

Agilent Technologies
USB/LAN/GPIB Interfaces

Connectivity Guide



Agilent Technologies

Notices

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1 Getting Started

This chapter includes:

- [Using This Guide](#)
- [Steps to Get Started](#)

NOTE

This guide does not describe LAN networks that include a gateway, such as the Agilent E5810A LAN/GPIB Gateway for Windows. See the applicable gateway documentation for information on gateway systems.

Also, this guide does not provide a detailed description of LAN, USB, or GPIB interfaces or TCP/IP networks. Consult standard reference texts for this information.

If you need to contact Agilent, see [Contacting Agilent](#) for addresses.



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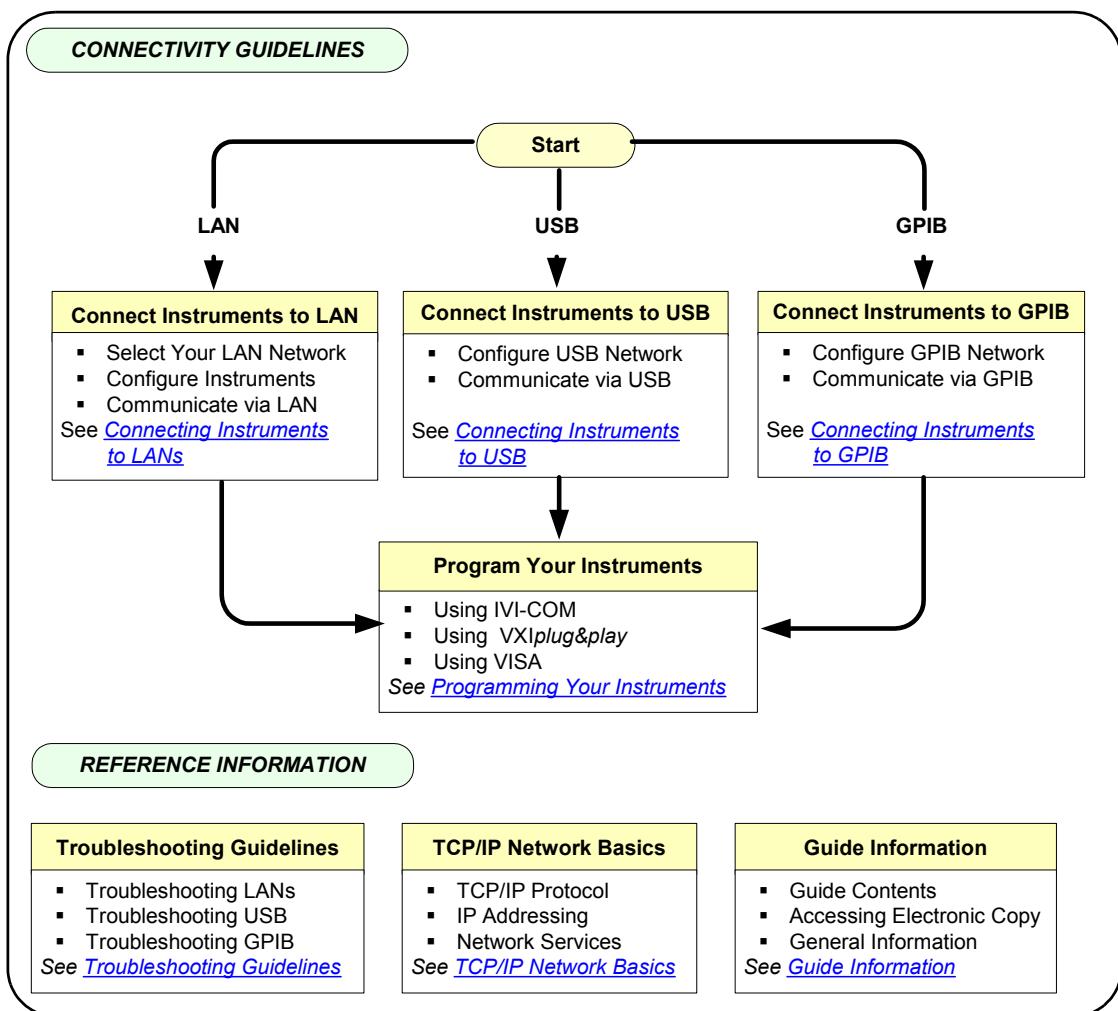
Using This Guide

This *Agilent Connectivity Guide* shows how to connect instruments to USB, LAN, and GPIB interfaces and how to configure and troubleshoot these interfaces on PCs with Windows 98, Windows Me, Windows 2000, or Windows XP operating systems. A summary of the guide contents follows.

Section	Description
CONNECTIVITY GUIDELINES	
<i>Getting Started</i>	Shows steps to get started and how to contact Agilent
<i>Connecting Instruments to LANs</i>	Gives guidelines to connect instruments to LANs
<i>Connecting Instruments to USB</i>	Gives guidelines to connect instruments to USB
<i>Connecting Instruments to GPIB</i>	Gives guidelines to connect instruments to GPIB
<i>Programming Your Instruments</i>	Gives guidelines to program instruments via LAN/USB/GPIB
REFERENCE INFORMATION	
<i>Installing I/O Software</i>	Shows how to install I/O software on your PC
<i>Troubleshooting Guidelines</i>	Troubleshooting guidelines for LAN, USB, and GPIB Interfaces
<i>TCP/IP Network Basics</i>	Provides an overview of TCP/IP networks
<i>Guide Information</i>	Lists general information for this guide
<i>Glossary</i>	Defines some of the terms used in this guide
<i>Index</i>	Index of selected items in this guide

Steps to Get Started

This figure shows suggested steps to get started setting up LAN, USB, or GPIB interfaces and the applicable sections of this guide. Some guidelines follow this figure to select the interface you want to set up.



- **Connect Instruments to LAN.** A Local Area Network (LAN) provides instrument connectivity over distances and allows sequential sharing of instruments among multiple PCs. A LAN is the recommended method to connect instruments together in applications such as new test systems. If you select LAN connections, go to [Connecting Instruments to LAN](#).
- **Connect Instruments to USB.** Universal Serial Bus (USB) is a quick and easy way to connect instruments to PCs on a benchtop. Typically, you can use USB to connect a single instrument to a PC. If you select USB connections, go to [Connecting Instruments to USB](#).
- **Connect Instruments to GPIB.** If you select General Purpose Interface Bus (GPIB) connections, go to [Connecting Instruments to GPIB](#).

2

Connecting Instruments to LAN

This chapter includes:

- LAN Quick Start
- Step 1: Install I/O Software on Your PC
- Step 2: Select LAN Network Type
- Step 3: Gather Network Information
- Step 4: Connect Your Instruments
- Step 5: Configure Your Instruments
- Step 6: Run Agilent Connection Expert
 - Add a LAN interface
 - Add and Configure a LAN Instrument
 - Communicate with Instruments Using Interactive IO



LAN Quick Start

This section shows suggested steps to help you quickly get started connecting and configuring your LAN-enabled instruments for site LAN or private LAN operation.

What are Site LANs and Private LANs? A **site LAN network** is defined as a local area network (LAN) in which LAN-enabled instruments and Windows PCs are connected to a site LAN (workgroup LAN, Intranet, or enterprise LAN) via (optional) routers, hubs, and/or switches. A **private LAN network** is defined as a local area network (LAN) in which LAN-enabled instruments and Windows PCs are NOT connected to a site LAN.

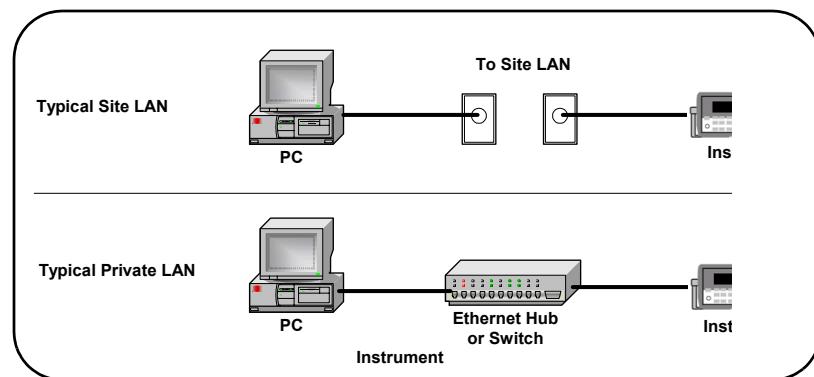


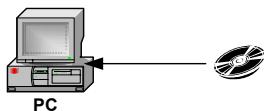
Figure 1 Example Site and Private LAN Networks

Getting Started To get started, you may want to copy the following overview of steps to use as a guide as you set up your instruments for site LAN or private LAN operation. For additional information:

- [TCP/IP Network Basics](#) for an introduction to TCP/IP networks
- [Troubleshooting LAN Interfaces](#) for LAN troubleshooting tips
- [Glossary](#) for a definition of some LAN terms
- [Contacting Agilent](#) if you need to contact Agilent

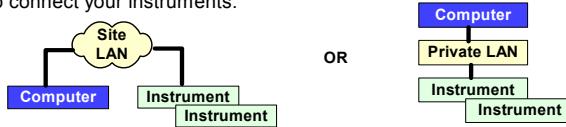
1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.



2 Select LAN Network Type

Select the type of LAN (site LAN or private LAN) to which you want to connect your instruments.



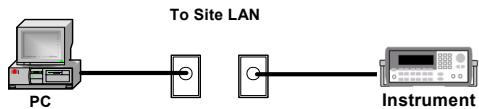
3 Gather Network Information

Gather network parameters for site LAN connections or define private LAN parameters.

Site LAN Network Information Card	
Instrument Information (Completed by Instrument User) (Serial Number and Ethernet (MAC) Hardware Address usually on label on instrument)	
Instrument Serial Number:	<input type="text"/>
Ethernet (MAC) Hardware Address:	<input type="text"/>

4 Connect Your Instruments

Connect your instruments to the site LAN or private LAN you selected.



5 Configure Your Instruments

As required, manually configure your instruments using the instrument's Web pages or front panel.

You can use the **Configuring Your Instrument** Web page to configure instruments.



6 Run Agilent Connection Expert

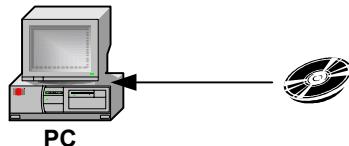
Run Agilent Connection Expert; add and configure the LAN interface (optional); add a LAN instrument; communicate with your instruments using Interactive IO; and program your instruments (optional).



Step 1: Install I/O Software on Your PC

1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.



What's in This Step? This step gives guidelines to install applicable I/O software on your PC. Go to [Installing I/O Software](#) for details. After the I/O software is installed, go to [Step 2: Select LAN Network Type](#).

NOTE

Agilent IO Libraries Suite supports the following operating systems:

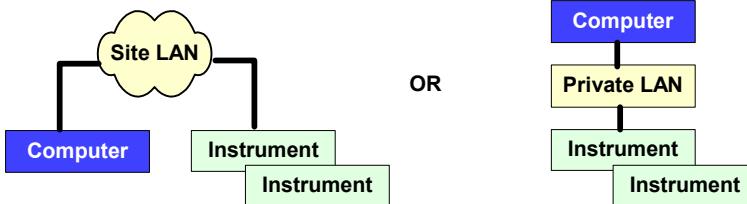
- Microsoft Windows 98 SE
- Microsoft Windows 2000
- Microsoft Windows Me
- Microsoft Windows XP

If you wish to use an earlier version of Windows, you must download a compatible version of the Agilent IO Libraries from
<http://www.agilent.com/find/iolib>

Step 2: Select LAN Network Type

2 Select LAN Network Type

Select the type of LAN (site LAN or private LAN) to which you want to connect your instruments.



What's in This Step? The first step is to determine whether you want your instruments and your PC to be connected to a site LAN or to a private LAN. This step shows some examples of site LAN and private LAN networks. Select site LAN or private LAN connections, based on your requirements. Then, go to [Step 3: Gather Network Information](#).

- For examples of typical site LAN networks, go to [Typical Site LAN Networks](#)
- For examples of typical private LAN networks, go to [Typical Private LAN Networks](#)

Typical Site LAN Networks

In this guide, a **site LAN network** is defined as a local area network (LAN) in which LAN-enabled instruments and Windows PCs are connected to a site LAN (workgroup LAN, Intranet, or enterprise LAN) via (optional) routers, hubs, and/or switches.

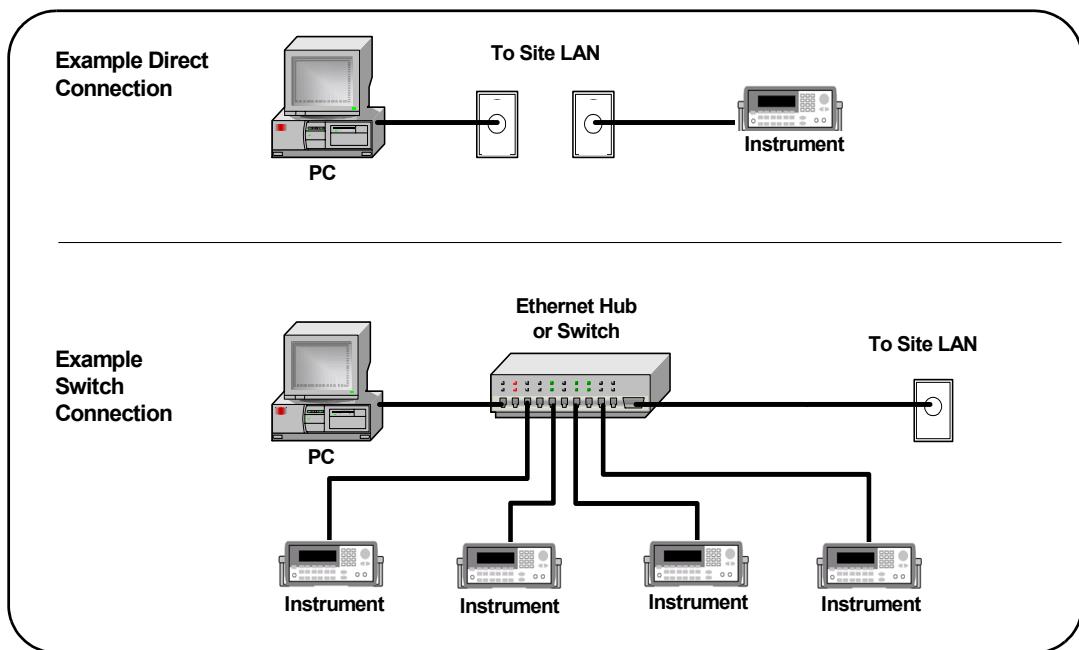


Figure 2 Example Site LAN Networks

Typical Private LAN Networks

In this guide, a **private LAN network** is defined as a local area network (LAN) in which LAN-enabled instruments and Windows PCs are **NOT** connected to a site LAN (workgroup LAN, Intranet, or enterprise LAN). This figure shows some example private LAN networks.

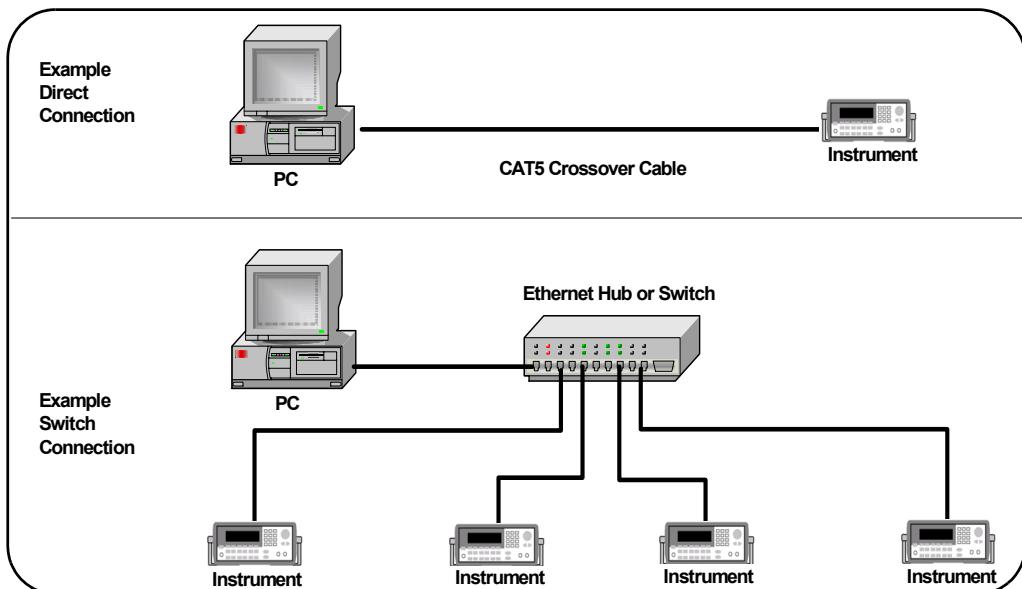


Figure 3 Example Private LAN Networks

NOTE

For a private LAN you, the designer of the LAN, are the “System Administrator” for the LAN and are responsible for defining all private LAN parameters.

Step 3: Gather Network Information

3 Gather Network Information

Gather network parameters for site LAN connections or define private LAN parameters.

Site LAN Network Information Card
Instrument Information (Completed by Instrument User) (Serial Number and Ethernet (MAC) Hardware Address usually on label on instrument)
Instrument Serial Number: _____
Ethernet (MAC) Hardware Address: _____

What's in This Step? When you have selected the type of LAN to connect your instrument to, the next step is to gather information for your site LAN or to define parameters for your private LAN. When you have gathered the necessary information, go to [Step 4: Connect Your Instruments](#).

- For steps to gather site LAN network information, go to [Gather Site LAN Network Information](#).
- For steps to select private LAN network parameters, go to [Define Private LAN Network Parameters](#).

Gather Site LAN Network Information

Suggested steps follow to gather information for instrument connections to a site LAN.

- 1 Does the Site LAN Support DHCP?** Find out if the site LAN supports Dynamic Host Configuration Protocol (DHCP). In general, if the site LAN supports DHCP, you can connect your instruments to the site LAN without contacting your IT department.

However, if your local policy requires it, contact your System Administrator in your Information Technology (IT) department and tell him/her you want to connect instruments to the LAN.

- 2 Select Automatic Configuration.** If the site LAN supports DHCP, IP addresses for the instruments are automatically assigned by the network. If you do not require fixed (static) IP addresses for your instruments, you do **not** need to complete the *Site LAN Network Information Card*. Go to [Step 4: Connect Your Instruments](#).
OR
Select Manual Configuration. If the site LAN does not support DHCP **or** if you want to set a fixed (static) IP address for each instrument, the System Administrator must assign the static IP addresses and you must manually configure your instruments.
- 3 Enter Instrument Information.** If the LAN does not support DHCP or if you selected manual configuration, make a copy of the *Site LAN Network Information Card* for each instrument to be connected to the site LAN. Record the instrument serial number and hardware (MAC) address on the **Instrument Information** section of the card.
- 4 Give the Cards to the System Administrator.** Give the partially completed card(s) to the System Administrator and ask him/her to complete the **Site LAN Information** part of each card and to return the card(s) to you. Then, go to [Step 4: Connect Your Instruments](#).

Site LAN Network Information Card	
Instrument Information (Completed by Instrument User) (Serial Number and Ethernet (MAC) Hardware Address usually on label on instrument)	
Instrument Serial Number:	_____
Ethernet (MAC) Hardware Address:	_____
Site LAN Information (Completed by System Administrator)	
Does the Network Support DHCP?	Yes <input type="checkbox"/> No <input type="checkbox"/>
If No, provide:	IP Address (Static): <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/>
Subnet Mask:	<input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/>
Default Gateway:	<input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/>
Does the Network Support DNS?	Yes <input type="checkbox"/> No <input type="checkbox"/>
If Yes, provide:	Instrument Host Name: <input type="text"/>
Instrument Domain Name:	<input type="text"/>
DNS Server IP Address:	<input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/>
Will You Allow Universal Plug&Play to be Enabled?	Yes <input type="checkbox"/> No <input type="checkbox"/>

Define Private LAN Network Parameters

Suggested steps follow to define parameters for a private LAN.

NOTE

For a private LAN you, the designer of the LAN, are the “System Administrator” for the LAN and are responsible for defining all private LAN parameters. However, you may want to check with the System Administrator in your Information Technology (IT) department for guidelines on designing your private LAN.

-
- 1 **Does the LAN Support DHCP?** In general, private LANs with a router support DHCP but typically do not support Dynamic DNS. Determine if the LAN supports DHCP.

NOTE

Most Agilent products and most PCs will automatically choose an IP address via auto-IP, if a DHCP server is not present.

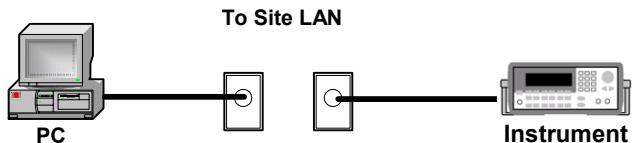
-
- 2 **Complete the Network Information Card.** Make a separate copy of the *Private LAN Network Information Card* for each instrument to be connected to the private LAN. For each card, define and record the network, PC settings, and instrument settings you want for the LAN. As required, see [TCP/IP Network Basics](#) or the [Glossary](#) for a definition of terms.
 - 3 **Where to Go Next.** When you have completed the *Private LAN Network Information Cards*, go to [Step 4: Connect Your Instruments](#).

Private LAN Network Information Card	
N E T W O R K	DHCP Enabled: Yes <input type="text"/> No <input type="text"/> Dynamic DNS Enabled: Yes <input type="text"/> No <input type="text"/> UPnP Enabled OK: Yes <input type="text"/> No <input type="text"/> Subnet Mask: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> DNS Server IP Address: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/>
P C	Hardware Address: <input type="text"/> IP Address: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> Subnet Mask: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> DNS Server: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> Host Name: <input type="text"/> Domain Name: <input type="text"/>
I N S T R U M E N T	Instrument Serial Number: <input type="text"/> Ethernet (MAC) Hardware Address: <input type="text"/> IP Address: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> Subnet Mask: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> DNS Server: <input type="text"/> . <input type="text"/> . <input type="text"/> . <input type="text"/> Host Name: <input type="text"/> Domain Name: <input type="text"/> DHCP: ON <input type="text"/> OFF <input type="text"/> Auto IP: ON <input type="text"/> OFF <input type="text"/> N/A <input type="text"/> UPnP: Enabled <input type="text"/> Disabled <input type="text"/> N/A <input type="text"/>

Step 4: Connect Your Instruments

4 Connect Your Instruments

Connect your instruments to the site LAN or private LAN you selected.



What's in This Step? This section gives guidelines to connect your instruments and LAN interface devices such as routers, hubs, or switches to site LANs or to private LANs. When you have connected your instruments, go to [Step 5: Configure Your Instruments](#).

To connect instruments to a site LAN, go to [Connect Instruments to Site LAN](#).

- To connect instruments to a private LAN, go to [Connect Devices to Private LAN](#).

Connect Instruments to Site LAN

This section shows typical ways you can connect LAN-enabled instruments and interface devices such as routers, hubs, and switches to a site LAN.

Two example network connections follow that you can use as templates to connect your instruments to the site LAN. Modify the connections as required for your application. When you have completed the instrument and device connections, go to [Step 5: Configure Your Instruments](#).

NOTE

The example connection steps assume the PC is configured for LAN operation and connected to an existing site LAN. If this is not the case and you need to configure the PC, see [Configuring Your PC for LAN Operation](#).

Example: Direct Connection (Site LAN)

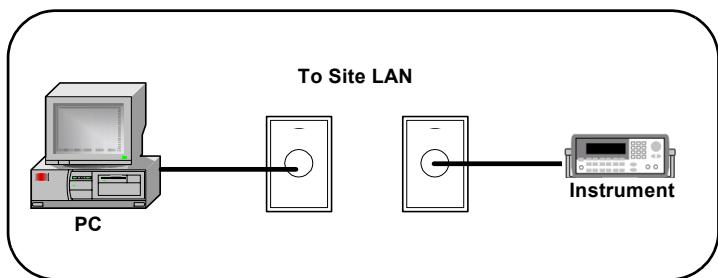


Figure 4 Direct Connection of Instruments to a Site LAN

- 1 Turn Power OFF.** Remove power to the instrument.
- 2 Connect Instrument to the LAN.** Use a standard CAT5 LAN cable to connect the instrument to the site LAN.
- 3 Turn Power ON.** Apply power to the instrument and verify proper instrument power-on sequence. See the instrument's *User's Guide* for information.

Example: Switch Connections (Site LAN)

This figure shows one way to connect instruments to a site LAN via an Ethernet hub or switch.

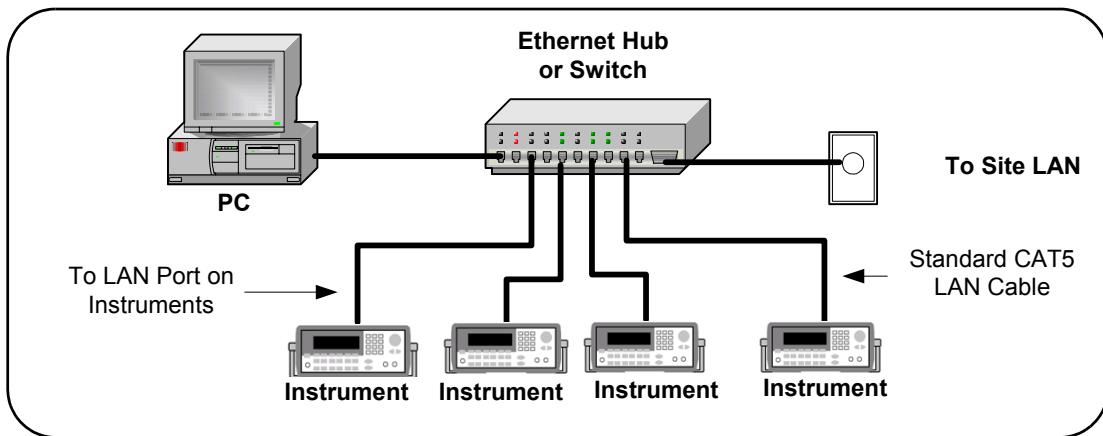


Figure 5 Connecting Instruments to a Site LAN via a Hub or Switch

- 1 Turn Power OFF.** Remove power from the instruments.
- 2 Connect Instruments to Hub/Switch.** If you use a hub or switch, use standard CAT5 LAN cables to connect each instrument to the hub or switch. See the hub/switch documentation for connections.
- 3 Turn Power ON.** Apply power to the hub/switch (if not already ON) and then to the instruments and verify proper power-on sequence. See the instrument's *User's Guide* for instrument information.

Connect Devices to Private LAN

This section shows typical ways you can connect LAN-enabled instruments and interface devices such as routers, hubs, and switches to a private LAN, assuming your PC is properly configured for LAN operation.

Two example network connections follow that you can use as templates to connect your instruments to a private LAN. Modify the connections as required for your application. When you have completed the instrument and device connections, go to [Step 5: Configure Your Instruments](#).

NOTE

The example connection steps assume the PC is properly configured for LAN operation. If this is not the case and you need to configure the PC, see [Configuring Your PC for LAN Operation](#).

Example: Direct Connections (Private LAN)

This figure shows one way to directly connect a Windows PC with a LAN-enabled instrument. Suggested connection steps follow.

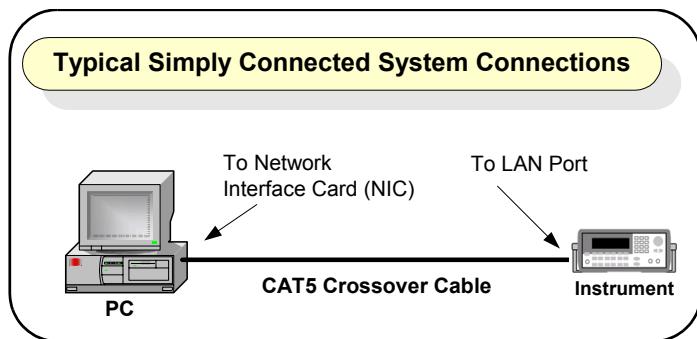


Figure 6 Typical Direct Connection of Instrument to PC

- 1 Turn Power OFF.** Remove power from the instrument.
- 2 Connect Instrument to the LAN.** Use a standard CAT5 crossover cable to connect the instrument to the LAN.

- 3 **Turn Power ON.** Apply power to the instrument and verify proper instrument power-on sequence. See the instrument's *User's Guide* for information on instrument power-on sequences.

Example: Switch Connections (Private LAN)

This figure shows one way to connect a Windows PC and LAN-enabled instruments via an Ethernet hub or switch. Suggested connection steps follow.

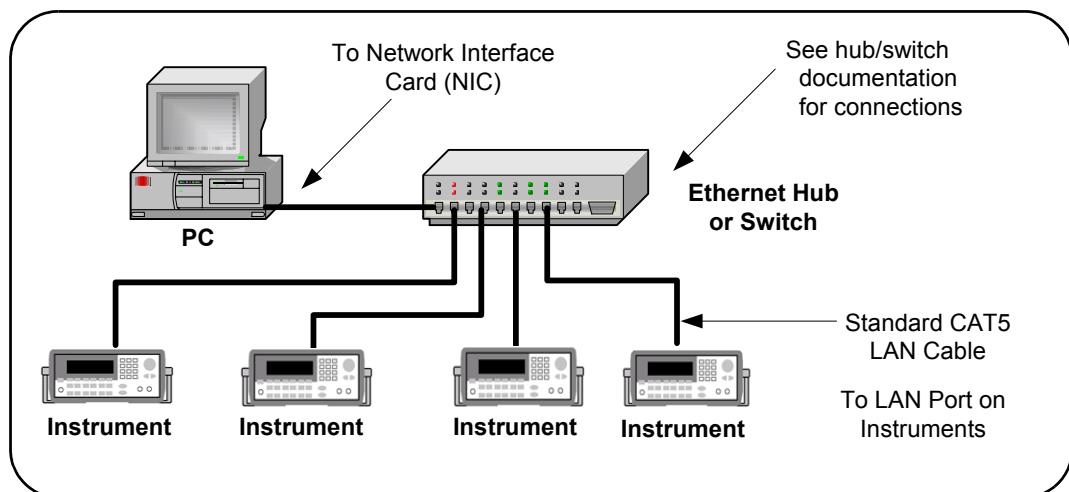


Figure 7 Example Connections via a Hub or Switch (Private LAN)

- 1 **Turn Power OFF.** Remove power to instruments and the hub/switch.
- 2 **Connect Instruments to Hub or Switch.** Use standard CAT5 LAN cables to connect each instrument to the hub or switch. See the hub or switch documentation for connection information.
- 3 **Turn Power ON.** Apply power to the hub/switch (if not already ON) and then to the instruments and verify proper power-on sequence. See the instrument's *User's Guide* for information on instrument power-on sequences.

Step 5: Configure Your Instruments

5 Configure Your Instruments

As required, manually configure your instruments using the instrument's Web pages or front panel.

You can use the **Configuring Your Instrument** Web page to configure instruments.

Configuring your 20-MHz Function/Arbitrary Waveform Generator

Note: You must click "Save" before changes to parameters become effective. Parameters marked with an asterisk (*) also require that the instrument be rebooted before changes take effect.

Parameter	Configured Value	Edit Configuration
DNS?*	On	<input type="radio"/> Off <input checked="" type="radio"/> On
These LAN parameters will be used during boot if DHCP is OFF or unavailable		
IP Address?*	192.168.160.202	[191.140.114.122]
Subnet Mask?*	255.255.254.0	[255.255.254.0]
Default Gateway?*	192.168.160.1	[191.140.114.1]

What's in This Step? This step shows how to manually set TCP/IP parameters for LAN-enabled instruments, using the instrument's Web Pages or front panel.

- If your LAN supports DHCP **and** you selected automatic configuration for your instruments, [skip this step](#) and go to [Step 6: Run Agilent Connection Expert](#).
- If the LAN does not support DHCP or you want to make configuration changes, you can use the steps in this section to configure your instruments. Then, go to [Step 6: Run Agilent Connection Expert](#).

Check Your Web Browser.

If your instrument is Web-enabled, the instrument includes a Web Server you can access using a supported Web Browser (Internet Explorer 5.0 or higher). You can then use your Web Browser and the instrument's Web Pages to view/modify network configuration parameters as required.

NOTE

If your instrument is not Web-enabled or you cannot access the instrument at its IP address, you must set the TCP/IP parameters from the instrument's front panel.

Set/Change LAN Parameters

- 1 **Display the Instrument Welcome Page.** To display an instrument's **Welcome Page**, determine the instrument's IP address from the front panel display. Then, open your Web Browser. From the Web Browser address line, type '<http://<Instrument IP Address>>', where *<Instrument IP Address>* is the IP address displayed on the front panel, and press **Enter** to display the instrument's **Welcome Page**.

For example, if the instrument's current IP address is 169.254.3.2 (as displayed on the instrument's front panel), typing <http://169.254.3.2> and pressing **Enter** displays the instrument's **Welcome Page**. The following figure shows a typical display for the Agilent 33220A.

Welcome to your
Web-Enabled 20 MHz Function/Arbitrary Waveform Generator

Information about this Web-Enabled Instrument

Instrument:	33220A 20 MHz Function/Arbitrary Waveform Generator
Serial Number:	US 0123456
Description:	Agilent 33220A (US 0123456)
Hostname:	a-33220a-23456.Md.agilent.com
IP Address:	156.140.105.104
VISA TCPIP Connect String:	TCP1PO::a-33220a-23456::INSTR

[Advanced information](#)

2 View Current Configuration Page. To view the current configuration, click the **View and Modify Configuration** icon to display the **Current Configuration Page**. An example display for the 33220A follows.

Current Configuration of 20 MHz Function/Arbitrary Waveform Generator

[Modify Configuration](#)

Parameter	Currently in use
DHCP:	ON
IP Address:	156.140.105.104
Subnet Mask:	255.255.254.0
Default Gateway:	156.140.104.1
DHCP Server:	156.140.104.102
DNS Server:	156.140.2.11
Hostname:	a-33220a-23456
Domain:	Md.agilent.com
Description:	Agilent 33220A (US 0123456)
Lan Keepalive Timeout:	1800

3 Display the Configuring the *Instrument* Page. From the **Current Configuration Page**, click the **Modify Configuration**

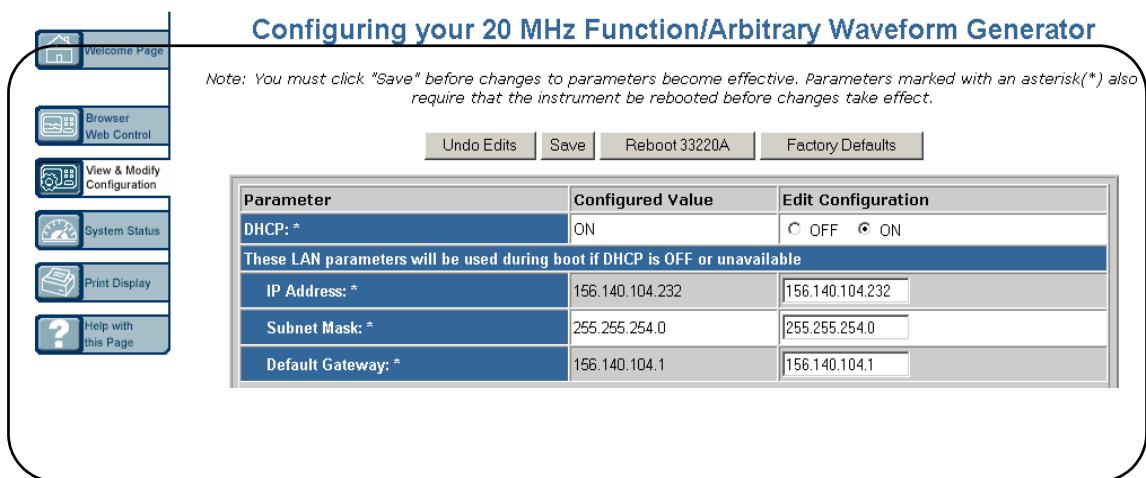
box to display the **Configuring the Instrument Page**. You can then set/change instrument parameters as required

- 4 Set/Change TCP/IP Parameters.** This figure shows a partial **Configuring your 20MHz Function/Arbitrary Waveform Generator Page**. For example, to change the settings for the 33220A IP address and default gateway from the values shown in the **Configured Value** column to those shown in the **Edit Configuration** column, type the desired values in the **Edit Configuration** column. Then click **Save**. Click **Reboot 33220A** to make the changes effective.

NOTE

Since the IP Address, Subnet Mask, and Default Gateway parameters are marked with an asterisk (*), you must click **Save** and then click **Reboot 33220A** to make the changes effective.

The **Configured Value** for the IP Address, Subnet Mask and Default Gateway are NOT necessarily the values currently set for the instrument. These values will be used during boot if DHCP is OFF or is unavailable.



Step 6: Run Agilent Connection Expert

6 Run Agilent Connection Expert

Run Agilent Connection Expert; add and configure the LAN interface (optional); add a LAN instrument; communicate with your instruments using Interactive IO; and program your instruments (optional).



What's in This Step? This step shows how to

- Run Agilent Connection Expert
- Add and configure a LAN interface (optional)
- Add a LAN instrument
- Communicate with your instruments
- Program your instruments (optional)

Run Agilent Connection Expert

Click the Agilent IO Control icon in your Microsoft notification area,



and select **Agilent Connection Expert**, or click **Refresh All** in the explorer pane if the Connection Expert is already running.

Add a LAN interface

One LAN interface labeled LAN (TCP1P0) appears in the explorer pane by default. If there is not a LAN interface available, or you wish to connect different instruments via LAN with different connection parameters (such as different connect timeouts), then take the following steps:

- 1 Click **Add Interface** on the Connection Expert toolbar to create an additional LAN interface.
- 2 When the **Manually Add an Interface** box appears with LAN interface highlighted, click **Add**.
- 3 When the **LAN Interface** configuration box appears, modify the properties as desired, then click **OK**.

NOTE

The required Auto-discover setting for LAN interfaces is **off**. To prevent disrupting your network traffic, Connection Expert does not automatically query each bus on the LAN to detect the presence of new devices.

Configure a LAN Interface

When you select a LAN interface in the explorer pane, the properties pane displays the current properties for that interface. The properties that you are most likely to need are displayed at the top of the properties pane. If you see a button labeled More, you may click it to see additional properties, as shown in the graphic below.

- 1 Click **More** to view the full property list.

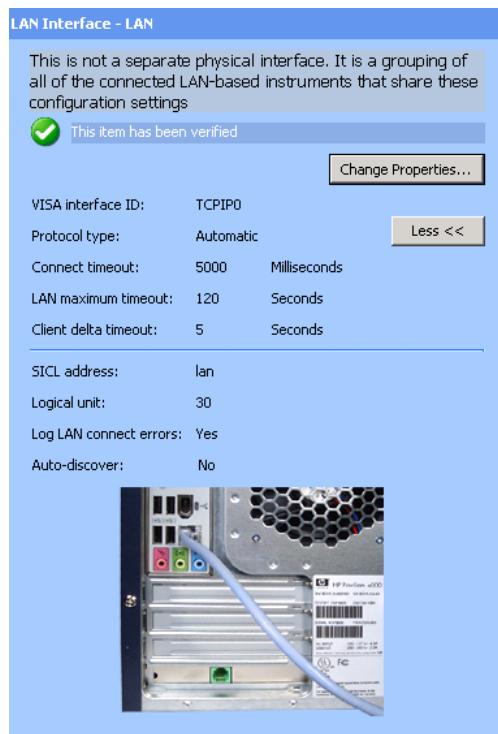


Figure 8 LAN Interface Properties Pane

- 2 Select a LAN interface in the explorer pane. Click the **Change Properties...** button in the properties pane. The LAN Interface dialog box appears, as shown below.

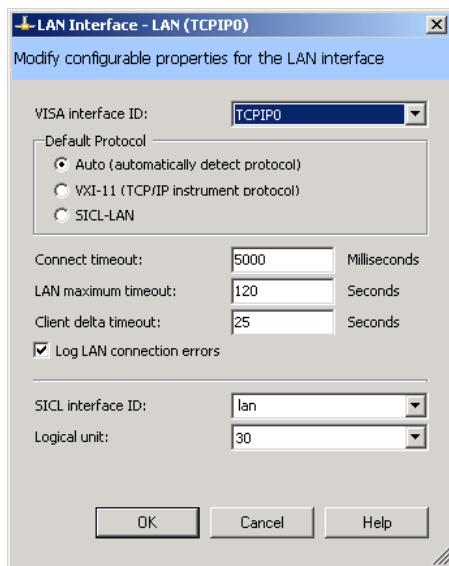


Figure 9 LAN Interface Configuration Dialog Box

- 3 Change the properties and click **OK**. Your changes will appear in the properties pane.

VISA Interface ID. A symbolic name that is used to uniquely identify this interface. The VISA interface ID combines the interface type and a numeric identifier. For example, TCPIP0 is the default VISA interface ID for a TCPIP interface.

Protocol type. The protocol type to be used with the LAN client software on this PC. The Agilent IO Libraries Suite supports three protocol choices: Automatic (automatically detect protocol), VXI-11 (TCP/IP Instrument protocol), and SICL-LAN protocol.

Default selection: Automatic

Connect timeout. The time, in milliseconds, that the PC will wait when attempting to connect to a LAN instrument. Default value: 5000 milliseconds

LAN maximum timeout: The actual timeout value used when a test program specifies a timeout value of infinity. Default value: 120 seconds

Client delta timeout. The incremental time that is added to the timeout value specified in a test program to allow for the additional time required to transfer information over a LAN connection. Default value: 25 seconds

SICL interface ID. The unique name that SICL programs use to identify this interface.

Logical unit. A number used to uniquely identify an interface in Agilent VEE and SICL applications. The logical unit number is an integer in the range of 0-99.

NOTE

The logical unit may be used in place of the SICL interface ID in Agilent VEE and SICL applications. The logical unit is not used by VISA.

Log LAN connect errors. You can set the Connection Expert to log LAN connection error information in your Windows Event Viewer or Event Log. Default setting: Yes

Auto-discover. Auto-discover is not shown in the Change Properties dialog box, because it is required to be Off (No) for a LAN interface.

Add and Configure a LAN Instrument

When an instrument resides on your local area network (LAN), there are several ways to add the instrument to your test system configuration. You may also use any of these methods to make a change to an existing instrument.

NOTE

Connection Expert only discovers LAN instruments automatically in your *local subnet* to prevent disrupting your network traffic. In practical terms, your *local subnet* is defined as being on your side of the nearest router. To communicate with LAN instruments that are *remote* (on the other side of the router), you must be able to specify a Hostname or IP address in the LAN Instrument dialog box.

Connecting an instrument on your LAN local subnet

When an instrument is on your LAN local subnet, the easiest way to add the instrument is to request that Connection Expert discover the instrument. This eliminates the need to specify the IP address or the instrument hostname.

Connecting an instrument *outside* your LAN local subnet

When an instrument resides outside your LAN local subnet, you may specify the instrument by either the IP address or the instrument hostname.

Connection Expert can discover any server on the local subnet that uses either the VXI-11 or the SICL-LAN protocol.

After Connection Expert discovers a remote instrument on the LAN, it performs the same bus addressing procedures as it would for a local instrument. If Connection Expert can open a connection to an instrument, it considers that the instrument has been “discovered” (even though Connection Expert does not send or receive any information).

To discover an instrument on your local subnet,

- 1 Select the LAN interface node in the explorer pane, **LAN (TCPIP0)** for this example. Right-click to get a menu. Then click **Add Instrument**. (Alternatively, you could click

the **Add Instrument** button on the tool bar, the Task Guide, or the I/O Configuration menu.)
The Add Instrument dialog box appears, as shown.

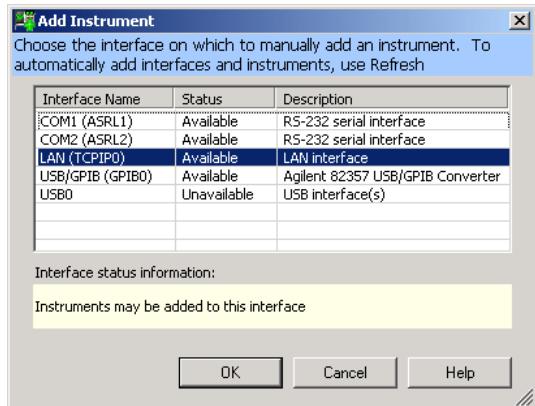


Figure 10 The Add Instrument Dialog Box

- 2 Leaving the LAN interface selected, click **OK**. The LAN instrument configuration dialog box appears, as shown.

2 Connecting Instruments to LAN

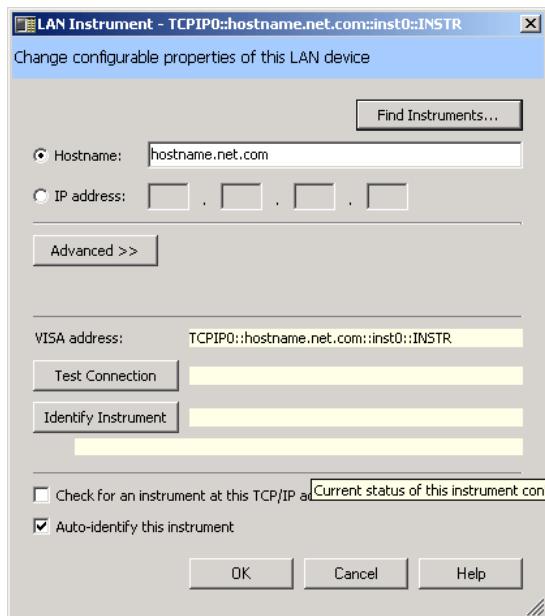


Figure 11 LAN Instrument Configuration Dialog Box

Click **Find Instruments...**

NOTE

Find Instruments only searches in your local subnet. In practical terms, your **local subnet** is defined as instruments on your side of the nearest router. To communicate with LAN instruments that are remote (on the other side of the router), you must be able to specify a **Hostname** or **IP address** in the LAN Instrument dialog box above.

- 3 When the **Search for instruments on the LAN** dialog box appears (as shown below), leave **LAN** selected, and click **Find Now**.

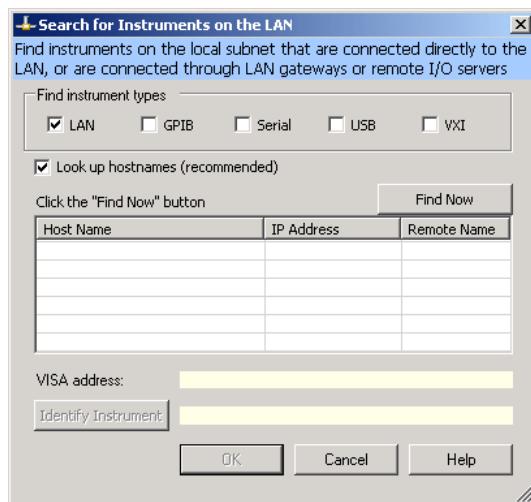


Figure 12 Search for Instruments on the LAN Dialog Box

- 4 When the LAN instruments on the subnet are discovered as shown below, select the one of interest, click **Identify Instrument** (if desired), then **OK**.

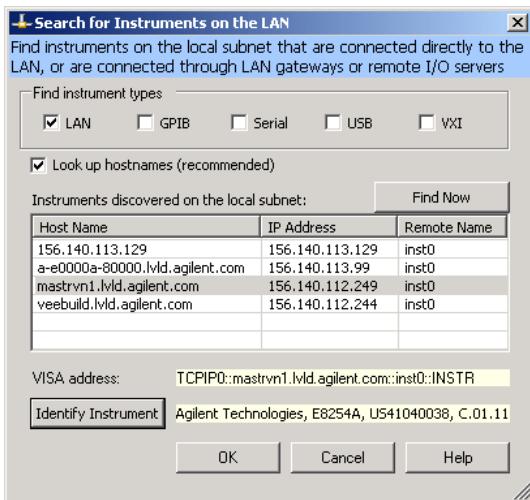


Figure 13 Discovery of LAN Instruments on the Subnet

- 5 Click **OK** when you are satisfied that the correct instrument has been located and selected. You now see the LAN Instrument configuration dialog box displayed including information from your selected instrument, as shown below.

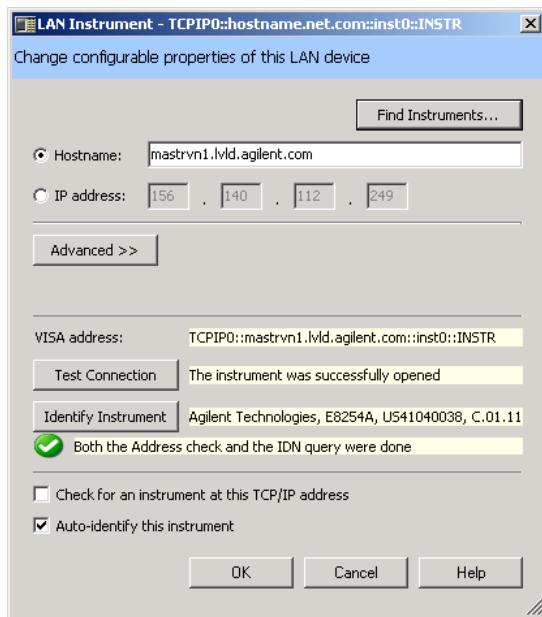


Figure 14 Configuration Properties for Selected Instrument

Automatically, you have the IP address, the Hostname, a default Remote name, the VISA address, a verified test connection. The instrument's identity has been verified. Click **OK** to return to the main Connection Expert window. Now you see the LAN instrument added to the explorer pane and its properties enumerated in the properties pane, as shown.

2 Connecting Instruments to LAN

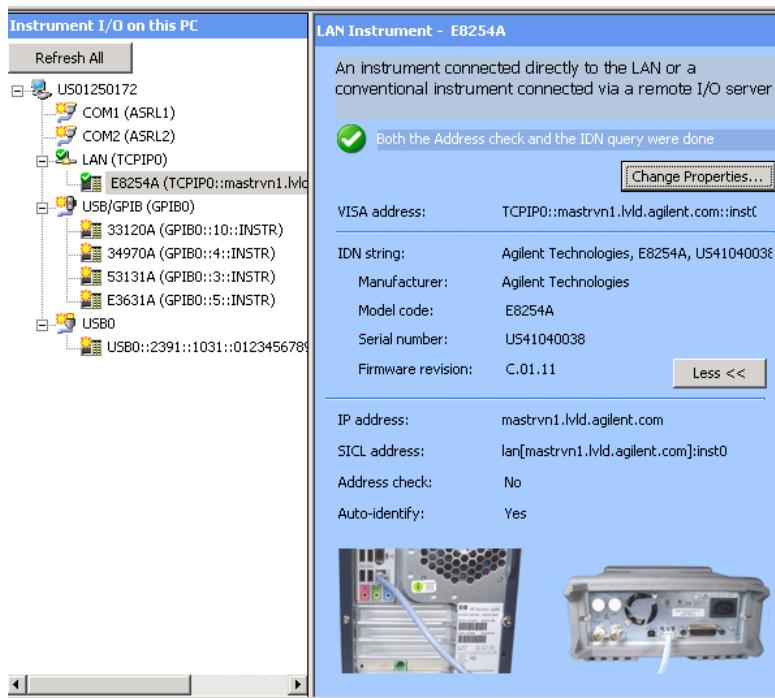


Figure 15 Newly Added LAN Instrument in Connection Expert

To add a LAN instrument by specifying the hostname or IP address

- 1 In the explorer pane, click the LAN interface node where you want to add the instrument.
- 2 Right-click the interface node, and select **Add Instrument** from the drop-down menu
- 3 When the **Add Instrument** dialog box appears with the LAN interface highlighted, click **OK**.
- 4 When the **LAN Instrument** configuration dialog box appears, as shown below, select and edit either the **IP address** or the **Hostname**. With either choice, you will also need to enter the remote name for the instrument.

Optional tests: Click **Test Connection**. Click **Identify Instrument**.

Click **OK**.

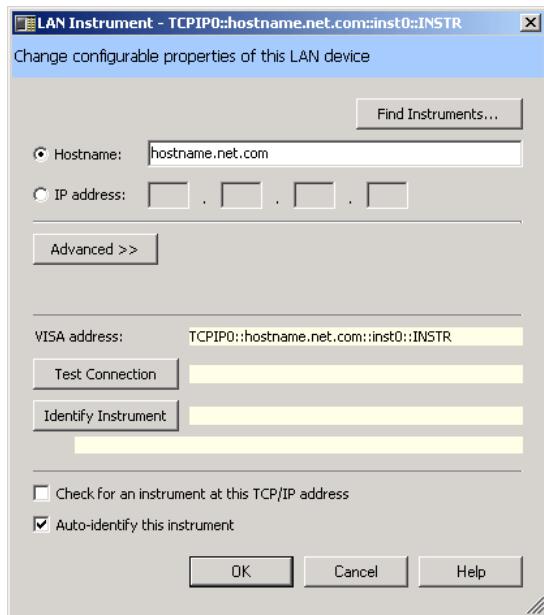


Figure 16 Editing Properties in the LAN Instrument Dialog Box

Communicate with Instruments Using Interactive IO

You can use the Interactive IO utility within Connection Expert, VISA Assistant, or the Telnet utility to verify communication with instruments via the LAN.

This section gives guidelines to communicate with your instruments using Interactive IO.

NOTE

Communication with installed LAN instruments was established in [Run Agilent Connection Expert](#) if the instruments were visible and verified in the Connection Expert explorer view. Therefore, this is an optional step you can use to verify communication with instruments.

Interactive IO is a software utility that lets you interactively send commands to instruments and see their responses without writing any program code.

You can use Interactive IO to quickly verify connectivity to your instrument, to troubleshoot communication problems, to learn the instrument's command set, and to rapidly prototype commands and check the instrument's responses before writing code.

Start Interactive IO from within the Connection Expert, either by clicking the *Send commands to this instrument* task in the task guide, or, on the Connection Expert menu bar, by clicking **Tools > Interactive IO**.

Example using Interactive IO

- 1 Select the desired instrument in the explorer view. Click **Tools > Interactive IO**. Interactive IO gives you a number

of common IEEE 488.2 and SCPI commands for communicating with instruments, as shown below.

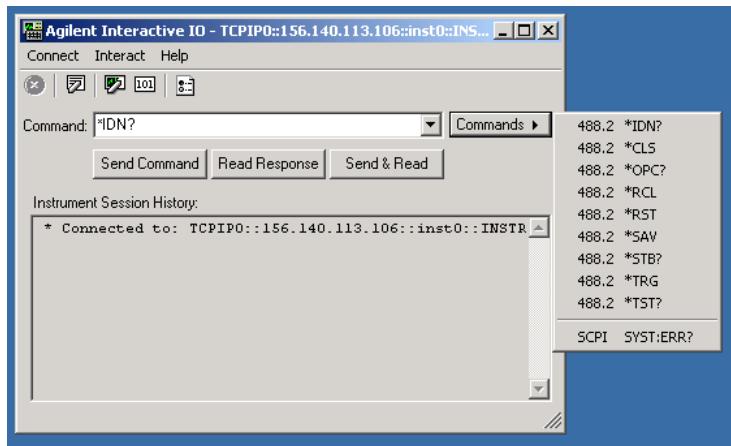


Figure 17 Common 488.2 and SCPI Commands in Interactive IO

You can also type in instrument-specific commands (from your instrument's programming guide). The common 488.2 commands and their meanings are listed in the table below.

488.2 Commands	Meaning
*IDN?	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
*CLS	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
*OPC?	The Operation Complete query places an ASCII character “1” into the device’s Output Queue when all pending selected device operations have been finished.
*RCL	The Recall command restores the current settings of a device from a copy stored in local memory.
*RST	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.

2 Connecting Instruments to LAN

*SAV	The Save command stores the current settings of the device in local memory.
*STB?	The Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
*TRG	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
*TST?	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	The queue query message is a request for the next entry from the instrument's error/event queue. Items in this queue contain an integer in the range [-32768, 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

- 2 Open the **Commands** menu and select a command. The example below shows a *IDN? command selected.

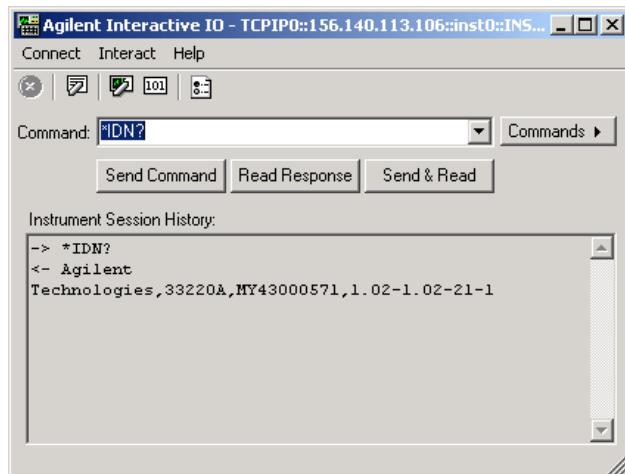


Figure 18 *IDN? Command Example in Interactive IO

- 3 Click **Send & Read** to send the command and receive a response. The results are displayed in the **Instrument Session History**.

Alternatively, you can click the **Send Command** and **Read Response** buttons, when you desire, to control the time gap between these commands.

Interactive IO has a default timeout value set (5000 ms.), which may not be long enough for your particular application. To change that default, go to **Interact > Options**, edit the **Timeout** value, and click **OK**.

2 Connecting Instruments to LAN

3

Connecting Instruments to USB

This chapter includes:

- USB Quick Start
- Step 1: Install I/O Software on Your PC
- Step 2: Connect Instruments to USB
- Step 3: Identify Instruments Automatically
- Step 4: Communicate with Instruments
- (Optional) Step 5: Program Your Instruments



USB Quick Start

This section shows suggested steps to help you quickly get started connecting USB-enabled instruments to the Universal Serial Bus (USB).

NOTE

Optionally, a USB hub may be connected between the PC and USB instrument(s). However, this configuration is not described in this guide. See your USB hub documentation if you use a USB hub.

Typical USB Interface System In this guide, a **USB interface system** is defined as a system in which USB-enabled instruments are connected via a USB cable to a USB 1.1 port in a Windows PC or to a USB 2.0 port in a Windows XP PC (with Service Packs 1 or 2). This figure shows a typical USB interface system with a PC and a USB instrument connected via a USB cable.

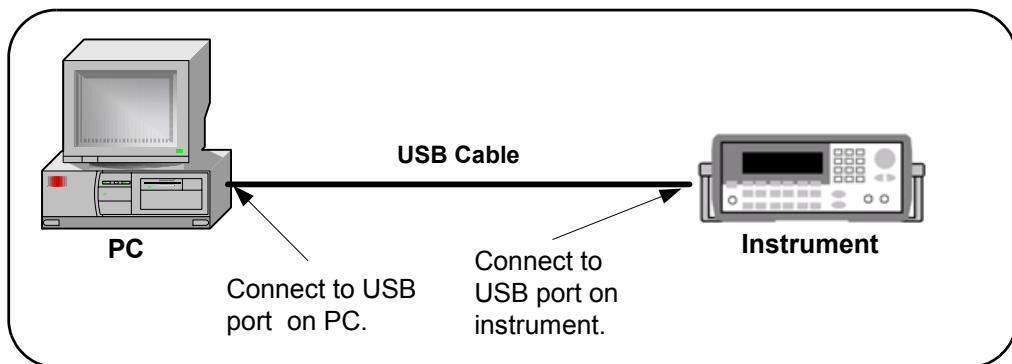


Figure 19 Typical USB Interface System

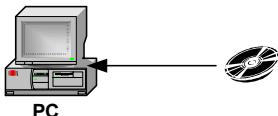
Getting Started To get started, you may want to print the figures for Steps 1 - 5 to use as a guide as you set up your USB system. See the associated step if you need more details.

Other Information You Can Use

- [Troubleshooting USB Interfaces](#) for USB troubleshooting tips
- [Glossary](#) for a definition of some USB terms
- [Contacting Agilent](#)

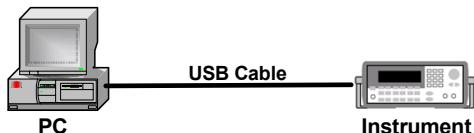
1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.



2 Connect Instruments to USB

Use USB cables to connect your instruments to the USB port(s) on your PC, or use the Agilent 82357A USB/GPIB Interface Converter.



3 Identify Instruments Automatically

With Connection Expert running, you can discover and identify your USB instruments automatically.

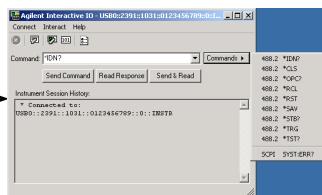
After the instruments are powered and connected to the PC, **Connection Expert** executes identification queries automatically.



4 Communicate with Instruments (Optional)

Use **Interactive IO** within **Connection Expert** to send commands and read responses via the USB interface.

Use **Interactive IO** to send commands such as 488.2 "*IDN?" to your instruments.



5 Program Your Instruments (Optional)

This is an optional step. As desired, you can program instruments via the USB interface using applications such as IVI-COM, VXIlpnp, or VISA.

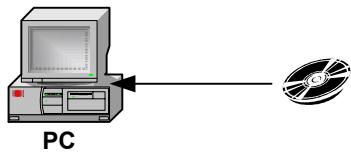
VISA: viOpen (...,"UsbDevice1",...)
SICL: iopen ("UsbDevice1")

VISA Alias

Step 1: Install I/O Software on Your PC

1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.



What's in This Step? Install Agilent IO Libraries Suite and other I/O software on your PC before you connect instruments to USB. See [Installing I/O Software](#) for details. Then, go to [Step 2: Connect Instruments to USB](#)

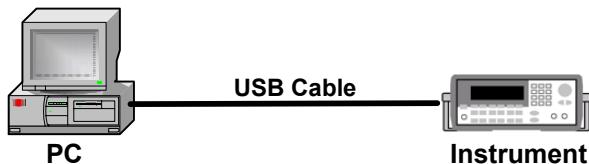
NOTE

Version M.01.00 or later of the Agilent IO Libraries is required for USB. This procedure documents the use of Agilent IO Libraries Suite 14.0.

Step 2: Connect Instruments to USB

2 Connect Instruments to USB

Use USB cables to connect your instruments to the USB port(s) on your PC, or use the Agilent 82357A USB/GPIB Interface Converter.



What's in This Step? This step provides a USB interface overview, shows how to connect USB Instruments using the USB ports on your PC, or by using the Agilent 82357A USB/GPIB Interface Converter.

USB Interface Overview

When a USB device that implements the USBTMC or USBTMC-USB488 protocol is plugged into the computer, the Agilent IO Libraries Suite automatically detects the device. It is important to note that only USBTMC and USBTMC-USB488 devices are recognized by the IO Libraries Suite. Other USB devices such as printers, scanners, and storage devices are not recognized and cannot be programmed with the Agilent IO Libraries Suite. “USB instruments” in the remainder of this section refers to devices that implement the USBTMC or USBTMC-USB488 protocol.

Connecting an Instrument via USB or Converter. The Universal Serial Bus (USB) is a quick and easy way to connect instruments to PCs on a benchtop. Some newer instruments have USB interfaces built in; for those that do not, you can use the **Agilent 82357A USB/GPIB Interface Converter** to connect GPIB instruments to a USB port on your PC. You can use USB to connect a single instrument to a PC; or, with the 82357A, you can connect up to 14 GPIB instruments.

NOTE

Do not confuse the **Agilent 82357 USB/GPIB Interface Converter** with a USBTMC device. The 82357 is automatically configured as a GPIB interface, not as a USBTMC device, when it is plugged into the computer.

Steps to Connect USB Instruments

Use the steps in this figure to directly connect USB instruments to a Windows PC. If you have not yet installed I/O software on your PC, go to [Installing I/O Software](#) and install the software BEFORE you connect USB instruments to your PC. When you have made the connections for your system, go to [Step 3: Identify Instruments Automatically](#).

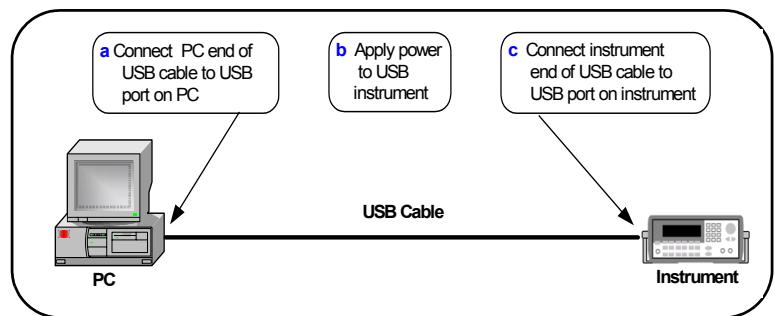


Figure 20 Connecting a USB Instrument to a PC

NOTE

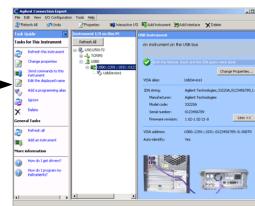
If you have not yet installed I/O software on your PC, go to [Step 1: Install I/O Software on Your PC](#) and install the software BEFORE you connect USB instruments to your PC. Be sure to use a USB 2.0-compliant USB cable, even if you are using USB 1.1 operation.

Step 3: Identify Instruments Automatically

3 Identify Instruments Automatically

With Connection Expert running, you can discover and identify your USB instruments automatically.

After the instruments are powered and connected to the PC, Connection Expert executes identification queries automatically.



What's in This Step? This step provides an overview of how Connection Expert automatically identifies USB instruments, and how you can assign VISA aliases, or programming aliases, to address those instruments in a more convenient way.

Automatic Identification of USB Devices. When a USB instrument is plugged into the PC, the IO Libraries Suite adds a USB interface, a USB instrument, and a VISA alias (**UsbDevice1**, in this case) to the **Instrument I/O on this PC** tree. Note that the USB/GPIB converter, **USB/GPIB (GPIB0)**, looks different from the USB interface.

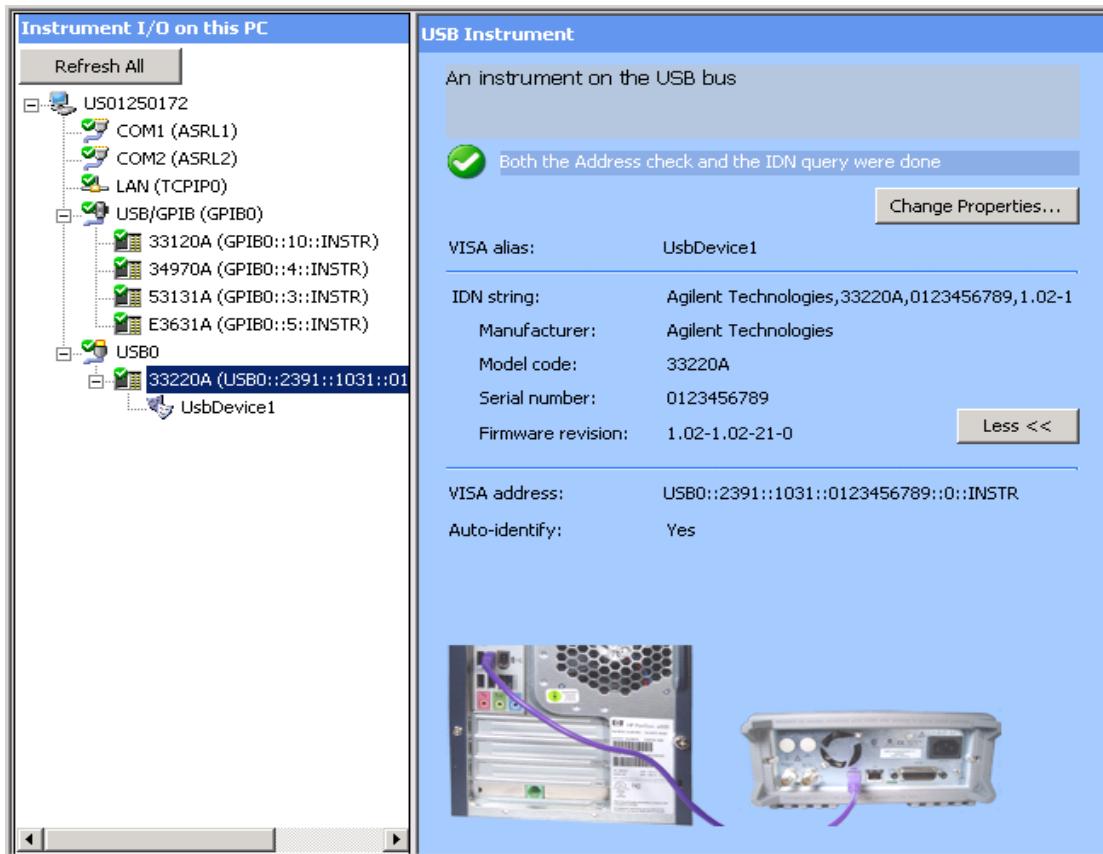


Figure 21 Appearance of the USB Converter vs. USB Interface

Both a listener check and an identification query are done automatically, as you can see on the right side in the **USB Instrument** pane next to the green-white check mark symbol.

NOTE

When power is applied, a **Found New Hardware** dialog box may also appear from the MS Windows operating system. Just step through the boxes clicking **OK**. (You don't need to insert a CD, since you have already installed the I/O software.) You may see two wizards using the converter. Don't worry; step through both. Then return to this section.

The instrument's identification parameters can also be seen, such as the IDN string, the manufacturer, the model code, the serial number, the firmware revision as well as pictures of the instrument and PC rear connection panels.

Assigning a VISA Alias. Connection Expert automatically assigns a default alias name. You can modify a VISA alias by right-clicking on the USB instrument in the Instrument IO pane and selecting **Add VISA alias** from the drop-down menu. A **Changing VISA Alias Properties** dialog box appears.

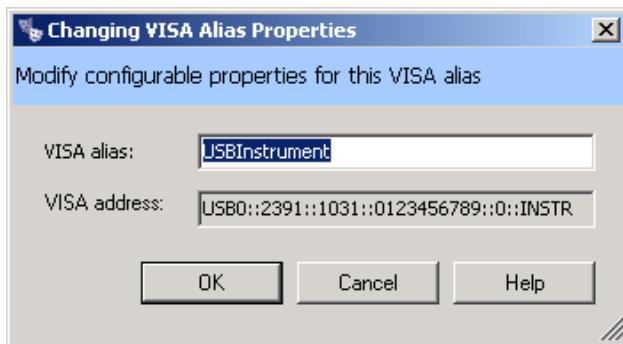


Figure 22 Changing VISA Alias Properties Dialog Box

You can change this VISA alias name to one of your own choosing before clicking **OK**.

NOTE

A VISA alias is a name of your choosing, which you assign to a device and use in your programs. Once assigned, the alias is a synonym for the device's VISA address, so you can use it to open a VISA session (using the viOpen function) and to get resource information (using viParseRsrc or viParseRsrcEx).

Using VISA aliases in your programs, rather than VISA addresses, provides two significant advantages:

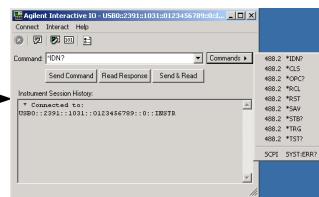
- **Portability.** If you program using aliases, you can run your program on a new test system, whose instruments are at different addresses, simply by using the Connection Expert to create the same aliases on the new system as you created on your development system. Similarly, you can move or replace instruments without changing or recompiling test code, simply by changing the alias definitions in the Connection Expert.
- **Readability.** Your programs will be much easier to read and understand if, for example, your multimeter is called "myDMM" instead of "GPIB2::14::8::INSTR". This is particularly important in the case of USB instruments, whose VISA addresses are typically long and cumbersome, containing the instrument's serial number among other information.

Step 4: Communicate with Instruments

4 Communicate with Instruments (Optional)

Use **Interactive IO** within **Connection Expert** to send commands and read responses via the USB interface.

Use **Interactive IO** to send commands such as 488.2 "*IDN?" to your instruments.



What's in This Step? This step shows how to use Interactive IO to send 488.2 commands to your USB instruments and read responses. Next, go to [\(Optional\) Step 5: Program Your Instruments](#).

NOTE

Communication with installed instruments was established in [Step 2: Connect Instruments to USB](#). Therefore, this is an optional step you can use to verify communication with instruments.

Steps to Check Identification Parameters

- 1 Highlight the USB instrument in the **Instrument I/O on this PC** pane. Then click the **Interactive IO** icon on the toolbar. (If you are using a USB/GPIB converter, then you would be highlighting a GPIB instrument.)

The **Interactive IO** dialog box appears. The **Commands** menu is selected, as shown below.

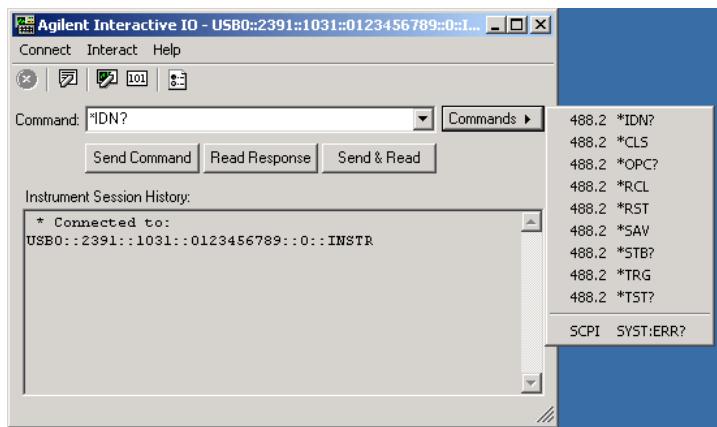


Figure 23 Interactive IO with 488.2 Commands Displayed

- 2 Select a command, or enter one in the **Command** area.
- 3 Click **Send & Read** to send the command to the instrument and read a response. Alternatively, you may click **Send Command** and **Read Response**, as you desire.

The Instrument Session History area will display the results.

NOTE

If you are getting a timeout when sending and receiving commands, you can change your **Timeout** default setting of 500 ms in the **Interact > Options** dialog box.

488.2 Commands	Meaning
*IDN?	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
*CLS	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
*OPC?	The Operation Complete query places an ASCII character “1” into the device’s Output Queue when all pending selected device operations have been finished.
*RCL	The Recall command restores the current settings of a device from a copy stored in local memory.
*RST	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.
*SAV	The Save command stores the current settings of the device in local memory.
*STB?	The Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
*TRG	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
*TST?	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	The queue query message is a request for the next entry from the instrument’s error/event queue. Items in this queue contain an integer in the range [-32768, 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

NOTE

Some instruments do not recognize any/all 488.2 commands.

(Optional) Step 5: Program Your Instruments

5 Program Your Instruments (Optional)

This is an optional step. As desired, you can program instruments via the USB interface using applications such as IVI-COM, VXI*pnp*, or VISA.

VISA: viOpen (...,"UsbDevice1",...)
SICL: iopen ("UsbDevice1")

VISA Alias

What's in This Step? This is an optional step that gives guidelines to communicate with your instruments using I/O software such as IVI-COM or VXI*plug&play* instrument drivers, or VISA.

3 Connecting Instruments to USB

4

Connecting Instruments to GPIB

This chapter includes:

- [GPIB Quick Start](#)
- [Step 1: Install I/O Software on Your PC](#)
- [Step 2: Install GPIB Cards in Your PC](#)
- [Step 3: Connect Instruments to GPIB Card](#)
- [\(Optional\) Step 4: Configure GPIB Interface Cards](#)
- [\(Optional\) Step 5: Communicate with Instruments](#)
- [\(Optional\) Step 6: Program Your Instruments](#)



GPIB Quick Start

This section shows suggested steps to help you quickly get started connecting GPIB instruments to the General Purpose Interface Bus (GPIB).

Typical GPIB Interface System In this guide, a **GPIB interface system** is defined as a system in which GPIB instruments are connected to a GPIB interface card in a Windows PC via GPIB cables. (Refer to **Installing I/O Software** for a Windows support matrix.) This figure shows a typical GPIB interface system with a PC and two GPIB instruments connected via GPIB cables.

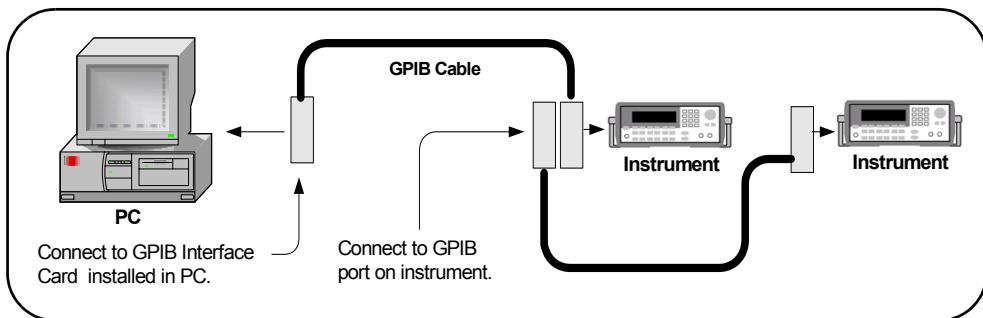


Figure 24 Typical GPIB Interface System

Getting Started To get started, you may want to print the figures for Steps 1 - 6 to use as a guide as you set up your GPIB system.

NOTE

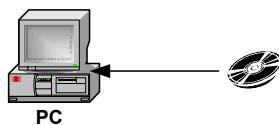
You can save time connecting GPIB instruments by using the Agilent 82357A USB/GPIB Interface Converter. (Then you won't need a GPIB card.) For more information, go to www.agilent.com/find/gpib.

Other Information You Can Use

- [Troubleshooting GPIB Interfaces for GPIB troubleshooting tips](#)
- [Glossary](#) for a definition of some GPIB terms
- [Contacting Agilent](#)

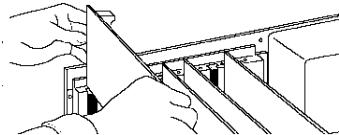
1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.



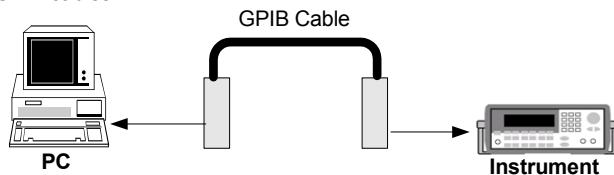
2 Install GPIB Cards in Your PC

As required, install one or more GPIB interface cards in your PC. (Or, connect the 82357A GPIB/USB Converter cable to a USB port on your PC.)



3 Connect Instruments to GPIB Card

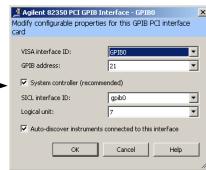
Connect your instruments to the installed GPIB interface card(s) using GPIB cables.



4 Configure GPIB Interface Cards (Optional)

Use **Agilent Connection Expert** to configure installed GPIB interface card parameters.

You can use the **GPIB Interface Properties** dialog box to configure GPIB interface cards installed in your PC.



5 Communicate With Instruments (Optional)

You can use Interactive IO to verify communication with instruments.



6 Program Your Instruments (Optional)

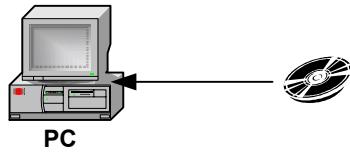
As desired, you can program instruments via the GPIB interface using Agilent VEE, Agilent T&M Toolkit 2.0, Visual Basic 6, Visual Basic.NET, or many other programming environments.

VISA: viopen (... "GPIB0::5::INSTR"...)

Step 1: Install I/O Software on Your PC

1 Install I/O Software on Your PC

Install Agilent IO Libraries Suite from a CD or the Web.

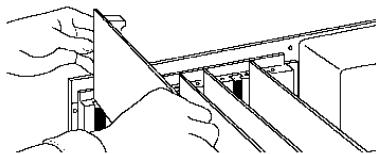


What's in This Step? Before you connect your instruments to GPIB, install Agilent IO Libraries Suite software on your PC. See [Installing I/O Software](#) for details. Then, go to [Step 2: Install GPIB Cards in Your PC](#).

Step 2: Install GPIB Cards in Your PC

2 Install GPIB Cards in Your PC

As required, install one or more GPIB interface cards in your PC. (Or, connect the 82357A GPIB/USB Converter cable to a USB port on your PC.)



What's in This Step? This step shows how to install GPIB interface cards (such as an Agilent 82350 PCI GPIB Interface for Windows) in your PC.

NOTE

If you have not yet installed I/O software on your PC, go to [Step 1: Install I/O Software on Your PC](#) and install the software BEFORE you install GPIB Interface Cards in your PC.

NOTE

If you are using the 82357A GPIB/USB Converter, just plug your cable into the USB port on the PC and connect it to the GPIB port on the instrument, and continue to [Step 5: Communicate with Instruments](#).

Steps to Install a GPIB Card in Your PC

Example steps follow to install an Agilent 82350 PCI GPIB Interface Card for Windows in your PC. Modify the steps as required if you install a different GPIB interface card in your PC. When you have installed all required GPIB Interface Cards, go to [Step 3: Connect Instruments to GPIB Card](#).

CAUTION

To reduce the risk of damaging a GPIB Interface Card, only handle the card by the sheet metal frame or by its edges.

-
- 1 **Record the card serial number.** Remove the card from its anti-static bag and record the serial number for future reference. Save the anti-static bag so you can protect the card if you need to remove it from the PC.

For example, the 82350 serial number is located on the white serial number label on the card. The label contains 24 characters, with the last 8 characters (plus US) being the 82350 Serial Number. Thus, if the numbers on the serial number label are 82350-66511-4224-01-42300113, since the last 8 characters are 42300113, the 82350 Serial Number is US42300113.

- 2 **Remove the PC cover.** Remove power from the PC and from all of its peripherals. Then, remove the power cord from the PC. Unlock and remove the cover from the PC to allow access to the I/O slots. See your PC documentation for instructions.

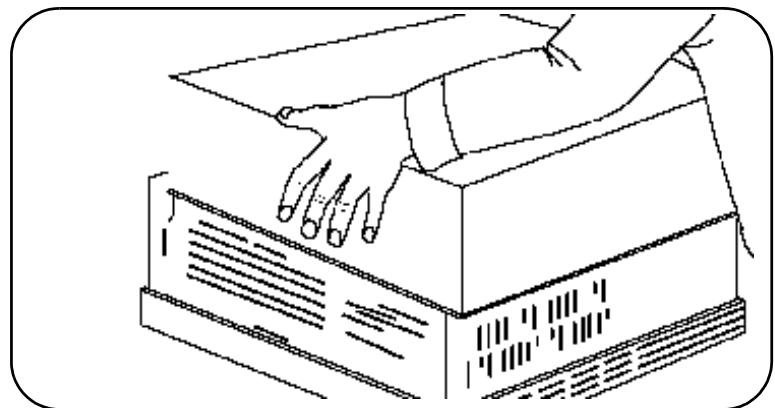


Figure 25 Removing the PC Cover

3 Remove the cover plate. Remove one of the PC back panel cover plates. The 82350B is a 5V PCI card and will not fit in a 3.3V PCI slot or in an EISA or ISA slot. Choose a 5V PCI slot that will give adequate clearance for the GPIB connector. If you install more than one 82350, you may want to install the cards so there is at least one empty slot between every two 82350s.

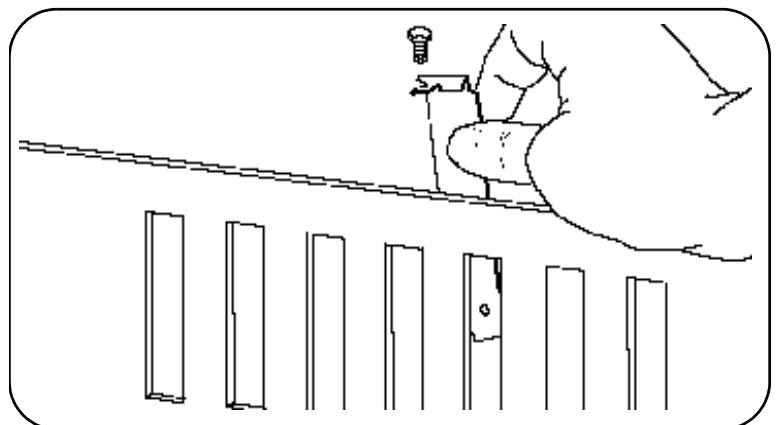


Figure 26 Removing a Cover Plate

- 4 Install the 82350.** Insert the edge connector: Insert the 82350 Interface Card edge connector into the PCI expansion slot connector of the PC. Make sure the interface is fully seated by pushing firmly on the top edge of the card with the palm of your hand. The GPIB connector should extend through the back panel opening to allow GPIB cable connection.

When inserting the 82350, be sure to hold the card by its edges. Also, be careful with the metal faceplate around the GPIB connector as the faceplate can be bent.

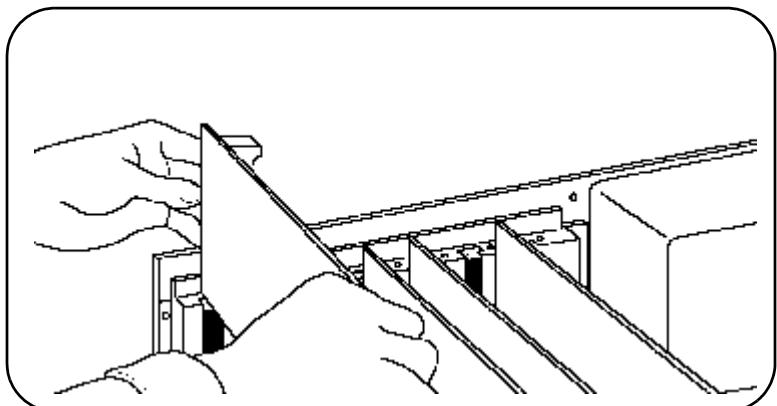


Figure 27 Installing the GPIB Card

- 5** Replace the Cover Plate Screw. This will hold the 82350 in place. Save the blank cover plate for use if the 82350 is later removed. Replace the PC cover(s) as described in your PC documentation.

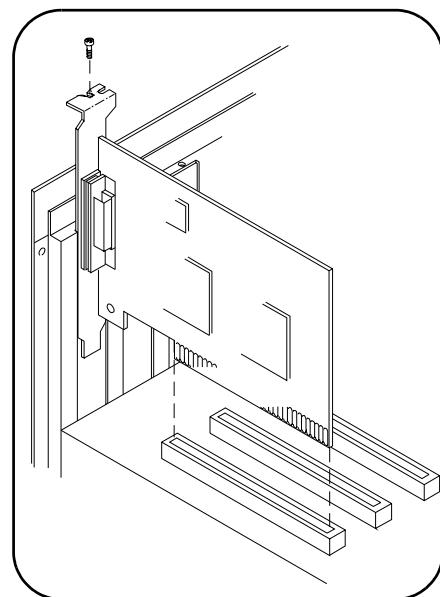
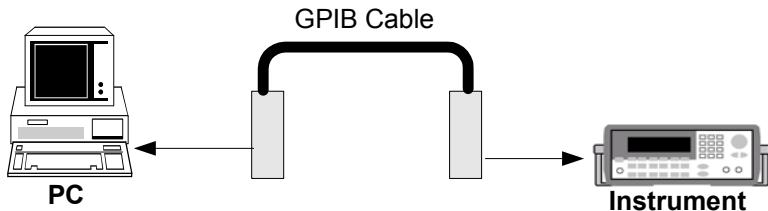


Figure 28 Replacing the Cover Plate Screw

Step 3: Connect Instruments to GPIB Card

3 Connect Instruments to GPIB Card

Connect your instruments to the installed GPIB interface card(s) using GPIB cables.



What's in This Step? This step gives guidelines to connect GPIB instruments to a GPIB Interface Card (such as an Agilent 82350) installed in your PC by using GPIB cables. When you have made the connections for your system, go to [Step 4: Configure GPIB Interface Cards \(Optional\)](#).

Steps to Connect Instruments to GPIB Cards

- 1 **Review Connection Guidelines.** The recommended method for connecting a GPIB system is linear with the system controller (PC) at one end of the system. However, a GPIB system can also be connected together in a star, linear, or a combination configuration as long as the total number

of devices on the system is ≤ 15 and these guidelines are followed:

- To minimize stress on connector mountings, no more than three cable connector blocks should be stacked on top of one another. The GPIB connector screws should be finger-tightened only.
- Minimize cable length as much as possible. All system devices must have tri-state drivers and must be powered on. Turning devices on or off while a system is running may cause faulty operation.
- For operation with data transfer rates < 500 Kbytes/sec., the total allowed length of all GPIB cables is ≤ 2 meters times the number of devices connected together, up to a maximum of 20 meters.
- For operation with data transfer rates > 500 Kbytes/sec., the total allowed length of all GPIB cables is ≤ 1 meter times the number of devices connected together, up to a maximum of 15 meters.
- The cable length between adjacent devices is not critical as long as the system meets the overall restriction. GPIB bus extenders are available that allow operation over much greater distances.

NOTE

For assistance selecting and buying cables, go to
<http://www.agilent.com/find/gpib> and click **GPIB Cables and GPIB Adapters**.

-
- 2 Connect GPIB Cables to the GPIB Interface Card.** Connect a separate GPIB cable to each installed GPIB Interface Card. Tighten the GPIB connector screws finger-tight only. (The screwdriver slots are for removal purposes only.) Two example connections follow to connect a single GPIB instrument or to connect multiple GPIB instruments.

Example: Connecting a Single GPIB Instrument

This figure shows connections from a single GPIB instrument to the GPIB connector of an Agilent 82350 GPIB Interface Card installed in your PC.

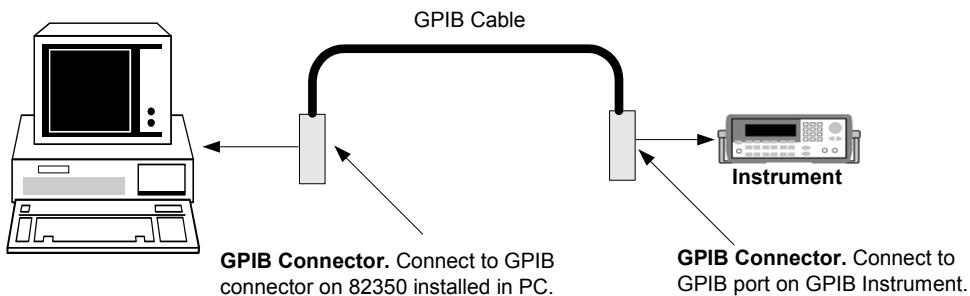


Figure 29 Connecting a Single GPIB Instrument

You may want to record the primary GPIB address of the attached instrument for future programming use. Or you can use Connection Expert to create programming aliases that are meaningful to you. After making the connections, reconnect the PC power cord and apply power to the PC and to attached peripherals/instruments.

CAUTION

To avoid damage to the connectors, only finger-tighten the connectors.

Example: Connecting Multiple GPIB Instruments

This figure shows one way to connect three GPIB instruments to an Agilent 82350 GPIB interface card. You may want to record the primary GPIB address of each attached instrument for future programming use; or you can

use Connection Expert to create programming aliases that are meaningful to you. After making the connections, reconnect the PC power cord and apply power to the PC and attached peripherals/instruments.

CAUTION

To avoid damage to the connectors, only finger-tighten the connectors.

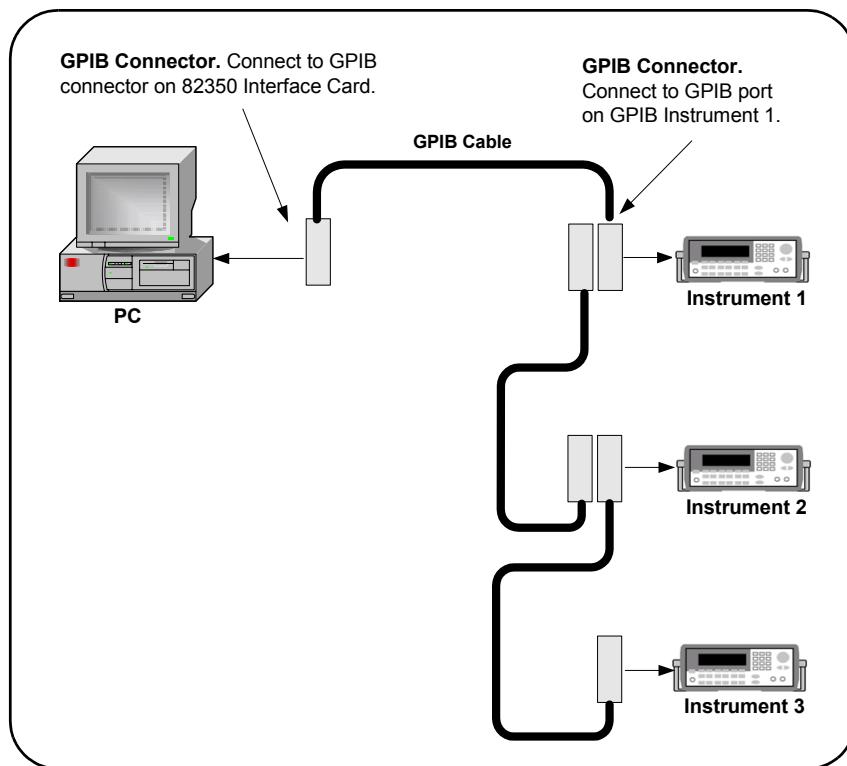


Figure 30 Connecting Three GPIB Instruments

Step 4: Configure GPIB Interface Cards

4 Configure GPIB Interface Cards (Optional)

Use **Agilent Connection Expert** to configure installed GPIB interface card parameters.

You can use the **GPIB Interface Properties** dialog box to configure GPIB interface cards installed in your PC.

The dialog box shows configuration settings for a GPIB interface. It includes fields for VISA interface ID (GPIB0), GPIB address (21), System controller (recommended), STCL interface ID (gpb0), Logical unit (7), and Auto-discover instruments connected to this interface. Buttons for OK, Cancel, and Help are at the bottom.

What's in This Step? This step shows suggested actions to use Connection Expert to configure a Windows operating system for a PC that has an Agilent 82350 GPIB Interface Card (or equivalent) installed. The default configuration is done automatically. Click **Refresh All** to update it at any time. This section shows how to verify or change configuration parameters.

Steps to Configure GPIB Interface Cards

- 1 **Apply Power.** Apply power to the PC and to the installed GPIB instruments. As Windows starts again, a **Found New Hardware Wizard** may start. This figure shows a typical

Windows 2000 display. The display may be different for other operating systems.



Figure 31 Found New Hardware Wizard Example

2 Install Configuration Files. Use this table for the actions to take for the operating systems listed.

OS	Action
98/Me	<ul style="list-style-type: none">When the Wizard asks for the <i>Agilent IO Libraries</i> CD, click OK. Note: Make sure that you have installed Agilent IO Libraries Suite first. You will not need a CD.When the Wizard asks for the <i>hpioclas.dll</i> file, browse to C:\windows\system\ and click OK.
2000/XP	<ul style="list-style-type: none">Click <u>Next></u> to accept the default suggestions. Note: Make sure that you have installed Agilent IO Libraries Suite first. You will not need a CD.Click Finish to complete the installation.

3 Open Connection Expert. Click the Agilent IO Control icon,



and then click **Agilent Connection Expert**. When the main screen appears, you will see a map of the system connections in the **Instrument I/O on this PC** pane (also called “explorer pane”). *If you see your interface and instruments in the explorer pane, you are ready to go!*

NOTE

For a description of Connection Expert and the Agilent IO Libraries Suite, see the *Agilent IO Libraries Suite Getting Started Guide*. This guide is on the *Automation-Ready CD with Agilent IO Libraries Suite* and is available from the IO Control **Documentation** menu.

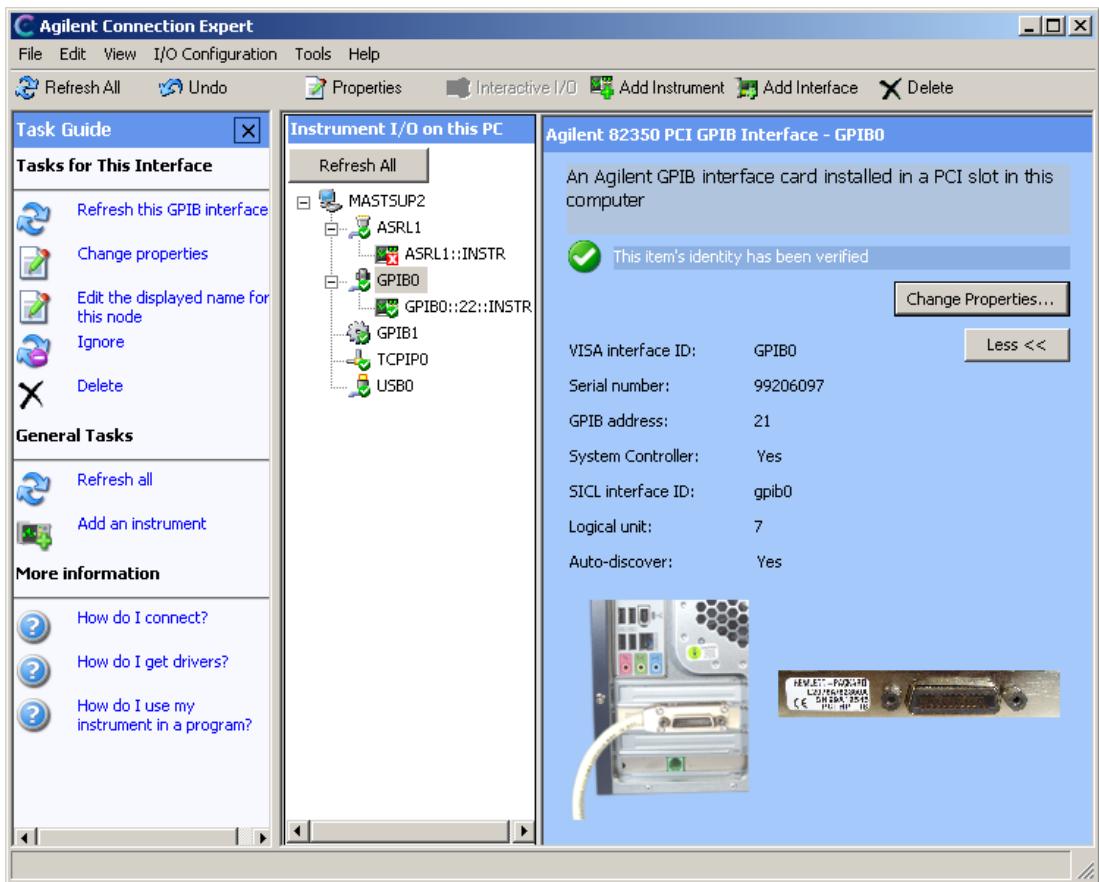


Figure 32 Agilent Connection Expert

When you select a particular instrument in the explorer pane, you see the parameters of the instrument in the properties pane on the right – such as the product number, serial number, VISA address, GPIB address, and firmware revisions. The green check mark icon at the top signifies that a listener check and IDN query were performed automatically.

- 4 Configure GPIB Card Parameters.** With the **82350 PCI GPIB Card** selected in the instrument explorer pane, click **Change Properties**.

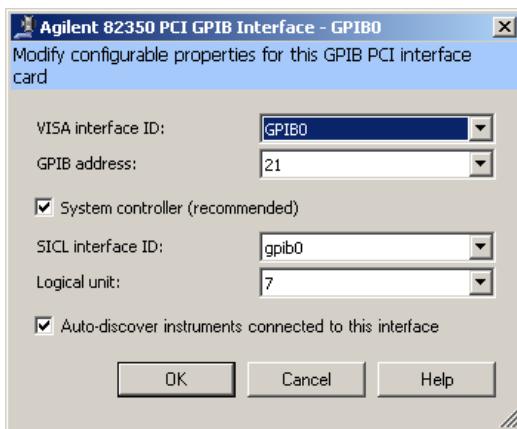


Figure 33 The 82350 Configuration Dialog Box

Set the **VISA interface ID**, **SICL interface ID**, **Logical Unit** and **GPIB address** values as required. Also, verify that this is the **System Controller** for the GPIB to which it is attached (this is the typical operating mode). (See the **System Controller** discussion.) Then, click the **OK** button. Some guidelines to set these values follow.

82350 GPIB Interface Card Configuration Parameters	
VISA Interface ID	Symbolic name that VISA uses to uniquely identify this GPIB interface. The default VISA Interface ID is GPIB0. The 82350 Interface Name for VISA must begin with the string GPIB and have an integer appended to it, such as GPIB0, GPIB1, GPIB2, etc. Remember this value to properly address GPIB devices in your VISA applications.
GPIB Address	Address of this GPIB interface controller on the GPIB bus. It is usually 21 if the GPIB interface is a System Controller or 20 if the GPIB interface is a non-System Controller (see System Controller, following). These addresses are chosen by convention but any address in the range 0 - 30, inclusive, may be used.

System Controller	Determines if this interface controls which bus devices talk and which bus devices listen. If several devices exist on a bus, be sure each has a unique GPIB bus address and only one device is the system controller (it is usually the device installed in the computer). Each GPIB interface has its own independent bus. Thus, each interface may be a System Controller as long as it is not chained together with other GPIB interfaces. However, two or more System Controllers on the same bus will cause the bus to be inoperative.
SICL Interface ID	Symbolic name that SICL uses to uniquely identify this GPIB interface. The default Interface ID is gpib0. The SICL Interface ID must be a unique string of alphanumeric characters, starting with a letter. Remember this value and the Logical Unit number to properly address GPIB devices in your SICL applications.
Logical Unit	Number that SICL uses to uniquely identify this 82350 interface. The Logical Unit number is an integer in the range of 0 - 10000. Remember this value and the SICL Interface ID to properly address the GPIB interface in your SICL applications, including Agilent VEE programs.

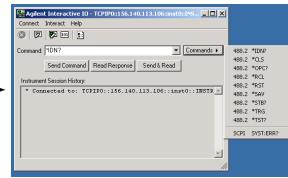
5 Change/Accept the Configuration Values. If the configuration values displayed are acceptable to you, click the **OK** button.

Repeat Steps for Other Cards. If you have installed more than one GPIB interface card in your PC, repeat these steps for the remaining cards. Then go to [Step 5: Communicate with Instruments \(Optional\)](#).

Step 5: Communicate with Instruments

5 Communicate With Instruments (Optional)

You can use Interactive IO to verify communication with instruments.



What's in This Step? If your instruments show up in the explorer pane as verified, communication has been established. This section shows how to further verify instruments and connections using Interactive IO. When you have verified communication with your instruments (as desired), go to [Step 6: Program Your Instruments \(Optional\)](#).

Communicating Using Interactive IO

Interactive IO is a utility within Agilent IO Libraries Suite that communicates with instruments. It can be used to send and receive strings to instruments, which support formatted I/O.

NOTE

Timeout Errors: If you are getting timeout errors when sending commands and waiting for results, you can lengthen the timeout in the **Interact > Options** menu, which is set at 5000 ms by default.

NOTE

When to Use VISA Assistant: VISA Assistant is still installed as part of the Agilent IO Libraries Suite, but, for most users, it has been replaced by the Interactive IO utility. Interactive IO provides a simpler, more intuitive way to send commands to instruments and read the results.

Some capabilities of VISA Assistant are not yet available in the Interactive IO utility. These include:

- Memory I/O for VXI and GPIB-VXI interfaces
- Reading and writing of VISA attributes
- Configuration of *VXIplug&play* drivers

If you need these capabilities, you can start the VISA Assistant utility by clicking the **Agilent IO Control > VISA Assistant**, or by clicking **Tools > VISA Assistant** on the Connection Expert menu bar.

Example using Interactive IO to control an Agilent 34401A

- 1 Select an instrument in the Connection Expert explorer pane.
- 2 Click the **Interactive IO** icon below the menu bar.
- 3 Open the **Commands** menu and select a command. The example below shows a ***IDN?** command has been chosen. (See the table below for commands and meanings. You can also type an instrument-specific command.)
- 4 Click **Send & Read** to send the selected command and have the instrument return a result. Your selections are displayed in the **Instrument Session History** area, as

shown in this example below. (You can also click the **Send Command** and **Read Response** buttons separately for additional control over these actions.)

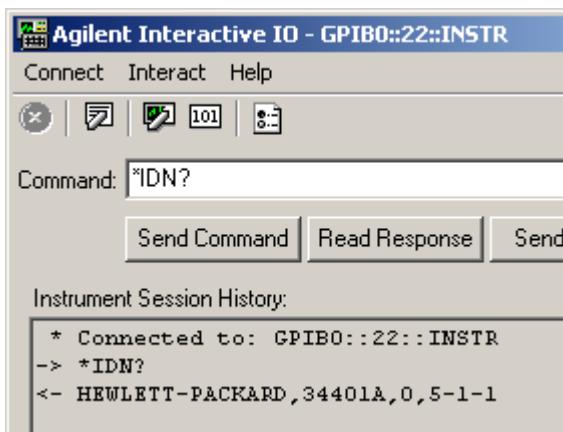


Figure 34 Interactive IO Utility with Instrument Session History

488.2 Commands	Meaning
*IDN?	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
*CLS	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
*OPC?	The Operation Complete query places an ASCII character “1” into the device’s Output Queue when all pending selected device operations have been finished.
*RCL	The Recall command restores the current settings of a device from a copy stored in local memory.
*RST	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.
*SAV	The Save command stores the current settings of the device in local memory.

*STB?	The Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
*TRG	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
*TST?	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	The queue query message is a request for the next entry from the instrument's error/event queue. Items in this queue contain an integer in the range [-32768, 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

Step 6: Program Your Instruments

6 Program Your Instruments (Optional)

As desired, you can program instruments via the GPIB interface using Agilent VEE, Agilent T&M Toolkit 2.0, Visual Basic 6, Visual Basic.NET, or many other programming environments.

VISA: viopen (..."GPIB0::5::INSTR"...)

What's in This Step? *This is an optional step.* After you have set up your GPIB system, as desired you can program GPIB instruments from your PC via the GPIB interface. See [Programming Your Instruments](#) for guidelines and examples.

5

Programming Your Instruments

This chapter includes:

- Programming Overview
- Addressing Instruments
- Sample Programs



Agilent Technologies

Programming Overview

This section provides an overview of programming instruments via LAN, USB, and GPIB interfaces. Four example programs are included to demonstrate generating a simple sine wave on an Agilent 33220A 20 MHz Function/Arbitrary Waveform Generator using Standard Commands for Programmable Instruments (SCPI).

The example programs are written in Microsoft Visual Basic 6.0 or Microsoft Visual C++ for Agilent VISA COM, IVI-COM, VISA, and VXI*plug&play* I/O. They are primarily intended to display SCPI commands for the 33220A and not to demonstrate the programming environment or the I/O.

NOTE

The programs in this guide are protected by copyright.

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You have a royalty-free right to use, modify, reproduce and distribute the programs listed in this guide (and/or any modified version) in any way you find useful, provided that you agree that Agilent has no warranty, obligations, or liability for any program content.

Agilent Technologies provides programming examples for illustration only. All example programs assume you are familiar with the programming language being demonstrated and the tools used to create and debug procedures. Agilent support engineers can help explain the functionality of Agilent software components and associated commands, but they will not modify these samples to provide added functionality or construct procedures to meet your specific needs.

Obtaining Instrument Drivers

Selected combinations of program environments and I/O are included in the sample programs in this guide. You will need to acquire the programming environment and the I/O independent of the *Agilent IntuiLink for the 33220A Waveform Generator CD*, which is used for a sample program.

In many cases, you receive two CDs with your purchase of an Agilent hardware or software product: one is the *Automation-Ready CD with Agilent IO Libraries Suite* and the other is the product-specific CD. The instrument/software product CD will contain any drivers or libraries that increase the ease of use or support the measurement applications.

- VISA COM, IVI-COM, VISA, and VXIplug&play instrument drivers for the Agilent 33220A and other instruments may be obtained at <http://www.agilent.com/find/drivers>. To download a driver, you will be asked to register on the Agilent Developer Network (ADN) free of charge.

The various types of drivers on ADN include:

- IVI-COM Drivers and Components
- VXIplug&play Drivers
- IntuiLink Connectivity Software (Agilent IntuiLink Toolbars - access to instruments in Excel, Word, and VB.)
- VEE Panel Drivers
- D-SCPI Drivers
- SCPI Drivers

(Or, you can search the drivers by instrument model number, current and older versions.)

- USB ports ONLY work properly on Windows XP when the latest Microsoft USB drivers from Windows XP Service Pack 1 or 2 have been properly installed. In addition, if using USB on Windows 2000, Agilent recommends you install the latest Service Pack for Windows 2000.

NOTE

Upgrading your Windows XP PC to Service Pack 1 will probably not update the USB drivers automatically. See www.agilent.com/find/connectivity to verify if correct USB drivers are installed and to install correct drivers as required.

Installing Agilent IO Libraries Suite

The *Automation-Ready CD with Agilent IO Libraries Suite* provides easy instructions for connecting, configuring, and verifying your instruments with IO Libraries Suite. Go to **Installing I/O Software** for a more detailed discussion.

When you're ready to start programming, IO Libraries Suite has provided a number of sample programs for a variety of instruments. To access these programs from the Start menu, click **Start > Programs > Agilent IO Libraries Suite > Program Samples**. Sample programs are provided in Microsoft C, C#, Excel, Visual Basic 6.0, and Visual Basic .NET.

To use a sample program:

- 1 Select a program for your instrument or a similar instrument. Open the program in your programming environment.
- 2 Replace the instrument addressing in the program with your instrument's VISA address or VISA alias.
- 3 If necessary, replace the command strings in the program with commands for your instrument.

- 4 Run the program and debug, if necessary.

NOTE

To obtain the Agilent IO Libraries Suite, go to www.agilent.com/find/iolib. If you own any Agilent instrumentation or software products, you can download the IO Libraries Suite free of charge.

Using VISA COM in Other Visual Basic Projects

All Visual Basic programs in this guide use Agilent VISA COM. To use VISA COM in another Visual Basic project, perform these steps:

- 1 **Set the Reference.** Set the reference to include the libraries in the Project/References menu:
 - "VISA COM 3.0 Type Library" corresponds to GlobMgr.dll
 - "Agilent VISA COM Resource Manager 1.0" corresponds to AgtRM.DLL
 - "VISA COM 488.2 Formatted I/O 1.0" corresponds to the BasicFormattedIO.dll
- 2 **Create Formatted I/O Reference.** Create the formatted I/O reference with a statement such as "Dim Fgen As VisaComLib.FormattedIO488".
- 3 **Create the New Object.** Use "Set Fgen = New VisaComLib.FormattedIO488" to create the actual object.

Addressing Instruments

This section gives guidelines to address instruments via a LAN, USB, or GPIB interface, including:

- Addressing Instruments via LAN
- Addressing Instruments via USB
- Addressing Instruments via GPIB

To simplify the addressing in your programs, you can also use VISA aliases. A VISA alias is a name of your choosing, which you assign to a device and use in your programs. Once assigned, the alias is a synonym for the device's VISA address, so you can use it to open a VISA session (using the viOpen function) and to get resource information (using viParseRsrc or viParseRsrcEx).

Agilent Connection Expert allows you to define VISA aliases for the devices in your test system. VISA aliases can be used in VISA programs and in VISA COM programs.

Why use VISA aliases? Using VISA aliases in your programs, rather than VISA addresses, provides two significant advantages:

- **Portability.** If you program using aliases, you can run your program on a new test system, whose instruments are at different addresses, simply by using the Connection Expert to create the same aliases on the new system as you created on your development system. Similarly, you can move or replace instruments without changing or recompiling test code, simply by changing the alias definitions in Connection Expert.

- **Readability.** Your programs will be much easier to read and understand if, for example, your multimeter is called "myDMM" instead of "GPIB2::14::8::INSTR". This is particularly important in the case of USB instruments, whose VISA addresses are typically long and cumbersome, containing the instrument's serial number among other information.

Default aliases for USB devices. Connection Expert gives an alias to each instrument you connect via USB, because VISA addresses for USB devices are long and cumbersome. Connection Expert assigns aliases UsbDevice1, UsbDevice2, etc.; you can change these names by selecting the alias node in the explorer view and clicking the Change... button.

Using aliases with SICL. When you create a VISA alias, Connection Expert automatically creates a SICL alias of the same name. You can use a SICL alias in place of a SICL address in the iopen function call, with the same advantages described above.

Addressing Instruments via LAN

To address instruments via the LAN, you must first check the default configuration of the TCP/IP LAN interface using Agilent Connection Expert. A summary of the applicable LAN networking protocols follows. See [LAN Interface Overview](#) for a description of LAN hardware, software, and network protocols.

LAN Networking Protocols

There are two LAN networking protocols provided with the Agilent IO Libraries Suite software. You can use one or both of these protocols when configuring your systems to use VISA and SICL over LAN.

- **SICL-LAN Protocol** is a networking protocol developed by Agilent that is compatible with all VISA LAN products. This LAN networking protocol is the default choice in the Agilent IO Libraries Suite configuration when configuring the LAN interface. The SICL-LAN protocol on Windows supports VISA operations over LAN to GPIB interfaces.
- **VXI-11 (TCP/IP Instrument Protocol)** is a networking protocol developed by the VXIbus Consortium based on the SICL-LAN Protocol that permits interoperability of LAN software from different vendors who meet the VXIbus Consortium standards.

When using either of these networking protocols, the LAN software uses the TCP/IP protocol suite to pass messages between the LAN device and the server. The server accepts device I/O requests over the network from the device and then proceeds to execute them.

By default, the LAN supports both protocols by automatically detecting the protocol the server is using. When a VISA **viOpen** or SICL **iopen** call is performed, the LAN interface driver first tries to connect using the SICL-LAN protocol. If that fails, the driver will try to connect using the VXI-11 protocol.

If you want to control the protocol used, you can configure more than one LAN interface using Connection Expert and set each interface to a different protocol. The protocol used will then depend on the interface you are connecting through.

In VISA, the protocol used is determined by the configuration settings and cannot be changed programatically. In SICL, the programmer can override the configuration settings by specifying the protocol in the **iopen** string.

Example: Using Network Protocols

Some examples using VXI-11 and SICL-LAN protocol follow. Note that SICL names are case-sensitive.

- `iopen("lan[machineName]:gpib0,1")` will use the configured default protocol. If AUTO is configured, SICL-LAN protocol will be attempted. If that is not supported, VXI-11 protocol will be used.
- `iopen("lan;auto[machineName]:gpib0,1")` will automatically select the protocol (SICL-LAN if available and VXI-11 otherwise.)
- `iopen("lan;sicl-lan[machineName]:gpib0,1")` will use SICL-LAN protocol.
- `iopen("lan;vxi-11[machineName]:gpib0,1")` will use VXI-11 protocol.
- The Agilent IO Libraries Suite also supports TCP/IP socket reads and writes. To open a socket session, use `iopen("lan,socketNbr[machineName]")`. For example, `iopen("lan,7777[machineName]")` will open a socket connection for socket number 7777 on '`machineName`'.

Configuring TCP/IP LAN Interfaces

When you have configured VISA LAN interfaces, you can then use the interface name specified during configuration in a VISA `viOpen` call of your program. A summary of the steps to configure a TCP/IP LAN interface follows.

NOTE

A single **TCP/IP LAN** interface can be used by any number of **VISA LAN** devices. The main reason for having more than one LAN interface configured is that you want to use different protocols (such as SICL-LAN or VXI-11) in different **VISA LAN** devices.

- 1 To check the configuration of the TCP/IP LAN interfaces using **Connection Expert**, click the **Agilent IO Control** icon (blue **IO** icon on the Windows taskbar) and click **Agilent Connection Expert**. When the main screen appears, highlight the LAN interface in the **Instrument IO on this PC** pane -- **LAN (TCPIPO)** in this example -- and check the configuration in the **LAN Interface** properties pane on

the right. To alter any default properties, click **Change Properties..**

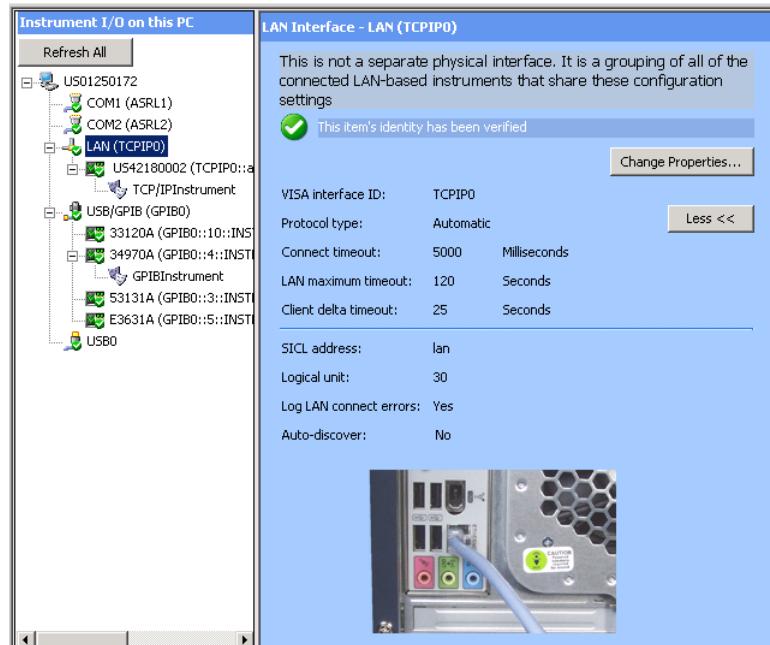


Figure 35 LAN Interface Properties Pane (on right)

- 2 When the **LAN interface** configuration screen appears, you can change the **VISA interface ID**, **Logical unit number**, **LAN maximum timeout**, **Connect timeout value**, **Client delta timeout**, and **SICL interface ID** as required. Also, you can select the **Default Protocol** (Auto, VXI-11, or SICL-LAN) and choose whether to **Log LAN connection errors**. Then click **OK**.

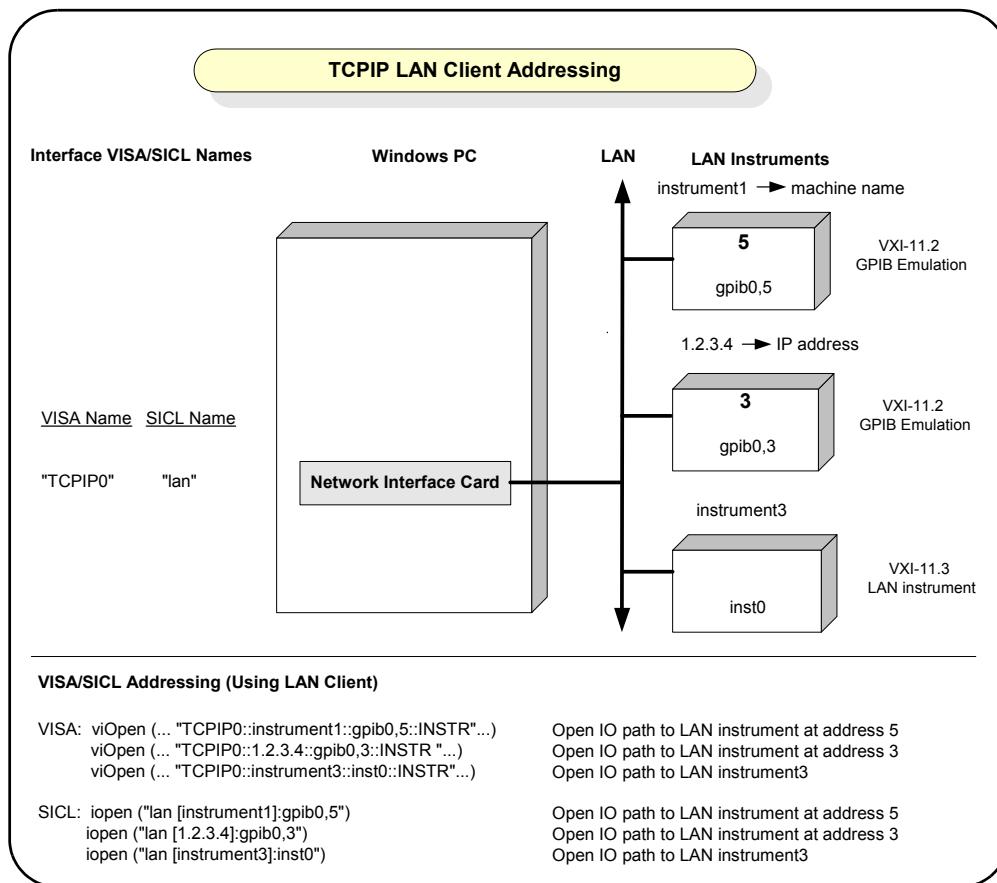
Example: Addressing LAN Instruments Using VISA/SICL

The TCP/IP LAN interface system in this figure consists of a Windows PC with a LAN (NIC) card and three LAN instruments. Instrument1 and instrument2 are VXI-11.2 (GPIB Emulation) instruments and instrument3 is a VXI-11.3 LAN instrument.

For this system, Connection Expert has been used to assign the LAN card a VISA name of "TCPIP0" and SICL name of "lan". For the addressing examples, instrument1 has been addressed by its machine name, instrument 2 has been addressed by its IP address, and instrument3 by its LAN name (inst0).

5 Programming Your Instruments

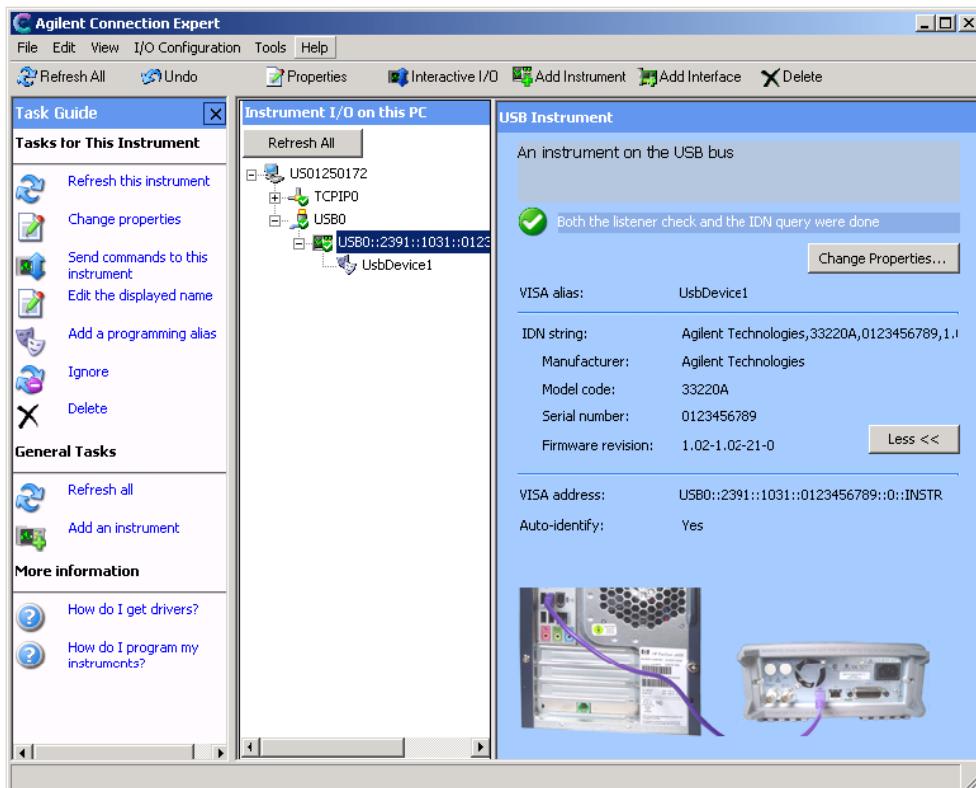
Since unique names have been assigned by Connection Expert, you can now use the VISA **viOpen** command or the SICL **iopen** command to open the I/O paths to the GPIB instruments as shown in the figure.



Addressing Instruments via USB

As desired, you can use a VISA alias to address instruments via USB. The VISA alias associates an alias with a specific instrument. You can use it as a VISA *rsrcName* or SICL *address* instead of using the instrument's Vendor ID, Product ID, Serial Number, and Interface Number. See the following steps to set, add, delete or change a VISA alias.

- 1 Display the Connection Expert Main Screen.** Click the blue **IO** icon (on the Windows taskbar) and select **Agilent Connection Expert** to display the Connection Expert main screen.



Connection Expert automatically configures a USB interface, discovers any USB devices, and assigns default VISA alias names, as shown in the figure above.

- 2 **Display the Changing VISA Alias Properties dialog box.**
Highlight the USB alias name in the **Instrument IO on this PC** pane. Then click **Change Properties** in the USB Instrument pane on the right to display the **Changing VISA Alias Properties** dialog box. Change the default VISA alias name.



Figure 36 Changing VISA Alias Properties Dialog Box

The address is based on the instrument Vendor ID, Product ID, Serial Number, and Interface Number.

- 3 Click **OK**.

Addressing Instruments via GPIB

To address instruments via an 82350 GPIB interface or 82357 USB/GPIB interface converter, you must first check the default configuration of the interface using Connection Expert. (Modify the steps as required if you use an 82341 ISA or 82357 card.)

Steps to Configure a GPIB Interface

- 1 **Configure GPIB Card Parameters.** With the **82350 PCI GPIB Card** selected in the instrument explorer pane, click **Change Properties** in the GPIB Interface properties pane on the right.

The 82350 configuration dialog box appears, as shown below.

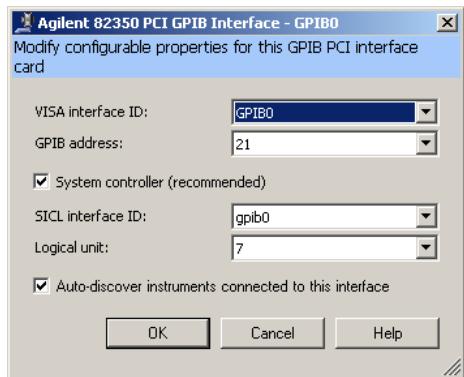


Figure 37 The 82350 Configuration Dialog Box

Set the **VISA interface ID**, **SICL interface ID**, **Logical Unit** and **GPIB address** values as required. Also, verify that this is the **System Controller** for the GPIB to which it is attached (this is the typical operating mode). (See the **System Controller** discussion.) Then, click the **OK** button. Some guidelines to set these values follow.

82350 GPIB Interface Card Configuration Parameters	
VISA Interface ID	Symbolic name that VISA uses to uniquely identify this GPIB interface. The default VISA Interface ID is GPIB0. The 82350 Interface Name for VISA must begin with the string GPIB and have an integer appended to it, such as GPIB0, GPIB1, GPIB2, etc. Remember this value to properly address GPIB devices in your VISA applications.
GPIB Address	Address of this GPIB interface controller on the GPIB bus. It is usually 21 if the GPIB interface is a System Controller or 20 if the GPIB interface is a non-System Controller (see System Controller, following). These addresses are chosen by convention but any address in the range 0 - 30, inclusive, may be used.

5 Programming Your Instruments

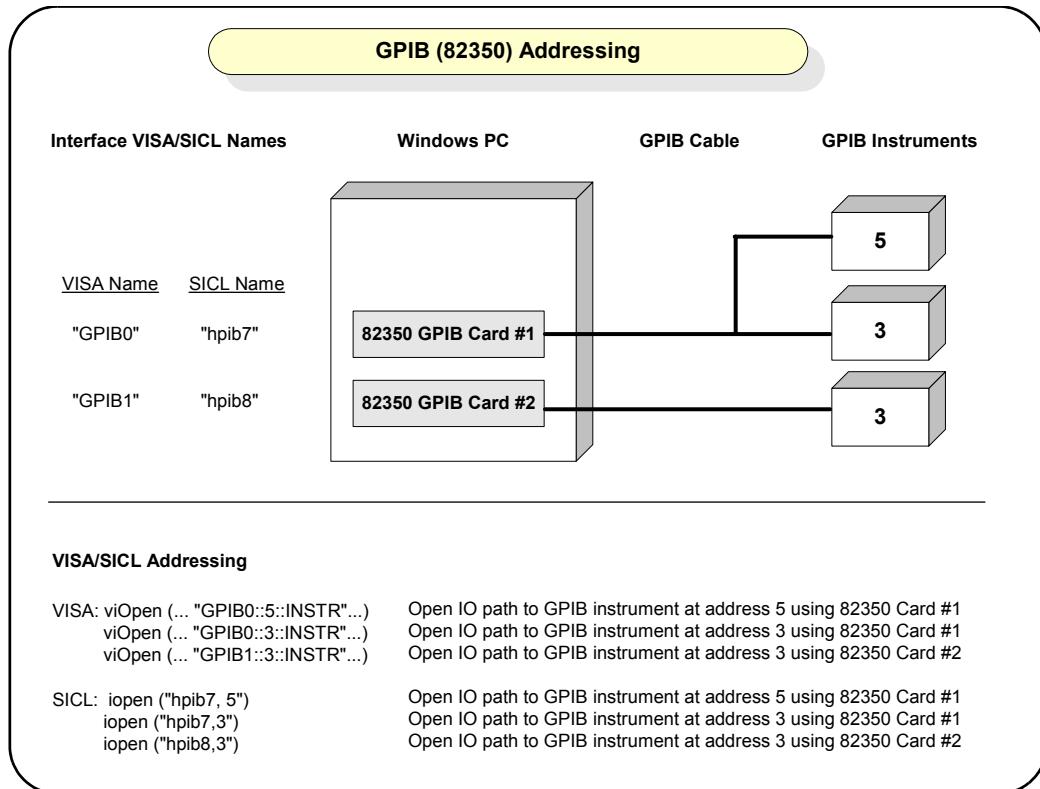
System Controller	Determines if this interface controls which bus devices talk and which bus devices listen. If several devices exist on a bus, be sure each has a unique GPIB bus address and only one device is the System Controller (it is usually the device installed in the computer). Each GPIB interface has its own independent bus. Thus, each interface may be a System Controller as long as it is not chained together with other GPIB interfaces. However, two or more System Controllers on the same bus will cause the bus to be inoperative.
SICL Interface ID	Symbolic name that SICL uses to uniquely identify this GPIB interface. The default Interface ID is gpib0. The SICL Interface ID must be a unique string of alphanumeric characters, starting with a letter. Remember this value and the Logical Unit number to properly address GPIB devices in your SICL applications.
Logical Unit	Number that SICL uses to uniquely identify this 82350 interface. The Logical Unit number is an integer in the range of 0 - 10000. Remember this value and the SICL Interface ID to properly address the GPIB interface in your SICL applications.

2 Change/Accept the Configuration Values. If the configuration values displayed are acceptable to you, click the **OK** button.

Repeat Steps for Other Cards. If you have installed more than one GPIB interface card in your PC, repeat these steps for the remaining cards.

Example: Addressing GPIB Instruments Using VISA/SICL

This figure shows example VISA and SICL addressing for GPIB instruments connected to a PC via a GPIB interface.



The GPIB interface system consists of a Windows PC with two 82350 GPIB cards connected to three GPIB instruments via GPIB cables. For this system, Connection Expert has been used to assign GPIB card #1 a VISA name of “GPIB0” and a SICL name of “gpib0”.

Connection Expert has also been used to assign GPIB card #2 a VISA name of “GPIB1” and a SICL name of “gpib1”. With these names assigned to the interfaces, the VISA/SICL addressing is as shown in the figure.

Since unique names have been assigned by Connection Expert, you can use the VISA **viOpen** command to open the I/O paths to the GPIB instruments as shown in this figure. Or, you can use the SICL **iopen** command to open the I/O paths shown.

Sample Programs

Sample programs follow to demonstrate sine waveform generation for an Agilent 33220A 20 Mhz Function/Arbitrary Waveform Generator. The sample programs are essentially repeated to show the same functionality with different programming environments and I/O. IO Libraries Suite has provided a number of sample programs for a variety of instruments. To access other sample programs from the Start menu, click **Start > Programs > Agilent IO Libraries Suite > Programming Samples**

The example programs in this section are:

- [Example: Simple Sine Waveform \(Visual Basic and VISA COM\)](#)
- [Example: Simple Sine Waveform \(C# and VISA COM\)](#)
- [Example: Simple Sine Waveform \(Visual C++ and VISA\)](#)

Example: Simple Sine Waveform (Visual Basic and VISA COM)

This program selects the function as “sine,” and then sets the frequency, amplitude and offset of the waveform for an Agilent 33220A. The program is written in Visual Basic 6.0 and uses VISA COM.

```
Private Sub cmdSimpleSine_Click()  
  
Dim io_mgr As VisaComLib.ResourceManager  
Dim Fgen As VisaComLib.FormattedIO488  
  
Set io_mgr = New AgilentRMLib.SRMCLs  
Set Fgen = New VisaComLib.FormattedIO488  
Set Fgen.IO = io_mgr.Open(txtIO.Text)  
  
On Error GoTo MyError
```

5 Programming Your Instruments

```
' This program sets up a waveform by selecting the waveshape  
' and adjusting the frequency, amplitude, and offset.
```

```
With Fgen
```

```
    .WriteString "*RST"          ' Reset the function generator  
    .IO.Clear                    ' Clear errors and status registers  
  
    .WriteString "FUNCTION SINusoid" ' Select waveshape  
        ' Other options are SQuare, RAMP, PULSe, NOISe, DC, and USER  
    .WriteString "OUTPUT:LOAD 50"    ' Set the load impedance in Ohms  
        ' (50 Ohms default)  
  
        ' May also be INFinity, as when using oscilloscope or DMM  
  
    .WriteString "FREQuency 2500"    ' Set the frequency.  
    .WriteString "VOLTage 1.2"       ' Set the amplitude in Vpp.  
        ' Also see VOLTage:UNIT  
    .WriteString "VOLTage:OFFSet 0.4" ' Set the offset in Volts  
  
        ' Voltage may also be set as VOLTage:HIGH and VOLTage:LOW for  
        ' low level and high level  
  
    .WriteString "OUTPUT ON"        ' Turn on the instrument output
```

```
End With
```

```
Exit Sub
```

```
MyError:  
    txtError = Err.Description & vbCrLf  
    Resume Next  
End Sub
```

Example: Simple Sine Waveform (C# and VISA COM)

This program selects the function as “sine,” and then sets the frequency, amplitude and offset of the waveform for an Agilent 33220A. The program is written in C# and VISA COM.

NOTE

"VISA COM 3.0 Type Library" corresponds to GlobMgr.dll.

Once you have selected C# in Visual Studio, click **Project > Add Reference...**. Select the **COM** tab. Scroll down the list of components presented, and select **VISA COM 3.0 Type Library**.

```
using System;
using System.Drawing;
using System.Collections;
using System.ComponentModel;
using System.Windows.Forms;
using System.Data;

namespace WindowsApplication1
{
    /// <summary>
    /// Summary description for Form1.
    /// </summary>
    public class Form1 : System.Windows.Forms.Form
    {
        private System.Windows.Forms.Button button1;
        private System.Windows.Forms.TextBox USBInstrument;
        /// <summary>
        /// Required designer variable. "USBInstrument" is a VISA alias
        /// for the 33220A Function/Arbitrary Waveform Generator.
        /// </summary>
        private System.ComponentModel.Container components = null;
        public Form1()
        {
            //
            // Required for Windows Form Designer support
            //
            InitializeComponent();
        }
}
```

```
//  
// TODO: Add any constructor code  
// after InitializeComponent call  
//  
}  
  
/// <summary>  
/// Clean up any resources being used.  
/// </summary>  
protected override void Dispose( bool disposing )  
{  
    if( disposing )  
    {  
        if (components != null)  
        {  
            components.Dispose();  
        }  
    }  
    base.Dispose( disposing );  
}  
  
#region Windows Form Designer generated code  
/// <summary>  
/// Required method for Designer support -  
/// do not modify  
/// the contents of this method with the  
/// code editor.  
/// </summary>  
private void InitializeComponent()  
{  
    this.button1 = new System.WinForms.Button();  
    this.USBinstrument = new System.WinForms.TextBox();  
    this.SuspendLayout();  
    //  
    // button1  
    //  
    this.button1.Location = new System.Drawing.Point(56, 96);  
    this.button1.Name = "button1";
```

```
this.button1.TabIndex = 0;
this.button1.Text = "button1";
this.button1.Click += new
System.EventHandler(this.button1_Click);
//
// textBox1
//
this.USBInstrument.Location = new System.Drawing.Point(88, 136);
this.USBInstrument.Name = "USBInstrument";
this.USBInstrument.TabIndex = 1;
this.USBInstrument.Text = "USBInstrument";
this.USBInstrument.TextChanged += new
System.EventHandler(this.USBInstrument_TextChanged);
//
// Form1
//
this.AutoScaleBaseSize = new System.Drawing.Size(5, 13);
this.ClientSize = new System.Drawing.Size(292, 273);
this.Controls.Add(this.USBInstrument);
this.Controls.Add(this.button1);
this.Name = "Form1";
this.Text = "Form1";
this.Load += new System.EventHandler(this.Form1_Load);
this.ResumeLayout(false);

}
#endifregion

/// <summary>
/// The main entry point for the application.
/// </summary>
[STAThread]
static void Main()
{
    Application.Run(new Form1());
}

private void Form1_Load(object sender, System.EventArgs e)
{
}
```

5 Programming Your Instruments

```
private void USBInstrument_TextChanged(object sender,
    System.EventArgs e)
{
}

private void button1_Click(object sender, System.EventArgs e)
{
    Ivi.Visa.Interop.ResourceManager io_mgr=new
        Ivi.Visa.Interop.ResourceManagerClass();
    Ivi.Visa.Interop.FormattedIO488 fgen=new
        Ivi.Visa.Interop.FormattedIO488Class();

    fgen.IO=(Ivi.Visa.Interop.IMessage)io_mgr.Open(USBInstrument.Text,Ivi.
    Visa.Interop.AccessMode.NO_LOCK,2000,"");
    fgen.WriteString("*rst",true);
    fgen.IO.Clear();
    fgen.WriteString("FUNCTION SINusoid",true); //Select waveshape
    //
    //Other options are SQUare, RAMP, PULSe, NOISe, DC, and USER
    //
    fgen.WriteString("OUTPUT:LOAD 50",true);
    //Set the load impedance in Ohms
    //(50 ohms default)
    //
    //May also be INFinity, as when using oscilloscope or DMM
    //
    fgen.WriteString("FREQuency 2500",true); //Set the frequency
    fgen.WriteString("VOLTage 1.2",true); //Set the amplitude in
    //Vpp.
    //Also see VOLTage:UNIT
    fgen.WriteString("VOLTage:OFFSet 0.4",true);
    //Set the offset in Volts
    //Voltage may also be set as VOLTage:HIGH and VOLTage:LOW for
    //low level and high level.
    //
    fgen.WriteString("OUTPut ON",true);
    //Turn on the instrument output
}
}
```

Example: Simple Sine Waveform (Visual C++ and VISA)

This example program is intended for use with Microsoft Visual C++ 6.0 and requires VISA to be installed. This program uses the arbitrary waveform function to download and output a square wave pulse with a calculated rise time and fall time. The waveform consists of 4000 points downloaded to the function generator as ASCII data.

```
#include <string.h>
#include <stdlib.h>
#include <stdio.h>
#include <visa.h>

#define CHECK(func) \
do {\
    ViStatus _s = (func);\
    if (_s < 0) \
    {\
        fprintf(stderr, "Error: %s returned %d\n", #func, _s);\
        exit(0);\
    }\
} while (0)

/* Specify the default address */
#define DEFAULT_LOGICAL_ADDRESS "GPIB0::10::INSTR"

void main()
{
    ViSession viDefaultRM, Instrument;
    ViRsrc TxtAddress = DEFAULT_LOGICAL_ADDRESS;
    ViUInt32 actual;
    char SCPIcmd[10000];
    unsigned short i;

    CHECK(viOpenDefaultRM(&viDefaultRM));
    CHECK(viOpen(viDefaultRM, TxtAddress, VI_NULL, VI_NULL,
    &Instrument));

    /* Specify long seconds timeout for waveform download */
    CHECK(viSetAttribute(Instrument, VI_ATTR_TMO_VALUE, 40000));
}
```

5 Programming Your Instruments

```
strcpy(SCPIcmd,"*RST\n"); /* Reset the function generator */
CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
strcpy(SCPIcmd,"*CLS\n"); /* Clear errors and status registers */
CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

/* Compute waveform */

fprintf(stderr, "Computing Waveform...\n");

strcpy(SCPIcmd, "DATA VOLATILE");
for(i = 1; i <= 5; i++) /* Set rise time (5 points) */
    sprintf(SCPIcmd, "%s,%3.1f", SCPIcmd, (double)(i - 1)/5);

for(i = 6; i <= 205; i++)
    strcat(SCPIcmd, ",1"); /* Set pulse width (200 points) */

for(i = 206; i <= 210; i++) /* Set fall time (5 points) */
    sprintf(SCPIcmd, "%s,%3.1f", SCPIcmd, (double)(210 - i)/5);

for(i = 211; i <= 4000; i++)
    strcat(SCPIcmd, ",0"); /* Set remaining points to zero */

strcat(SCPIcmd,"\\n");

/* Download data points to volatile memory */

fprintf(stderr,"Downloading Arb...\n");

CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

fprintf(stderr,"Download Complete\\n");

/* Set up arbitrary waveform and output */

strcpy(SCPIcmd,"DATA:COPY PULSE, VOLATILE\\n"); /* Copy arb to
non-volatile memory */
CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
```

```
&actual));
    strcpy(SCPIcmd, "FUNCTION:USER PULSE\n"); /* Select the active
arb waveform */
    CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
    strcpy(SCPIcmd, "FUNCTION:SHAPE USER\n"); /* Output the selected
arb waveform */
    CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

    strcpy(SCPIcmd, "OUTPut:LOAD 50\n"); /* Output termination is 50 Ohms
*/
    CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
    strcpy(SCPIcmd, "FREQuency 5000;VOLTage 5\n"); /* Output frequency is
5 kHz @ 5 Vpp */
    CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
    strcpy(SCPIcmd, "OUTPut ON\n"); /* Enable output */
    CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

    CHECK(viClose(Instrument));
    CHECK(viClose(viDefaultRM));
}
```

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6

Installing I/O Software

This chapter includes:

- System Requirements for Agilent IO Libraries Suite
- Installing the IO Libraries Suite Software
- Installation Troubleshooting
- Selecting Application Software
- Modifying, Repairing, or Removing IO Libraries Suite
- Keeping Your Software Up To Date
- Using Agilent VISA in Side-by-Side Mode

NOTE

This chapter assumes that you are installing Agilent IO Libraries Suite from the *Automation-Ready CD*. If you are installing from the Web, double-click the downloaded executable to extract files and launch the setup program; then proceed with the software installation as documented in this chapter.



Agilent Technologies

System Requirements for Agilent IO Libraries Suite

Processor: 100MHz required, 800 MHz or higher recommended

Operating system: Any one of the following Microsoft Windows versions:

Windows XP Professional or Home Edition, Service Pack 1 or later

(service pack required for USBTMC device support)

Windows 2000 Professional, Service Pack 4 or later

(service pack required for USBTMC device support)

Windows Millennium Edition (Me)

Windows 98 Second Edition

Available memory: 64 MB (96 MB or greater recommended)

Browser: Internet Explorer 5.01 or greater

Available disk space required for installation: 215 MB

160 MB for Microsoft .NET Framework

55 MB for Agilent IO Libraries Suite

Disk space required for operation: 125 MB

70 MB for Microsoft .NET Framework

55 MB for Agilent IO Libraries Suite

Video: Super VGA (800x600) 256 colors or more

NOTE

You must have Administrator privileges to install Agilent IO Libraries Suite and to run Connection Expert.

NOTE**Every IO Libraries Suite installation is a “Full installation”**

In past versions of IO Libraries, there was an option to install IO Libraries as either a Full version or a Runtime version. Beginning with IO Libraries Suite 14.0, the installation process provides a **Full installation** for all users (i.e. there is no longer a Runtime installation option).

This means that every installation now includes the development components of the Agilent IO Libraries Suite software, which allow you to develop your own I/O programs. If you wish to minimize the size of the installed software, select a **Custom** installation; when you get to the **Select Features** dialog, do not select the manuals and the sample programs.

Installing the IO Libraries Suite Software

This section describes how to install Agilent Connectivity Guide on your PC. The process is as follows:

- 1** Verify that your PC meets the minimum system requirements.
- 2** If you are upgrading to IO Libraries Suite from a previous version of IO Libraries, you must remove the instruments and interfaces listed below before you upgrade your software. This step is necessary in order for these devices to obtain the correct drivers to work with Agilent IO Libraries Suite.
 - Disconnect any USB instruments from your PC.
 - Disconnect any Agilent 82357 USB/GPIB interface converters from your PC.
 - Disconnect any Agilent E8491 IEEE 1394 PC Link to VXI interfaces from your PC.
- 3** Close all other applications on your PC.
- 4** Insert the *Automation-Ready CD with Agilent Connectivity Guide* into the CD-ROM drive of your PC. Wait a few seconds for the auto-run window to appear.

If the auto-run window does not appear automatically,

- Click **Start > Run...**

- Type <drive>:autorun\auto.exe, where <drive> is your CD drive letter.

5 When the auto-run window appears, click **Install Software**.

Optional: If you want more information before you begin the installation, click **Connect in 3 Steps** and/or **Readme**.

- The *Three-Step Connection Procedure* explains how to connect an instrument to your PC quickly and easily, using the IO Libraries Suite.
- The Read Me file includes last-minute information about the IO Libraries Suite software.

6 Wait for the InstallShield Wizard to appear.

Click **Next >** to begin the IO Libraries Suite software installation.

7 Read the License Agreement(s). If you accept the terms, click **Yes**.

8 If you are upgrading to IO Libraries Suite from a previous version of IO Libraries (version M or before), you will see a dialog box that asks you to remove the earlier IO Libraries version. Notice that you *must* allow the previous version to be removed if you want to install the current version of IO Libraries Suite.

Select the check box if you want to save your current I/O configuration.

- If you select this option, interfaces and instruments that were either discovered by, or manually added to, the old IO Config utility will appear when you run Connection Expert.
- If you do not select this option, Connection Expert will display only the interfaces and instruments that it discovers automatically. Serial and LAN instruments will not appear; you will have to add them manually.

9 Click **Next >** to proceed with the installation of IO Libraries Suite.

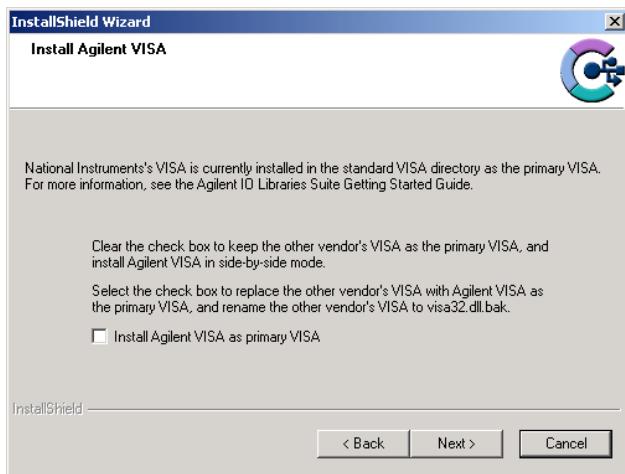
- 10 When the InstallShield Wizard **Setup Type** dialog box appears, as shown, select **Typical** or **Custom**, then click **OK**.



Figure 38 InstallShield Wizard Setup Type Dialog Box

The **Typical** setup installs the recommended features for your configuration in standard locations on your PC. In a **Typical** setup, if another vendor's VISA software is already installed on this PC, Agilent VISA is installed as secondary. If no other vendor's VISA software is found on this PC, Agilent VISA is installed as primary.

If you chose the **Custom** setup, then you will see the dialog box below, which asks whether you want to install Agilent VISA as the primary VISA.



11 For details on this topic, see [Using Agilent VISA in Side-by- Side Mode](#) on page 135.

12 If you chose a **Custom** setup, you will now see the **Choose Destination** dialog box.

From this dialog, you may select specific destination folders for:

- The IO Libraries Suite software
- Agilent VISA (only if you have not previously installed *VXIplug&play* drivers or other VISA components)*
- IVI shared components (only if you have not previously installed IVI shared components or IVI drivers.*

*The destination folders chosen here will affect where you must install related instrument drivers in the future.

13 If you chose a **Custom** setup, you will now see the **Select Features** dialog box.

- Click on any feature in the list to see the feature description and the space requirements for the selected set of features. It is recommended that you install the manuals and sample programs if you plan to program with the Agilent IO Libraries; however, you may omit them to save space.
- Select the check box for each feature to be installed. Clear the check box for each feature to omit.
- When you are done selecting features, click **Next >**.

14 The **Start Copying Files** dialog appears; click **Next>** to begin copying files.

- If the Microsoft .NET Framework has not previously been installed on your PC, you will see the .NET Framework files being copied onto your computer. The Microsoft .NET Framework provides necessary infrastructure for Agilent IO Libraries Suite utilities, as well as for .NET programming tools and many other applications. You will only need to install the .NET Framework once, even if you remove and reinstall or upgrade your IO Libraries Suite.
- If the IVI (Interchangeable Virtual Instrument) Shared Components have not previously been installed on your PC, you will now see them being copied onto your computer. The IVI Shared Components provides necessary infrastructure for Agilent IO Libraries Suite utilities, as well as for IVI-COM instrument drivers.
- After the files have been copied, you may see a dialog asking you to restart your PC. This occurs only if you have certain I/O hardware configurations. If you choose not to reboot at this time, you should reboot before running Connection Expert.

15 When the **InstallShield Wizard Complete** dialog appears, select the check boxes for the actions that you want to do next.

- Select the **ReadMe** file check box if you want to view the ReadMe file.

- Select the **Launch Agilent Connection Expert** check box, if you want to run Connection Expert now. Run Connection Expert if you are ready to connect, configure, and verify your instruments. If you need to install hardware, such as a GPIB card, then wait to run Connection Expert after you have done that installation.

Click **Finish**.

If you are installing Agilent IO Libraries Suite along with another instrument, interface, or software package such as Agilent VEE or Agilent T&M Toolkit, there may be another CD with additional software (drivers, sample programs, etc.).

16 If you want to install this additional software,

- Insert the CD into the CD drive on your PC.
- Follow the instructions that came with the CD or the hardware.

17 Re-connect any USB instruments or E8491 IEEE-1394 FireWire to VXI interfaces that you may have disconnected.

18 Run the Connection Expert utility to verify your I/O configuration:

- In the Windows taskbar notification area, click the **I/O** icon (IO Control).
- Click **Run Connection Expert**.
- Locate your interfaces and instruments in the explorer pane. Click on them to see their properties (displayed in the right-hand pane). Observe their state, also displayed in the right-hand pane: if communication to the interface or instrument has been successfully established, it will be in the Verified state, denoted by a green check mark.
- Change the default I/O configuration (if necessary) by clicking **Change Properties...** in the property pane of the interface or instrument you wish to configure.

- If you would like to test your connections manually, select your instrument, right-click and choose **Send Commands to this Instrument**.

Installation Troubleshooting

If you encounter problems while installing the IO Libraries Suite, the following steps may help.

- 1 Close or Cancel all InstallShield Wizards and other Agilent IO Libraries Suite windows. Exit any other applications on your system.
- 2 Browse to the autorun folder of your Automation-Ready CD and double-click to run auto.exe. This restarts the installation process.
- 3 If you see the standard InstallShield Wizard, step through the installation process as described in this chapter.
- 4 If you see **Modify**, **Repair**, and **Remove** options, select **Repair**. This will reinstall all installed features of IO Libraries Suite. If this does not solve the problem, restart the installation again, select **Remove**, and then reinstall the product.

Selecting Application Software

This table gives guidelines for using additional I/O software.

Use This Software:	When You Want to:
Instrument Web Browser (<i>Product Design or Product Characterization</i>)	
Provides a “soft front panel” displayed on your Web browser that you can use to control the instrument (Web-enabled instruments only).	Remotely communicate with instruments from your PC, but do not need to program the instruments. (The IO Libraries are not required.)

Agilent IntuiLink (<i>Product Design or Product Characterization</i>)	
Provides a “soft front panel” specific to an instrument that you can use to control instruments.	Remotely communicate with instruments from your PC, but do not need to program the instruments (The IO Libraries are required.)
IVI-COM Drivers (<i>Product Characterization or Product Test</i>)	
IVI-COM drivers are implemented as COM (Microsoft Common Object Model) objects, and are therefore optimized and recommended for use in Microsoft Visual Studio and Visual Studio .NET.	IVI-COM drivers that implement standard instrument-class interfaces provide syntactical interchangeability; this means that you may be able to replace an instrument in your test system with another, similar instrument with fewer changes or even no changes to your test program, depending on your use of instrument-specific interfaces.
VXIplug&play Drivers (<i>Product Characterization or Product Test</i>)	
VXIplug&play drivers (also known as Plug&Play or Universal Instrument Drivers) conform to a set of system-level standards produced by the VXIplug&play Systems Alliance. These standards apply to instrument drivers, soft front panels, installation packages, documentation, technical support and application development environments. VXIplug&play drivers are widely used and based on the VISA API.	VXIplug&play drivers allow you to develop application programs that are portable across many computer platforms and I/O interfaces.

Modifying, Repairing, or Removing I/O Libraries Suite

- 1 Click **Start > Settings > Control Panel > Add/Remove Programs**
- 2 Select **Agilent I/O Libraries Suite**.
- 3 Click **Change/Remove**
- 4 Select the action you want to take:

Modify: Adds, replaces, or removes selected features. You can change your installation from primary to side-by-side or from side-by-side to primary by using this option. You can also use this to install manuals or sample code if you did not initially install them.

Repair: Reinstalls all features.

Remove: Removes the product from your PC.

Keeping Your Software Up To Date

Web resource for the latest IO Libraries Suite software:

www.agilent.com/find/iolib

When you update the IO Libraries Suite software, you may choose to preserve your test system configuration. This includes the instruments, instrument aliases, interfaces, and all related properties.

Web resource for the latest instrument drivers:

www.agilent.com/find/drivers

This Web site includes many types of instrument drivers, including IVI-COM and VXI*plug&play* drivers.

Using Agilent VISA in Side-by-Side Mode

Agilent IO Libraries Suite includes an implementation of VISA (Virtual Instrument Software Architecture), one of three available application programming instruments for instrument control. The VISA standard requires that visa32.dll, the dynamic-link library that implements the VISA interface, be installed in prescribed locations; therefore, only one installed implementation (the **primary** implementation) can fully comply with the standard at any one time. Because of this, you must take special care if you want to use Agilent IO Libraries Suite alongside any other implementation of VISA, such as National Instruments' NI-VISA.

When you have both Agilent VISA and another vendor's VISA installed on the same system, you will need to decide whether to let your programs use the primary VISA or

whether to explicitly direct them to use the Agilent VISA implementation.

NOTE

In general, you do not need to install NI-VISA to use National Instruments GPIB cards and devices. You can install NI-488.2 as a driver for these devices, and avoid the complications of side-by-side operations.

Agilent IO Libraries Suite supports the option to install Agilent VISA in side-by-side mode, which allows Agilent VISA to be used simultaneously with another vendor's VISA implementation. In side-by-side mode, Agilent VISA is installed only in a secondary location and therefore does not overwrite another vendor's VISA if it is present on the computer.

In general, non-Agilent VISA implementations do not support operation as the secondary VISA (in side-by-side mode). This means that you must operate Agilent VISA in side-by-side mode as the secondary VISA, and the other vendor's VISA as primary.

About primary and secondary VISA:

- VISA programs normally use visa32.dll, which is installed in the Windows system directory. This is the primary VISA, as defined by the VISA standard.
- Agilent VISA is implemented in agvisa32.dll, which is also installed in the Windows system directory.
- If Agilent VISA is installed as primary, the Agilent version of visa32.dll is installed in the Windows system directory. It simply forwards all VISA calls to agvisa32.dll.
- If you install Agilent VISA as primary, all files needed to support side-by-side mode are also installed. This means that if you subsequently install another vendor's VISA as primary, you can still use Agilent VISA as secondary.

If Agilent VISA is installed in side-by-side mode (as the secondary VISA):

- agvisa32.dll is installed, but Agilent's visa32.dll is not. Thus, it will not overwrite another vendor's visa32.dll residing in the standard location.
- Agilent support files are not installed in the bin, include and lib directories of the VISA path (e.g. c:\program files\visa\winnt), since they would overwrite the other vendor's support files. Copies of the Agilent versions of the VISA support files reside in the agbin, include and lib subdirectories under <VISA path>\agvisa. (These files are installed even when Agilent VISA is primary.)
- The IO Control menu and the status bar at the bottom of the Connection Expert window will contain a message indicating whether Agilent VISA is installed as primary, installed as secondary, or installed as primary but overwritten by another vendor's VISA. In the latter case, Agilent VISA will operate identically to a secondary installation.

VISA programs that are linked to the standard VISA DLL (e.g. C:\WINDOWS\system32\visa32.dll) will use the primary VISA. However, if a VISA program is linked with agvisa32.lib or dynamically loads agvisa32.dll, it will always use Agilent VISA (regardless of whether Agilent VISA is primary or secondary). Addressing is identical regardless of whether you are using the primary or secondary VISA in your program.

See the *Agilent IO Libraries Suite Online Help* for more information about side-by-side VISA operation.

6 Installing I/O Software

7

TCP/IP Network Basics

This chapter includes:

- LAN Interface Overview
- TCP/IP Protocols
- IP Addressing

- IP Address Configuration Methods
- Device Hostname Services
- Configuring Your PC for LAN Operation

NOTE

The information in this section is a summary of TCP/IP networks and LANs and is not intended to be a complete discussion of the subject. Consult standard reference texts for further details on TCP/IP and LANs.



Agilent Technologies

LAN Interface Overview

This section provides an overview of Local Area Networks (LANs) that use Transmission Control Protocol/Internet Protocol (TCP/IP), including:

- Typical Network Topologies
- LAN Hardware Architecture

Typical Network Topologies

LANs using TCP/IP can be divided into two categories: Site LANs and Private LANs.

Site LAN Topology

A Site LAN can be a workgroup LAN, Intranet, or enterprise (corporate) LAN. Typically, a site LAN includes several PCs, routers, and servers. The LAN network is usually administered and controlled by a **system administrator** (or **network administrator**) who installs, monitors, and troubleshoots the network.

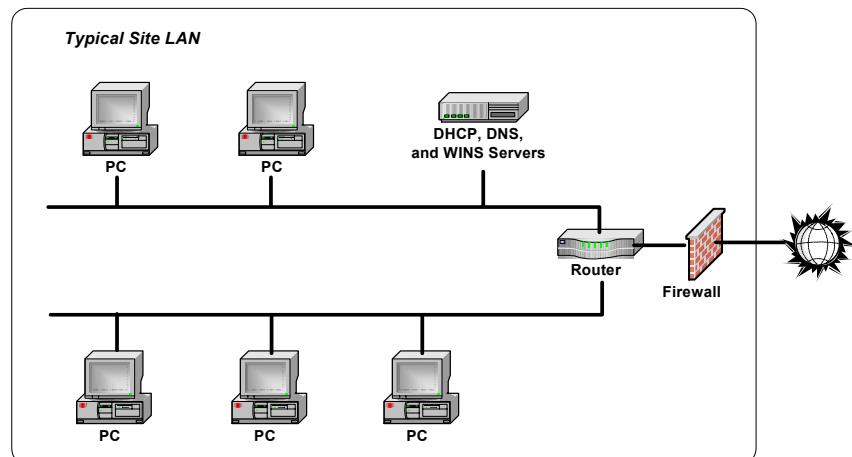


Figure 39 Portion of a Typical Site LAN

Within the site LAN, every device (PC, router, server, etc.) is called a **host**. A host is any device on a network that has a TCP/IP address. TCP/IP addresses are called **IP addresses**, and each device on the network must have a unique IP address. A typical IP address for a device is 156.140.105.50. In general, communication within the site LAN and to private LANs is behind a **firewall**.

Communication among devices on the site LAN is controlled by **routers**. A router is a host that interfaces with other networks and can move data (called packets) from one network to another or can move data within the network, depending on the IP addresses of the hosts that are communicating with each other.

The **servers** on the site LAN can supply addressing and naming services, such as Dynamic Host Configuration Protocol (DHCP) to automatically assign IP addresses to hosts on the network or Domain Name Service (DNS) or Windows Internet Naming Service (WINS) that allow hostnames to be associated with their IP addresses.

Private LAN Topology

A private LAN (also called a local or isolated network) can operate as a local network (not connected to any other network) or can be connected to a site LAN or to another local network. This figure shows an example private LAN with three hosts (PC and two instruments). Communication between the PC and the instruments is via a **switch** or **hub**. You can also connect a single instrument to a PC by using a **crossover cable**.

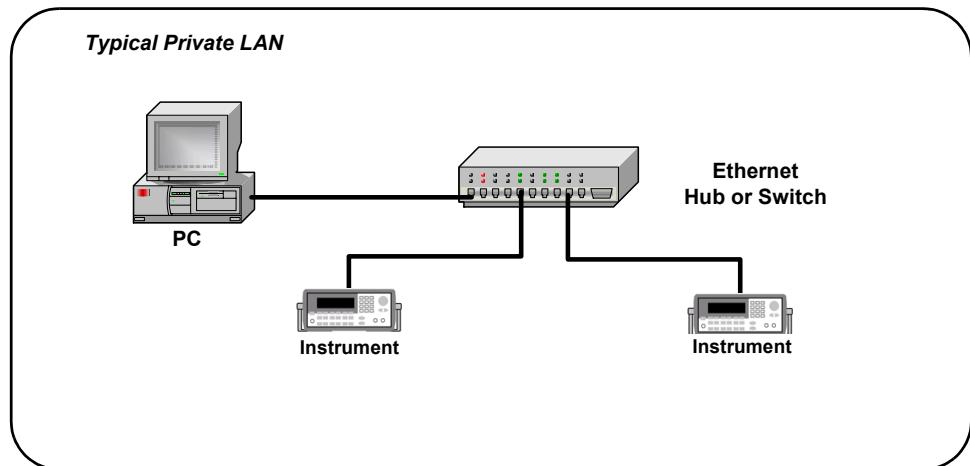


Figure 40 Typical Private LAN

LAN Hardware Architecture

A LAN is a way to extend the control of instrumentation beyond the limits of typical instrument interfaces. You can communicate with instruments using a web browser, the Telnet utility, or sockets. However, to program (send SCPI commands) over the LAN, you must first configure the LAN interface using Agilent Connection Expert, provided with the Agilent IO Libraries Suite.

Client-Server Model

The LAN software uses the **client-server model** of computing. Client-server computing refers to a model where an application (the **client**) does not perform all necessary tasks of the application itself. Instead, the client makes requests of another device (the **server**) for certain services.

A LAN interface, such as a PC, makes requests over the network to a server, such as a PC or a LAN-enabled instrument. For example, in this figure the Server PC and the instruments can act as LAN servers. Once the LAN server has completed the requested operation on the instrument or device, the LAN server sends a reply to the LAN interface. This reply contains requested data and status information that indicates whether or not the operation was successful.

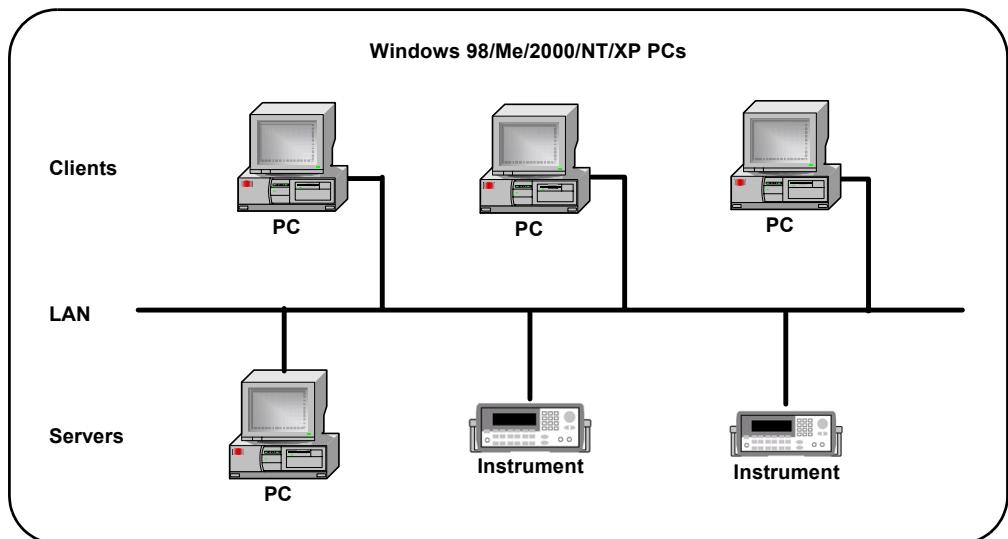


Figure 41 Client-Server Model

Packet Switching

A TCP/IP network is a **packet-switched** network. In this type of network, the computer that is sending the data (source host) breaks the data into smaller segments, called **packets**.

Each packet is individually addressed and is sent to the destination (destination host.) The destination host then reassembles the packets into the original message. Each

packet can be sent from source to destination in any of several routes. The **routers** in the network control the paths of the packets.

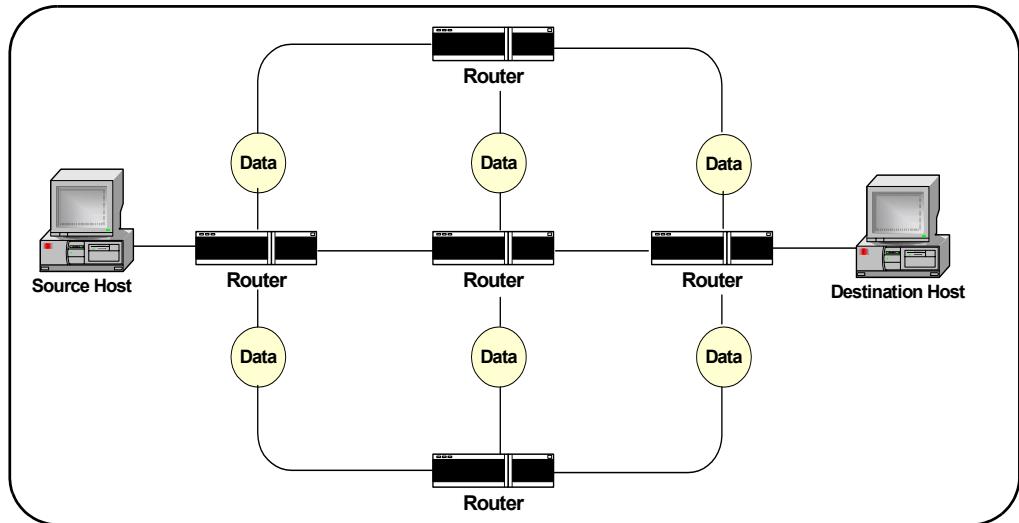


Figure 42 Example of Packet-Switched Network

TCP/IP Protocols

This section summarizes protocols for LAN networks that use TCP/IP for communication between hosts (devices such as computers, printers, and instruments), including:

- [The TCP/IP Network Model](#)
- [The Network Interface Layer](#)
- [The Internet Layer](#)
- [The Transport Layer](#)
- [The Application Layer](#)

The TCP/IP Network Model

The TCP/IP network model is based on **protocols** and an associated set of layers that control the actions of the network. A **protocol** is a rule or set of rules and standards for communication and data transfer between **hosts** on a network. A **host** is any device on the network (such as a computer, server, printer, etc.) that has a TCP/IP address. To exchange data on the network, the source and destination hosts must agree on the protocol and each host must have a unique (TCP/IP) address. When protocols are grouped together, they form a **protocol suite** and work together as a **protocol stack**.

TCP/IP Layers The TCP/IP network model is based on the Department of Defense (DoD) model.

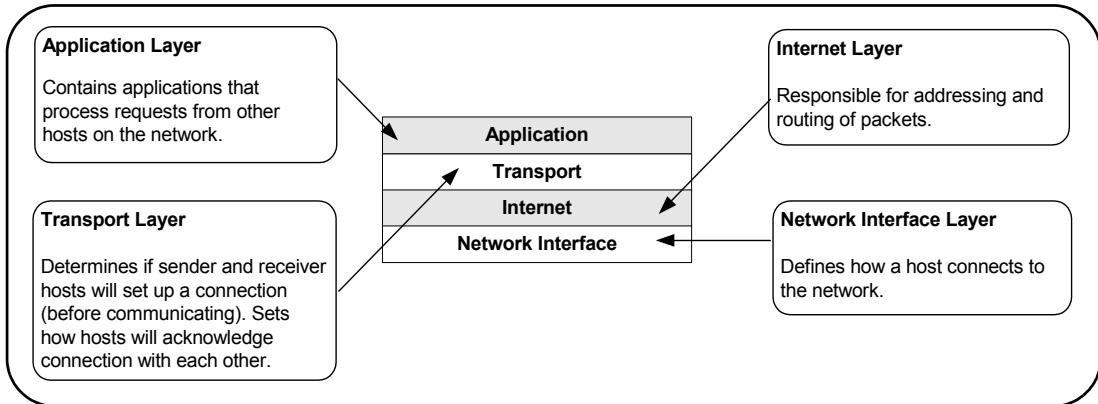


Figure 43 Functions of the TCP/IP Layers

TCP/IP Protocol Overview This table summarizes the components of each layer and shows the applicable Request for Comments (RFC) for each component.

Layer	Component Name	Description	Specification
Internet	IP - Internet Protocol	The lowest level protocol by which data are sent from one computer to another on the Internet.	RFC 791* RFC 2460**
	ICMP - Internet Control Message Protocol	A message control and error-reporting protocol between IP devices on a network.	RFC 792
	ARP - Address Resolution Protocol	A protocol for translating IP addresses into Ethernet addresses.	RFC 826
Transport	TCP - Transmission Control Protocol	A connection-oriented protocol running over IP that reliably delivers data.	RFC 793
	UDP - User Datagram Protocol	A datagram-oriented protocol running over IP	RFC 768

Layer	Component Name	Description	Specification
Application	DNS - Domain Name System	A protocol for translating a Hostname into an IP address.	RFC 1034 and RFC 1035
	DHCP - Dynamic Host Configuration Protocol	A protocol for obtaining TCP/IP parameters from a central server.	RFC 2131 and RFC 2132
	FTP - File Transfer Protocol	A protocol that defines how files are transferred from one host to another on a network.	RFC 959
	HTTP - Hypertext Transfer Protocol	A protocol that defines how files are exchanged on the Internet	RFC 1945 and RFC 2068

* = IPv4 (current standard), ** = IPv6 (proposed new standard)

The Network Interface Layer

The lowest layer in the TCP/IP stack is the Network Interface Layer. The primary responsibility of this layer is to define how a host device (computer, instrument, etc.) connects to the network. The Network Interface Layer acts as a host's connection (interface) to the network. There are no TCP/IP protocols associated with the Network Interface layer.

The Network Interface Layer is used to send and receive packets. At the Network Interface Layer, a header that contains addressing information is applied to each packet. A part of this header is the host **hardware address**. The hardware address must be unique to the device and does not change during the life of the device.

The hardware address, also called the Media Access Control (MAC) Address, Ethernet Address, Physical Address, or Network Interface Card (NIC) Address, is a 12-digit hexadecimal address. A typical hardware address is 00:30:D3:00:00:23, where the first six digits represent the manufacturer of the device and the last six digits represent the serial number assigned to the device.

NOTE

For a TCP/IP packet to be delivered to a device, the packet **must** contain the destination device's hardware address.

As packets are sent through the network, each host on the network looks at the packet to see if the packet is addressed to the host's hardware address. If not, the host ignores the packet.

The Internet Layer

The Internet Layer of the TCP/IP model contains the protocols responsible for addressing and routing of packets. The Internet Layer includes several protocols, including:

- Internet Protocol (IP)
- Address Resolution Protocol (ARP)
- Internet Control Message Protocol (ICMP)

For TCP/IP communications to be successful, the packet examined by the Network Interface Layer must include a hardware address. As the packet moves up to the Internet Layer, it also must include an **IP address**. The Internet Layer provides the protocols to determine the hardware address for routing the packet to its destination.

Internet Protocol (IP) Internet Protocol (IP) is responsible for determining the source and destination IP addresses of every packet sent on the network. Typically, IP addresses are assigned by a **System Administrator**. An IP address is assigned to each host on a network and each host must have a unique IP address.

In contrast to a hardware address that refers to a physical network interface card, an IP address is a **logical address** that is assigned to the host. The IP address can be changed, since it refers only to the host. A typical IP address is 167.155.21.45. See [IP Addressing](#) for a description of IP addresses.

Address Resolution Protocol (ARP) Address Resolution Protocol (ARP) is a protocol used to **resolve** (translate) a **logical address** to a physical (hardware) address. ARP is

used when a source host wants to communicate with a destination host, but has only the IP address. After the hardware address is resolved, ARP maintains that information for a short period of time.

Internet Control Message Protocol (ICMP) Internet Control Message Protocol (ICMP) is primarily used to send error messages, perform diagnostics, and control data flow. You can also use ICMP with the Packet InterNet Groper (**Ping**) utility. To ping another host from a Command Prompt, type **ping <ip_address>**.

Example: Using ping for Echo Request

For example, you could use the Ping utility to send ICMP echo request packets to the destination host and request the destination host return these packets. If the packets are returned, you can assume the connection is good. If the packets are not returned, a connectivity problem exists. This figure shows an example return from pinging a computer at IP address 156.140.72.1.

```
C:\>ping 156.140.72.1

Pinging 156.140.72.1 with 32 bytes of data:
Reply from 156.140.72.1: bytes=32 time<10ms TTL=254

Ping statistics for 156.140.72.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 44 Example Using Ping Utility

The Transport Layer

The Transport Layer of the TCP/IP model contains the protocols responsible for addressing and routing of packets. The Transport Layer determines if the sender and receiver will establish a connection before communicating and how often acknowledgements of the connection are sent. The protocols at the Transport Layer deliver data to and receive data from the Transport Layer protocols of other hosts. Hosts can be on the same local network or on a remote network. The Transport Layer has two protocols:

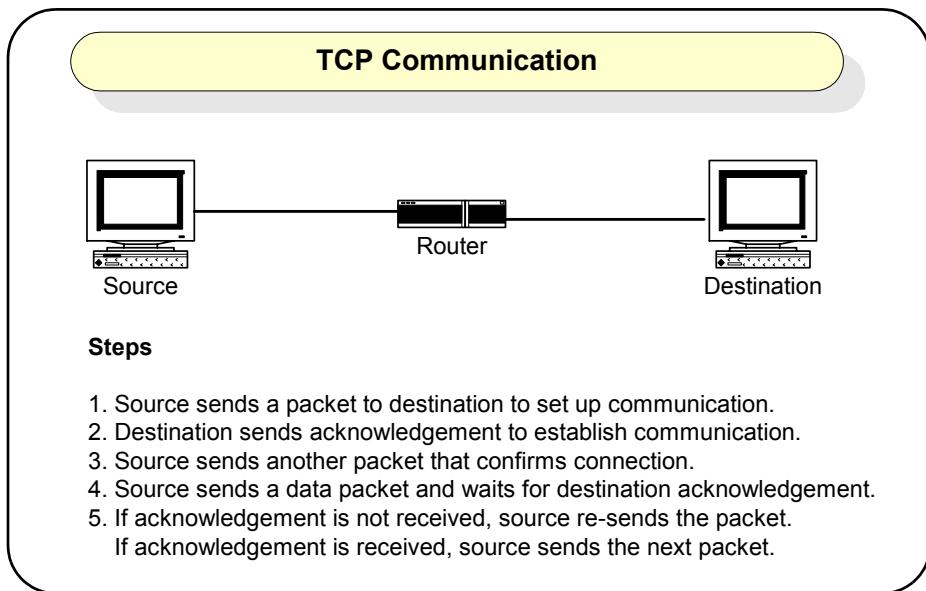
- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

Transmission Control Protocol (TCP) Transmission Control Protocol (TCP) is the protocol that connects the sending host and the receiving host to each other. TCP provides the connection as packets are moved between hosts having the conversation. Every packet has a TCP header that includes **sequence numbers**, acknowledgement numbers, address information, and other information. If packets get out of order enroute from the source to the destination, the sequence number allows the packets to be reassembled in the correct order.

As each packet is sent from the source host, an acknowledgement of receipt is sent by the destination host within a specified time. If the acknowledgement is not sent within this time, the sender re-sends the packet.

If the receiver gets the packet in a damaged condition, the packet is discarded and the receiver sends no acknowledgement. In this case, since an acknowledgement was not received in the specified time, the sender re-sends

the packet. This figure shows a network in which the source and destination are using TCP and summarizes the steps to use TCP for communication between hosts.



User Datagram Protocol (UDP) User Datagram Protocol (UDP) is used for connectionless, non-guaranteed communication. Unlike TCP, UDP does not set up a connection and does not use acknowledgements. Instead, UDP sends out packets without waiting for acknowledgement from the destination.

The Application Layer

The Application Layer is the layer where requests for data or services are processed. Applications at this layer are waiting for requests to process and all applications are “listening” at their respective **port**. The Application Layer has two protocols:

- File Transfer Protocol (FTP)

- Hypertext Transfer Protocol (HTTP)

NOTE

The Application Layer is not where an Internet browser, spreadsheet, etc. interact. Applications running at the Application Layer interact with the browser, spreadsheet, etc. applications.

Ports This figure shows the TCP/IP protocol stack. In the stack, TCP and UDP each have access to 65,536 ports at the Application Layer. As a packet moves up the stack, IP directs the packet to either a TCP port or to a UDP port. Since all applications are listening at their respective ports, when the packet arrives at the appropriate port, it can be processed correctly.

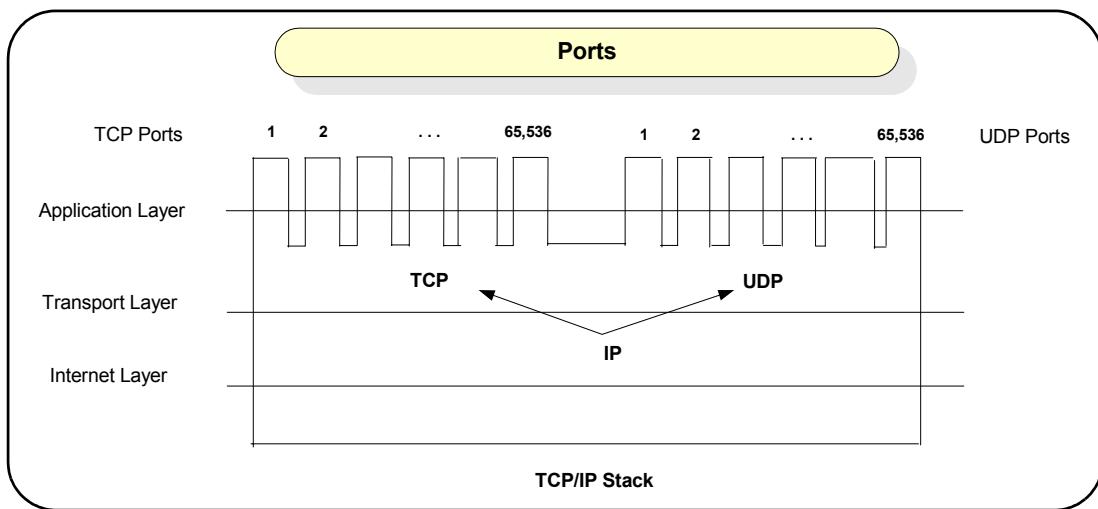


Figure 45 TCP/IP Protocol Stack

Sockets For TCP/IP protocol, when a packet is delivered to a specific IP address, it is passed up to TCP or UDP and then to the appropriate host. This process forms a funnel through the TCP/IP stack, called a **socket**. A socket is uniquely defined by the IP address, the end-to-end protocol (TCP or UDP), and the port number.

This figure shows typical socket architecture. When a socket is first created, it has an associated protocol but not an IP address or port number. A socket must be **bound** to a port number before it can receive messages from a remote application.

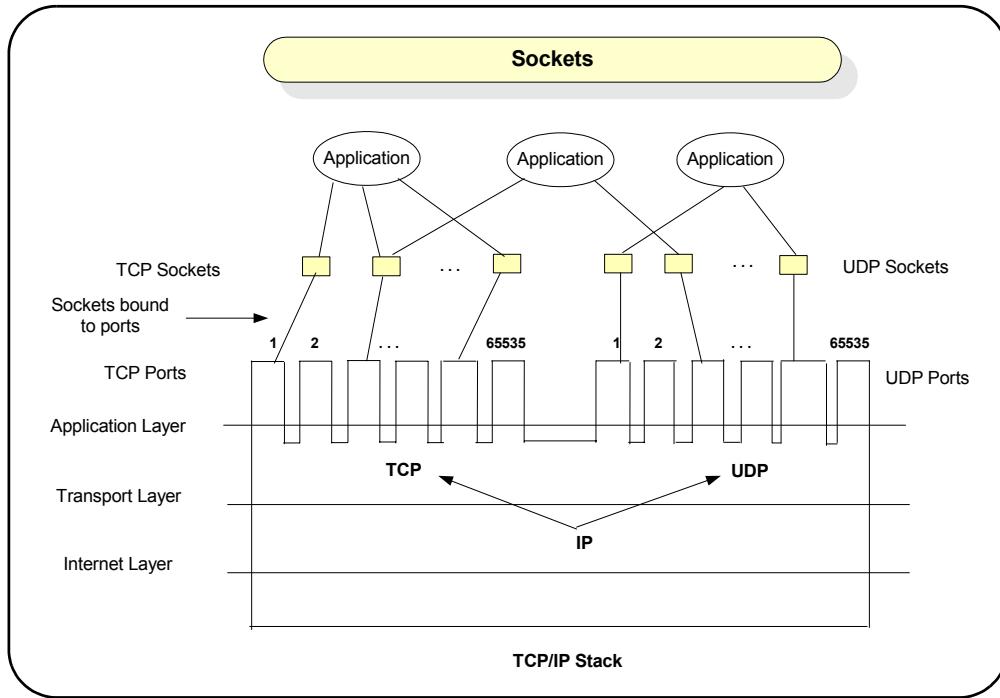


Figure 46 Typical Socket Architecture

File Transfer Protocol (FTP) File Transfer Protocol (FTP) is an application used to transfer files from a host to another host and store the files on the requesting host. In an FTP session, one host (the client) requests a file and the other host (the server) transfers a copy of the file to the client. The two hosts thus establish a **client/server** relationship. File transfer can be in text or binary format.

An FTP client can use a word processor, FTP command line utility or FTP command server to request a file from the server. The command-line FTP client application requires you to know FTP commands, while an FTP command

interpreter allows you to connect to an FTP server without using FTP commands. You can login to FTP using anonymous so that no password is required.

Hypertext Transfer Protocol (HTTP) Hypertext Transfer Protocol (HTTP) is an application used to transfer files from one host (the server) to another host (the client) and to display the files at the requesting host. The HTTP application runs on a Web server, listens for requests at a TCP port (usually port 80 for requests), and sends files back to the requestor.

The requesting host displays the files on a web browser, such as Internet Explorer. A client makes an HTTP request by typing a **Uniform Resource Locator (URL)** in the address line of the web browser or by clicking a **hyperlink** on a page that is displayed on the web browser.

IP Addressing

This section describes IP addressing for TCP/IP networks, including:

- IP Address Classes
- Subnets and Subnet Masks
- Local and Remote Networks
- IP Address Configuration Methods

IP Address Classes

Each host on a TCP/IP network must have a unique address. This address is called the **IP address** and consists of a **network portion** and a **host portion**. The network portion and host portion of an IP address are determined by the **subnet mask**.

Each IP address consists of four decimal numbers separated by periods. However, TCP/IP uses the 32-bit binary equivalent of the IP address. For example, the decimal value and binary equivalent of IP address 14.230.26.116 is:

$$14.230.26.116 = 0000\ 0110.1110\ 0110.0001\ 1010.0111\ 0100$$

IP addresses are divided into five classes: Class A, Class B, Class C, Class D, and Class E. This table summarizes standard Class A, Class B, and Class C IP addresses. In the table, the **Range** is the range of values for the first 8 bits of the IP address, regardless of class. In the **Binary Equivalent** column, N = a network bit and H = a host bit.

Class	Range	Network Bits	Binary Equivalent
A	1 - 127	8	NNNN NNNN.HHHH HHHH.HHHH HHHH.HHHH HHHH
B	128 - 191	16	NNNN NNNN.NNNN NNNN.HHHH HHHH.HHHH HHHH

Class	Range	Network Bits	Binary Equivalent
C	192 - 223	24	NNNN NNNN.NNNN.NNNN.NNNN.HHHH HHHH

NOTE

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value) such as IP addresses must be expressed with care, as most web software on the PC will interpret byte values with leading zeros as octal numbers. Thus, "255.255.020.011" is actually equivalent to decimal "255.255.16.9" rather than "255.255.20.11" because ".020" is interpreted as "16" expressed in octal and ".011" as "9". To avoid confusion, use only decimal expressions of byte values (0 to 255), with **no leading zeros**.

For example, the Agilent 33220A assumes that all IP addresses and other dot-notation addresses are expressed as decimal byte values and strips all leading zeros from these byte values. Thus, trying to enter "255.255.020.011" in the IP address field, it becomes "255.255.20.11" (a purely decimal expression). You should enter exactly the same expression, "255.255.20.11" in your PC web software to address the instrument. Do not use "255.255.020.011" as the PC will interpret that address differently due to the leading zeros.

Example: Class A, B, and C IP Addresses

This table shows three example IP addresses, where the bold part of the binary equivalent is the network portion of the address and the non-bold portion is the host portion of the address. For a Class A address, the first 8 bits are the network portion and the remaining 24 bits are the host portion of the address.

For a Class B IP address, the first 16 bits are the network portion and the remaining 16 bits are the host portion of the address. For a Class C IP address, the first 24 bits are the network portion and the remaining 8 bits are the host portion of the address.

Class	IP Address	Binary Equivalent
A	54.16.23.1	0011 0110. 0001 0000. 0001 0111. 0000 0001
B	154.16.23.1	1001 0110. 0001 0000. 0001 0111. 0000 0001

Class	IP Address	Binary Equivalent
C	204.16.23.1	1100 1100. 0001 0000. 0001 0111. 0000 0001

Subnets and Subnet Masks

As noted, an IP address consists of a network portion and a host portion. A **subnet mask** is a number that looks like an IP address that shows IP how many bits are used for the network portion of the IP address by “masking” the network portion of the IP address. Every IP address must have a subnet mask. You can use standard or custom subnet masks. To see how subnet masks are used, we will first define a **subnet**.

What is a Subnet? Large networks can be divided by a System administrator by creating a number of smaller networks, called **subnets**. The larger network is divided into subnets by using **routers** (also called **default gateways**). All devices on one side of the router form a separate subnet. Each subnet must have a unique set of IP addresses that are defined by the **subnet mask** for that network. Each side of the router must have a separate network address.

Standard Subnet Masks A subnet mask (like an IP address) is 32 bits long, with several contiguous bits (all 1s) that represent the network portion of the IP address and the rest of the bits (all 0s) that represent the host portion of the IP address.

For example, the standard subnet mask for a Class A address is **255.0.0.0** (binary **1111 1111.0000 0000.0000 0000.0000 0000**), so the first eight bits (all 1s) are used for the network portion of the IP address and the remaining 24

bits (all 0s) are used for the host portion of the IP address. This table shows the standard subnet masks for Class A, Class B, and Class C IP addresses.

Class	Standard Subnet Mask	Standard Subnet Mask (Binary Equivalent)
A	255.0.0.0	1111 1111. 0000 0000. 0000 0000. 0000 0000
B	255.255.0.0	1111 1111. 1111 1111. 0000 0000. 0000 0000
C	255.255.255.0	1111 1111. 1111 1111. 1111 1111. 0000 0000

Custom Subnet Masks You can create custom subnet masks for Class A, Class B, and Class C IP addresses. For example, for a Class A IP address, by using custom subnet mask **255.255.224.0** you can create 2,046 unique networks with 4,094 unique host on each network.

A custom subnet mask adds more bits for the network portion of the IP address and uses fewer bits for the host portion of the IP address. These additional bits are called **subnet bits**.

NOTE

Consult a standard network or TCP/IP book or use a subnet calculator (available on the Web) for creating custom subnets.

Local and Remote Networks

For every packet sent from a source host, IP must determine if the destination host is on the same **local network** or is on a **remote network**. If the destination host is on the same local network as the source host, IP directly gets the hardware address of the destination host. If the destination host is on a remote network, IP sends packets to the **router**.

Example: Creating Local and Remote Networks

For example, consider the two networks (subnets) in this figure that are created using a router. Computer A, instrument B, instrument C, and one side of the router form

one local network, while computer D, instrument E, instrument F, and the other side of the router form another local network.

If computer A wants to send a packet to instrument B or to instrument C, the destination is **local** (all hosts are on the same side of the router). In this case, IP can get the hardware address of the destination host (instrument B or instrument C) and can establish communication directly with the destination host.

However, if computer A wants to send a packet to instrument E or to instrument F, the destination is **remote** (hosts are separated by the router). In this case, IP gets the hardware address of the router. The packet is then sent to the router for transmission to the destination host (instrument E or instrument F).

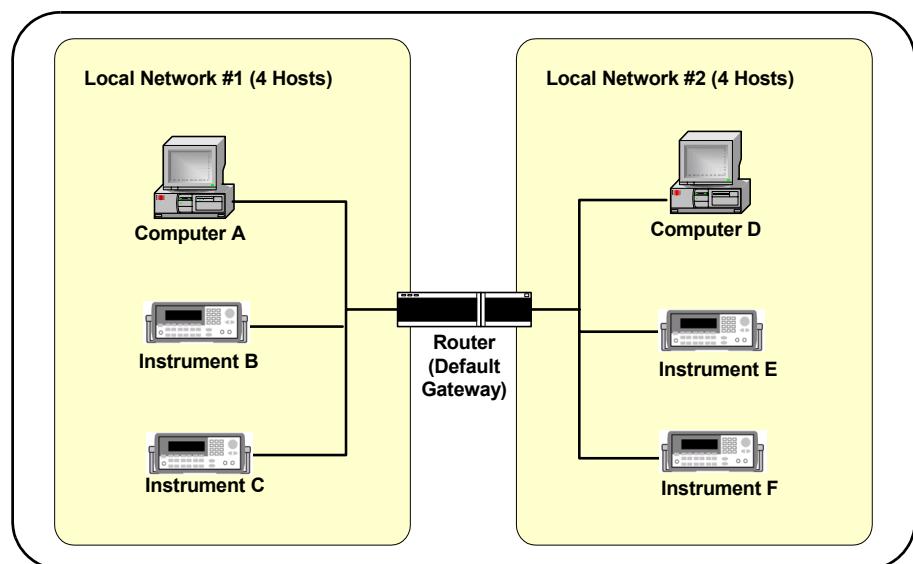


Figure 47 Two Networks (Subnets) Using a Router

IP Address Configuration Methods

This section introduces some IP address configuration methods, including:

- Configuration Methods Overview
- Dynamic Host Configuration Protocol (DHCP)
- Auto-IP/ZEROCONF
- Duplicate IP Address Detection

Configuration Methods Overview

IP address configuration methods can be divided into two categories: automatic IP configuration and manual IP configuration.

- **Dynamic Host Configuration Protocol (DHCP)** provides **automatic** TCP/IP setup for devices on networks that support DHCP.
- **Auto-IP/ZEROCONF** provides **automatic** TCP/IP setup for devices on networks that do not support DHCP.
- **Manual IP Configuration** provides **manual** TCP/IP setup for devices on manually configured networks.

This table shows the applicability of these methods to various network topologies.

Network Topology	Automatic IP			Manual IP
	DHCP	Auto-IP	ZEROCONF	
Site LAN [with DHCP]	Yes	No	No	Yes
Site LAN [without DHCP]	No	Yes	Yes	Yes
Private LAN [with DHCP]	Yes	No	No	Yes
Private LAN [without DHCP]	No	Yes	Yes	Yes

Dynamic Host Configuration Protocol (DHCP)

Dynamic Host Configuration Protocol (DHCP) allows each host on the network to be automatically assigned a unique IP address when the device is connected to a network that supports DHCP and is turned ON.

To enable DHCP on a Site LAN, the System Administrator assigns a pool of IP addresses to a **DHCP Server** to be leased to hosts on the network. Each host on the network is called a **DHCP Client**.

Auto-IP/ZEROCONF

Auto-IP/ZEROCONF can be used to automatically assign IP addresses on networks that do not have DHCP Servers. Auto-IP is a defacto standard for IP address allocation implemented by Microsoft and Apple. ZEROCONF is an Internet standard (RFC) that is currently under development and is expected to be widely implemented in Linux, Windows, etc. Auto-IP and ZEROCONF are similar techniques for IP address allocation and can interoperate together.

Both Auto-IP and ZEROCONF allocate IP addresses from the link-local IP address range (169.254.xxx.xxx). The addresses are allocated using an ARP-based protocol to determine if the desired address is already in use. Auto-IP and ZEROCONF can both be used such that DHCP is tried first and then Auto-IP/ZEROCONF are used after DHCP times out (typically after about 45 - 60 seconds).

Check your instrument's *User's Guide* to determine if the instrument supports Auto-IP/ZEROCONF and, if supported, if Auto-IP/ZEROCONF can be disabled.

Duplicate IP Address Detection

Duplicate IP address detection ensures that an instrument does not attempt to start operation using an IP address that is already in use on that network. Duplicate IP Address detection provides basic diagnostic information to identify a problem on the network.

Duplicate IP Address detection is described by several Internet standards (RFC 2642/RFC 2131/ZEROCONF). It is implemented using ARP (Address Resolution Protocol) and uses broadcast Ethernet communication. The scope of duplicate IP address detection is the current Ethernet subnet. Most operating systems (Windows, Apple, etc.) implement duplicate IP address detection.

Duplicate IP Addresses on non-DHCP Networks Generally, duplicate IP addresses only occur on a manually configured IP address network that does not use DHCP and Auto-IP/ZEROCONF. For example, a user may try to determine an IP address for a host by PINGing IP addresses on the network until an IP address is selected that does not respond.

Based on this non-response, the user may assume the IP address is unused and assign it to their device. However, at a later date, a host that legitimately has that IP address will attempt to use it. As a result, both hosts will experience network problems that can be very difficult to track down.

A duplicate IP address can also happen when a user makes an error during manual entry of an IP address and accidentally configures an IP address already in use elsewhere.

Duplicate IP Addresses on DHCP Networks Duplicate IP addresses on DHCP systems are unlikely but they are possible. The DHCP specification (RFC 2131) specifies how a duplicate IP address check should be done within the DHCP Discover/Offer/Request/Acknowledgement protocol sequence. Ideally, the network interface should be disabled when a

duplicate IP address is detected. Windows informs the user of the duplicate IP address, but does NOT disable the network interface.

If two or more devices on the network have the same IP address, the first device that starts using the duplicate IP address will not detect a problem because it is the only device using that IP address. However, when a second device starts and attempts to use the duplicate IP address, a duplicate IP address error is reported.

To recover from a duplicate IP address condition, eliminate the duplicate IP address condition and then restart the affected devices. For example, an instrument can be restarted (to clear up the error) by disconnecting the Ethernet port long enough to be detected by the Ethernet connection monitoring or by cycling power to the instrument.

Device Hostname Services

This section introduces some device hostname services, including:

- Device Hostname Services Overview
- Dynamic DNS Naming
- RFC NetBIOS Naming
- Static DNS Naming

Device Hostname Services Overview

For ease of operation and communication on a TCP/IP network, you can assign a name to a host, called a **hostname**. However, since TCP/IP must use IP addresses to connect a host to another host, hostnames must be resolved (translated) to an IP address before TCP/IP can use the names.

Device hostname services can be divided into two categories: automatic hostname services and manual hostname services. This table shows the applicability of these services to various network topologies.

	Automatic Hostname Services		Manual Hostname
Network Topology	Dynamic DNS	RFC NetBIOS	Static DNS
Site LAN (Direct Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Site LAN (Router Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Private LAN (Router Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Private LAN (Direct Connection)	Typically not used in this topology	Works in all network topologies	Works in all network topologies

Dynamic DNS Naming

Dynamic Domain Name System (Dynamic DNS) is a distributed database of **hostnames** and associated IP addresses on the Internet. All hostnames on the Internet are divided into categories, called **domains**, such as .com, .edu, .org, etc. Dynamic DNS automatically provides hostnames and domain names for devices on networks that support Dynamic DNS. This figure shows a typical process for a DHCP Client to register a hostname and a PTR (pointer) name via a DHCP Server.

If the registration process fails, the DHCP Client hostname may not be assigned to the instrument. If you want to change the hostname after the registration process initiated by the DHCP server, you will probably need to cycle power on the instrument to re-initiate a DHCP request and hostname registration attempt.

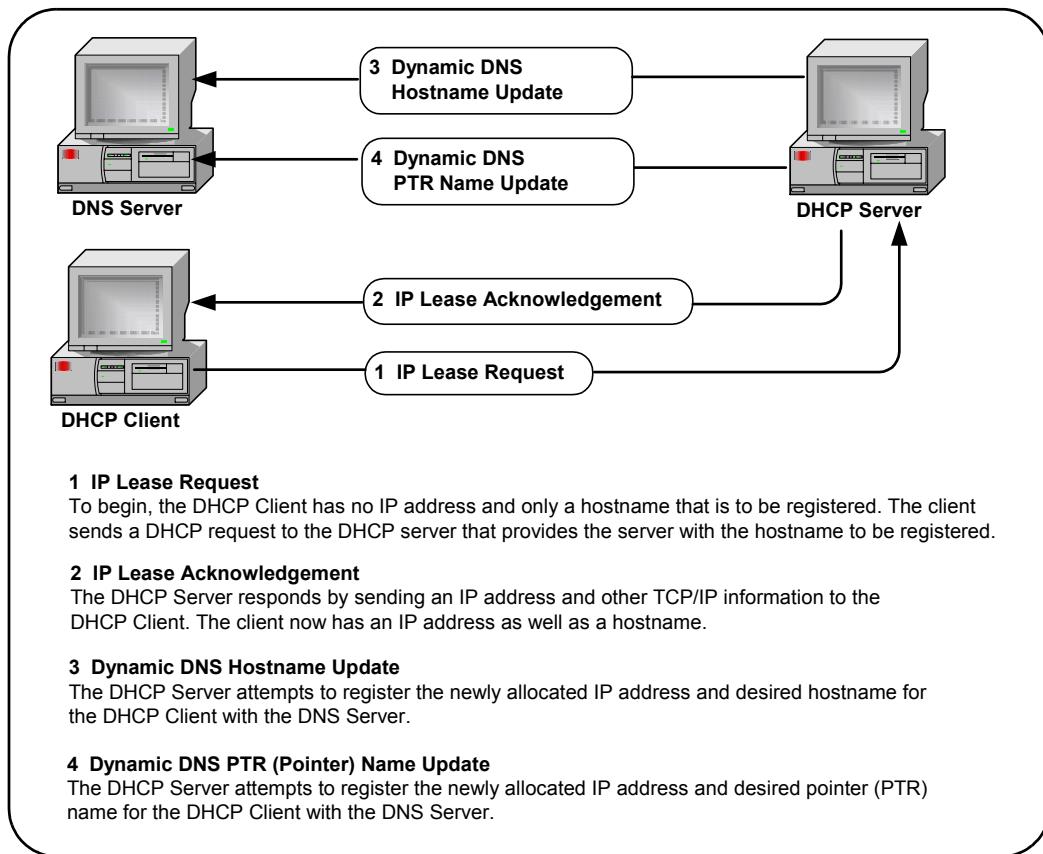


Figure 48 DHCP Client Registering a Hostname and PTR Name

RFC NetBIOS Naming

RFC NetBIOS Naming is a peer-to-peer naming protocol used by Microsoft File/Print Sharing that automatically provides hostnames for devices on networks that support RFC NetBIOS Naming. RFC NetBIOS naming uses a six-step process to resolve an IP address for a specified host name, as shown in the following figure. TCP/IP completes each step

in the sequence shown before returning an error message. RFC NetBIOS naming does require a reboot to force a naming change to take effect.

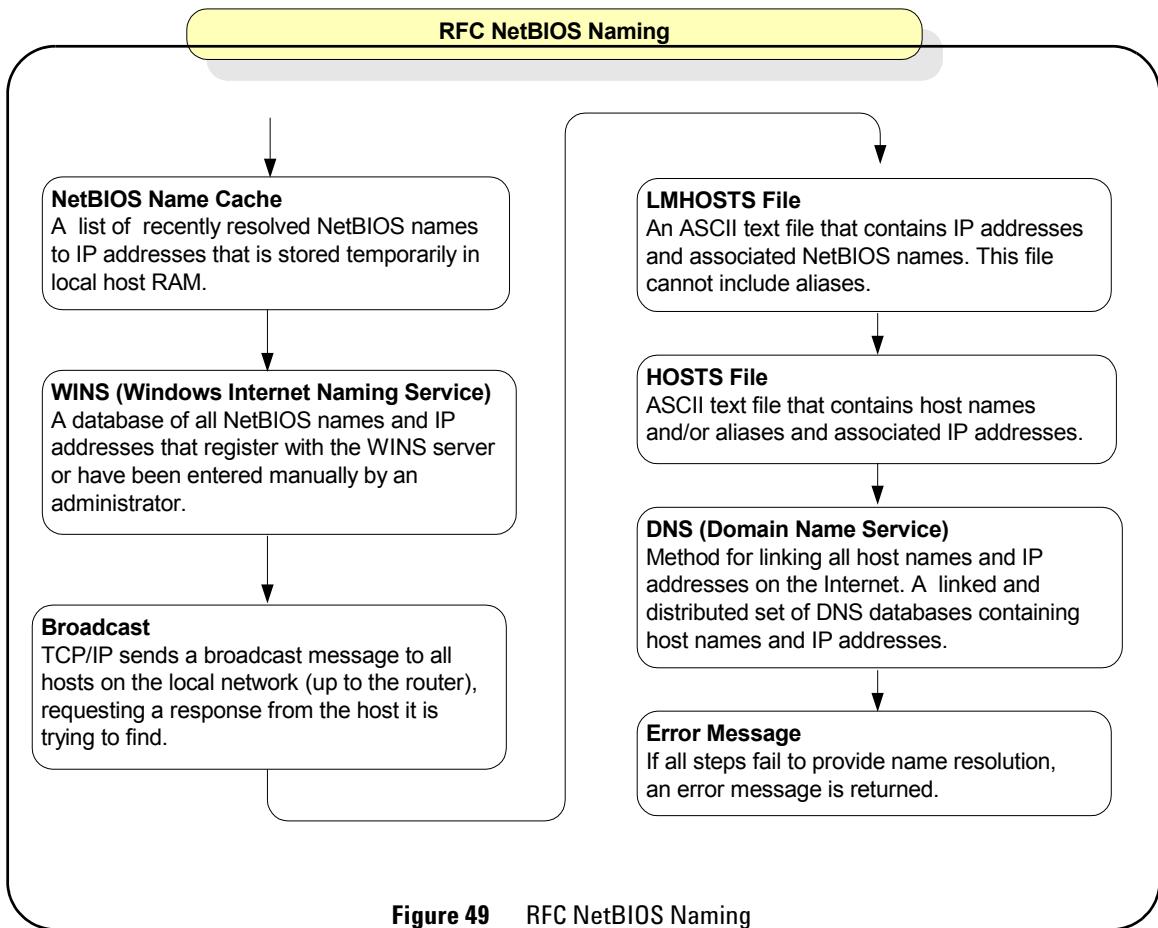


Figure 49 RFC NetBIOS Naming

Static DNS Naming

In contrast to automatic DNS name resolution, **Static DNS naming** does not require any host functionality to support dynamic methods of hostname resolution. Static DNS Naming

uses a seven-step process to resolve an IP address to a specified hostname. TCP/IP completes each step in the sequence shown before returning an error message. See your instrument's *User's Guide* to determine if your instrument supports Static DNS Naming.

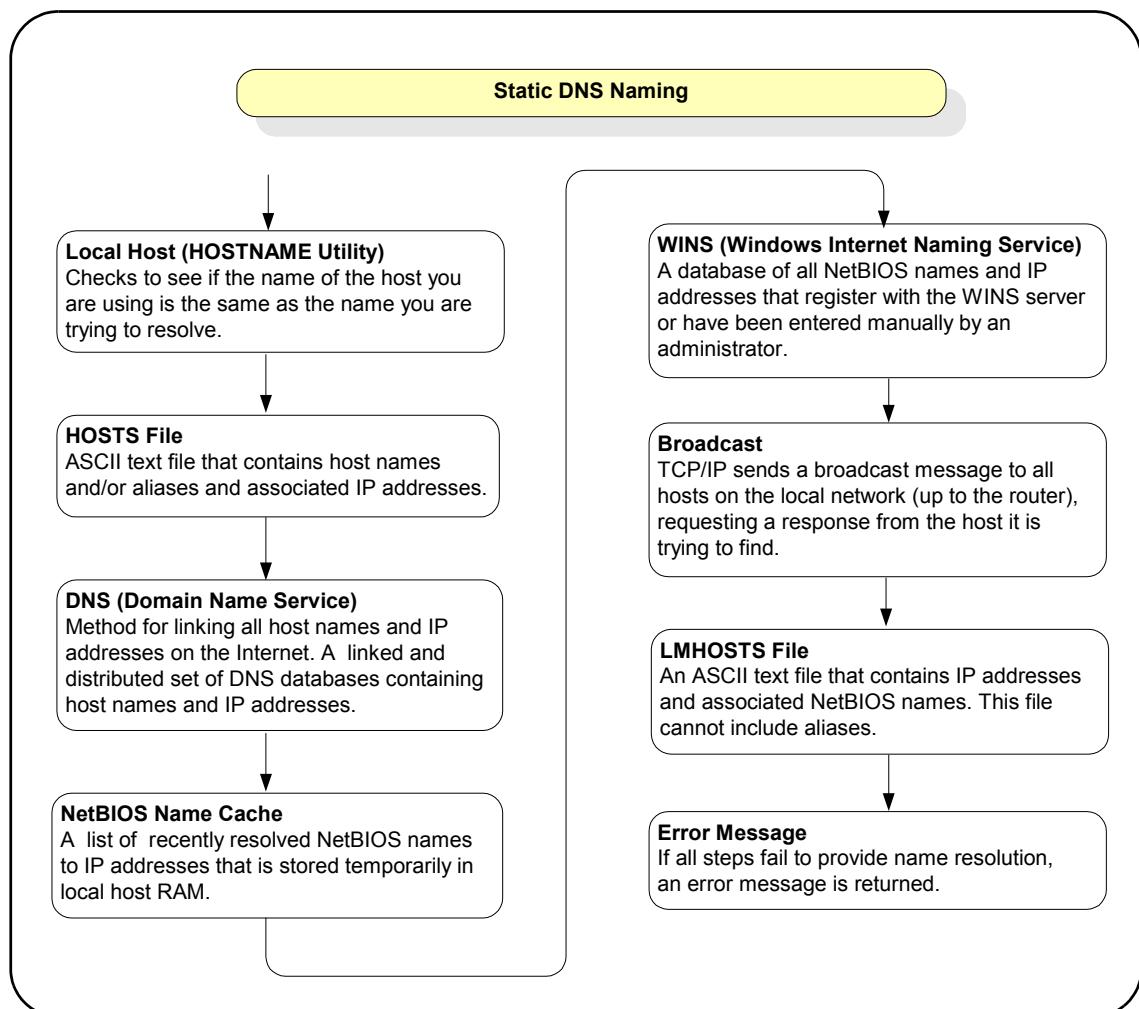


Figure 50 Static DNS Naming

Configuring Your PC for LAN Operation

This section shows steps to configure your PC, as required, for operation on a private LAN or for operation on site LANs that do not support DHCP, including:

- [Checking PC Settings](#)
- [Installing Network Interface Cards](#)
- [Installing TCP/IP on Your PC](#)
- [Setting PC IP Address](#)
- [Setting PC Hostname](#)

NOTE

If your PC is part of an existing private LAN or site LAN, you probably do not need to do the steps in this section. If local policies require it, contact your System Administrator before changing PC settings.

Checking PC Settings

To check the current settings for your PC, type **ipconfig /all** from the Command Prompt. The figure below shows a typical display for a Windows 2000 PC. The display for other operating systems may be different. If the settings are correct for your LAN operation, do not do any of the steps in this section. If the settings need to be changed, go to [Installing Network Interface Cards](#).

```
C:\>ipconfig /all
Windows 2000 IP Configuration

Host Name . . . . . : mypc1
Primary DNS Suffix . . . . . : lvid.agilent.com
NMT Type . . . . . : Hybrid
IP Routing Enabled . . . . . : No
WINS Proxy Enabled . . . . . : No
DNS Suffix Search List . . . . . : lvid.agilent.com
agilent.com

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . . . . . : lvid.agilent.com
Description . . . . . : Realtek RTL8139(A)-based PCI Fast Et
hernet Adapter
Physical Address . . . . . : 00-10-B5-09-53-30
DHCP Enabled . . . . . : Yes
Autoconfiguration Enabled . . . . . : Yes
IP Address . . . . . : 156.140.184.163
Subnet Mask . . . . . : 255.255.252.0
Default Gateway . . . . . : 156.140.184.1
DHCP Server . . . . . : 156.140.184.102
DNS Servers . . . . . : 156.140.184.1
Primary WINS Server . . . . . : 130.29.152.23
Secondary WINS Server . . . . . : 130.29.154.21
Lease Obtained . . . . . : Wednesday, October 02, 2002 4:03:29 AM
Lease Expires . . . . . : Thursday, October 03, 2002 4:03:29 AM
C:\>
```

Installing Network Interface Cards

Network Interface Cards (NIC) provide the hardware interface between your PC and network devices such as routers, hubs, or switches. As required, install NIC(s) in your PC according to the NIC manufacturer's instructions.

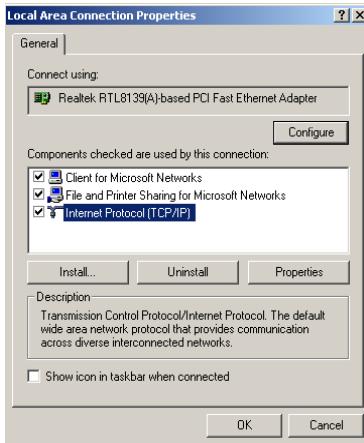
Installing TCP/IP on Your PC

To configure a network interface card, the TCP/IP protocol must be installed and configured. See the following examples for a Windows 2000 PC or for a Windows XP PC. Modify the steps as required for your operating system.

Example: Installing TCP/IP (Windows 2000)

- 1 Click Start > Settings > Network and Dial-up Connections to display the Network and Dial-up Connections dialog box.
- 2 Right-click Local Area Connection and then click Properties to display the Local Area Connection Properties dialog box.

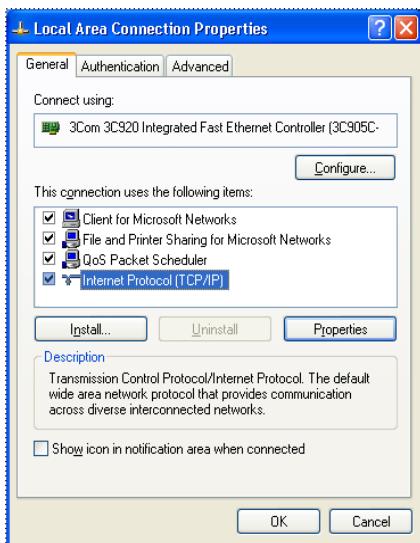
- 3 The General tab should display **Internet Protocol (TCP/IP)**. If not, click **Install...**, then select **Protocol** and click **Add**. Then, select **TCP/IP Protocol** and click **Install**.



Example: Installing TCP/IP (Windows XP)

- 1 Click **Start > Network > Internet Connections**. From the “or pick a control panel icon”, select **Network Connections**.
- 2 Right-click **Local Area Connection** and then click **Properties** to display the **Local Area Connection Properties** dialog box.

- 3 The General tab should display **Internet Protocol (TCP/IP)**. If not, click **Install**, then select **Protocol** and click **Add**. Then, select **TCP/IP Protocol** and click **Install**.



Setting PC IP Address

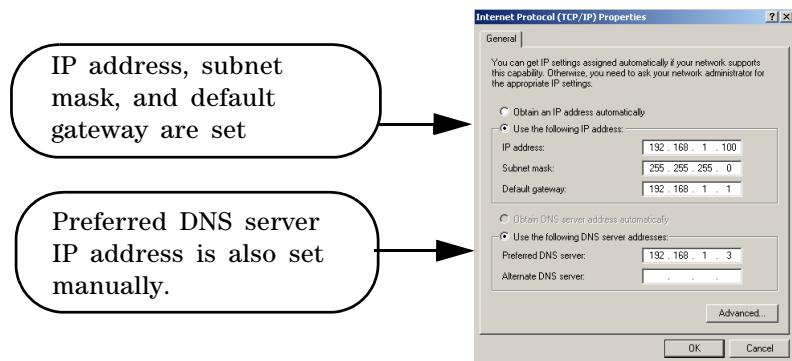
Depending on the LAN capabilities, you can select automatic or manual methods to set the IP address and the DNS Server address on your PC. These examples show how to set an IP address for a Windows 2000 or Windows XP PC. Modify the steps as required for your operating system.

NOTE

You should *not* change the IP configuration of your PC unless you are sure this is necessary. In almost all cases, the PC should be automatically configured.

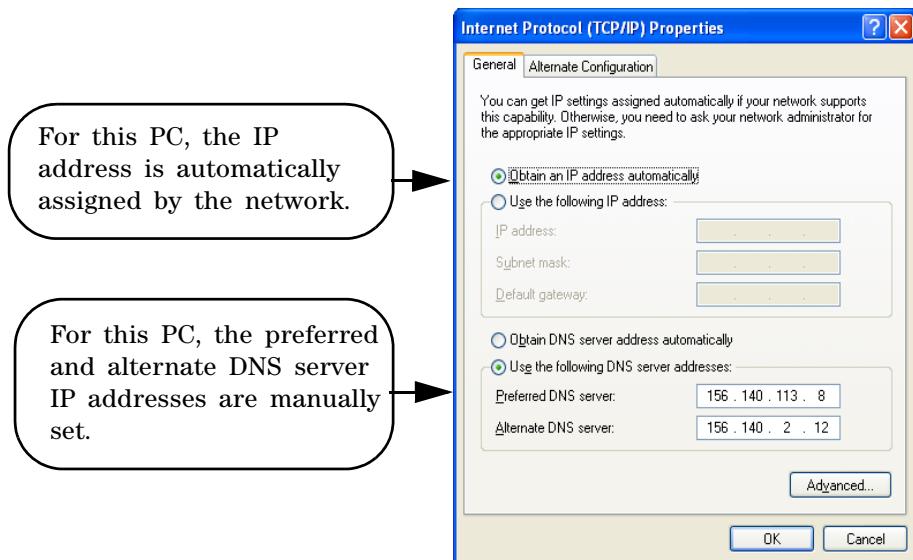
Example: Setting PC IP Address (Windows 2000)

- 1 Click Start > Settings > Network and Dial-up Connections to display the Network and Dial-up Connections dialog box.
- 2 Right-click Local Area Connection and then click Properties to display the Local Area Connection Properties dialog box.
- 3 From the General tab, select TCP/IP Protocol and then click Properties to display the Internet Protocol (TCP/IP) Properties dialog box. Select the method to set the IP address and/or Preferred and Alternate DNS server addresses.
- 4 If you select manual assignments, enter the desired values. When you have finished, click the OK box to enable the assignments. This figure shows an Internet Protocol (TCP/IP) Properties dialog box to manually assign IP and DNS Server configuration on a Windows 2000 PC.

**Example: Setting PC IP Address (Windows XP)**

- 1 Click Start > Network > Internet Connections.
- 2 From the “or pick a control panel icon”, select Network Connections.
- 3 Right-click Local Area Connection and then click Properties to display the Local Area Connection Properties dialog box.
- 4 From the General tab, select TCP/IP Protocol and then click Properties.

- 5 Select **Use the Following IP Address** and then enter the IP address and subnet mask for the network. As required, enter the default gateway and DNS settings. Follow the on-screen instructions and reboot your PC as required.
- 6 This figure shows an **Internet Protocol (TCP/IP) Properties** dialog box to automatically obtain IP addresses and to manually assign DNS Server addresses on a Windows XP PC.

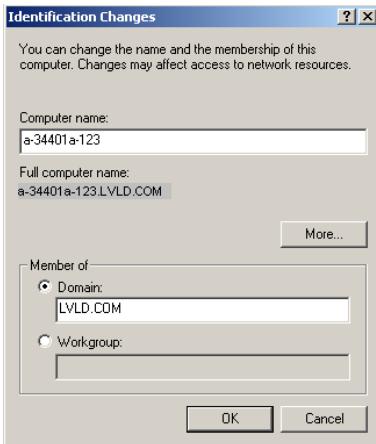


Setting PC Hostname

As desired, you can set an approved Hostname and a Domain Name (such as *dept.company.com*) for your PC. Examples for Windows 2000 and Windows XP follow. Modify the steps as required for your operating system.

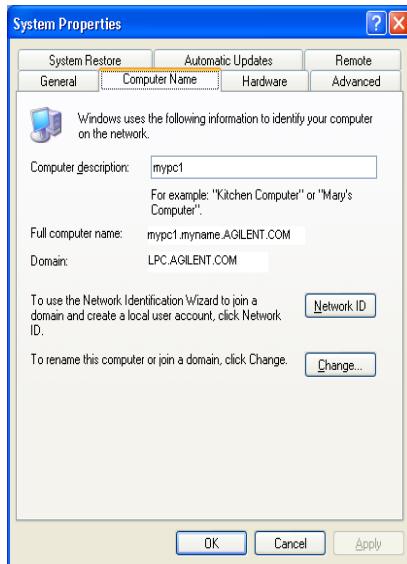
Example: Setting PC Hostname (Windows 2000)

- 1 Right-click the **My Computer** icon and then click **Properties** to display the **System Properties** dialog box. Select the **Network Identification** tab and then click **Properties** to display the **Identification Changes** dialog box.
- 2 As required, set/change the Hostname and/or Domain Name. When you have finished, click the **OK** box to enable the assignments. This figure shows an example **Identification Changes** dialog box on a Windows 2000 PC. As desired, you can change the Hostname and/or Domain Name.

**Example: Setting PC Hostname (Windows XP)**

- 1 Right-click the **My Computer** icon and then click **Properties** to display the **System Properties** dialog box.
- 2 Select the **Network Identification** tab and then click **Properties** to display the **Identification Changes** dialog box.
- 3 As required, set/change the Hostname and/or Domain Name. When you have finished, click the **OK** box to enable the assignments.

- 4 This figure shows an example **Identification Changes** dialog box on a Windows XP PC. As desired, you can change the hostname and/or domain name.



8

Troubleshooting Guidelines

This chapter includes:

- Troubleshooting LAN Interfaces
- Troubleshooting USB Interfaces
- Troubleshooting GPIB Interfaces



Troubleshooting LAN Interfaces

This section shows suggested troubleshooting steps for LAN interfaces, including the following items. For information on TCP/IP networks, see [TCP/IP Network Basics](#).

- [LAN Troubleshooting Overview](#)
- [Hardware Checks](#)
- [Communication Checks](#)
- [Web Browser Checks](#)

LAN Troubleshooting Overview

LAN troubleshooting guidelines follow. However, the first step is to check for normal operation, as shown in [Checking for Normal Operation](#).

Checking for Normal Operation Before beginning LAN troubleshooting steps, you should first check to see what symptoms appear when you attempt to connect to instruments via the LAN. To see if your PC has network access to an instrument, open the Web browser on the PC and type in the instrument's IP address (or hostname, if known) on the web browser's address line.

If the instrument's [Welcome Page](#) appears, this PC has network connection to the instrument. Repeat this step for each instrument on the network. An example for the Agilent 33220A follows. If normal operation cannot be established, go to [Troubleshooting Flowchart](#) for a suggested sequence of troubleshooting steps.

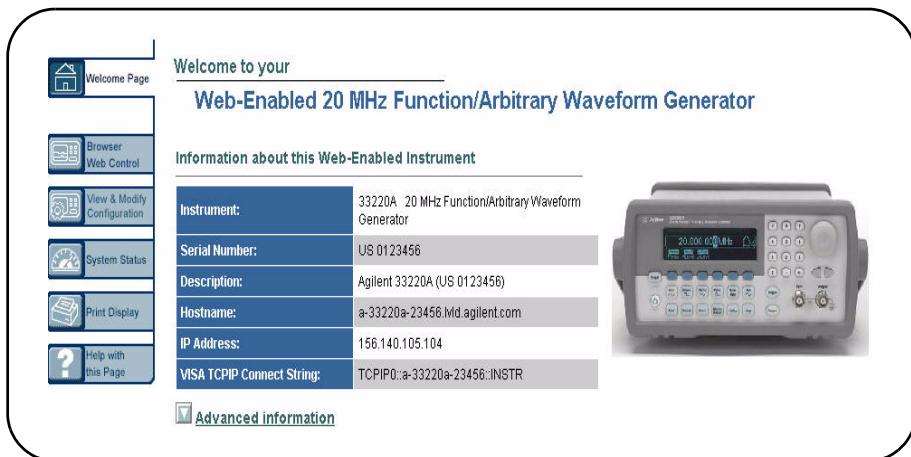
NOTE

There are additional troubleshooting tips in the *IO Libraries Suite Online Help*.

Example: Using a Web Browser

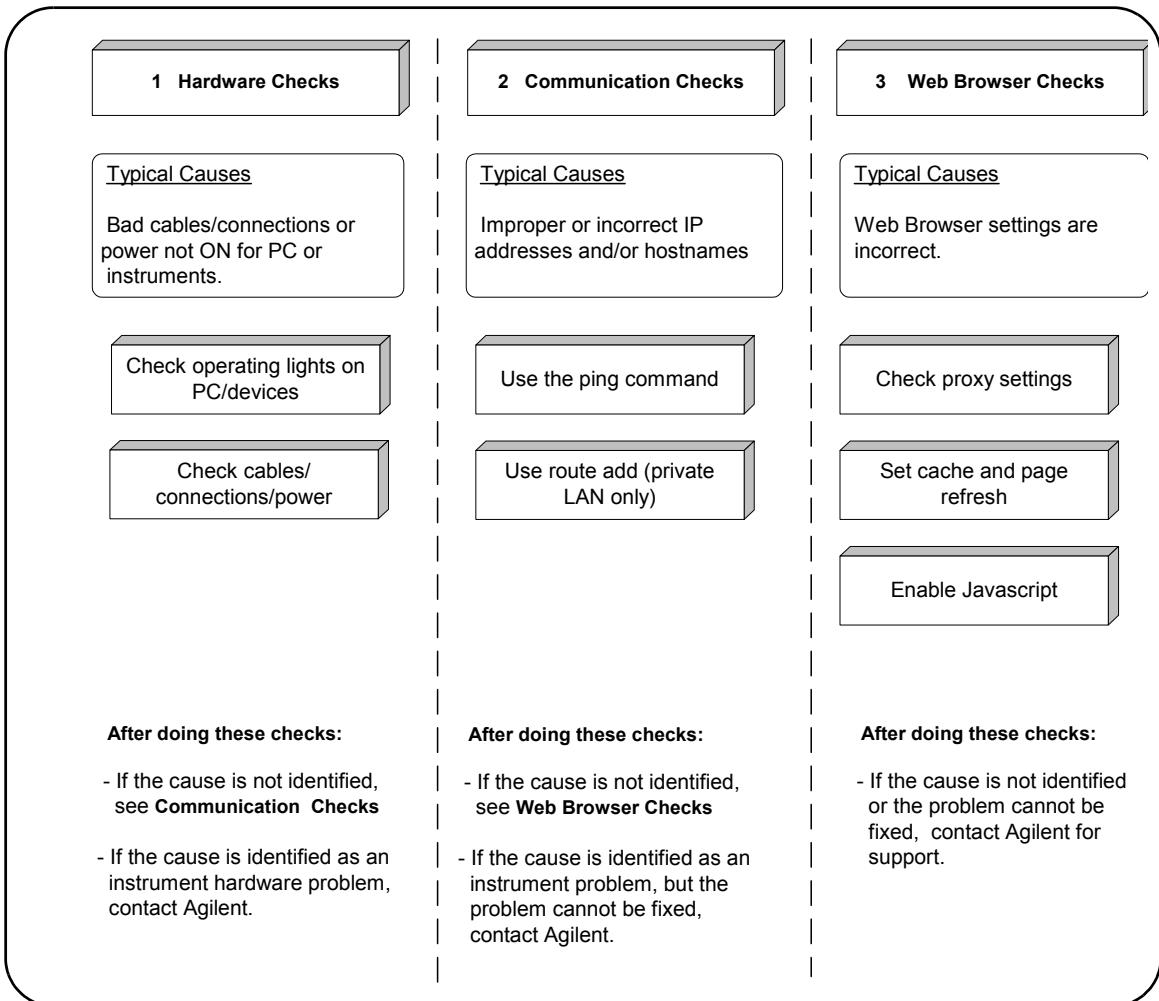
Since the 33220A is Web-enabled, to display the 33220A **Welcome Page**, first determine the 33220A IP address from the instrument's front panel display. Next, open your web browser and type '<http://<33220A IP Address>>', where **<33220A IP Address>** is the IP address displayed on the front panel. Then, press **Enter** to display the 33220A **Welcome** page.

For example, if the current IP address is 169.254.3.2, typing <http://169.254.3.2> and pressing **Enter** displays the 33220A **Welcome** page. This figure shows a portion of an example **Welcome** page display for the Agilent 33220A.



8 Troubleshooting Guidelines

Troubleshooting Flowchart If normal operation cannot be established, see this flowchart for suggested troubleshooting steps. We suggest you start at [Hardware Checks](#).



Hardware Checks The first step in troubleshooting LAN networks is to check the hardware setup for all devices connected to the LAN. This table shows some possible causes and corrective actions.

After you have made the hardware checks and taken corrective actions as required, again check for normal operation as shown in [Checking for Normal Operation](#). If normal operation has not been established, go to [Communication Checks](#).

Possible Cause(s)	Corrective Action(s)
PC Suspended or Network Interface Card (NIC) not operational.	Verify that the PC is not in a Suspended power state. If the lights on the NIC are ON, the NIC is probably operational.
Ethernet Hub or Switch not ON or not operational.	Verify that the hub/switch is powered ON. If the hub/switch lights are ON, the hub/switch is probably operational.
Instruments are not ON or are not operational.	Verify that all instruments are powered ON. If the power-on light is ON, the instrument is probably operational. Also, check the NIC lights on the instruments. If the NIC lights are ON, the hardware LAN connection to the instrument is OK.
Cables are not properly connected	Check LAN cable connections between PC, hub/switch, and instruments. Tighten connectors or replace cables as required.

Communication Checks

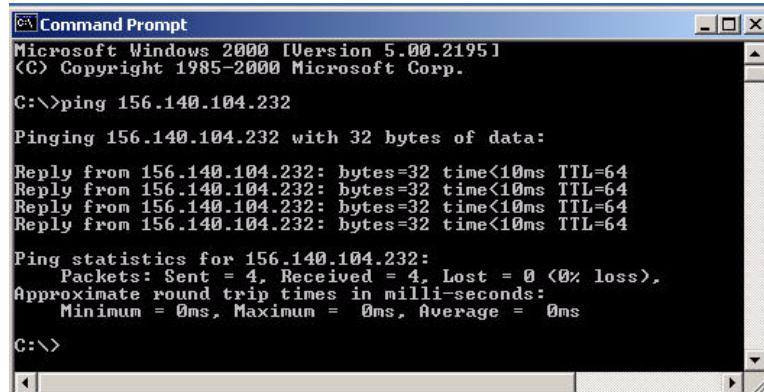
If there are no hardware problems, but normal communication has not been established, the next step is to make communication checks using the **ping** command. In addition, for private LANs only, you may need to use the **route add** command to establish communication. If you can establish communication using these checks, but the web browser display is not correct, go to [Web Browser Checks](#).

Using the ping Command An example to verify communication using the **ping** command follows.

NOTE

If you cannot verify communication to connected instruments using the **ping** command, try using **ping** to a device at a known address. If this is successful, the problem is likely with the instrument (for site LANs) or with the hub/switch or instruments (for private LANs).

Example: Verifying Communication Using the ping Command For example, on Windows 2000 to send a **ping** command from your PC to an instrument click **Start > Programs > Accessories > Command Prompt**. When the **Command Prompt** window opens, type **ping <IP_address>**, where **<IP_address>** is the IP address of the instrument, and then press the **Enter** key. A typical display follows, where **ping** was successful.



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

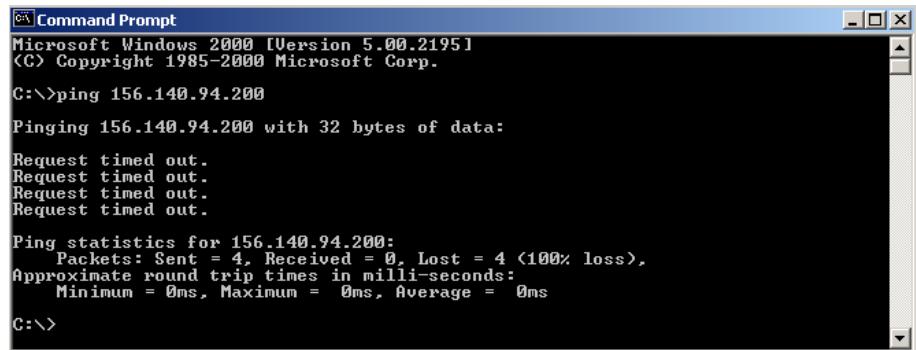
C:\>ping 156.140.104.232

Pinging 156.140.104.232 with 32 bytes of data:
Reply from 156.140.104.232: bytes=32 time<10ms TTL=64

Ping statistics for 156.140.104.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

A typical display follows, where **ping** was not successful.



The screenshot shows a Command Prompt window titled "Command Prompt". It displays the following text:

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

C:\>ping 156.140.94.200
Pinging 156.140.94.200 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 156.140.94.200:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Using the route add Command If you are having difficulty with a private LAN (using a hub, switch, or even a simple crossover cable), a possible cause for no communication between the PC and connected instruments is that the PC has not recognized that it is connected to two different subnets. (See [Local and Remote Networks](#) for details.)

One way to put the PC and the instrument on the same subnet is to use **route add <Instrument IP Address> <PC IP Address>** from the **Command Prompt**. If this action does not correct the problem, go to [Web Browser Checks](#).)

NOTE

If your devices are connected to site LAN, do not use the **route add** command.

Example: Using the route add Command

For example, on Windows 2000 to send a **route add** command, click **Start > Programs > Accessories > Command Prompt**. When the **Command Prompt** window opens, type **route add <Instrument IP Address> <PC IP Address>**, where **<Instrument IP_address>** is the IP address of the instrument and **<PC IP Address>** is the IP address of the instrument. Then press the **Enter** key.

For example, if the IP address of your PC is 155.139.103.152 and the instrument address is 169.254.58.10, the two devices are probably on different subnets. To add the instrument to the subnet for the PC, use one of the following:

! route is lost when the PC is rebooted
`route add 169.254.58.10 155.139.103.152`

or

! route persists when the PC is rebooted
`route -p add 169.254.58.10 155.139.103.152`

Web Browser Checks

If all hardware connections are OK and you have been able to establish communication between your PC and instruments, but the web browser display is incorrect or the web browser display does not appear at all, the problem could be that the web browser settings are incorrect.

Suggested steps follow to check your web browser settings, including the following items. If doing these steps does not correct the problem, contact Agilent for support. See [Contacting Agilent](#) for addresses.

- Checking Proxy Settings
- Setting Cache and Page Refresh
- Enabling Javascript

Checking Proxy Settings A **proxy** is a service running on a computer that takes an information request from another computer and passes the request on as if the request were its own. Typically, many companies use proxies to control access from their internal network to the external Internet.

In some situations, you may not be able to communicate with the instrument if you are using a proxy server. Typically, the web page will time out because the requested

address is not accessible by the network, although the correct IP address or hostname is entered into the web browser address field.

To fix this communication problem between the web browser and the instrument web server, the browser must be informed that any requests to the instrument should **not** utilize a proxy.

Example: Setting Proxy Notification (Internet Explorer 5.0 and above)

Example steps check proxy settings for Internet Explorer versions 5.0 and above follow. The steps are for Windows 2000. Modify the steps as required for other operating systems.

- 1 Click **Start > Settings > Control Panel** to display the **Control Panel**
- 2 From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box
- 3 From the **Internet Properties** dialog box, select the **Connections** tab
- 4 Click the **LAN Settings...** button under **Local Area Network (LAN) settings**
- 5 Under **Proxy server**, if “**Use a proxy server**” is checked, click the **Advanced...** button
- 6 Under **Exceptions**, add the IP address of the instrument or a fully-qualified domain name (such as **myinstr.example.com**) to the list box called “**Do not use proxy server for addresses beginning with:**” Use a semicolon (;) to separate multiple entries.
- 7 Click the **OK** button on the bottom of the **Internet Options** dialog box to make changes active.

Setting Cache and Page Refresh For faster performance, most web browsers cache web pages. If a page is cached, an image of the web page is stored locally. When you navigate

to a page that has already been viewed, the browser will load the page from its cache rather than loading it from the network.

Usually, this process works well for static web pages. However, this process may cause problems for 'dynamically' changing web pages. This problem may occur when you are navigating using the browser's forward/back/refresh options.

Doing this usually causes the browser to first look in its cache to see if the page exists. If the page is cached, the browser displays the page from the cache instead of going to the network to update changes. Since instrument web pages are dynamic in nature, the cache may contain content that is outdated. If you see a problem where dynamic pages are not being updated automatically, the browser should be instructed to check for newer versions of a web page on every page visit.

Example: Cache and Page Refresh (Internet Explorer 5.0 and above)

Example steps for cache and page refresh for Internet Explorer versions 5.0 and above follow. The steps are for Windows 2000. Modify the steps as required for other operating systems.

- 1** Click Start > Settings > Control Panel to display the Control Panel.
- 2** From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box.
- 3** From the **Internet Properties** dialog box, select the **General** tab.
- 4** Under **Temporary Internet files**, click the **Settings...** button to display the **Settings** dialog box.
- 5** Under **Check for newer versions of stored pages:**, click the **"Every visit to the page"** radio button ("Automatically" should be okay for Internet Explorer 5.5 and greater).
- 6** Click the **OK** button on the **Settings** page to accept the change.

- 7 Click the **OK** button on the bottom of the **Internet Options** dialog box to make changes active.

NOTE

If the previous steps to not resolve the problem, you may want to clear the cache. To do this, repeat steps 1 - 4. Then, in the **Temporary Internet files**, click the **Delete Files...** button to display the **Delete Files** dialog box. Click **OK** to delete the files and clear the cache.

Enabling Javascript Instruments that are Web-enabled may generate web pages that depend on Javascript and Frames. For proper operation, you may need to enable Javascript.

Example: Enabling Javascript (Internet Explorer 5.0 and above)

Example steps for enabling Javascript for Internet Explorer versions 5.0 and above follow. The steps are for Windows 2000. Modify the steps as required for other operating systems.

- 1 Click **Start > Settings > Control Panel** to display the Control Panel.
- 2 From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box.
- 3 From the **Internet Properties** dialog box, select the **Security** tab.
- 4 Click the **Custom Level...** button.
- 5 Under **Settings**, scroll down to the category called **Scripting**.
- 6 Click the **Enable** radio button under **Active Scripting**.
- 7 Click the **Enable** radio button under **Scripting of Java applets**.
- 8 Click the **OK** button on bottom of page to accept security settings.
- 9 When the **Warning!** dialog box appears, click the **YES** button when asked **“Are you sure you want to change the security settings for this zone?”**
- 10 Click the **OK** button on the bottom of the **Internet Options** dialog box to make the changes active.

Troubleshooting USB Interfaces

This section shows suggested troubleshooting steps for Universal Serial Bus (USB) interfaces, including:

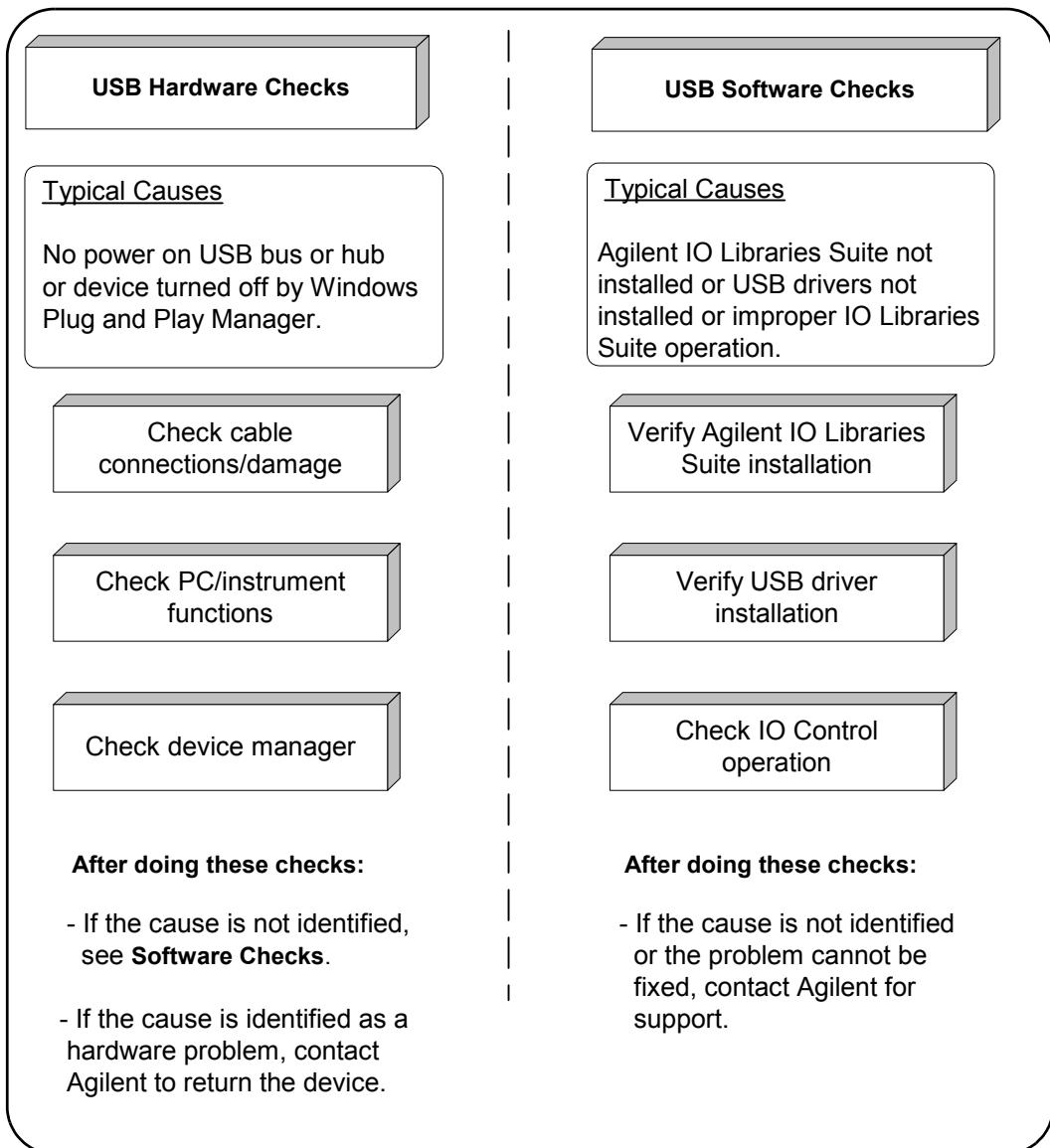
- [USB Troubleshooting Overview](#)
- [USB Hardware Checks](#)
- [USB Software Checks](#)

NOTE

The troubleshooting procedures in this section are primarily oriented toward USB instruments and the Agilent IO Libraries Suite. Consult your instrument's User's Guide for troubleshooting details for the instrument.

USB Troubleshooting Overview

This figure shows a typical USB interface with a PC and a USB instrument. A suggested troubleshooting flowchart for USB instruments and the Agilent IO Libraries Suite follows. We suggest you start at [USB Hardware Checks](#) and then go to [USB Software Checks](#), as required.



USB Hardware Checks

This section gives guidelines to make hardware troubleshooting checks for connected USB instruments. Start your troubleshooting sequence by performing the following hardware checks. If performing the hardware checks do not correct the problem, go to [USB Software Checks](#).

Check Cable Connections/Damage Check all USB cables for good connection to the USB connector on your PC, to all USB hubs (if installed) and the USB cable connections to connected USB instruments. An improperly attached USB connector can cause the interface to malfunction.

Check all USB cables for cuts/damage and check for bent/misaligned/crushed connector pins. Replace cables as required. If these actions do not solve the problem, try disconnecting and reconnecting (or replacing) USB cables. If the cable checks do not solve the problem, go to [Check PC/Instrument Functions](#).

Check PC/Instrument Functions Verify that all USB hubs, and all connected USB instruments are functional and are powered ON. Verify that host computer is not in a Suspended power management state. If these actions do not solve the problem, reboot the PC. If this does not solve the problem, go to [Check Device Manager](#).

Check Device Manager You can use the Windows Device Manager to reinstall the USB instrument driver, as required. For example, with Windows 2000, go to **Control Panel** by selecting **Start > Settings > Control Panel**. Then, select **System > Hardware > