

Demo Guide

Keysight M937xA PXIe Vector Network Analyzers



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Preparation for Demo

Equipment requirements

- M937X Demo kit
- PXIe Chassis (PXIe or PXI-H slot)

NOTE

Recommended Practices for Temperature Control

- The use of a Keysight chassis (e.g. M9018A) is recommended for optimum temperature control.
- Use slot blockers and EMC filler panels in empty module slots to assure proper operating temperatures.
- At ambient temperatures above 45° C (113° F), set the chassis fan to High.

- PXI Express embedded controller or remote controller
 - System requirements

Operating system	Windows 7 (32 & 64 bit) Windows Vista, SP 1 & 2 (32 & 64 bit)
Processor speed	1.5 GHz dual core (x86 or x64) minimum, (2.4 GHz recommended)
Available memory	1 GB minimum (8 GB recommended)
Available disk space	1 GB minimum (8 GB recommended)

NOTE

For a list of computers compatible with Keysight Technologies PXIe M9018A chassis, refer to Tested Computer Technical Note (literature no. 5990-7632EN).

NOTE

.NET framework runtime components are installed by default with Windows Vista and Windows 7. Therefore, you may not need this amount of available disk space.

- Hardware requirements


Embedded controller	Keysight M903xA or an equivalent embedded controller that meets the following requirements: <ul style="list-style-type: none"> • PXIe system controller (PXI-1 embedded controllers are not compatible) • Utilize a 2x8, 4x4, or 1x8 PXIe system slot link configuration. • Run one of the operating systems listed in System Requirements (above)
Remote controller	(For Keysight M9018A chassis use only) A PC running one of the operating systems listed in System Requirements (see appendix) and an Keysight M9021A Cable Interface x8 with one of the following PC interface options: <ul style="list-style-type: none"> • Keysight M9045B PCIe ExpressCard Adaptor x1, with cable (for a laptop PC) • Keysight M9048B PCIe Desktop Adaptor x8, with cable (for a desktop PC)

- Computer display to remote desktop OR external display with DVI interface & cable (for VGA interface use VGA to DVI adapter).
- 8 in-lb (0.91 N.m) torque driver

Items included in the demo kit

Below is list of items included in the demo kit.


Part Number	Qty	Description
M9375A-CFG001	1	M9375A-CFG002 PXI VNA 26.5 GHz Software option fully loaded
M9370-90006	1	M9375A Demo Guide (This document)
M9370-90001	1	M9375A Installation Guide
Y1241A	1	Cable kit for multiport configuration. Includes: M9370-20006 Cable Assy – RF, LO Jumper M9370-20018 Cable Assy – SMB Trigger Jumper M9370-20019 Cable Assy – SMB Reference Jumper
Y1281A	1	Accessory and tool kit. Includes: 5002-3361 Cable Removal Tool, SMB/MMCX 5023-1450 Custom long deep socket for 3.5/SMA connector nuts
5062-6691	2	Cable Assy 20 in SMA(m), SMA(m)
1250-1666	1	Adapter-Coaxial straight SMA(f), SMA(f)
NA	1	USB memory
NA	1	Mini-circuit VBZF-2000+ 2GHz BPF



**KEYSIGHT
M9375A
Network Analyzer**

M9375A-CFG002
PXI VNA 26.5 GHz
Software option fully loaded

Y1241A
Cable kit for multiport configuration




M9370-20006
Cable Assy – RF, LO Jumper


M9370-20018
Cable Assy – SMB Trigger Jumper

M9370-20019
Cable Assy – SMB Reference Jumper

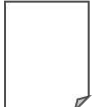
Y1281A
Accessory and tool kit



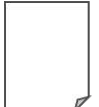
5023-1450
Custom long deep socket for
3.5/SMA connector nuts




5002-3361
Cable Removal Tool, SMB/MMCX




M9370-90001
Installation guide



M9370-90006
Demo guide




Part Number: 5062-6691




Part Number: 5062-6691

5062-6691
Cable Assy 20in SMA(m), SMA(m)




Mini-circuit VBZF-2000+ 2GHz BPF



Part Number:
1250-1666

1250-1666
Adapter-Coaxial straight SMA(f), SMA(f)



USB memory

Setup 2-port configuration using single module

In this section, the procedure to setup a 2-port configuration is shown. If you are using a non-Keysight chassis and controller, the basic procedure of the setup will be the same as the steps below.

For tips and hints of setting up the M937X in non-Keysight chassis or controller, refer to appendix.

Verify and install the software

If you know that your system has the latest software installed, skip this step and install the hardware.

1. Power up the controller.

CAUTION

If you're using a remote controller and you have installed the interface cable, you must power up the chassis BEFORE you power up the PC. When you power down your system, shut down the PC BEFORE you power down the chassis.

2. Use windows key to show control panel, and select "Uninstall a program" to show list of programs installed in the system.

1. Check the revision of the Keysight IO Libraries Suite (IOLS). It should be revision 16.3.17914.4 or newer.
2. Check the revision of the M937X. It should be higher revision than the firmware on the web. www.keysight.com/find/pxivna

3. Install software if the system does not have the latest software.

1. Install the Keysight IO Libraries Suite. Using either the USB or the downloadable file at www.keysight.com/find/iosuite. Follow the installer prompts to install the IO libraries. This software must be installed at first.
2. Install the network analyzer software. Using either the USB memory or the downloadable file at www.keysight.com/find/pxivna, launch the installer. Follow the installer prompts to install soft front panel, device drivers (IVI-C, IVI-COM, and LabVIEW G) and documents.

NOTE

When you install the product software, the IVI driver files are installed in the standard IVI Foundation directories (for example, C:\Program Files\IVI Foundation\IVI\Drivers\). Example programs are provided to demonstrate most driver functionality. The reference material for the driver functions (a Microsoft HTML Help .chm file) is installed. In addition, you can directly access the .chm file (AgM9391.chm) from this Start menu location: Start > All Programs > Agilent IVI Drivers > AgNA > AgNA Documentation.

Install the module

CAUTION

Please review all safety information located in Chapter 3, “Safety, Regulatory, and Environmental Information,” of startup guide (M9370-90001) before proceeding with installing and using the analyzer.

1. Power down the controller

CAUTION

PXI hardware does not support “hot-swap” (changing modules while power is applied to the chassis) capabilities. Before installing or removing a module to/from the chassis, power-off the chassis to prevent damage to the module

2. Insert M937X modules in a chassis with a PXIe, or PXI-H chassis slots



H

The network analyzer module can be installed in any PXIe or hybrid PXI slot marked with a peripheral slot compatibility image (solid black circle for PXIe, or solid black circle with the letter “H” for hybrid).



3. Leave the 50 ohm loads attached as shown in below figure.



Measuring 2-port device with soft front panel


In this demo, we use soft front panel to measure 2-port device. The soft front panel can be launched by VNA launcher.

Using the Soft Front Panel to make a measurement

Keysight soft front panels provide easy to use instrument communications. The graphical user interface guides developers through module setup using a similar look and feel as the popular PNA. Users can quickly configure the instrument parameters and perform calibrations.

Launch Soft Front Panel

Click the **Network Analyzer** SFP shortcut



Select M937XA module to run
Click Run

Connect to M9370x VNA

Select Instrument:

Chassis Slot	Visa Address	Description
0	5	PXI12::0::0::INSTR

Selected Module(s): 2 port VNA at slot 5

PXI12::0::0::INSTR

Help Run Cancel

NOTE

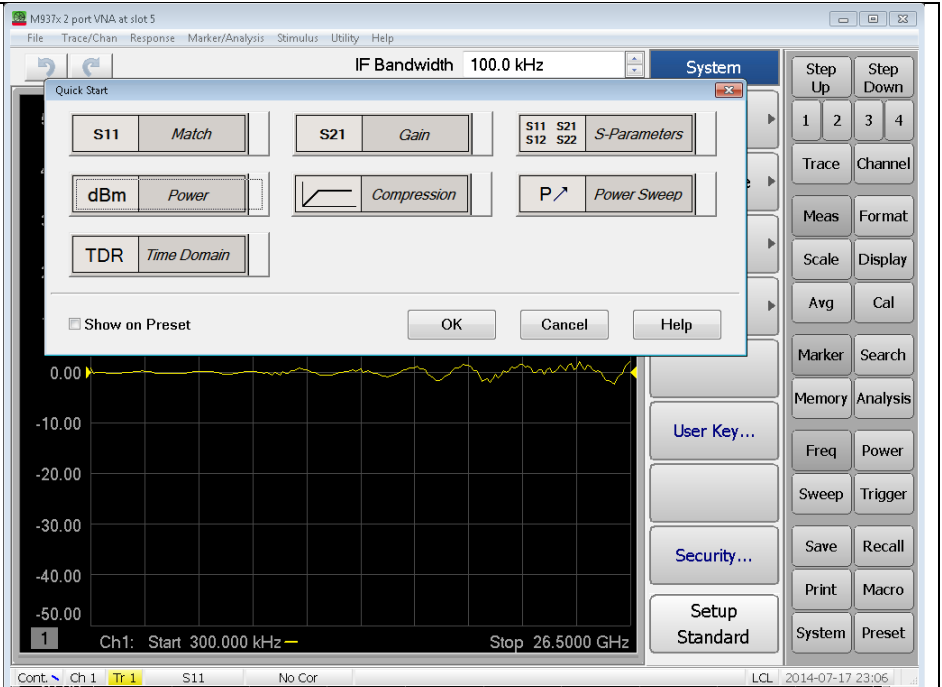
When more than one module is installed in the chassis, you can choose to configure the modules as a Multiport VNA or as Multi-site VNAs. See following section for more details on multiport or multi-site VNA configuration.

