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

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 ([http://ivifoundation.org/](http://ivifoundation.org/)), 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.

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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

![Fig I - Adding a new LAN instrument](image)

4. Enter the IP address of the device in the "Hostname or IP Address" field
5. "TCP/IP 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

![Fig II - The successfully tested LAN device settings for a power sensor with IP address 192.168.9.53](image)

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.

![Connection Expert home screen summarising the new LAN instrument (Add or Change Aliases is highlighted)](image)

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. Right-click on "Network Devices" and select "Create New VISA TCP/IP Resource"

![Creating a new VISA TCP/IP Resource in NI MAX](image)

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

![Successfully testing the LAN configuration](image)

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

![The LAN device summary with PWR_1 entered as an alias name](image)

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

![Fig vii - Identifying the LAN instrument in Keysight Connection Expert](image)

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

![Fig viii - Setting the EOL Sequence](image)

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](image)

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

![Fig x - Requesting the serial number; the response is 11412110017](image)
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.

![Opening the VISA Test Panel in NI MAX](image1)

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

![Uncheck the "Suppress End on Reads" option](image2)

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".

![Requesting the model name; the response (FCPM-6000RC) is highlighted](image3)
6. To query the serial number of the device, enter ":SN?\n" and then click "Query"
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

```vbnet
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)

mbSession.TerminationCharacterEnabled = True
" Important

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", vbCrLf).Replace("\r", vbCrLf)

' Remove escape sequences

stSerialNo = mbSession.Query(textToWrite)
' The query must be sent twice in VB

stSerialNo = mbSession.Query(textToWrite)

' The query must be sent twice in VB

textToWrite = ":MN?\n\r"

' The text string to send (get model name)

textToWrite.Replace("\n", vbCrLf).Replace("\r", vbCrLf)

' Remove the /n/r characters

stModelName = mbSession.Query(textToWrite)

stModelName = mbSession.Query(textToWrite)

mbSession.Dispose()
" Close the session

MsgBox(stModelName & " " & stSerialNo)
```

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

```csharp
using NationalInstruments.VisaNS;

// Use the VISA namespace

MessageBasedSession mbSession;
" Create a new message based session

mbSession = (MessageBasedSession)ResourceManager.GetLocalManager().Open("TCPIP0::10.0.6.4::23::SOCKET");

mbSession.TerminationCharacterEnabled = true;
" Important

string textToWrite = ""

string stSerialNo = ""
string stModelName = ""

textToWrite = ":SN?\n\r"

TextToWrite.Replace("\n", vbCrLf).Replace("\r", "\r")

' The text string to send (get serial no)

stSerialNo = mbSession.Query(textToWrite);

' Remove escape sequences

' Send the query

textToWrite = ":MN?\n\r"

TextToWrite.Replace("\n", vbCrLf).Replace("\r", "\r")

' The text string to send (get model name)

stModelName = mbSession.Query(textToWrite);

' Remove escape sequences

' Send the query

mbSession.Dispose();
" Close the session

MessageBox.Show(stModelName + " " + stSerialNo);`