

User Guide

ShockLine™

MS46121A Series

Compact Vector Network Analyzer

MS46121A-004 VNA, 40 MHz to 4 GHz, 1-Port

MS46121A-006 VNA, 150 kHz to 6 GHz, 1-Port



Anritsu

Anritsu Company
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Morgan Hill, CA 95037-2809
USA

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www.valuetronics.com

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Manufacturer's Address: Microwave Measurements Division
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USA

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Product Name: One-port ShockLine VNA

Model Number: MS46121A

conforms to the requirement of:

EMC Directive: 2004/108/EC
Low Voltage Directive: 2006/95/EC

Electromagnetic Compatibility: EN 61326-1:2013

Emissions: EN 55011:2009 +A1:2010 Group 1 Class A

Immunity:	EN 61000-4-2:2009	4 kV CD, 8 kV AD
	EN 61000-4-3:2006 +A2:2010	3 V/m
	EN 61000-4-4:2004	0.5 kV S-L, 1 kV P-L
	EN 61000-4-5:2006	0.5 kV L-L, 1 kV L-E
	EN 61000-4-6: 2009	3 V
	EN 61000-4-11: 2004	100% @ 20 ms

Electrical Safety Requirement:

Product Safety: EN 61010-1:2010

Morgan Hill, CA


Eric McLean, Corporate Quality Director

12 FEB 2015
Date

European Contact: For Anritsu product CE information, contact Anritsu EMEA Limited, 200 Capability Green, Luton, Bedfordshire, LU1 3LU, England. (Telephone: +44 (0)1582 433200; Email: bert.francis@anritsu.com)

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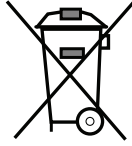
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印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
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Symbols Used in Manuals

Danger



This indicates a risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Warning



This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Caution



This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.



This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.



This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.



This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

For Safety

Warning



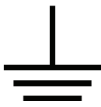
Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.

Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

Warning



or



When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning



This equipment can not be repaired by the operator. Do not attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Caution



Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

Chapter Descriptions

Chapter 1 — Overview

This chapter provides an overview of the ShockLine MS46121A Series Vector Network Analyzer (VNA) and a description of its major functions and available documentation. A summary of available precision component kits including mechanical calibration kits and verification kits is included.

Chapter 2 — Installation

This section provides information for the initial inspection and preparation for use of the ShockLine MS46121A Series VNA and includes information on instrument installation, loading ShockLine Software, and initial inspection.

Chapter 3 — Calibration

This chapter provides information for the manual calibration and 1-Port measurement setup of the MS46121A Series 1-Port VNA.

Chapter 4 — Troubleshooting

This section provides basic troubleshooting methods if the MS46121A is not connecting properly. The software should automatically detect and install drivers when the MS46121A is plugged into the computer.

Appendix A — Maintenance and Security

The MS46121A is a secure device and can be moved in and out of the secure facilities as there are no user accessible locations on the MS46121A.

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Chapter 1 — Overview

1-1 Introduction

This chapter provides an overview of the ShockLine MS46121A Series Vector Network Analyzer (VNA) and a description of its major functions and available documentation. A summary of available precision component kits including mechanical calibration kits and verification kits is included.

1-2 Recommended External PC Configuration and Operating System

The MS46121A is a 1-Port Compact USB VNA that is controlled from an external PC running ShockLine software. The recommended external PC configuration and operating system is listed in [Table 1-1](#).

Table 1-1. Recommended External PC Configuration

Equipment	Description
Operating System	Windows 7 or 8, 64 bit
CPU	3 GHz
RAM	4 GB
Disk	120 GB
Graphics	3D Hardware Accelerated Graphics Capability

1-3 ShockLine MS46121A Series VNA Description

The ShockLine MS46121A Series VNA is an instrument system that contains a built-in source, test set for signal separation, and analyzer. The MS46121A is a 1-Port Compact USB VNA that is controlled from an external pc running ShockLine software. Designed for simple engineering, manufacturing, and educational applications, the MS46121A series VNA supports manual test programming through the same Graphical User Interface (GUI) available on all the ShockLine family VNAs. Test results can be displayed real time on an external pc. Screen captures can easily be printed or saved in common graphic file formats.

