

APPLICATION NOTE

Verification of a working remote communications connection using NI-MAX

INTRODUCTION:

Automating a test can dramatically increase the productivity, throughput, and accuracy of a process. Automating a setup involves connecting a computer to the test instrumentation using a standard communications bus like USB or LAN and then utilizing code entered via a software layer (like LabVIEW, .NET, Python, etc..) to sequence the specific instrument commands and process data.

This process normally goes quite smoothly, but if there are problems, there are some basic troubleshooting steps that can help get your test up-and-running quickly.

In this note, we are going to show how to use NI-MAX to test the communications connection between an instrument and a remote computer using both a <u>USB</u> and a <u>LAN</u> connection to ensure that they are working properly. Once the connection is verified, you can begin to work on the control software.

National Instruments Measurement and Automation Explorer (NI-MAX) is a free communications tool provided with NI's VISA library.

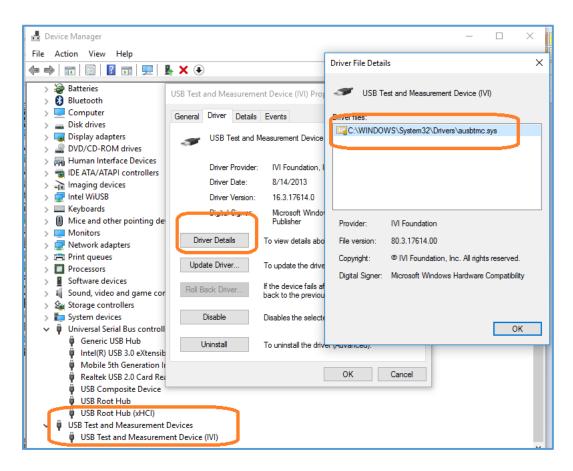
You can learn more here: http://digital.ni.com/public.nsf/allkb/71544521BDE34FFB86256FCF005F4FB6

USB Connections:

1. Power on and connect the instrument via USB cable to the computer. On a computer running Windows, the first time you connect the USB from an instrument should open a dialog box or show a notification of a new device being connected.

You can check the status of the USB connections by opening Device Manager located in the Control Panel menu of most Windows Operating systems and expanding the driver information as shown below in this Windows 10 example:

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This indicates that the operating system recognizes the connected instrument as a test instrument.

If the device manager reports the USB connection as some other type of device (printer, camera, unknown, etc.), there is likely a problem linking the proper driver (*ausbtmc.sys*) to the instrument. One possible solution to this is to disable the driver, disconnect the USB cable, verify that *ausbtmc.sys* exists, and then reconnect the USB cable.

2. Run NI-MAX by left-clicking on the icon on the desktop or finding it via the start menu



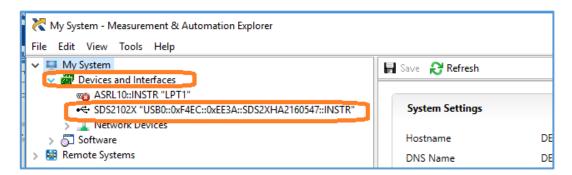


3. This will open the main window, as shown below:



My System	🖬 Save 🔗 Refresh			y? Hide He
 iiii Devices and Interfaces iiii Software iiiii Remote Systems 	System Settings		A Bac	Luid
	Hostname DNS Name Vendor Model Serial Number Firmware Version Operating System System Start Time Description System Configuration Web Access	DESKTOP-4AMV6V5 DESKTOP-4AMV6V5 Dell Inc. Inspiron 3558 8PH0982 A11 Microsoft Windows 10 Home 4/20/2017 7:25 AM	Instr Mea Auto Expl Meas Auton Your Your Instr What do? Hana Hana Softw Hana	ruments surement & mation orer unements nation Explorer la provides access to vational uments products. It do you want to <u>ge my devices and</u> <u>acces</u> <u>ge my installed</u> <u>nal Instruments</u>
	System Resources		virtua	<u>e scales for my</u> al instruments gure my IVI
	Total Physical Memory	5.91 GB	instru	rt/export my
	Free Physical Memory	1.43 GB		e configuration
	Total Virtual Memory	8.66 GB	-	

4. Expand the "Devices and Interfaces" menu. You should see the instruments attached via USB with a brief description as shown for an SDS2000X oscilloscope below:





This indicates that a software application (NI-MAX) has correctly identified a test and measurement device (the oscilloscope) over the USB connection.

