor supplied with the instrument. This is approved for the voltage and plug configuration in your country.

Model	USB connection	External power supply		
		Voltage	Current	Total power
PicoVNA-R06	USB 2.0 Compatible with USB 3.0	12 to 15 V DC	1.9 A max at 15 V	28.5 W
SOLT-AUTO E-Cal module		N.A.		

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WARNING
Containment of radio frequencies
The instrument contains a swept or CW radio frequency signal source (300 kHz to 6.02 GHz at +6 dBm max. [108: 300 kHz to 8.50 GHz at +6 dBm max.]) The instrument and supplied accessories are designed to contain and not radiate (or be susceptible to) radio frequencies that could interfere with the operation of other equipment or radio control and communications. To prevent injury or death, connect only to appropriately specified connectors, cables, accessories and test devices, and do not connect to an antenna except within approved test facilities or under otherwise controlled conditions.

2.5 Environment

WARNING
This product is suitable for indoor or outdoor use, in dry locations only. The product's external mains power supply is for indoor use only.

WARNING
To prevent injury or death, do not use the VNA or accessory in wet or damp conditions, or near explosive gas or vapor.

CAUTION
To prevent damage, always use and store your VNA or accessory in appropriate environments.

	Storage	Operating
Temperature	–20 °C to +50 °C	+5 °C to +40 °C
Humidity	20% to 80% RH (non-condensing)	
Altitude	2000 m	
Pollution degree	2	

IP66 protection is only assured when all covers, caps and seals are properly fitted. The supplied dust caps must be present on any unused connectors. The instrument cannot be submerged. If the instrument has been exposed to rain, spray, dust or salt air, ensure that all connector interfaces are clean and dry before making precision measurements.

IP66 protection applies to the instrument body only, and not to accessories (including the ECal module), which are not IP66 rated. Accessories and the external power supply should be protected from moisture and dust.

CAUTION
Do not block the air vents at the back of the instrument as overheating will cause damage.

Do not insert any objects through the air vents as internal interference will cause damage.

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2.6 Care of the product

The product and accessories contain no user-serviceable parts. Repair, servicing and calibration require specialized test equipment and must only be performed by Pico Technology or an approved service provider. There may be a charge for these services unless covered by the Pico three-year warranty.

WARNING
To prevent injury or death, do not use the VNA or accessory if it appears to be damaged in any way, and stop use immediately if you are concerned by any abnormal behavior.

CAUTION
Regularly inspect the instrument and all probes, connectors, cables and accessories before use for signs of damage or contamination.

To prevent damage to the device or connected equipment, do not tamper with or disassemble the instrument, case parts, connectors, or accessories.

When cleaning the product, use a soft cloth and a solution of mild soap or detergent in water, and do not allow liquids to enter the casing of the instrument or accessory.

Take care to avoid mechanical stress or tight bend radii for all connected leads, including all coaxial leads and connectors. Mishandling will cause deformation of sidewalls, and will degrade performance. In particular, note that test port leads should not be formed to tighter than 5 cm (2”) bend radius.

To prevent measurement errors and extend the useful life of test leads and accessory connectors, ensure that liquid and particulate contaminants cannot enter. Always fit the dust caps provided and use the correct torque when tightening. Pico recommends: 1 Nm (8.85 inch-lb) for supplied and all stainless steel connectors, or 0.452 Nm (4.0 inch-lb) when a brass or gold-plated connector is interfaced.

3. System requirements

To ensure that the PicoVNA-R and PicoVNA software operate correctly, you must use a computer with the system requirements and one of the operating systems shown in the table below.