The ShockLine MS46121A Series VNA provides a maximum frequency range from 150 kHz to 6 GHz. ShockLine software can control up to 16 MS46121A VNAs simultaneously with each VNA assigned a separate software channel. Each channel has up to 20001 total test points available and up to 16 trace display graphs. Each trace can have up to 12 standard markers and one reference marker.



Figure 1-1. 1-Port USB MS46121A ShockLine VNA with USB cable attached.

1-4 ShockLine MS46121A Series VNA Models

The ShockLine VNA is available in two frequency models as shown in [Table 1-2](#).

Table 1-2. ShockLine MS46121A Series VNA Models

VNA Model Number	Name	Specifications	Test Port Connectors
MS46121A-004	USB 1-Port Vector Network Analyzer	40 MHz – 4 GHz	N Connector Test Port
MS46121A-006	USB 1-Port Vector Network Analyzer	150 kHz – 6 GHz	N Connector Test Port

Options

Option	Descriptions
MS46121A-002	Low Pass Time Domain

1-5 ShockLine MS46121A VNA Instrument Control

Other than test and I/O connectors, there are no user controls on the VNA. The ShockLine MS46121A Series VNA is controlled and operated by an external PC controller loaded with ShockLine Software.

Note

The PC Controller is an External Computer which is provided by the user. Windows 7, Windows 8 or Windows 8.1 is required to run the ShockLine software (V1.1.05 or later) that controls the MS46121A series VNA. The ShockLine Software is provided in the enclosed compact USB memory device or on the Anritsu website at: <http://www.anritsu.com>

The MS46121A Series VNA is controlled via

- An external computer, with monitor or touchscreen, keyboard and mouse
- ShockLine Software V1.1.05 or later
- USB A to a Micro-B Connector

Graphical User Interface

The graphical user interface (GUI) provides a combination of a menu command bar, icon task bar, and right-side navigation menu for most system functions. All of the on-screen navigation elements can be accessed on the user supplied computer.

1-6 Accessories

Accessory	Part Number
External PC with Windows 7 or Windows 8	Not Included
USB cable with a USB A to Mini-B Connector	3-2000-1498
Compact USB Memory Device with ShockLine Software	2000-559-R

1-7 Calibration and Verification Kits

Precision Component and Calibration Kits

Precision-component calibration kits are available. Calibration kits contain components used to identify and separate error sources inherent in microwave test setups. Certain kits contain a USB memory device that provides coefficient, characterization, or measurement data for each component. Refer to the instrument data sheet for detailed specifications on automatic calibrators and mechanical calibration.

Mechanical Calibration Kits

The mechanical calibration kits provide 50 ohm calibrations for N devices.

1-8 User Documentation

The following ShockLine MS46121A Series Vector Network Analyzers documentation is available on the Anritsu web site and is provided with the instrument on the User Documentation USB device.

- MS46121A Series VNA ShockLine User's Guide – 10410-00335
- All User Documentation above on a USB device – 2300-559

For additional technical specifications and configuration data, see the following publication:

- ShockLine MS46121A Series VNA ShockLine Technical Data Sheet - 11410-00839

Updates to Manuals

For updates to any of the MS46121A Series VNA documentation, visit the Anritsu web site at: <http://www.anritsu.com> or contact ShockLineVNA.support@anritsu.com.

1-9 Documentation Conventions

The following conventions are used throughout the entire MS46121A Series VNA documentation set:

- ShockLine VNA refers to any ShockLine VNA module or system.
- VNA refers to any ShockLine VNA module.
- MS46121A Series VNA refers to any of the VNAs in the MS46121A family.
- When required to identify a specific VNA model, the specific model number is used, such as MS46121A-004 (refers to the 4.0 GHz model).