5. By left-clicking on the instrument, you can see additional information about it:

K SDS2102X "USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR" - Measurement & Automation Explorer						
File Edit View Tools Help						
🗸 📮 My System	🔚 Save 🛛 😪 Refresh 🛛 💥 Open VISA Test Panel					
Devices and Interfaces						
ASRL10::INSTR "LPT1" SDS2102X "USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR"		Settings				
> 🔔 Network Devices						
> 万 Software > Remote Systems		Name				
		Vendor	Siglent Technologies Co,. Ltd.			
		Model	SDS2102X			
		Serial Number	SDS2XHA2160547			
		Status	Present			
		USB Interface Number	0			
		488.2 Compliant				
		VISA Resource Name	USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR			

6. To further test the connection, right-click on the instrument and select Open VISA Test Panel or select it from the side bar:

₹ SDS2102X "USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR" - Measuremen	nt & Automation Explorer	
File Edit View Tools Help		
 My System Devices and Interfaces ASRI 10-UNISTR "LIPTI" SDS2102X "USB0::0xF4EC::0xEE3A::SDS2 Network Devices Software Software Remote Systems 	Settings	pen VISA Test Panel Siglent Technologies C SDS2102X SDS2XHA2160547 Present 0 VSB0::0xF4EC::0xEE3A:



The VISA Test Panel window shows some helpful information, including the instrument manufacturer, model, serial number, and the USB identifier (VISA Address) along the top.

💥 USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR - VISA Test Panel	-	- 🗆 X
Configuration 😡 Input/Output 🔅 Advanced NI I/O Trace	Help	NATIONAL INSTRUMENTS
USB Settings I/O Settings View Attributes USB Information	Return Data No Error	^
Manufacturer Siglent Technologies Co,. Ltd. (0xF4EC)		
Model SDS2102X (0xEE3A)		
Serial Number SDS2XHA2160547		
		v
Refresh Apply Changes		



7. Another useful item in the VISA Test Panel is the Input/Output function. This mode allows you to send specific instrument commands and receive instrument responses.

This is especially helpful when you are planning a specific test sequence, the effect of delays/timing, or troubleshooting a command. You can send each command one-at-a-time and check the performance of the instrument.

Select Input/Output > Basic I/O > and Enter the command in the text window:

- **IDN?* is a common identification string query (question or information request) that returns the information from the connected instrument
- */n* is a termination character that represents a new line. This is the standard termination character for SIGLENT instrumentation.
- Write will send the command to the instrument
- *Read* will pull data from the instrument
- *Query* will perform a read and then a write command to request and return data from the instrument

Configuration Input/Output Input/Output Advanced NI I/O Trace Help Input/Output Basic I/O Line Control USB Control Return Data Select or Enter Command "IDN?\n Bytes to Read Read Operation "IDN?\n Input/Output Bytes to Read No Error Write Query Read Read Status Byte Clear View mixed ASCII/hexadecimal Image: Control (*IDN?\n) Image: Control (*IDN?\n) Image: Control (*IDN?\n) Return Count: 6 bytes 2: Read Operation Return Count: 4 bytes Image: Control (*IDN?\n) Return Count: 4 bytes *IDN\sSIGLENT, SDS2102X, SDS2XHA2160547, 1.2.2.1\sR9\n Image: Control (*IDN?\n)	💥 USB0::0xF4EC::0xEE3A::SDS2XHA2160547::INSTR - VISA Test Panel		—		×
Select or Enter Command "IDN?\n "IDN?\n Write Query Read Read Status Byte Clear View mixed ASCII/hexadecimal 1: Write Operation (*IDN?\n) Return Count: 6 bytes 2: Read Operation Return Count: 48 bytes	Configuration Input/Output Advanced NI I/O Trace	Help		ATION/ STRUM	L ENTS
Copy to Clipboard Clear Buffer	Select or Enter Command *IDN?\n *IDN?\n Bytes to Read 1024 Write Query Read Read Status Byte Clear View mixed ASCII/hexadecimal 1: Write Operation (*IDN?\n) Return Count: 6 bytes 2: Read Operation Return Count: 48 bytes *IDN\sSIGLENT, SDS2102X, SDS2XHA2160547, 1.2.2.1\sR9\n	Read Oper	-		



USB Checklist:

- Is the USB port configured properly on the instrument? Some instruments feature USB ports that can be configured as TMC (Test and Measurement) or Printer communication ports. The USB port should be set to USBTMC or similar for remote control.