Setup measurement parameters

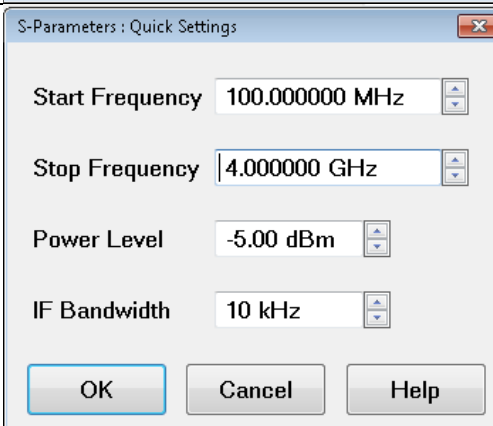
On the menu bar of M937X SPF,

Select Utility > Quick start...

Select S-Parameters



Setup measurement parameters as shows in left for the demo DUT.

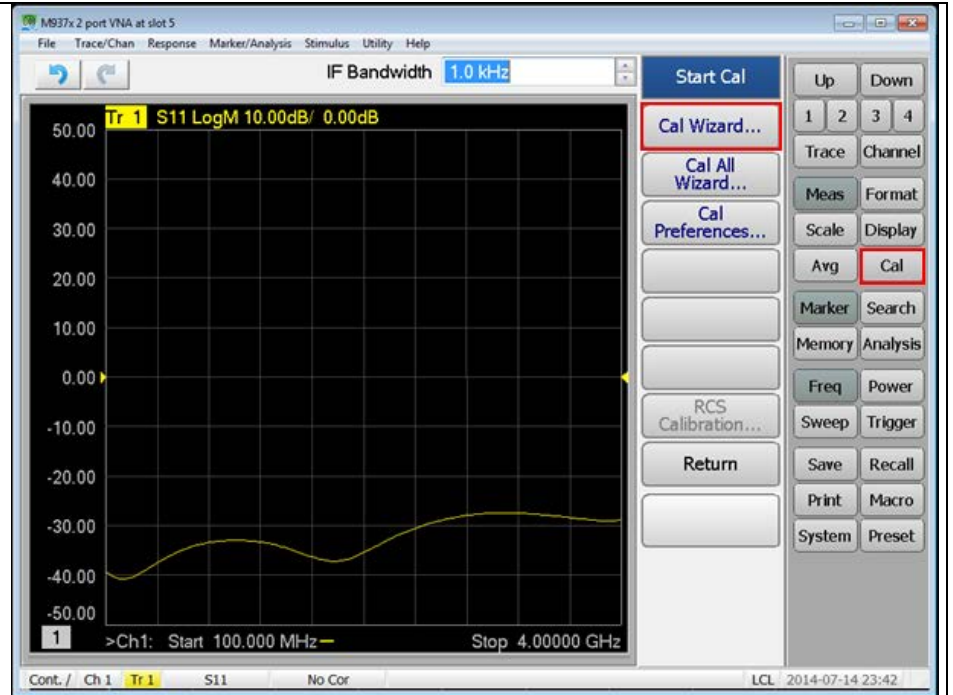


Perform calibration

Click [Cal] key on the right panel

Click [Cal Wizard...] key on the menu under "Start Cal".

Follow instruction to perform cal.



NOTE

ECal modules are controlled and powered through a USB connection. When you connect the module, the type of module, frequency range, and connector type are automatically recognized. For PXI modules, connect the ECal module to a USB port on the remote or embedded controller.

Demonstrating multiport configuration

The Keysight PXI VNA is an ideal solution for multiport measurements. The PXI VNA has a two-port (2- reference receivers and 2- test receivers) architecture in a one-slot module. It can be easily configured as a true multiport VNA by using additional modules installed in the same chassis. The true multiport VNA has no degradation in performance (i.e. dynamic range, trace noise, directivity,) due to external switches. The PXI VNA supports full n-port correction capability when configured as a multiport VNA.

NOTE

The mainframe should have the latest version of the software for this demonstration. Refer to [verify and install the software](#) section for more detail.

NOTE

In the following instructions, eight modules are configured. Use these instructions as a general guide if installing a different number of modules.

NOTE

The selected modules in a Multiport VNA **MUST** be sequential. For example, to configure a 6-port VNA using the above installed modules, you could choose Slots 5, 6, 7

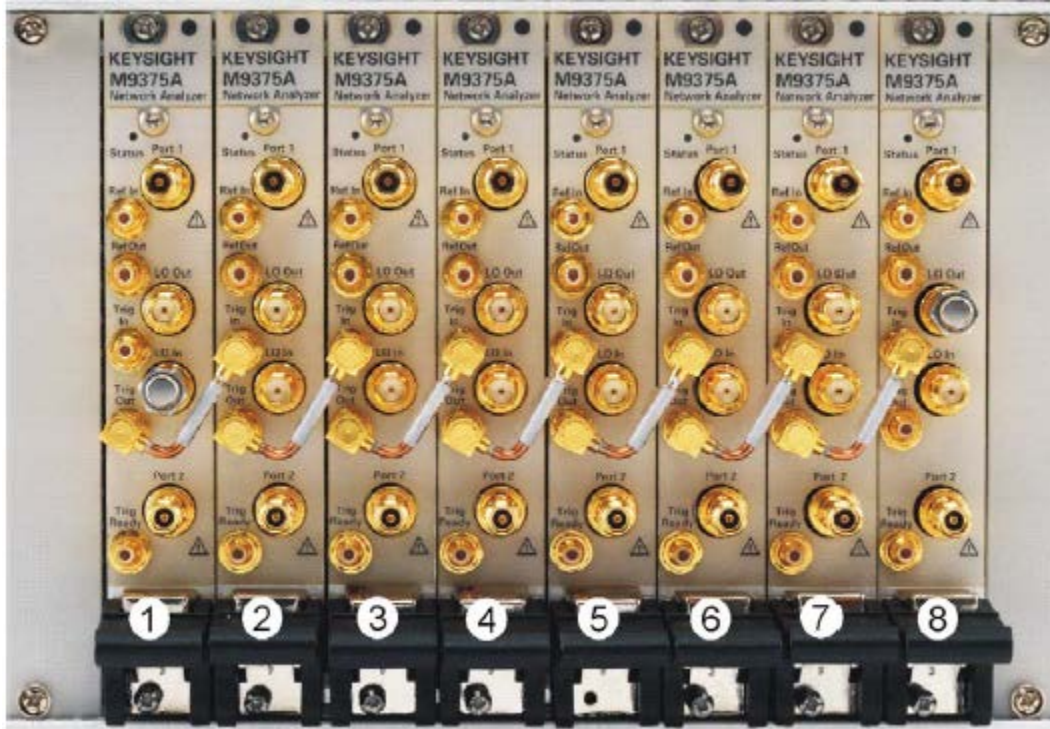
Install modules

1. As seen in below figure, each module is shipped with two 50 ohm loads attached to each module. To enable connections between module pairs, some of these loads must be removed.

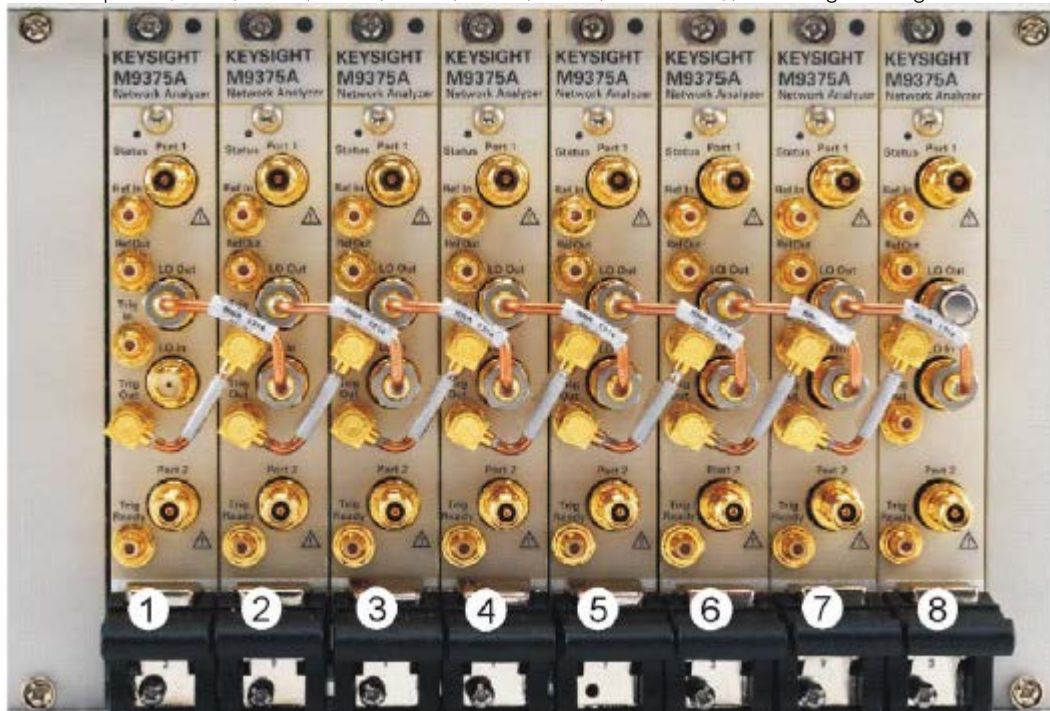


- a. On the module in slot 1, remove the 50 ohm load from the LO Out port. Leave the load installed on the LO In port.
- b. On the module in slot 8, remove the 50 ohm load from the LO In port. Leave the load installed on the LO Out port.
- c. On each of the remaining modules, remove both 50 ohm loads.
- d. Save the 50 ohm loads that were just removed for possible reuse in another module configuration.