Note

Many of the images in this document are used as typical representations of the product or of the product features. Your instrument and instrument displays may vary slightly from these images.

Instrument Connectors

Panel connectors are denoted with a bold Sans Serif font such as **10 MHZ IN**.

User Interface, Menus, and Soft Buttons

The ShockLine MS46121A Series VNA user interface consists of menus, button lists, sub-menus, toolbars, and dialog boxes. All of these elements are denoted with a special font. Generally, the top level menu items are denoted with a bold Sans Serif font and the subordinate items are denoted with a regular Sans Serif font, such as **Frequency** menu button.

User Interface Navigation

Elements in navigation shortcuts or paths are separated with the pipe symbol (“|”). Menu and dialog box names are distinctive Sans Serif font in CAPITALS. Button names are in Title Case. For example, the path to the Manual Cal menu is:

- MAIN | Calibration | CALIBRATION | Calibrate | CALIBRATE | Manual Cal | MANUAL CAL

User Input

User input such as entering values or other information is denoted in a mono-spaced font such as:

This font denotes a string of user input.

Chapter 2 — Installation

2-1 Introduction

This section provides information for the initial inspection and preparation for use of the ShockLine MS46121A Series VNA and includes information on instrument installation, loading ShockLine Software, and initial inspection.

Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation. If the ShockLine MS46121A Series VNA is physically damaged, notify your local sales representative or Anritsu Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Anritsu. Keep the shipping materials for the carrier's inspection.

Preparation for Use

The ShockLine MS46121A Series software requires installation. To interface with the instrument through direct manual control, the following is required:

- PC with Windows 7, Windows 8 or Windows 8.1
- Keyboard
- Mouse
- ShockLine Software (Anritsu part number 2300-559-R) V 1.1.05 or later
- USB A/micro-B latch cable, 1.8 meters (Anritsu part number 2000-1606-R)

2-2 Installing ShockLine Software

After unpacking, the ShockLine MS46121A 1-Port VNA is ready for use. The MS46121A requires an external PC to operate.

Note	An external computer with Windows 7, Windows 8 or Windows 8.1 Operating System is required to load the ShockLine software.
-------------	--

Connecting the External Computer

The External PC is the controller for the MS46121A 1-Port VNA. In order to enable the ShockLine VNA application to control the MS46121A, connect a USB A to Micro-B cable between the VNA and the external computer pre-loaded with the ShockLine Software.

Procedure

- Power up the external PC.
- Load the ShockLine Software provided from the USB memory device (Anritsu part number 2300-559-R) into the PC or download from the Anritsu website at www.anritsu.com/software.
- Run the ShockLine software installer as Administrator and follow the instructions displayed on the monitor to complete the installation of the software into the PC.

Note The user must run the installer as Administrator to properly install the ShockLine software

The VNA controller and the MS46121A communicates with SCPI or IVI-C. The two communication interfaces are listed below.

1. To use SCPI, TCP/IP protocol will be used with SOCKETS. The user will have to download a development tool to setup the socket and there are many open source development tools for this purpose. Sockets will run SCPI with or without NI VISA.
2. To use IVI-C, download the IVI-C driver from the ShockLine website at:www.anritsu.com/software.

2-3 Running ShockLine Software

The MS46121A series VNA relies on the External PC to perform SCPI or IVI-C programming and interfacing. There are two ways that the MS46121A can be controlled, locally through the Graphical User Interface (GUI) or remotely, via USB controlled SCPI or IVI-C.

To interface the VNA, connect the single port MS46121A to the External PC. Refer to [Figure 2-1](#).