- Try a direct connection to the controlling computer. USB hubs or long connections may cause issues.

- Try a different USB cable. Connectors can go bad or prove to be faulty.

- Try a different USB port on the computer.

- On machines running Windows, check the Device Manager. Test instrumentation should appear as USB Test and Measurement Device (IVI) and use the AUSBTMC.SYS driver



LAN Connections:

1. Power on and connect the instrument via LAN cable to a LAN network connected to the computer you wish to use.

You can check the status of the LAN connection by using a software tool like NMAP: https://nmap.org/



NMAP allows you to scan networks and identify IP addresses.

First, identify the LAN connection for the instrument. This is typically located in the System menu under IO or LAN settings.

Here is the IO information for an SDS2000X oscilloscope:

DHCP	Enable
IP Address :	192 168 . 0 . 87
Subnet Mask :	255 . 255 . 255 . 0
Gate Way :	192 . 168 . 0 . 1
Mac Address :	00:27:80:08:17:08

DHCP Enabled will automatically configure the instrument connection settings and apply a valid IP address. With DHCP enabled, the IP address may change over time. It is recommended to check the instrument IP address and then confirm that it is visible on the network using NMAP:

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Zenmap						
1 · · · ·						
Scan Tools Profile Help						
Target 192.168.0.0/24	Target 192.168.0.0/24 Profile: Ping scan					
Command: nmap -sn 192	.168.0.0/24					
Hosts Services	Nmap Output Ports / Hosts Topology Host Details Scans					
OS ◀ Host ▲	nmap -sn 192.168.0.0/24					
92.168.0.1						
192,168.0.2	Starting Nmap 7.40 (https://nmap.org) at 2017-04-21 12:39 Eastern Daylight Time					
192,168.0.3	Nmap scan report for 192.168.0.1 Host is up (0.0010s latency).					
-	MAC Address: 14:B7:F8:0E:D3:C5 (Technicolor CH USA)					
192.168.0.5	Nmap scan report for 192.168.0.2 Host is up (0.00s latency).					
192.168.0.7	■ 192.168.0.7 No.C ± 3 Lip (0: 405 laten(y). MAC Address: 58:60187:681:86:557:68 (Cisco-Linksys)					
192.168.0.8	Nmap scan report for 192.168.0.3 Host is up (0.0010s latency). MAC Address: 14:87:168:06:103:66 (Technicolor CH USA)					
192.168.0.10						
192.168.0.86	Nmap scan report for 192.168.0.5 Host is up (0.037s latency). MAC Address: 70:81:16:186:68:44 (Apple)					
192,168.0.87						
	Nmap scan report for 192.168.0.7					
	Host is up (0.031s latency). MAC Address: 28:18:78:6F:71:54 (Microsoft)					
	Nmap scan report for 192.168.0.8					
	Host is up (0.053s latency). MAC Address: 40:0E:85:76:DE:4F (Samsung Electro-mechanics(thailand))					
	Nmap scan report for 192.168.0.10					
	Host is up (0.027s latency).					
	Mag science report for 192,168,0.87					
	Host is up (0.0010s latency).					
L .	MAC Address: 00:27:80:08:17:08 (Unknown)					
	Host is up.					
	<u>Mmap done:</u> 256 IP addresses (9 hosts up) scanned in 5.75 seconds					

Here, we are performing a Ping (short scan to identify what IP addresses are being used) over the range of IP addresses that may match the instrument.

