Communicate with Test Instruments Over LAN Using Visual Basic

Application Note 1555

When you order a new test and measurement instrument, you may discover that it has a local area network (LAN) interface along with the more traditional GPIB interface. Test and measurement instrument makers Agilent Technologies, Racal Instruments, Keithley and others have been shipping instruments with LAN (Ethernet) interfaces for more than a year. Using LAN lets you communicate with your instruments remotely; it is fast and simple, and you don't need any additional proprietary software or cards. In this application note we show you how to communicate with instruments on the LAN from your PC using Microsoft® Visual Basic. You can download the code examples from **www.agilent.com/find/socket_examples.**

Connecting the instrument

You can connect a test instrument directly to a network LAN port with a LAN cable, or you can connect your instrument directly to the PC. If you decide to connect the instrument directly to the PC LAN port, you will need a special cable called a crossover cable. Once the instrument is connected, you must establish an IP address for it. Dynamic Host Configuration Protocol (DHCP) is typically the easiest way to configure an instrument for LAN communication. DHCP automatically assigns a dynamic IP address to a device on a network. See the instrument's user's guide for more information on this topic.

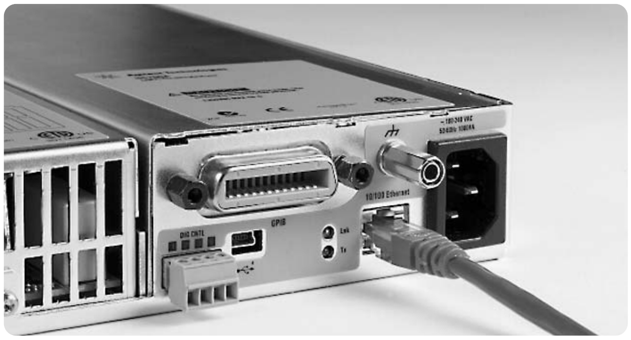
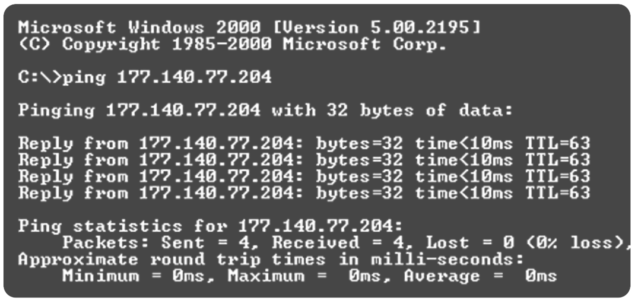


Figure 1.
Ethernet connection to LAN on an N6700A modular power system

Testing communication using the Windows command prompt

Once you have an IP address, test the IP address from your PC. Go to the MS DOS command prompt window (in Windows 2000 the menu sequence is **Start>Programs> Accessories>Command Prompt)**. At the command prompt, type **ping <IP address>**. The IP address is four groups of numbers separated by decimal points. If everything is working, your instrument will respond. Figure 2 shows a successful ping response.



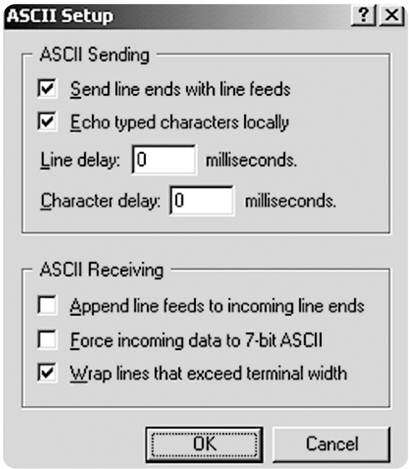
```
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\>ping 177.140.77.204

Pinging 177.140.77.204 with 32 bytes of data:

Reply from 177.140.77.204: bytes=32 time<10ms TTL=63
Reply from 177.140.77.204: bytes=32 time<10ms TTL=63
Reply from 177.140.77.204: bytes=32 time<10ms TTL=63
Reply from 177.140.77.204: bytes=32 time<10ms TTL=63

Ping statistics for 177.140.77.204:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum =  0ms, Average =  0ms
```

Figure 2.

Response to a ping for a working LAN connection

Testing communication using HyperTerminal

Alternately, you can test the communication to the instrument with the Windows HyperTerminal program **(Start >Programs >Accessories >Communications >HyperTerminal)**. When the Connection Description dialog box appears, type a name and click **OK**. The name will be used to save your settings. Next, in the Connect To dialog box, select **TCP/IP** (Winsock) and type in the IP address for the instrument. The port number determines the protocol for the communication. We will use ASCII characters and instrument SCPI commands. The Internet Assigned Number Authority (IANA) registered port number for the instrument SCPI interface is 5025. Some instrument manufactures may choose to use a unique port number; check the instrument documentation for the the port number. Now go to the **File>Properties** menu and select the **Settings** tab and click **ASCII Setup...**. Select **Send line ends with line feed** and **Echo typed characters locally** (see Figure 3). Click **OK** to close the dialog boxes. In the terminal window type in *IDN?, and hit **Enter**. Do not use the backspace key or any editing keys. If everything is working, you will get back the manufacturer and model number. Save the settings with **Save as...**



ASCII Setup

ASCII Sending

☑ Send line ends with line feeds

☑ Echo typed characters locally

Line delay: 0 milliseconds.

Character delay: 0 milliseconds.

ASCII Receiving

□ Append line feeds to incoming line ends

□ Force incoming data to 7-bit ASCII

☑ Wrap lines that exceed terminal width

Figure 3.

ASCII setup for Windows HyperTerminal for LAN communications

In order to communicate with the instrument from Visual Basic, you will need both the port number and the IP address. It is a good practice to verify both before you begin programming.

Using MS Visual Basic to communicate

Now that the connections are confirmed, we are ready to use Visual Basic. Visual Basic 6.0 comes with Winsock control. From the Components dialog box (Ctrl-T), find and select the Microsoft Winsock control. Once the Winsock control is available in the Toolbox, place it on the form. There are three steps to make a connection to the instrument in the Form Load event: first you must insert the IP address (RemoteHost), as well as the port number (RemotePort), then invoke the connect method. The code created by the Winsock control is shown below.

```
If (Winsock1.State = sckClosed) Then
   ' Invoke the Connect method to initiate a connection.
   Winsock1.RemotePort = "5025"
   Winsock1.RemoteHost = "177.140.77.204"
   Winsock1.Connect
End If
```

The connection may take a bit of time, so this is a good place to add a wait statement or to test the connection status. You can test the connection status with this code

```
Dim status as Long
If Winsock1.State = sckConnected then debug.Print "Connected"
```

Once connected, the Windows Sockets object is ready for communication.

Sending instrument commands

Sending a string to the instrument is straightforward. Note that we add a carriage-return line feed at the end of the command.

```
Winsock1.SendData "*IDN?" & vbCrLf
```

You can get the response in one of two ways. If the above string is in a button, clicking the button sends the string command and then exits the subroutine. When exiting the subroutine, Visual Basic is idle and events can be executed. In that case, receiving the data is just a matter of waiting for the DataArrival event to fire and then retrieving the data like this:

```
Private Sub Winsock1_DataArrival(ByVal bytesTotal As Long)
     Dim strData As String
     Winsock1.GetData strData, vbString
End Sub
```

However, most of the time you want to write and read several times without exiting the subroutine. To do this, we wrote a simple ReadString routine that will allow you to do just that. The ReadString routine immediately checks the connection buffer and then executes a DoEvents until the buffer has increased in size indicating the arrival of the latest data. DoEvents allows VB to pause the subroutine and capture an event such as the instrument response to a query on the LAN.

This is a shortened version of the ReadString subroutine contained in the example VB project.

```
Public Function ReadString(skt As Winsock) As String
   Dim strData As String
   Dim numbBytes As Long
   Dim i As Long

   numbBytes = skt.BytesReceived

   DoEvents

   ' check repeatedly if there is new data.
   For i = 1 To 10000
       If skt.BytesReceived > numbBytes Then Exit For
       DoEvents
   Next i

   ' Gets the data and Clears buffer
   skt.GetData strData, vbString
   ReadString = strData
End Function
```

Rather than add a carriage return line feed every time we send a string, we also wrote a WriteString routine that adds the vbCrLf

```
Public Sub WriteString(skt As Winsock, ByVal cmd As String)
        skt.SendData cmd & vbCrLf
End Sub
```

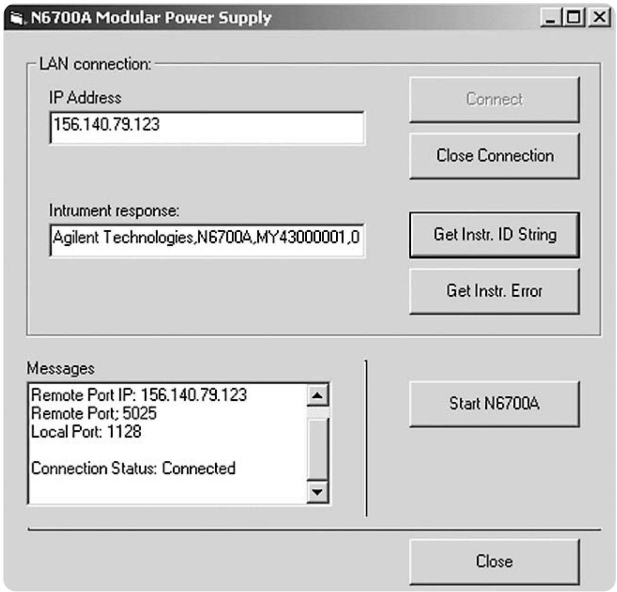
Using these two routines, you can check the ID of an instrument and place it into a text box with the following code:

```
WriteString Winsock1, "*idn?"
txtID.Text = ReadString(Winsock1)
```

Examples downloads

A complete Visual Basic and C++ project that demonstrates sockets with Agilent instruments is available for the Agilent 33220A function generator and the N6700A modular power system at **www.agilent.com/find/socket_examples.** All the instrument-specific code is in one command button subroutine. You can easily modify either of these projects for other instruments.

The example Visual Basic code brings up a dialog box for making the LAN connection. The port number is set to 5025. If it needs to be changed, change the constant RemPort in the modWinSock module. Start the code. Type in the IP address and click on **Connect**. The progress of the connection will be shown in the Messages field. The instrument-specific code is in the click event for the button labeled Start.



IP Address: 156.140.79.123

Intrument response: Agilent Technologies,N6700A,MY43000001,0

Remote Port IP: 156.140.79.123
Remote Port; 5025
Local Port: 1128

Connection Status: Connected

Figure 4.
User interface of VB software example to make connection to instrument with sockets

Conclusion

Using sockets in Visual Basic with LAN-enabled instruments eliminates the need for proprietary I/O library code loaded to the PC. This approach is very fast, it enables remote operation, and it is easy to implement in Microsoft Visual Basic.

Related Agilent literature

Publication title	Publication type	Publication number	Web address
33220A 20MHz Function Arbitrary Waveform Generator	Data sheet	5988-8544EN	http://cp.literature.agilent.com/litweb/pdf/5988-8544EN.pdf
N6700-series Modular DC Power Supply	Data sheet	5989-1411EN	http://cp.literature.agilent.com/litweb/pdf/5989-1411EN.pdf

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