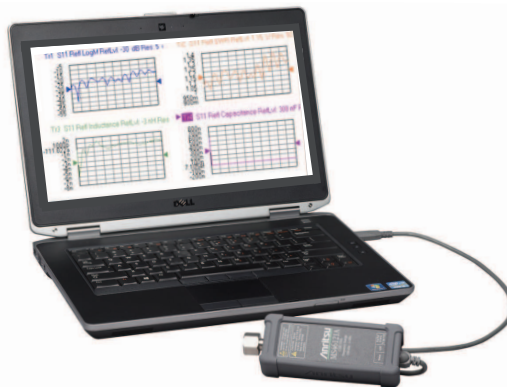


Figure 2-1. MS46121A Connected to PC Controller

The ShockLine software communicates with the VNA hardware through an Anritsu USB driver.

- There is no external power supply. The MS46121A is powered via USB. Power up the device by connecting the USB A connector of the cable to the computer and the Micro-USB connector to the MS46121A.
- Double click the ShockLine desktop icon to launch the ShockLine software to use the MS46121A.

2-4 Automation Interface

This section describes the setup to the automation interface to the MS46121A.

Communication Setup

The MS46121A configuration accepts one to sixteen 1-Port VNAs to be connected at a time to the ShockLine software application. The ShockLine software will set up the channels depending on the number of MS46121As that are plugged in. The software will show an even number of displays. If an odd number of single port VNAs are connected, one channel will be display as unused. [Figure 2-2](#).



Figure 2-2. Display with Multiple 1–Ports

Once the MS46121As have been connected and initialized, setup the automation interface to the instrument.

Navigation

To access the IP address and TCP port number, select:

- Utilities | SYSTEM | Network Interface

SCPI Usage

The IP address and TCP port number will be used for SCPI to declare the instruments address for communication.

Note

Launch ShockLine GUI to enable SCPI communication. GUI menus will turn gray and the GUI interface will be locked out when remote communications are active.

IVI Installation and usage

If the user is working with IVI-C, there are some necessary steps to get started with remote programming. The IVI-C driver can be downloaded from the MS46121A product page, located on the Anritsu website. Go to www.anritsu.com/software.com.

Refer to [Figure 2-3](#). Once the driver is downloaded, there are 3 items in the zip file. The 3 items will be the same for 32-bit and 64-bit. Open the text document for the installation instructions.

Name	Type
ANVNA64-bitWindows.exe	Application
IVI-C_InstallerInstruction.txt	Text Document
IviSharedComponents64_2.2.1.exe	Application

Figure 2-3. Zip File Contents

Anritsu Installation Instructions for ShockLine IVI-C:

1. If you already have an IVI_Foundation installed on your host, proceed to STEP 3
2. Run the IVIShared Components installer as Administrator
3. Run the ANVNAXX-bit Windows installer as Administrator
 - Example code is provided in this IVI-C installer
 - Proceed to the <IVI_HOME>\Drivers\ANVNA folder for examples of using this IVI-C Driver
4. Install your desired development environment, if not already installed
 - C++/C: MS Visual Studio 2005
 - LabView: NI LabView
 - MatLab: Mathworks MatLab
 - Python: Python34
5. Run your desired development environment

Note	Remote communication is successful once the IVI-C sends commands and the ShockLine GUI exits. Unlike SCPI, the ShockLine GUI does not run while IVI-C is in use.
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2-5 Operating Environment and Power Requirements

USB Requirements

The ShockLine MS46121A Series VNA can be operated within the following environmental limits: The MS46121A requires USB 2.0. When using more than two MS46121A VNAs, an externally powered USB powered Hub is recommended.

Table 2-1. Operational Environmental and Power Requirements

Parameter	Specification
Environmental Requirements (per MIL-PRF-28800F; class 3)	
Operating Temperature Range:	0 to +50 degrees Celsius
Relative Humidity:	5 % to 95 % at +45 degrees Celsius, non-condensing

2-6 Getting Started

The following simple step by step procedure will setup the MS46121A for use with ShockLine software.

1. Plug in the MS46121A VNA/s into the computer that will control them via individual USB ports or an externally powered USB hub. Launching the ShockLine software without plugging in the VNAs first will result in the software asking the user if they want to run in simulation mode. See [Figure 2-4](#).