This can be performed by setting the target using the "/24" extension. This scans 24 bits For example, 192.168.10.0/24 would scan the 256 hosts between 192.168.10.0 and 192.168.10.255

Here is more information from NMAP: https://nmap.org/book/man-target-specification.html

For example, to ping all IP addresses that start with 192.168.0.<n>, set the target as follows:

👁 Zenmap						
Sc <u>a</u> n <u>T</u> ools <u>P</u> rofile <u>H</u> elp	Sc <u>a</u> n <u>T</u> ools <u>P</u> rofile <u>H</u> elp					
Target: 192.168.0.0/24	Target: 192.168.0.0/24					
Command: nmap -sn 192.1	168.0.0/24					
Hosts Services	Nmap Output	Ports / Hosts	Topology	Host Details	Scans	
OS 🖣 Host 🔺	OS 4 Host nmap -sn 192.168.0.0/24					
192.168.0.1						
J92.168.0.2	Starting Nmap 7.40 (https://nmap.org) at 2017-04-21 12:39 Nmap scan report for 192.168.0.1					
J92.168.0.3	2,168.0.3 Host is up (0.0010s latency).					
J92.168.0.5	MAC Address: 14:B7:F8:0E:D3:C5 (Technicolor CH USA) Nmap scan report for 192.168.0.2					
192.168.0.7	Host is up (0.00s latency).					
192.168.0.8	MAC Address: 58:6D:8F:86:5F:08 (Cisco-Linksys) Nmap scan report for 192.168.0.3 Host is up (0.0010s latency).					
102 160 0 10	nose is up	(0.00105 18	cency).			

Note the IP address and MAC address that identify your instrument.



2. Run NI-MAX by left-clicking on the icon on the desktop or finding it via the start menu



This will open the main window, as shown below:



My System My System Devices and Interfaces	🖬 Save 🛛 Refresh	🖬 Save 💦 Refresh 💦 Hide He					
G Software Remote Systems	System Settings		A Back				
	Hostname	DESKTOP-4AMV6V5	Instrur				
	DNS Name	DESKTOP-4AMV6V5	Autom	ation			
	Vendor	Dell Inc.	Explore				
	Model	Inspiron 3558		ion Explorer			
	Serial Number	8PH0982	your Nati				
	Firmware Version	A11		ents products.			
	Operating System	Microsoft Windows 10 Home	What do do?	o you want t			
	System Start Time	4/20/2017 7:25 AM	Manage interface	my devices an			
	Description			== my installed			
	System Configuration Web Access	Local Only *	National	Instruments			
	Access			virtual channe for my device			
	System Resources			<u>cales for my</u> struments			
	Total Physical Memory	5.91 GB		e my IVI ant drivers			
	Free Physical Memory	1.43 GB	device co	export my onfiguration			
	Total Virtual Memory	8.66 GB	<u>file.</u>				
	Free Virtual Memory	2.53 GB		ote Some ategories are			

3. Unlike USB, there is not an easy way to identify all of the instruments connected via LAN.

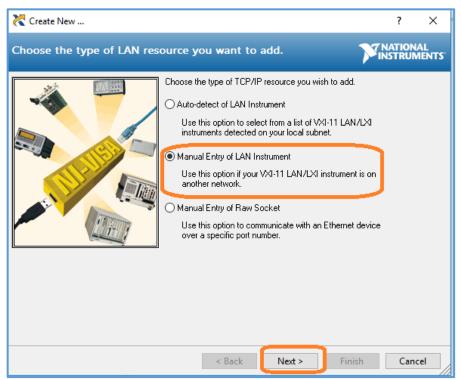
In many cases, you will have to manually add the LAN instrumentation. Recall from Step 2, our instrument IP address is 192.168.0.87



Right-click on Network Devices, and select Create New VISA TCP/IP Resource:

🔀 Network Devices - Measurement & Automation Explorer File Edit View Tools Help				
✓ I My System My System Mu System				
Devices and Interfaces ASRI 10-INSTR "LPT1" Network Provident Software Create New VISA TCP/IP Resource Software Remote Systems	Product	Name	Hostname	

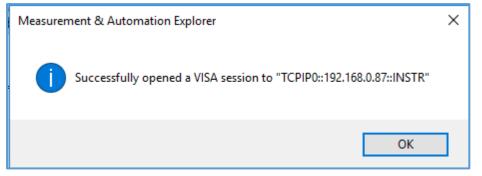
4. Select Manual Entry of LAN:





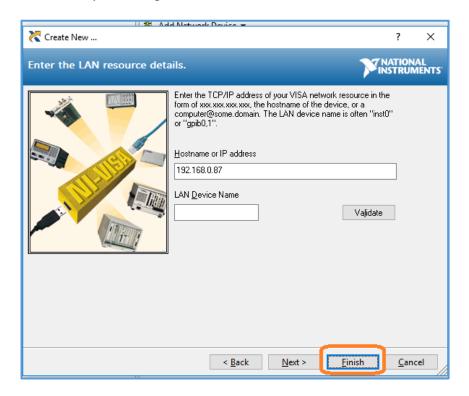
5. Enter the IP address and press Validate

	ld Network Device 📼	
💦 Create New		? ×
Enter the LAN resource deta	ails.	FIONAL TRUMENTS
	Enter the TCP/IP address of your VISA network resource in the form of xxx.xxx, xxx, the hostname of the device, or a computer@some.domain. The LAN device name is often "inst0" or "gpib0,1". <u>H</u> ostname or IP address	
	LAN <u>D</u> evice Name Validate)
	< <u>B</u> ack <u>N</u> ext > <u>F</u> inish	<u>C</u> ancel





6. After successfully creating a TCP/IP connection, select finish



7. After the system updates it's configuration, the instrument will appear in the Network Devices menu:

R TCPIP0::192.168.0.87::inst0::INSTR - Measurement & Automation Explorer File Edit View Tools Help					
✓ ■ My System ✓ ■ Devices and Interfaces	🖬 Save 🛛 Refresh 🛛 🕺 Open VISA Test Panel				
way Devices and interfaces wood ASRL10::INSTR "LPT1" AsRL10::INSTR "LPT1" AsRL10::INSTR AsRL10::INSTR Software	Settings				
	Name				
> 🔛 Remote Systems	Hostname	192.168.0.87			
	IPv4 Address	192.168.0.87			
	Status	Present			
	LAN Device Name	inst0			
	VISA Resource Name	TCPIP0::192.168.0.87::inst0::INSTR			



8. To further test the connection, right-click on the instrument and select Open VISA Test Panel or select it from the side bar:

CPIPO:: 192.168.0.87::inst0::INSTR - Measurement & Automation Explorer File Edit View Tools Help	
 ✓ Image: My System ✓ Image: Devices and Interfaces ✓ ASRL10:INSTR "LPTI" ✓ Letwork Devices ✓ Software ✓ Software ✓ Remote Systems ✓ Delete ✓ Open VISA Test Panel 	Save Refresh Open VISA Test Panel Settings Image: Comparison of the state of

The VISA Test Panel window shows some helpful information, including the TCP/IP identifier (VISA Address) along the top.

K TCPIP0::192.168.0.87::inst0::INSTR - VISA Test Panel			- 🗆	×
Configuration 😡 Input/Output	Advanced NI I/O Trace	Help		
TCP/IP Settings I/O Settings View Attributes TCP/IP Settings	Packet Settings	Return Data No Error		~
Hostname 192.168.0.87 Device Name inst0 Address 192.168.0.87	✓ No Packet Delay ☐ Keep Alive Packets			
Buffer Operations Transmit Buffer 0 Set Size Flush Buffer	Receive Buffer 0 Set Size Flush Buffer			*
	Refresh Apply Changes			



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- Write will send the command to the instrument
- *Read* will pull data from the instrument
- *Query* will perform a read and then a write command to request and return data from the instrument

Configuration Input/Output Advanced NI I/O Trace Help
Basic I/O Return Data C-tree = Deter Command "IDN?\n "IDN?\n Bytes to Read "IDN?\n Bytes to Read 1024 1024 Write Query Read Read Status Byte Clear View mixed ASCII/hexadecimal 1: Write Operation (*IDN?\n) Image: Clear Return Count: 6 bytes 2: Read Operation 2: Read Operation Return Count: 48 bytes *IDN\sSIGLENT, SDS2102X, SDS2XHA2160547, 1.2.2.1\sR9\n Image: Copy to Clipboard Copy to Clipboard Clear Buffer



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