2. Install a semi-rigid cable (M9370-20018), seen in below figure between the Trig Out port and the Trig In port on each of the module pairs (1 & 2, 2 & 3, 3 & 4, 4 & 5, 5 & 6, 6 & 7, and 7 & 8.) Press firmly to ensure a proper connection.

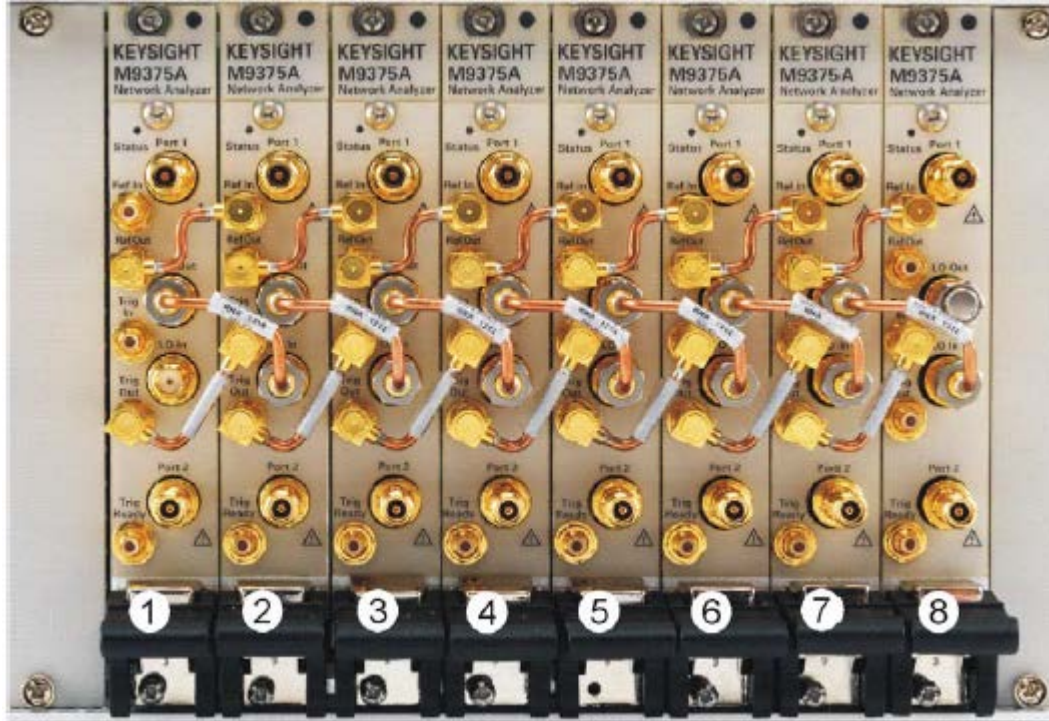


3. Install a semi-rigid cable (M9370-20006), seen in below figure, between the LO Out port and the LO In port on each of the module pairs (1 & 2, 2 & 3, 3 & 4, 4 & 5, 5 & 6, 6 & 7, and 7 & 8), hand tightening the connectors.



4. Tighten the semi-rigid cable, using the socket adaptor attached to the 8 in-lb (0.91 N.m) torque driver.

5. Install a semi-rigid cable (M9370-20019), seen in below figure, between the Ref Out port and the Ref In port on each of the module pairs (1 & 2, 2 & 3, 3 & 4, 4 & 5, 5 & 6, 6 & 7, and 7 & 8.) Press firmly to ensure a proper connection.

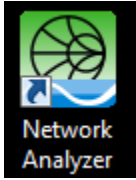


6. You have now completed the hardware installation procedure

Using Soft Front Panel to demonstrate multiport configuration

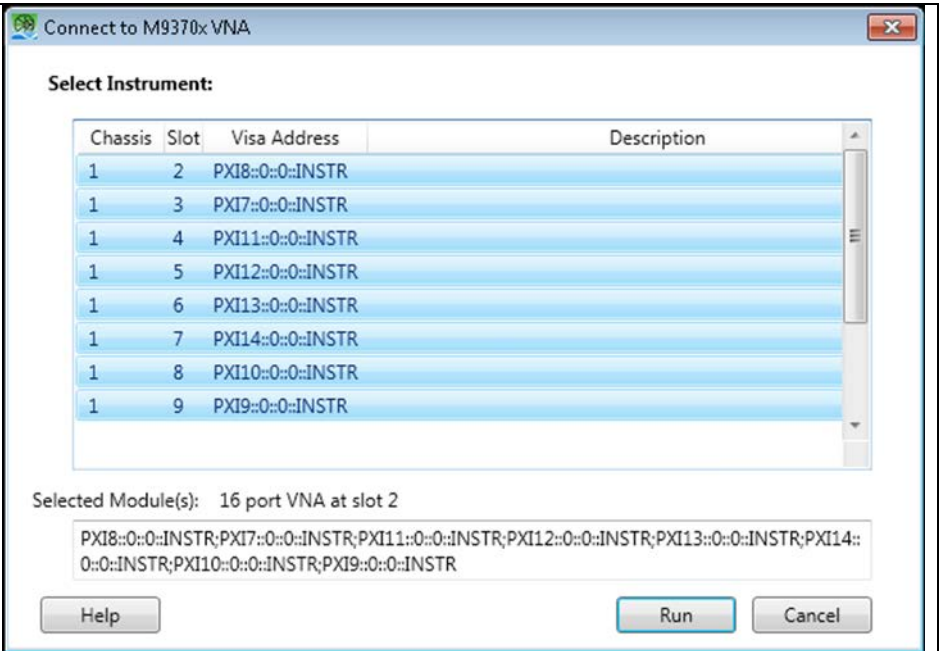
Launch software

Click the Network Analyzer SFP shortcut



Select M937XA modules to configure multiport VNA. In this example, 8 modules in the chassis in slots 2, 3, 4, 5, 6, 7, 8, 9 are selected.

Click Run

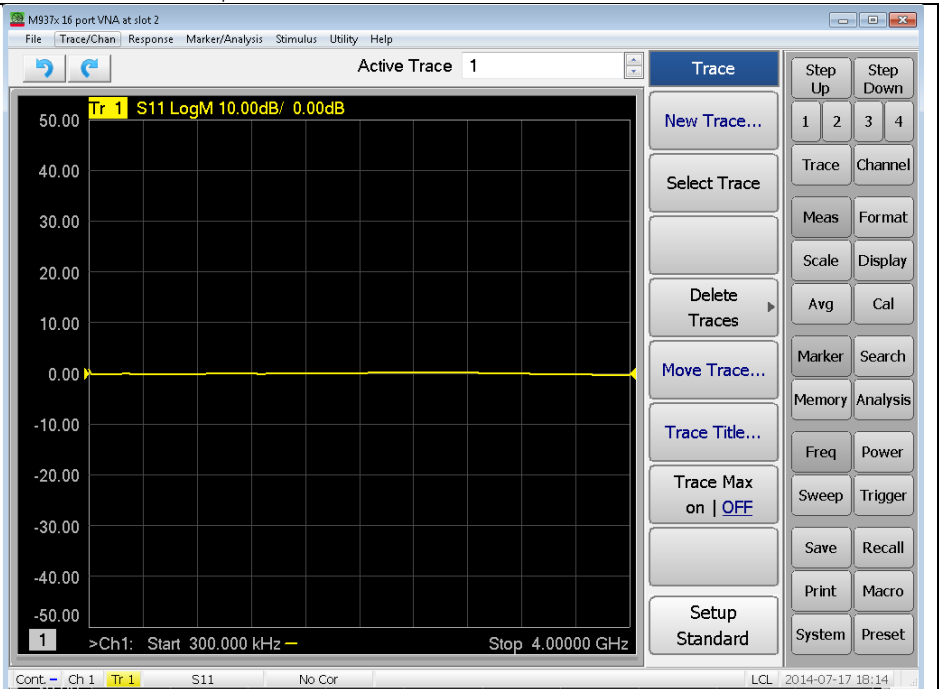


Setup measurement parameters

In this step, we setup the VNA to measure reflection of the all port.

On the M937X SPF...