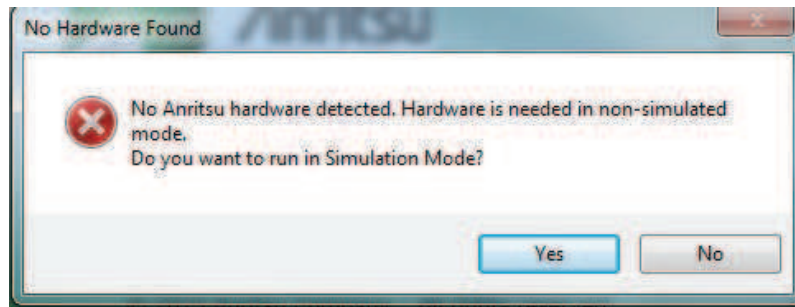


Figure 2-4. No Hardware Prompt

- After the MS46121A has been plugged into the computer, the status indicator light will be orange. Do not issue commands remotely or through the GUI while the indicator light is orange. The light turns green in approximately 10-15 seconds and the VNA is ready for use.

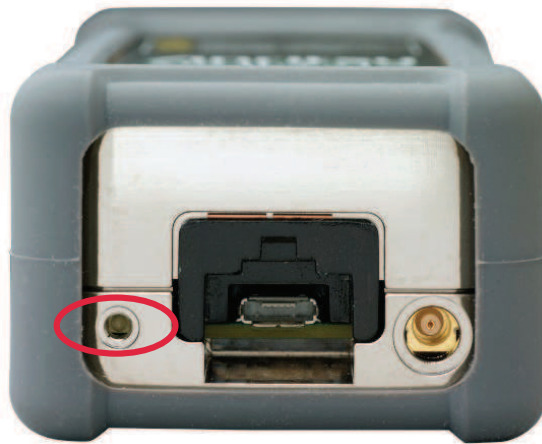


Figure 2-5. 1-Port VNA indicator light

- Open the ShockLine software. ShockLine software version must be V1.1.05 or later to run the MS46121A VNA.

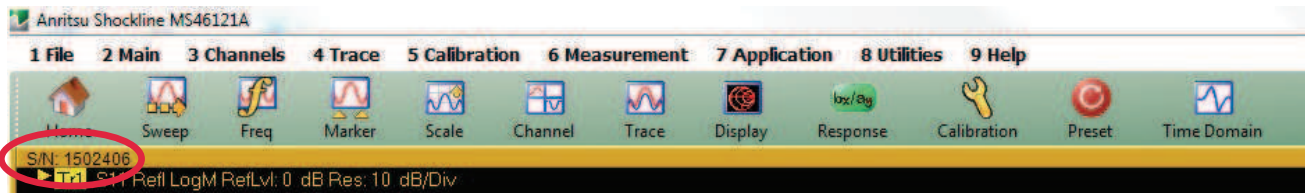


Figure 2-6. 1-Port VNA with serial number labeled on trace

- The ShockLine software will come up with the serial number of the MS46121A displayed in the channel label. See [Figure 2-6](#).
- Each MS46121A will have a dedicated channel and the respective serial number will be labeled to make keeping track of each VNA easier.
- In the unusual circumstance a new VNA is added and there is no response on the channel, before unplugging and re-plugging, the following steps are suggested:
 - Navigate
 - SWEEP | Hold Functions | Hold
 - Upon this menu, press the Hold button and wait 5 seconds
 - Press Sweep button
- Check to see if VNA is sweeping. If not, try un-plugging and re-plugging the VNA.