Processor, memory, free disk space	As required by the operating system
Operating system	Microsoft Windows x86_64-bit only macOS x86_64 and AArch64 Linux x86_64 and AArch64
Ports	USB 2.0 (also compatible with USB 3.0)
Display resolution	1280 x 720 minimum

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4. Contents of your PicoVNA-R kit

The PicoVNA-R Vector Network Analyzer - Relfectometer kit contains the following items:

PicoVNA-R Lite Kit

- PicoVNA-R06
- USB 3.2 Type-C to Type-C 1.8m Cable
- SMA/PC3.5/2.92 and N-type fixed multi-wrench
- Quick Start Guide
- Storage and carry case

PicoVNA-R Advanced Kit

- PicoVNA-R06
- DC power supply with four international plug adaptors
- USB 3.2 Type-C to Type-C 1.8m Cable
- USB 3.2 Type-C to Type-A 0.9m Cable
- SMA/PC3.5/2.92 and N-type fixed multi-wrench
- SMA (m) to SMA (m) adaptor
- SMA (f) to SMA (f) adaptor
- N (f) to SMA (m) adaptor
- N (f) to SMA (f) adaptor
- N (f) to N (f) adaptor
- Quick Start Guide
- Storage and carry case

Some product packs may contain additional items. For a full list of all available kits and additional accessories, see the *User's Guide* or visit **www.picotech.com**.

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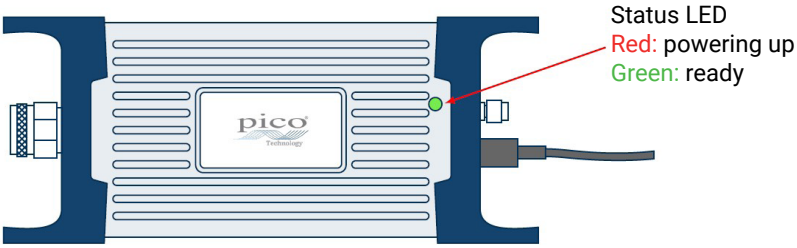
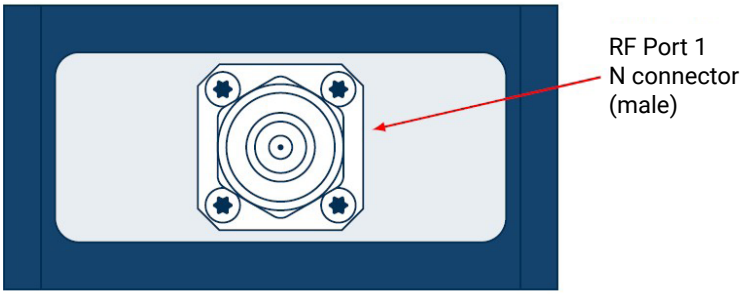
5. External connections

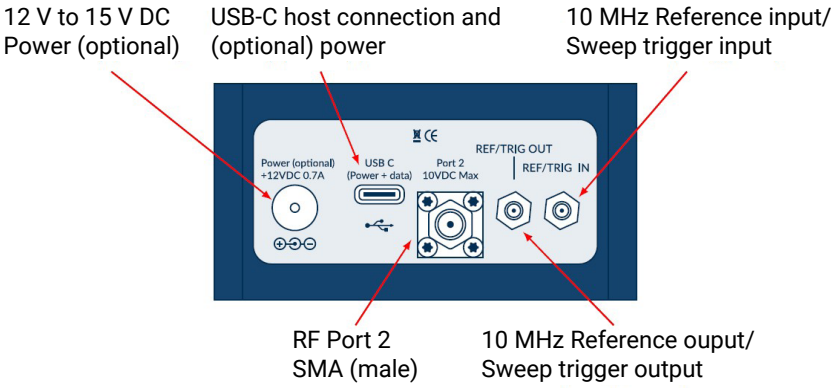
The figures below show the a) top, b) front and c) rear panels of the PicoVNA-R instrument respectively.



a) Top panel of the PicoVNA-R



b) Front panel of the PicoVNA-R



c) Rear panel of the PicoVNA-R

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6. Installing the PicoVNA-R software

6.1 Windows

1. Obtain the PicoVNA 5 software from www.picotech.com/downloads
2. Follow the instructions in the installer.
3. Once the software is installed, connect the PicoVNA instrument to the computer and open the software.

6.2 macOS

1. Obtain the PicoVNA 5 software from www.picotech.com/downloads. Note that you will need to select the correct package: x86 or AArch64 depending on your hardware.
2. Follow the instructions in the installer.
3. Once the software is installed, connect the PicoVNA instrument to the computer and the software.

6.3 Linux

PicoVNA 5 is distributed as a self-extractable compressed tar archive that can be launched directly to install the software. The following list of distributions have been tested, although PicoVNA 5 is designed to work on any Linux distribution released within the last ten years:

- Debian 8 (“jessie”) and later versions
- Ubuntu 18.04 (LTS) and later versions
- Linux Mint Cinnamon 21.1 (Vera) and later versions
- openSUSE Leap 15.0 and later versions
- Fedora 28 and later versions
- Arch Linux

PicoVNA 5 for Linux is distributed via a self-extracting archive. Follow these instructions in order to install the software:

1. Obtain the file picovna.run from www.picotech.com/downloads.
2. Open a terminal window to type commands.
3. Change directory in the terminal to the location where you downloaded the file in step 1.

This is likely the ~/Downloads directory, unless you specified a different directory when downloading the file or your web browser has a different default Downloads directory:

```
> cd ~/Downloads
```

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4. Ensure the file picovna.run is executable. Type the following:

   > chmod +x picovna.run

5. Run the installer, with sufficient permissions that it will be able to write to the /opt/picovna directory where the software will be installed:

   > sudo ./picovna.run

6. PicoVNA 5 is now installed. You will need to open a new terminal window in order to start the software by typing:

   > picovna

TIP! The installation process adds a line to the current user's .bashrc file to ensure that the /opt/picovna directory is present in the PATH environment variable. If you do not use bash as your default shell, you will need to manually add /opt/picovna to PATH.

6.4 Powering the instrument

There are two options for powering the PicoVNA-R06, described below. Option 1 is recommended for most users as it requires only a single cable, but it requires a USB port capable of supplying sufficient current and may drain a laptop battery faster.

Option 1: Power and data via USB-C	Option 2: Power via external PSU; data via USB-C
• Connect the USB-C cable from the PC to the PicoVNA-R06. • Wait for the status LED to turn green. The instrument can now be used, powered via USB-C.	• Connect the external power supply (12–15 V). • Wait for the status LED to turn green. • Connect the USB-C cable from the PC to the PicoVNA-R06. The instrument can now be used, powered via the external supply.

For Option 2, the supplied adaptor enables the IP66-rated power input connector on the PicoVNA-R06 to be used with a standard Pico 12 V power supply unit. The IP66-rated power input connector has a 2.1 mm centre contact pin, with 5.5 mm diameter hole. The centre pin is positive.

For both options, it does not matter whether the software is started before or after powering the instrument. The software will automatically connect when the instrument is connected to the PC and the status LED turns green.

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6.5 Setting the measurement parameters

The measurement span (in frequency or time) can be configured using the controls below each plot. An example of such a control is shown in Figure 6.5.1. Values can be input by typing, using the popup increment controls, or by hovering over the control and using the mouse scroll wheel.

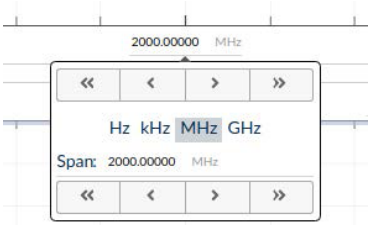

Figure 6.5.1: Measurement span controls

The test signal power level is set using the popup control shown in Figure 6.5.2, which is part of the status/toolbar at the bottom of the main display window. The receiver bandwidth is set using the popup control shown in Figure 6.5.3. For more options, refer to the PicoVNA5 User's Guide

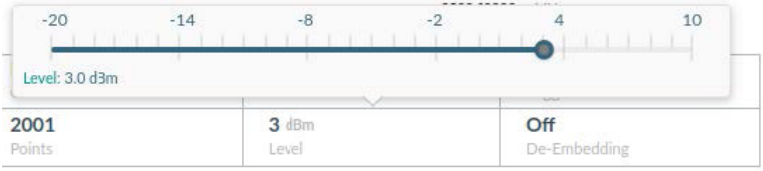

Figure 6.5.2: Setting the test signal level, via the popup located below the main display.