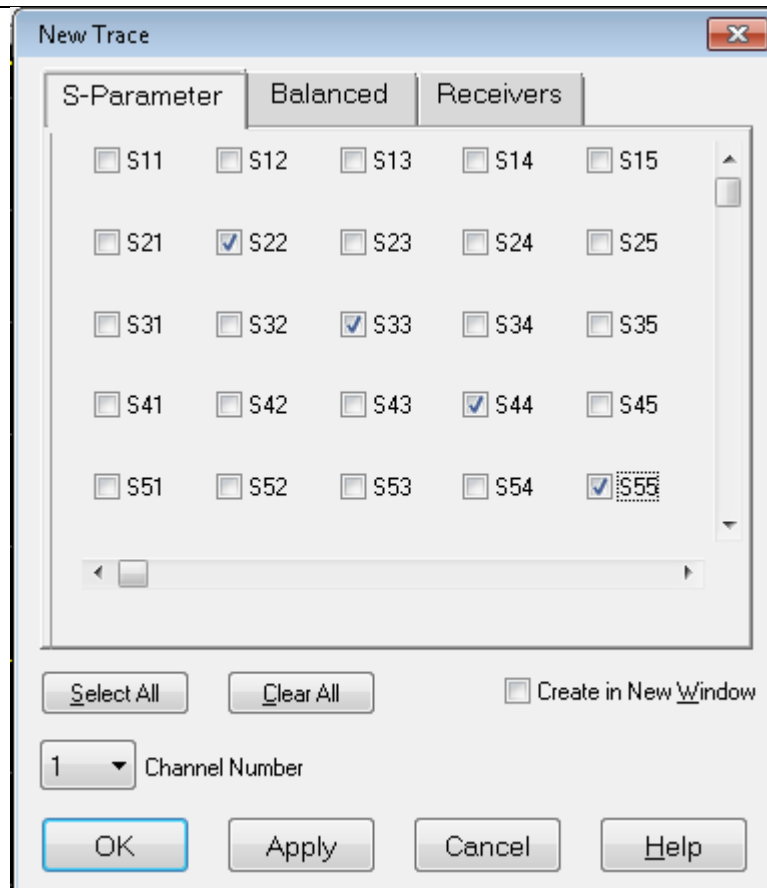
- Set start frequency to 100 MHz
- Set stop frequency to 4 GHz
- Set IFBW to 1 kHz



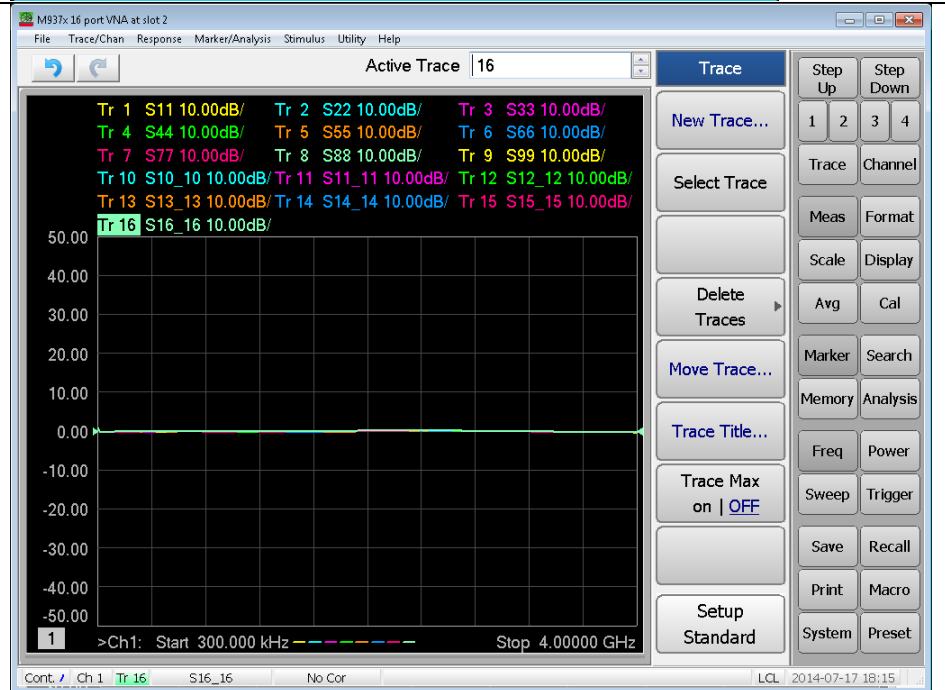
Now the measurement display has S11. We are going to add other 15 reflection parameters.

From menu bar of the M937X SPF,
Trace/Chan > Trace > New Trace...
Select

S22, S33, S44, S55, S66, S77, S88, S99,
S10_10, S11_11, S12_12, S13_13,
S14_14, S15_15, S16_16



Now you have all reflection parameter from port1 (S11) to port16 (S16_16)



Perform calibration

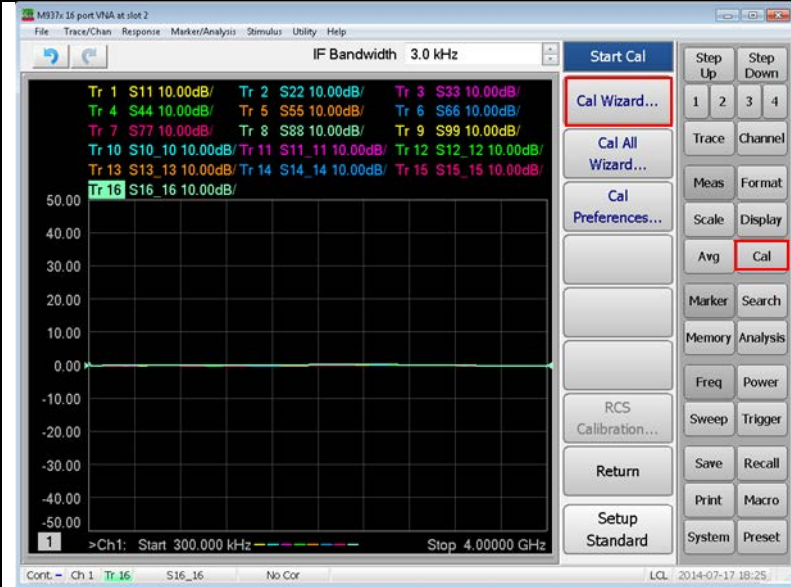
In order to perform calibration more than 2 port, the M937X need to have option 551.

- NOTE** All the demo unit of the M937X has the option 551 installed.
- NOTE** In order to enable option 551 capability in your multiport configuration, you have to have at least 1 module of the M937X which has option 551.
- NOTE** To check the option installed on the M937X, go to the menu bar of the M937X, then click Help > About Network analyzer...

Click [Cal] key on the right panel

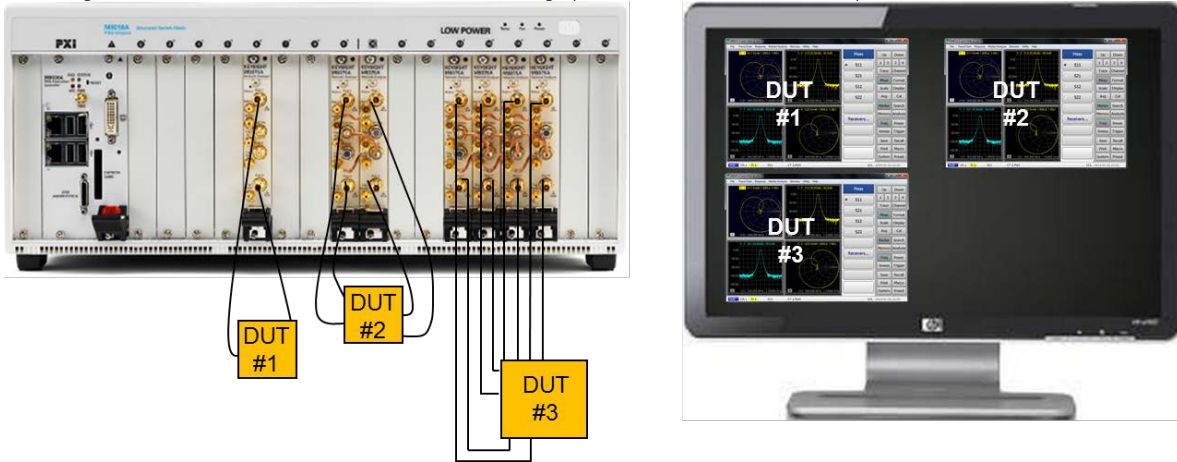
Click [Cal Wizard...] key on the menu under "Start Cal".

Follow instruction to perform cal.



Demonstrating multi-site configuration

While the 4-port VNA is running, you can also create a different, fully-functioning VNA which would run at the same time as the 4-port VNA. The only practical limit to the number of VNA instances is the CPU speed of the host controller. The benefit of creating Multi-site VNAs is measurement throughput. You could test multiple devices at the same time.



In this demo we use multiple M9375A to demonstrate multi-site configuration. The key point of this demo is to show flexibility of the setting.

NOTE The mainframe should have the latest version of the software for this demonstration. Refer to **verify and install the software** section for more detail.

NOTE In the following instructions, two pairs of 4-port operation are configured. Use these instructions as a general guide if installing a different number of modules.