8. If a VNA is removed, the channel of the removed VNA will stay on the ShockLine software and the other channels will not re-arrange or shift. If all VNAs are removed, the ShockLine software will shut down. Prior to exiting, the software will ask the user if the setup should be saved. See [Figure 2-7 I](#)
-

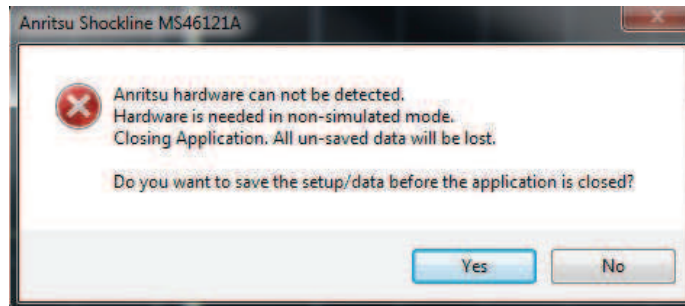


Figure 2-7. ShockLine warning when all MS46121As are removed from ports

Chapter 3 — Calibration

3-1 Chapter Overview

This chapter provides information for the manual calibration and 1-Port measurement setup of the MS46121A Series 1-Port VNA.

Standards Calibration

Before starting the calibration of the MS46121A, the user must have the Open, Short and Load (OSL) standards to perform the calibration. The standards must be characterized and their respective coefficients loaded into the ShockLine software. If the user has an Anritsu calibration tee, loading or creating cal kit coefficients will not be necessary. Some older Anritsu OSL calibration kits may need to have their coefficients loaded into the software.

1-Port VNA Manual Calibration

To calibrate the 1-Port VNA manually, refer to [Figure 3-1](#).

Calibration | Manual Cal | 1 Port Cal | Modify Cal Setup | Edit Cal Params

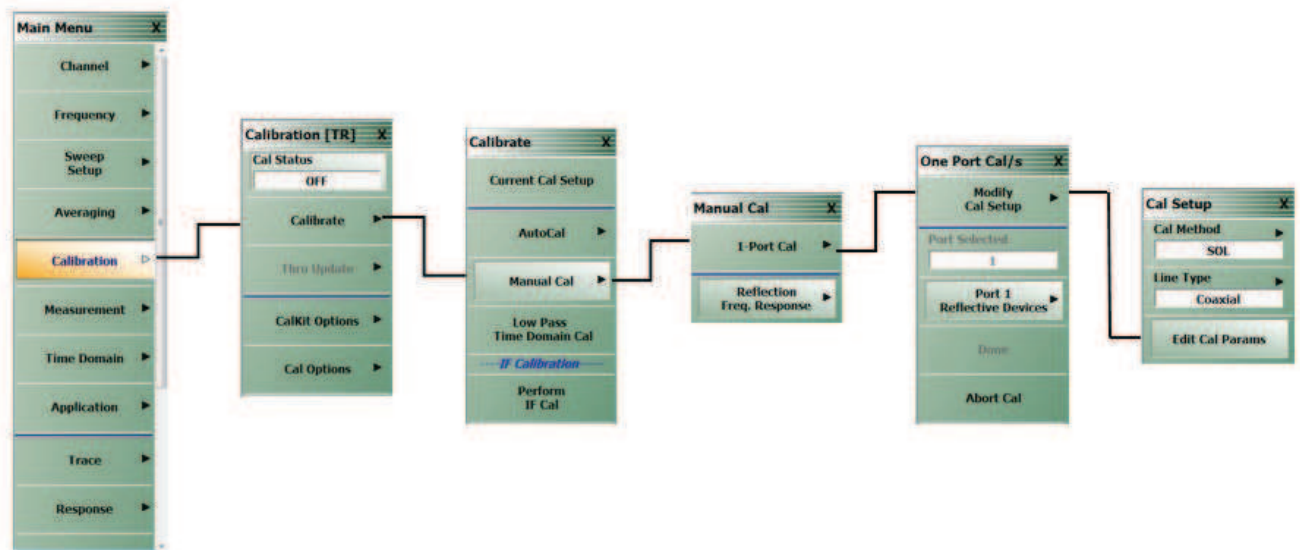


Figure 3-1. Menu Flowchart for 1 Port Calibration

For loading standard coefficients, refer to menu in [Figure 3-2](#). In this example, we have chosen the TOSLNF50A DUT connector since the MS46121A has a N(m) connector and we are using a TOSLNF50A (N(f))calibration Tee.

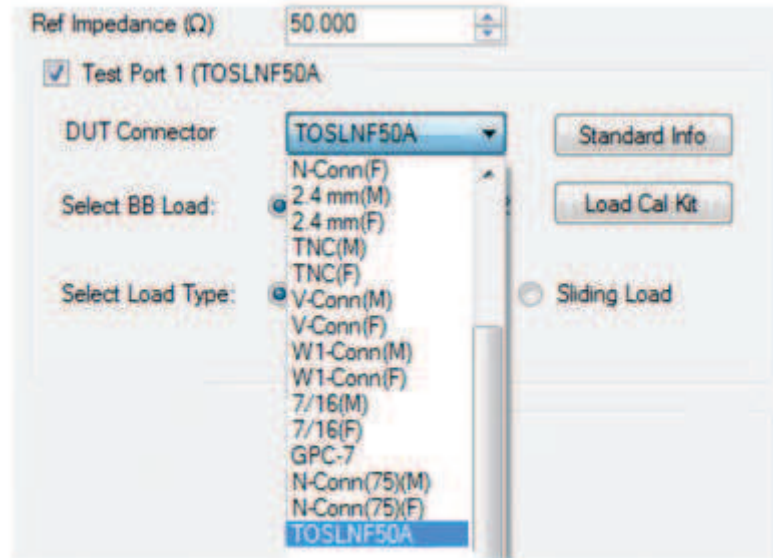


Figure 3-2. One Port Cal Setup (SOL, Coaxial) with Connector Drop Down Menu

Once this setup has been completed and the user has verified the correct calibration standards, the user must push the back button on the Cal Setup menu and then proceed with calibrating the MS46121A VNA. The user will choose Port 1 Reflective Devices and connect all three standards in any order until calibration is complete. The last thing to do is select the “Done” button after the prompt. This will complete the calibration and accurate S11 measurements can now be done.

3-2 Making a 1-Port Measurement

This section describes how the user can make a simple one port measurement. There are many types of trace displays to choose from including log mag, linear mag, real and complex impedance, phase and magnitude. The basic measurement will be outlined and can be changed, with minimal effort, to make all types of S11 measurements.

Setting up the Instrument

The MS46121A is a 1-Port Vector Network Analyzer, so the MS46121A must be calibrated using the Open, Short and Load for accurate measurements. The default for the MS46121A is a single screen with a log magnitude display.

Navigation

One channel in the software is assigned to each of the four MS46121A VNAs. See [Figure 3-3](#).



Figure 3-3. 4 Channel View

Chapter 4 — Troubleshooting

4-1 Chapter Overview

This section provides basic troubleshooting methods if the MS46121A is not connecting properly. The software should automatically detect and install drivers when the MS46121A is plugged into the computer.

4-2 Installation Errors

ShockLine software includes all the drivers necessary to make the MS46121A a plug and play device. Before contacting ShockLine support, the following steps are suggested.

1. Ensure the device is plugged in to the USB port.
2. Unplug MS46121A and try plugging it in again.
3. Try all USB ports as a PC USB port may be defective.
4. Unplug MS46121A, then re-plug and re-launch the ShockLine Software.
5. Confirm that the Anritsu USB driver has been installed by checking the Windows Device Manager under the Universal Serial Bus Controllers. See [Figure 4-1](#).
6. There should be no yellow triangles.
7. If there is a yellow triangle, try re-installing the ShockLine VNA software.
8. If the yellow triangle continues to exist after following steps 1-5, contact ShockLine support at: ShockLineVNA.support@anritsu.com.

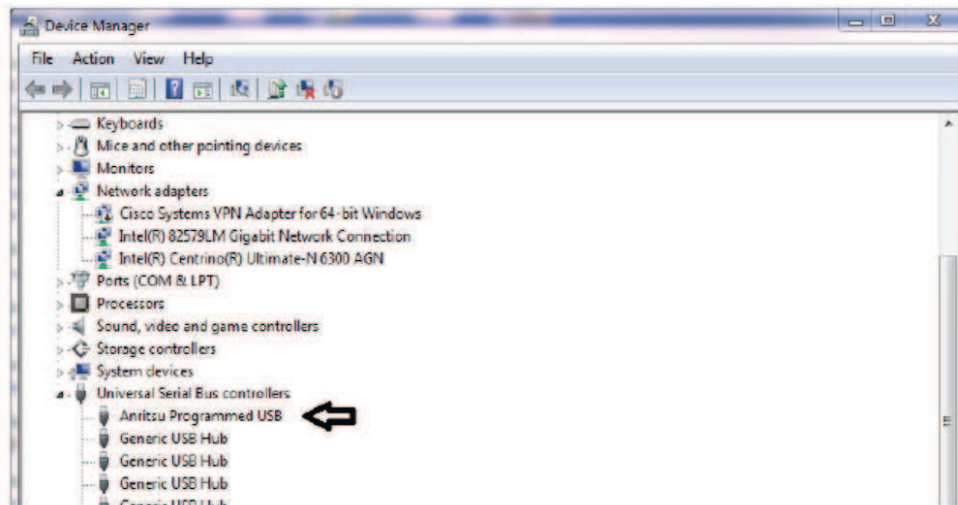


Figure 4-1. Universal Serial Bus Controller

Appendix A — Maintenance and Security

A-1 Security and Memory Overview

The MS46121A is a secure device and can be moved in and out of the secure facilities as there are no user accessible locations on the MS46121A.

The MS46121A USB 1-Port VNA has the following memory devices:

- Non-Volatile 500 kB FLASH. This contains FPGA configuration data. This memory is not accessible by the user.
- Non-Volatile 4 MB Data FLASH. This contains device configuration and calibration data. This memory is not accessible by the user.
- Volatile 2 MB RAM. This memory is for programming data and completely cleared during power down. This memory is not accessible by the user.

A-2 Preparation for Storage or Shipment

Use the following information for preparing the ShockLine MS46121A Series VNA for storage or shipment.

Preparation for Storage

Preparing the VNA for storage consists of cleaning the unit, packing it inside of the storage container with moisture-absorbing desiccant crystals, and storing the unit in a temperature-controlled environment that is maintained between $-40\text{ }^{\circ}\text{C}$ and $+75\text{ }^{\circ}\text{C}$.

Preparation for Shipment

To provide maximum protection against damage in transit, the VNA should be repackaged in the original shipping container. If not available, instructions for packaging and shipment are given below:

Remove Attached Equipment and Connectors

1. Remove any user-supplied connectors or adapters.

Use a Suitable Container

2. Obtain a corrugated cardboard carton with at least 125 kg test strength. This carton should have inside dimensions of no less than 15 cm (6.0") larger than the instrument unit dimensions to allow for cushioning.

Dimensions

3. The instrument body dimensions are:
 - **Height:** 36 mm
 - **Width:** 52 mm
 - **Depth:** 144 mm

Protect the Instrument

4. Surround the unit with polyethylene sheeting to protect the finish. A sealed bag is recommended as a best practice.

Cushion the Instrument

5. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the unit. Provide at least 8 cm (3.0") of dunnage on all sides.

Seal the Container

6. Seal the carton by using either shipping tape or an industrial stapler.

Address the Container

7. If the instrument is being returned to Anritsu for service, mark the address of the appropriate Anritsu service center and your return address on the carton in one or more prominent locations.

Contact information for all worldwide Anritsu Service Centers is available on the web site at:
<http://www.anritsu.com/Contact.asp>

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