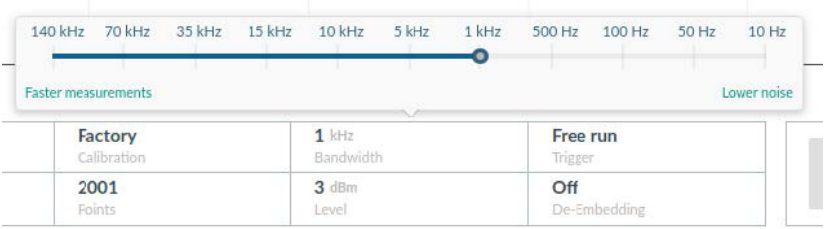

Figure 6.5.3: Setting the receiver bandwidth, via the popup located below the main display.

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6.6 Setting up the display

The measurement parameters and plot types can be configured using the axis options popup, opened by clicking anywhere in the left half of the legend above the graph. The available options are shown in Figure 6.5.4. An additional axis (to display additional measurements on the same plot) can be added to each plot using the graph options menu, opened by clicking the button in the lower right of each plot. For more options, refer to the PicoVNA5 User's Guide.

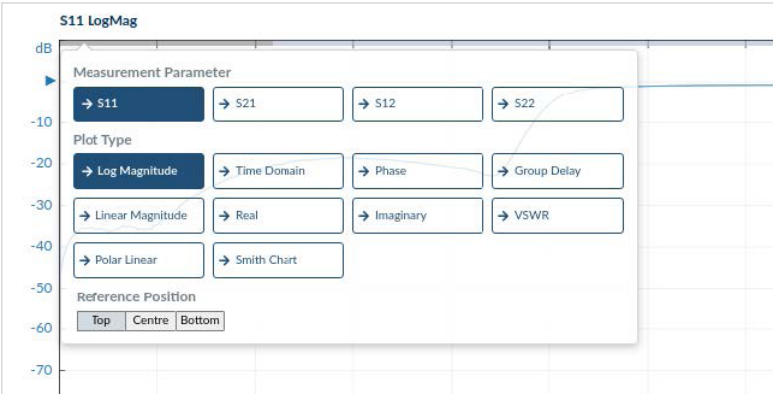

Figure 6.5.4: The axis options pop-up context menu, for configuring the measurement parameter and plot type of that axis.

6.7 Loading or performing a calibration

To perform a new calibration, click the "Calibration" button in the toolbar at the bottom of the main display window, then click "New Calibration" in the sidebar that appears and follow the on-screen instructions. The process of performing a new calibration is described in more detail in the PicoVNA5 User's Guide.

To recall a calibration that has been carried out previously, open the "Calibration" sidebar as above, click "My Calibrations" and then click "Load" next to the calibration to be recalled. Recalling a calibration is described in more detail in the PicoVNA5 User's Guide.

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6.8 Calibration tips

The bandwidth setting used during calibration contributes to the accuracy of the measurement. The table below shows suggested bandwidth and power settings to use during calibration for different types of measurement.

Measurement	Calibration bandwidth	Calibration power	Comments
Fastest Speed	10 kHz	−3 dBm	Set bandwidth to 140 kHz during measurement
Best accuracy	50 Hz	−6 dBm	Leave bandwidth set to 50 Hz during measurement
General use	1 kHz	−3 dBm	Leave bandwidth set to 1 kHz duringmeasurement

6.9 Running in demo mode

Demo mode can be used to explore and evaluate the user interface software with no instrument connected.

To enter demo mode, start the PicoVNA 5 software with no instrument connected. When the “Searching for devices” dialog appears, click on “Demo mode”. On the next screen, the software will offer a selection of demonstration measurements. When a demonstration measurement is selected, the software will enter demo mode.

7. Further information

7.1 Specifications

The *User’s Guide* and *Data Sheet* contain the latest specifications for your PicoVNA vector network analyzer.

7.2 Technical support

Regularly updated technical support information can be found in the Pico Technology support forum:

www.picotech.com/tech-support

7.3 Warranty and returns

These PicoVNA vector network analyzers are supplied with a three-year return-to-manufacturer warranty. For full terms and conditions, see the *PicoVNA User’s Guide*.

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