Control of Mini-Circuits' Portable Test Equipment (PTE) Using VISA

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1 - VISA Overview

VISA (Virtual Instrument Software Architecture) is a commonly used I/O (Input/Output) API (Advanced Programming Interface) for communication with test and measurement equipment. It is intended to provide a common interface, allowing test instrumentation from a variety of manufacturers to be controlled from a single software environment, using common processes.

The standard is managed by the IVI foundation (<u>http://ivifoundation.org/</u>), however there are various differing implementations available from test equipment manufacturers. This application note will focus on 2 of the most common VISA software implementations within the RF/Microwave test and measurement market:

- Keysight IO Libraries Suite, using Keysight Connection Expert
- National Instruments (NI) VISA, using NI's Measurement & Automation Explorer

The initial step to controlling Mini-Circuits' devices through VISA is to define the device as a LAN (Local Area Network) instrument (for Ethernet enabled models only). The device must be connected into the Ethernet network and the VISA software interface just needs to be configured with the device's IP address and port number. For Mini-Circuits' devices the default is port 23, reserved for Telnet communication.

2 - Configuring as a LAN Instrument

This section details the process for configuring any Mini-Circuits Ethernet controlled device through VISA as a LAN instrument, using the device's RJ45 port to connect to an Ethernet network.

2.a - Configuration using Keysight Connection Expert

- 1. Connect the PTE device to the local network and note the IP address
- 2. Launch Keysight Connection Expert
- 3. Navigate to Manual Configuration > Add New Instruments/Interfaces > LAN Instrument

Keysight Connection Expert			
Instruments PXI/AXIe Chassis	Manual Configuration	Settings	
Add New Instruments/Interfaces	Edit Existing Instruments,	/Interfaces	
LAN instrument	Add a LAN device		
LAN interface			
Remote GPIB interface	Set LAN Address:		
Remote USB interface			
Remote serial instrument	Hos	stname or IP Address:	
	TCF	PIP Interface ID:	TCPIP0 -

Fig i - Adding a new LAN instrument

- 4. Enter the IP address of the device in the "Hostname or IP Address" field
- 5. "TCPIP Interface ID" should usually be left as the default, this is the ID for the LAN itself
- 6. In the "Set Protocol" section, select "Socket" and enter port number "23"
- 7. Click "Test This VISA Address" to confirm the connection settings are correct Add a LAN device

Set LAN Address:		
Hostname or IP Address:	192.168.9.53	
TCPIP Interface ID:	TCPIPO -	
Set Protocol:		
Instrument	Remote Name:	inst0
Socket	Port Number:	23
HISLIP	Remote Name:	hislip0
Verify Connection:		
Test This VISA Address	TCPIP0::192.16	8.9.53::23::SOCKET
	Verified	
	<unknown manu<="" th=""><th>facturer>,<unknown model="">,9414ea76-9793-4466-9a21-4f90b249d333</unknown></th></unknown>	facturer>, <unknown model="">,9414ea76-9793-4466-9a21-4f90b249d333</unknown>
		Accept Cancel

Fig ii - The successfully tested LAN device settings for a power sensor with IP address 192.168.9.53

- 8. Click Accept to save the configuration and Connection Expert will return to the home screen where the new instrument will be listed along with any other known VISA devices.
- 9. The Mini-Circuits PTE device will be listed as "Unknown" but will be identifiable by the IP address

10. To add an "alias" in order to make the device more easily identifiable, click on the device and then select "Add or Change Aliases" from the summary screen

6 Keysight Connection Expert		? _ 🗆 ×
Instruments PXI/AXIe Chassis	Manual Configuration Settings	
Rescan Filter Instruments:		
<unknown>,</unknown>	Instrument Details	
CPIP0::192.168.9.53::23::SOCKET	Manufacturer:	Start Instrument Web Interface
	Model: <unknown> Serial Number: <unknown> Firmware Version: <unknown></unknown></unknown></unknown>	Delete User-Added Connections
	Connection Strings VISA Addresses TCPIP0::192.168.9.53::23::SOCKET VISA Aliases	Send Commands To This Instrument Start IO Monitor Add or Change Aliases
Messages: 9 Clear	Remote IO Server Off 3	2-Bit Keysight VISA is Secondary 17.0.19013.0
10:42:59 New connection TCPIP0::192.168.9.53:	:23::SOCKET to <unknown manufacturer="">,<unknown< td=""><td>Model>,a79756d0-8d95-40b8-aa10-e5e23</td></unknown<></unknown>	Model>,a79756d0-8d95-40b8-aa10-e5e23

Fig iii - Connection Expert home screen summarising the new LAN instrument (Add or Change Aliases is highlighted)

- 11. Enter the chosen Alias Name and make sure the correct VISA Address string is selected if there are multiple VISA instruments defined
- 12. The device is now configured and ready to use with a VISA address that takes the form "[LAN_Interface]::[IP_Address]::[Port]::SOCKET"

2.b - Configuration using NI MAX

- 1. Connect the PTE device to the local network and note the IP address
- 2. Launch NI MAX (Measurement & Automation Explorer)
- 3. In the navigation column on the left of the screen, expand "My System" and then "Devices and Interfaces"
- 4. Rick-click on "Network Devices" and select "Create New VISA TCP/IP Resource"

	💦 Network Devices - Measurement & Automation Explorer								
	File Edit View Tools Help								
🔺 🐺 My System		🖄 Add Network Device 🔻							
	A W Devices and Interfaces ASRI 10-INSTR "I PT1"	Product	Name	Hostname	IP Address	Serial Number			
	Network Devices								
	Software	·							
	Remote Systems								

Fig iv - Creating a new VISA TCP/IP Resource in NI MAX

- 5. Select "Manual Entry of Raw Socket" from the pop-up screen and click Next
- 6. Enter the IP address and port number "23", then click Validate to test the connection

Create New	8 3
Enter the LAN resource details.	
	Enter the TCP/IP address of your VISA network resource in the form of xxxxxxxxxxx the hostname of the device, or a computer@some.domain
	Hostname or IP address
	192.168.9.53
	Port Number
	23 Validate
	Measurement & Automation Explorer
	Successfully opened a VISA session to
	"TCPIP0::192.168.9.53::23::SOCKET"
	ОК
	< Back Next > Finish Cancel

Fig v - Successfully testing the LAN configuration

- 7. Click Finish to return to the home screen with the new device now listed under the "Network Devices" heading
- 8. The device configuration has an optional "alias" Name field which can be used to identify the device, just enter a name and click Save

Edit View Tools Help		
 My System We be a set of the set of the	🖬 Save 🤗 Refresh 🛛 🔀 Oper	n VISA Test Panel
•	Settings	
	Name	PWR_1
😫 Remote Systems	Hostname	192.168.9.53
	IPv4 Address	192.168.9.53
	Status	Present
	VISA Resource Name	TCPIP0::192.168.9.53::23::SOCKET

Fig vi - The LAN device summary with PWR_1 entered as an alias name

9. The device is now configured and ready to use with a VISA address that takes the form "[LAN_Interface]::[IP_Address]::[Port]::SOCKET"

3 - Control of a LAN Instrument Using the Keysight / NI Software Suites

The software suites from Keysight and National Instruments both provide a simple interface with which commands can be sent to Mini-Circuits PTE products once they have been configured as LAN instruments.

3.a - Sending Commands using Keysight Connection Expert

1. Open Keysight Connection Expert, select the appropriate LAN instrument and click "Send Commands To This Instrument" to open the Interactive IO interface

Keysight Connection Expert		? _		×
Instruments PXI/AXIe Chassis Manual G	onfiguration Settings			
Rescan Filter Instruments:				-
<unknown>,</unknown>	Instrument Details			
CPIP0::192.168.9.71::23::SOCKET	Manufacturer:	Start Instrument Web Interface		
	Model: <ur> Vinknown> Serial Number: <urknown></urknown> Firmware Version: <urknown></urknown> Connection Strings VISA Addresses </ur>	Delete User-Added Connections		
		Send Commands To This Instru Star t TO Monitor Add or Change Aliases	nent	,
Messages: 5 Clear	Remote IO Server Off 3	2-Bit Keysight VISA is Secondary 17	.0.1901	3.0
11:32:53 New connection TCPIP0::192.168.9.71::23::SOC 11:32:51 You are updating the information for TCPIP0::19	KET to <unknown manufacturer="">,<unknown model="">,7e1f49ed-e5. .168.9.71::23::SOCKET. You will see a confirmation when it is pro</unknown></unknown>	59-44dd-811a-18f96cb52e17 icessed.		

Fig vii - Identifying the LAN instument in Keysight Connection Expert

2. Click on the options tab and set the "EOL Sequence to "\n", this is the terminating character to be sent at the end of each command

Options			×
Timeout (mSecs)	20000		
EOL Sequence	\n		•
		OK	Cancel
ia viii - Settir	na the	FOI Se	

- 3. The full list of commands/queries available is listed in the programming manual for the Mini-Circuits PTE product, available for download from the Mini-Circuits website; enter these in the command section and click "Send & Read" to see the response
 - 4. To query the model name of the device, enter ":MN?\n" and then click "Send & Read"



Fig ix - Requesting the model name; the response is FCPM-6000RC

5. To query the serial number of the device, enter ":SN?\n" and then click "Send & Read"

•	•								
Conne 🔁	ct Interact	Help		Keysi	ght Intera	ictive IO	-		×
Stop Devi	🔊 ice Clear 🛛 Re	ioi ead STB	SYST:ERR?	🕅 Clear History	Dptions				
Command :sN	1?					•	Com	mands	•
Se	end Command	l Read	l Response	Send & Read					
Instrument Ses	sion History								
-> :sN? <- «x0D»SN=	1141211001	7							
CONNECTED TO	D TCPIPO::192	2.168.9.71	::23::SOCKET						
Fig x - Requesting the serial number; the response is 11412110017									



3.b - Sending Commands Using NI MAX

1. Open NI MAX, select the appropriate LAN instrument from the list and click "Open VISA Test Panel" to open the interactive communication window

RTCPIP0::192.168.9.71::23::SOCKET "FCPM" - Measurement & Automatic File Edit View Tools Help	n Explorer	
My System My System My System More and Interfaces More Systems More Systems More Systems	CPIP0::192.168.9.71:23	SNOCKET
	Device Type:	TCP/IP Raw Socket
	VISA Alias on My System: Device Status This static device is working pr	operty.
	Device Usage I Device enabled Settings 译 General 중 TCP/IP Settings	ngs

Fig xi - Opening the VISA Test Panel in NI MAX

2. Select the I/O Settings tab of the Configuration screen, uncheck the "Supress End On Reads" tick box and click "Apply Changes"



Fig xii - Uncheck the "Suppress End on Reads" option

- 3. Select the Input/Output tab in order to send commands/queries to the device
- 4. Commands can be written in the space below the "Select or Enter Command" label:
 - a. The full list of commands available is listed in the programming manual for the Mini-Circuits PTE product, available for download from the Mini-Circuits website
 - b. All commands must end with a new line character ("\n")
- 5. To query the model name of the device, enter ":MN?\n" and then click "Query"



Fig xiii - Requesting the model name; the response (FCPM-6000RC) is highlighted

6. To query the serial number of the device, enter ":SN?\n" and then click "Query"



Fig xiv - Requesting the serial number; the response (1141211001) is highlighted

4 - Programmatic Control of a LAN Instrument

It is a simple process to communicate with Mini-Circuits' PTE devices configured as VISA LAN Instruments in most programming environments. Communication is achieved using a message based session defined in the National Instruments API.

This communication process is applicable to all Mini-Circuits' PTE products but detailed examples for each are also available on request.

4.a - Example Using VB.NET for Control of a Power Sensor

```
Imports NationalInstruments.VisaNS
                                                          ' Import the VISA namespace
Dim mbSession As MessageBasedSession
                                                          ' Create a new message based session
' Open the message based session using the VISA connection string of the device
mbSession = CType(ResourceManager.GetLocalManager().Open("TCPIP0::192.168.9.71::23::SOCKET"),
                                                       MessageBasedSession)
                                                          ' Important
mbSession.TerminationCharacterEnabled = True
Dim textToWrite As String = ""
Dim stSerialNo As String
Dim stModelName As String
textToWrite = ":SN?\n\r"
                                                          ' The text string to send (get serial no)
textToWrite.Replace("\n", vbLf).Replace("\r", vbCr)
                                                          ' Remove escape sequences
stSerialNo = mbSession.Query(textToWrite)
                                                          ' The query must be sent twice in VB
stSerialNo = mbSession.Query(textToWrite)
textToWrite = ":MN?\n\r"
                                                          ' The text string to send (get model name)
textToWrite.Replace("\n", vbLf).Replace("\r", vbCr)
                                                          ' Remove the /n/r characters
stModelName = mbSession.Query(textToWrite)
                                                          ' The query must be sent twice in VB
stModelName = mbSession.Query(textToWrite)
mbSession.Dispose()
                                                          ' Close the session
MsgBox(stModelName & " " & stSerialNo)
```

4.b - Example Using C# for Control of a Power Sensor

using NationalInstruments.VisaNS;	// Use the VISA namespace
~~~~~	
MessageBasedSession mbSession;	<pre>// Create a new message based session</pre>
<pre>mbSession = (MessageBasedSession)ResourceManager.GetLoca</pre>	alManager().Open( _ "TCPIP0::10.0.6.4::23::SOCKET");
<pre>mbSession.TerminationCharacterEnabled = true;</pre>	// Important
<pre>string textToWrite = "" string stSerialNo = "" string stModelName = ""</pre>	
<pre>textToWrite = ":SN?\n\r" TextToWrite.Replace("\\n", "\n").Replace("\\r", "\r") stSerialNo = mbSession.Query(textToWrite);</pre>	<pre>// The text string to send (get serial no) // Remove escape sequences // Send the query</pre>
<pre>textToWrite = ":MN?\n\r" TextToWrite.Replace("\\n", "\n").Replace("\\r", "\r") stModelName = mbSession.Query(textToWrite);</pre>	<pre>// The text string to send (get model name) // Remove escape sequences // Send the query</pre>
<pre>mbSession.Dispose();</pre>	// Close the session
<pre>MessageBox.Show(stModelName + " " + stSerialNo);</pre>	



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