Install Modules

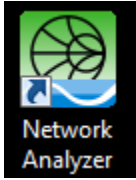
As seen in shown figure, install four modules. Install semi-rigid cables (M9370-20006 for LO In/Out, M9370-20018 for Trig In/Out, M9370-20019 for Ref In/Out) to connect each module. Also, connect 50 ohm loads on LO In of the first module and LO Out of the second module for each pair of 4-port configuration M957XA.



Using Soft Front Panel to demonstrate multi-site configuration

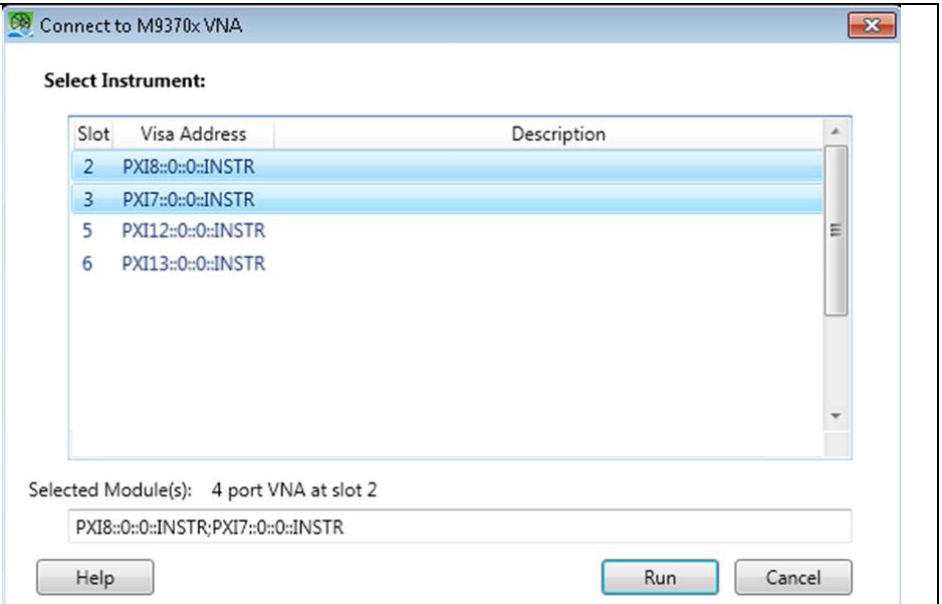
Launch software

Click the **Network Analyzer** SFP shortcut

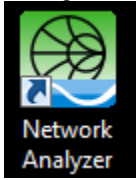


Select M937XA modules to run. In this example, select slot 2 and 3 to configure 4-port VNA.

Click Run



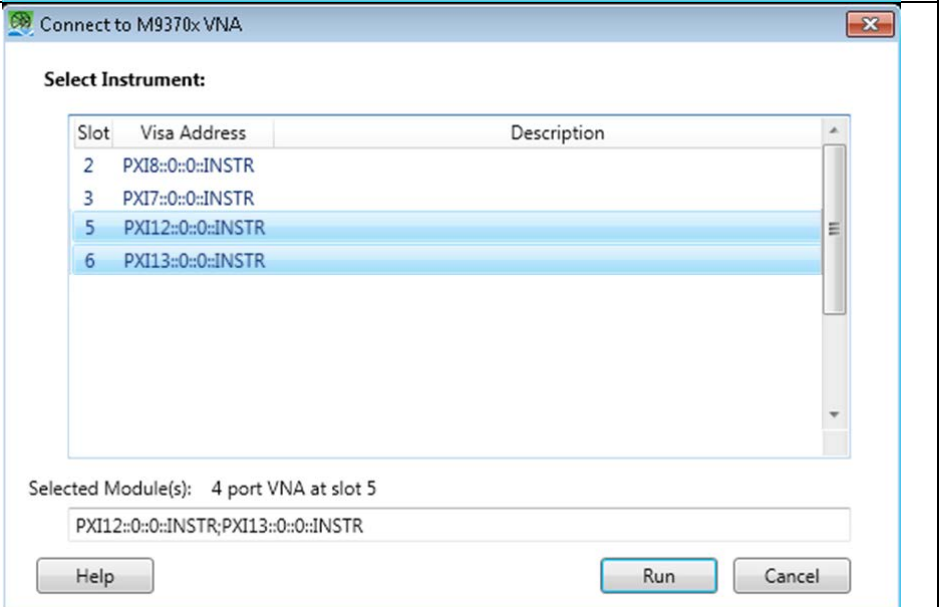
With the first VNA already running, again, click the **Network Analyzer** SFP shortcut, which restarts the Launcher dialog.



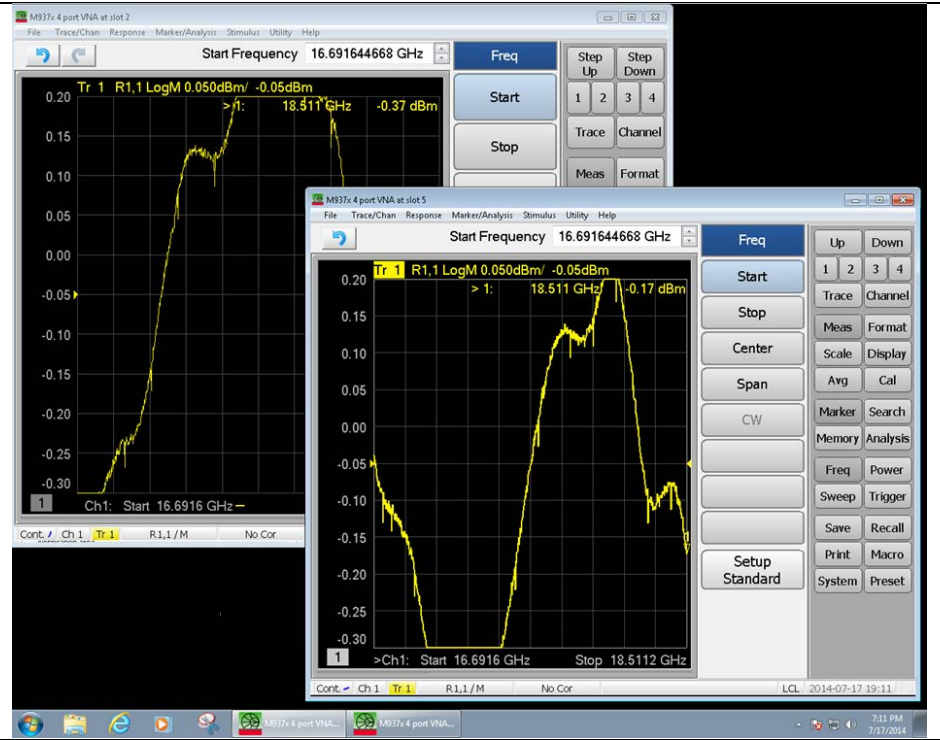
The Launcher dialog shows the same selected slots as the previous time. The selection is 'sticky' to allow you to quickly run the same configuration as before. Select M937XA modules to run. Click each to un-select the previously-selected slots.

Then select one or more of the previously-unused VNA modules. In this example, select slot 5 and 6 to configure 4-port VNA

Click Run



Now, you have two M937X SPF in one system.



Demonstrating program based PXIe VNA

The M973xA PXI VNA is supplied with a comprehensive portfolio of module drivers, documentation, examples, and software tools to help you quickly develop test systems with your software platform of choice. The module comes with IVI-COM, IVI-C, LabVIEW and MATLAB software drivers that work in the most popular T&M development environments including, LabVIEW and LabWindows/CVI from National Instruments, MATLAB from The MathWorks, Microsoft C/ C++, C#, and VB.NET.

IVI Driver Programming Examples

The IVI Driver Programming Examples are simple applications that demonstrate basic use of the driver in a variety of application development environments and programming languages. All the Example programs do the following:

1. Create an instance of the driver.
2. Initialize the driver in simulation mode (no instrument required).
3. Read several IVI Identity properties.
4. Check the instrument error queue.
5. Close the driver.

NOTE

Examples are coded to initialize the driver in simulation mode and should compile and run as is, without an instrument.

NOTE

Example Visual Studio projects were created with VS2008 and may be converted to newer versions. If you are using an older version of Visual Studio, you may cut and paste code from the example project source into a similar project created in your version of Visual Studio.

NOTE

You may use these examples as a starting point for creating programs for your driver. For additional info on using IVI drivers in a variety of development environments.

Example programs are copied at "C:\Program Files (x86)\IVI Foundation\IVI\Drivers\AgNA\Examples\" when you install IVI-COM.

Demonstrating Create Measurement VB Example

NOTE

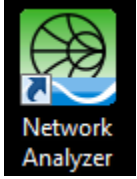
The mainframe should have the latest version of the software for this demonstration. Refer to [verify and install the software](#) section for more detail.

NOTE

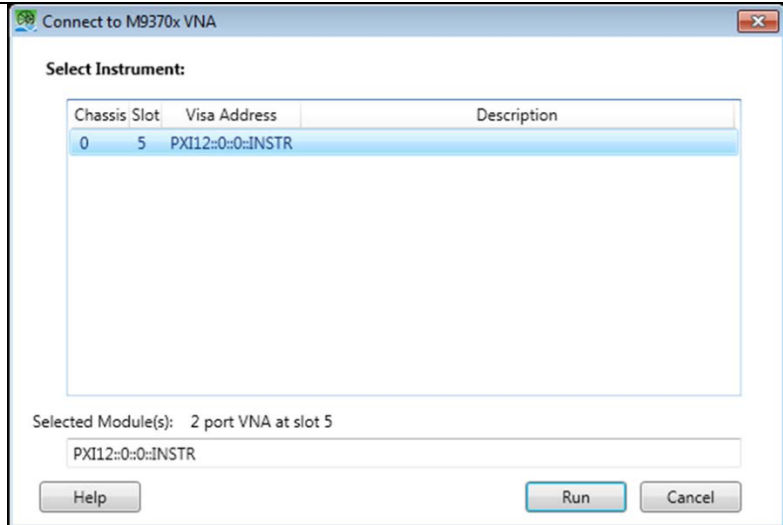
You need visual studio to run and edit the example program. You can use Microsoft Visual Studio Express, which is freeware development environment developed by Microsoft.

Launch Soft Front Panel

Click the **Network Analyzer** SFP shortcut

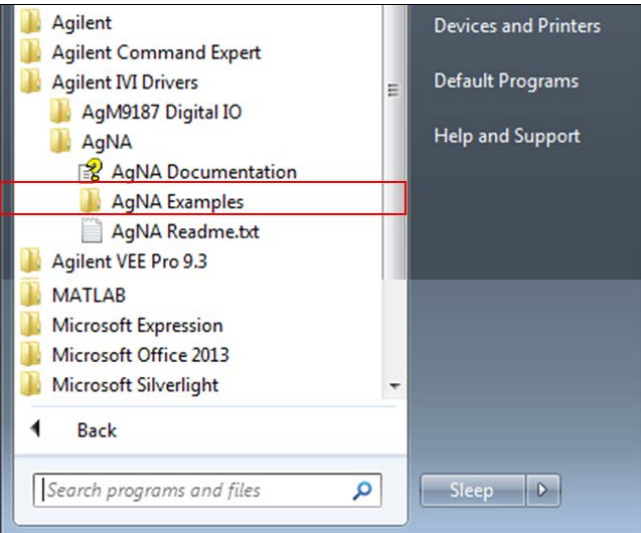


Select M937XA module to run
Click Run



Open example file

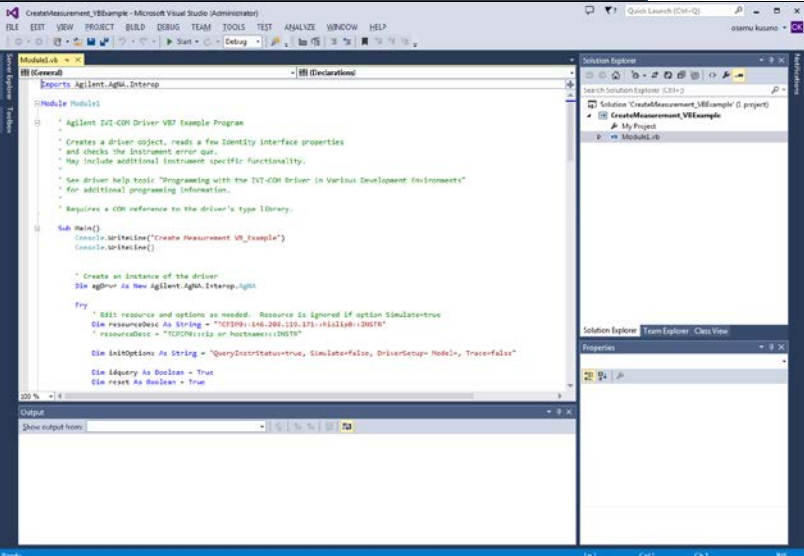
From start menu, Click...
Agilent IVI Drivers >
AgNA >
AgNA Examples



Open...
Examples > VS.NET > VB >
CreateMeasurement_VBExample

Copy and rename...
CreateMeasurement_VBExample_Copy.vbproj

then double click the file to open

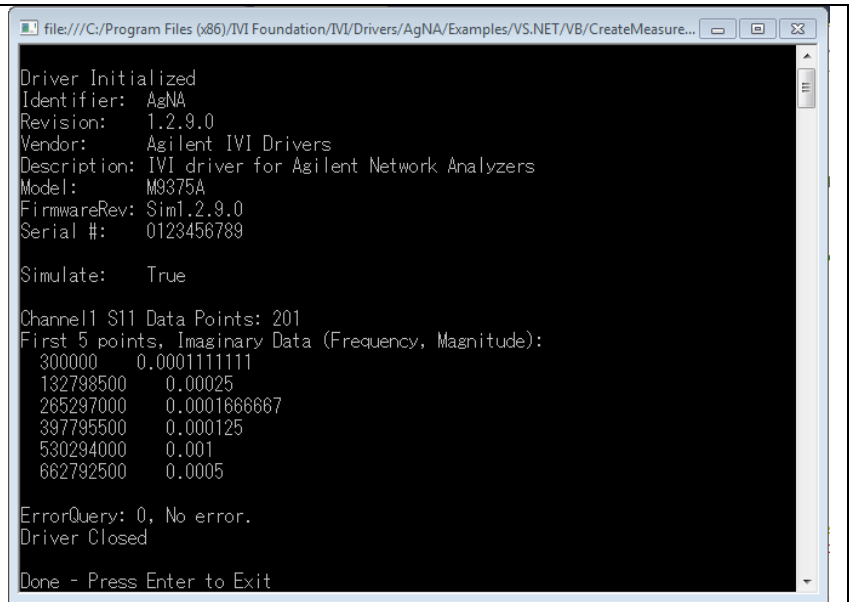


Run the program in simulation mode

On the Visual Studio, run the program by pressing start button (blue triangle button on top of the software).

The program runs in simulation mode.

Press Enter key to close the command prompt.



```
file:///C:/Program Files (x86)/IVI Foundation/IVI/Drivers/AgNA/Examples/VS.NET/VB/CreateMeasure...
Driver Initialized
Identifier: AgNA
Revision: 1.2.9.0
Vendor: Agilent IVI Drivers
Description: IVI driver for Agilent Network Analyzers
Model: M9375A
FirmwareRev: Sim1.2.9.0
Serial #: 0123456789

Simulate: True

Channel S11 Data Points: 201
First 5 points, Imaginary Data (Frequency, Magnitude):
300000 0.0001111111
132798500 0.00025
265297000 0.0001666667
397795500 0.000125
530294000 0.001
662792500 0.0005

ErrorQuery: 0, No error.
Driver Closed

Done - Press Enter to Exit
```

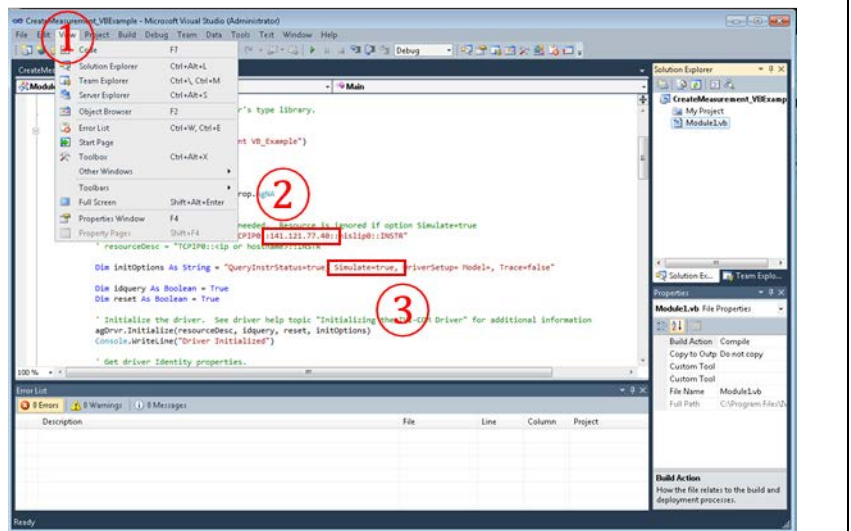
Modify the code

- 1) Show Solution Explorer
View > Solution Explorer

Select Module1

Double-click "Module1.vb" to show the code

- 2) On the line 26, change IP address to 146.208.119.171
- 3) On the line 29, change to simulate=false



```
on CreateMeasure_VBExample - Microsoft Visual Studio (Administrator)
File Edit Project Build Debug Team Data Tools Test Window Help
CreateMeasure_VBExample
  Module1
  Server Explorer
  Object Browser
  Error List
  Start Page
  Toolbars
  Other Windows
  Full Screen
  Properties Window
  Property Pages
  Solution Explorer
  MyProject
  ModuleLib
  Properties
  Build Action
  Copy to Outp
  Custom Tool
  File Name
  Full Path
  Build Action
  How the file relates to the build and deployment process.

Module1.vb
...
resourceDesc = "TCPIP0::146.208.119.171::inst0::INSTR"
...
Dim InitOptions As String = "QueryInstrStatus=true, Simulate=true, DriverSetup=Model, Trace=false"
Dim IdQuery As Boolean = True
Dim reset As Boolean = True
...
Initialize the driver. See driver help topic "Initializing the M937X Driver" for additional information
agDriver.Initialize(resourceDesc, IdQuery, reset, InitOptions)
Console.WriteLine("Driver Initialized")
...
Get driver identity properties.
...

```

NOTE

In this example, we use M937X installed in the system which IP address is 146.208.119.171. Use this example as the general guide for your program.

NOTE

In this example, we use HiSLIP protocol to access M937X hardware, by using below resource description:
resourceDesc = "TCPIP0::146.208.119.171::inst0::INSTR"
If you use HiSLIP protocol like above, M937X Soft Front Panel should be running to make connection.

You can also access M937X hardware directly, by using below resource description:

resourceDesc = "PXI12::0::0::INSTR"
resourceDesc = "PXI0::CHASSIS0::SLOTS5::FUNC0::INSTR"

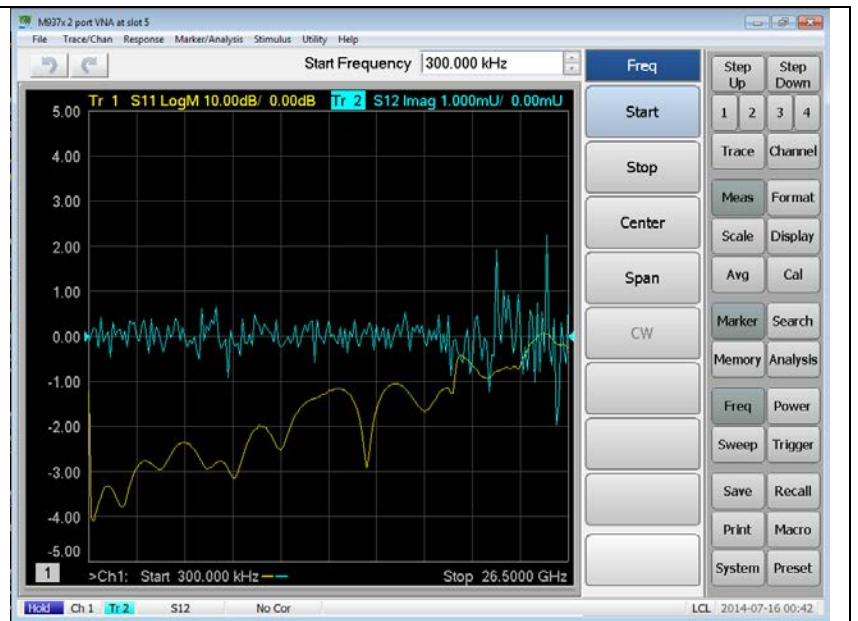
In this case, the M937X Soft Front Panel does not need to be running.

Run the program

On the Visual Studio, run the program by pressing start button.

You will see the command prompt. Different from previous run, the simulate status should be False.

On the M937X SFP, you will see S11 on Tr1 and S12 on Tr2.



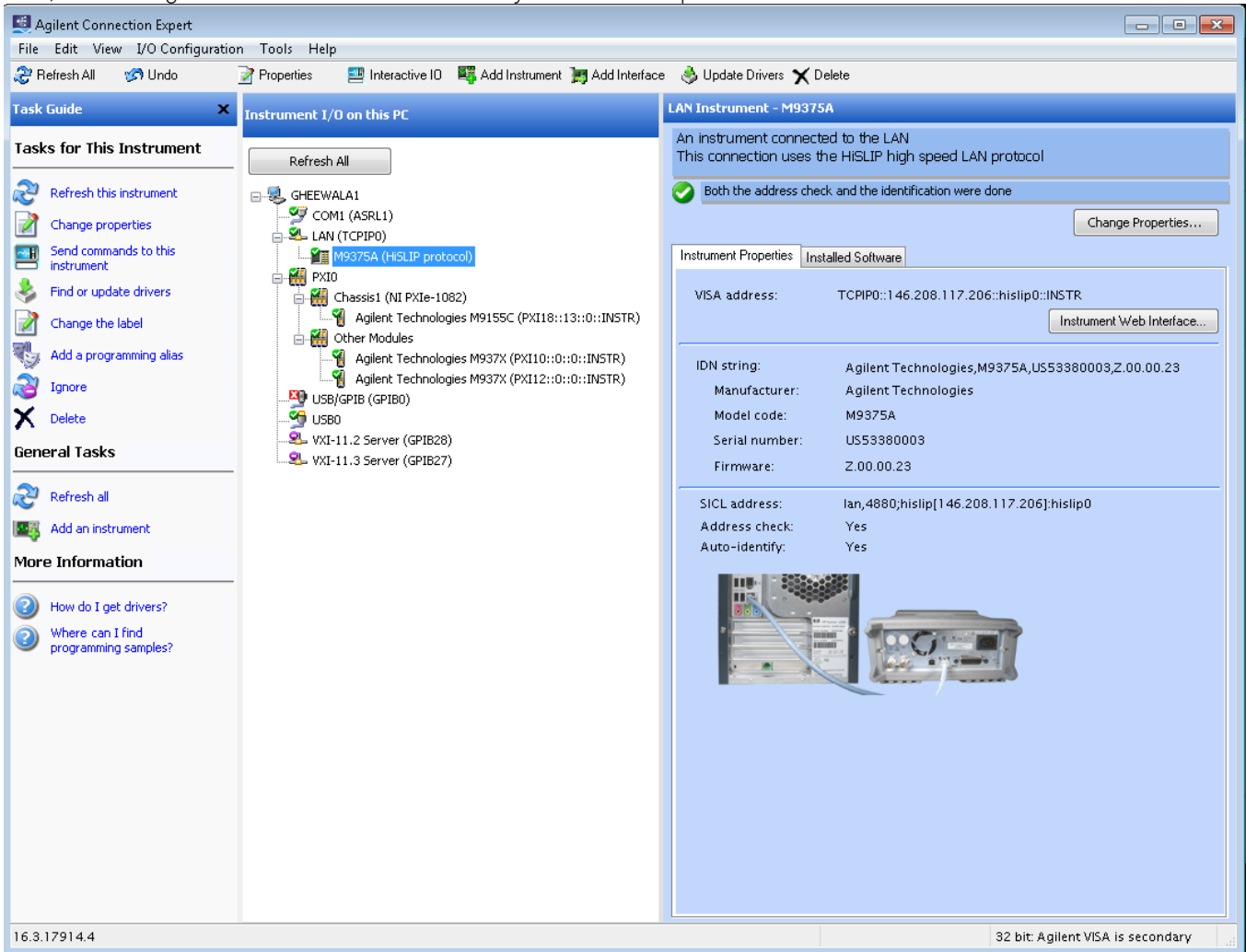
Troubleshoot

The common trouble with this program is IO error (Failed to open VISA resource).




Most of the case, the **resourceDesc** is not properly set on your program. The **resourceDesc** should be the same as VISA address you can see on the Keysight Connection Expert.

Also, do not forget to run the Soft Front Panel if you use HiSLIP protocol connection.



Appendix

Front Panel Features

	Feature	Description
	Status LED	<p>Amber – Power on but firmware has not run or firmware has been shut down cleanly. Green – Firmware is running, instrument is probably idle Flash Green each time a sweep or measurement is triggered (maximum rate will be around a few Hz). Additional measurement commands during a flash cycle are ignored by the flash state machine. Once the trigger rate exceeds the maximum flash rate, the light flashes until new measurements stop for a full flash cycle. Red – The last sweep had an error Off – Power supply off.</p>
	Port 1	APC 3.5 mm female connector. Sources stimulus signals for the DUT and receives
	Port 2	response signals from the DUT. Frequency range is determined by the analyzer model.
	LO In	APC 3.5 mm female connector. If the module is not configured with another analyzer, the connector is terminated with a 50 ohm load. If the module is configured with an analyzer in an adjacent slot, the connector receives the LO signal from the configured analyzer.
	LO Out	APC 3.5 mm female connector. If the module is not configured with another analyzer, the connector is terminated with a 50 ohm load. If the module is configured with an analyzer in an adjacent slot, the connector provides the LO signal to the configured analyzer.
	Ref In	SMB female connector. When a 10 MHz external reference signal is detected at this port, it will be used as the instrument frequency reference instead of the internal frequency reference.
	Ref Out	SMB female connector. Outputs a 10 MHz frequency reference signal for use by other test equipment.
	Trig In	SMB female connector. Inputs a signal to trigger the analyzer.
	Trig Out	SMB female connector. Outputs a signal either before or after a measurement.
	Trig Ready	SMB female connector. Outputs a “READY” signal to other devices.

Hints and Tips for using non-Keysight chassis and controllers

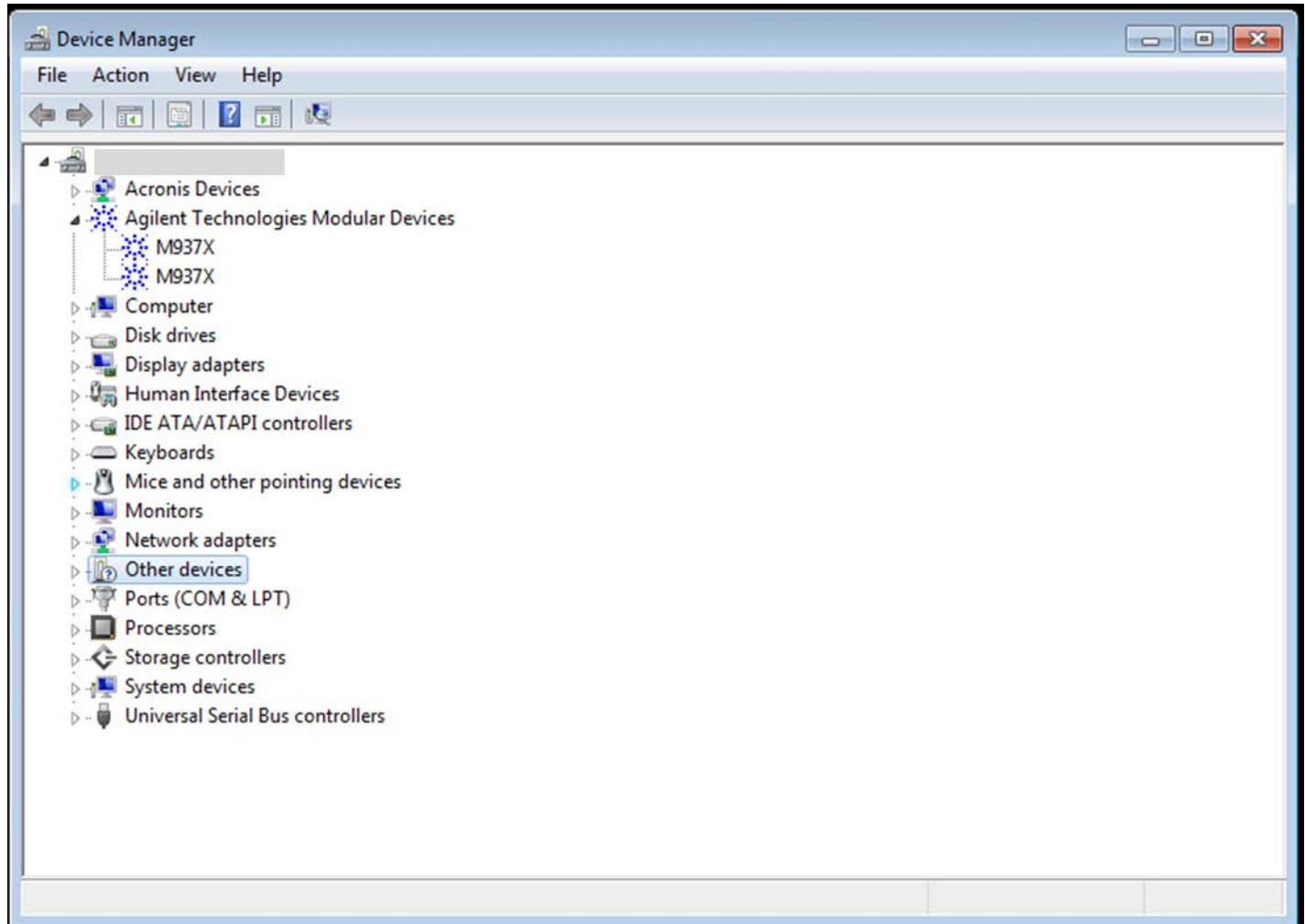
Instrument drivers

It is critical to have an instrument software driver for the M937X. For M937X, the instrument driver is made up of multiple layers such as kernel driver, VISA library, and IVI driver, and they work together to control M937X.

These drivers can be installed with the Keysight I/O libraries and M937X firmware.

Device manager

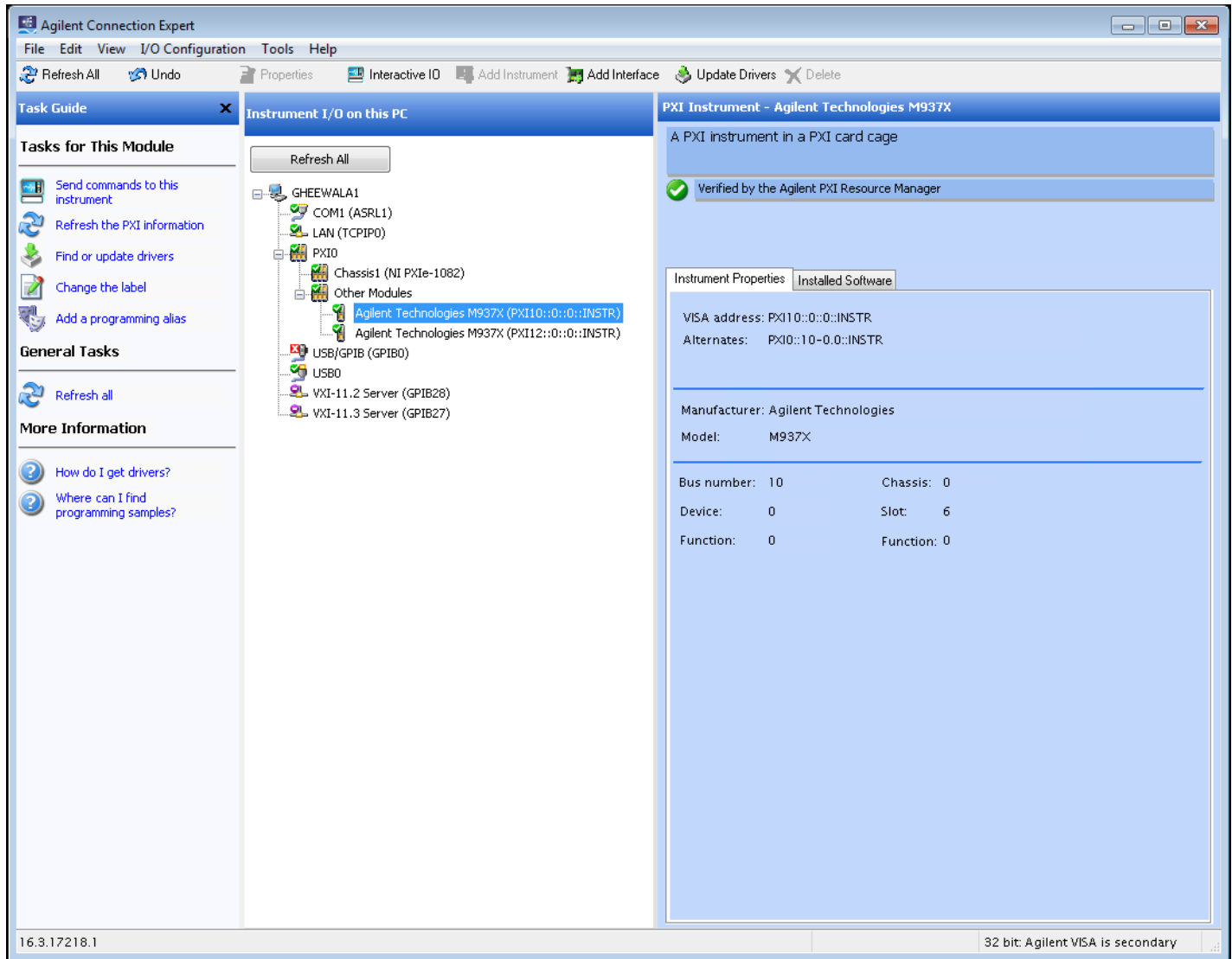
As a result of installing IO library and soft front panel, required drivers are installed in the system, and devices can be observed in the Windows Device Manager. Below is example of two M937X modules in the Device Manager.



Viewing the PCI devices using Windows Device Manager is a good check of the status of the modules and the drivers. This view tells us the modules were successfully enumerated during boot time and the instrument kernel drivers are present and associated with the hardware. These are the first and most important steps to achieve software access to your instruments.

Keysight Connection Expert (KCE)

Keysight Connection Expert (KCE) is installed with the Keysight I/O libraries. KCE can be used to inspect your instrument installation. It will help you visualize the contents of the chassis and inspect the driver revisions.



Installation for 3rd party drivers, such as those from National Instruments, are similar to the Keysight driver installation process. The process includes installation of both the I/O libraries (NI-VISA) as well as individual PXI instrument drivers. Details will vary depending on the PXI instrument provider, but some of the installations also include tools similar to what the Keysight installations provide. For example, when installing IN-VISA the Measurement & Automation Explorer (MAX) is also included. MAX is similar to KCE in that it gives you the ability to inspect your instrument installation. Because M937X only uses drivers which is installed by KCE and M937X software installer, normally there is no problem to installing IO libraries and M937X firmware to the system that already has NI MAX.

Reference documents

M937X Keysight product page
<http://keysight.com/find/pxivna>

M973X Help
<http://na.support.keysight.com/pxivna/help/index.html>

M937X Technical Overview
<http://cp.literature.keysight.com/litweb/pdf/5991-4884EN.pdf>

M937X Configuration Guide
<http://cp.literature.keysight.com/litweb/pdf/5991-4885EN.pdf>

Keysight IO Libraries Suite
www.keysight.com/find/iosuite

Application Note: PXI Interoperability—How to Achieve Multi-Vendor Interoperability in PXI Systems
<http://cp.literature.keysight.com/litweb/pdf/5991-0384EN.pdf>

Technical Overview: PXI and AXIe Modular Instrumentation – Tested computer list
<http://cp.literature.keysight.com/litweb/pdf/5990-7632EN.pdf>

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Print Date: Sept. 2014
Supersedes: None
M9370-90006
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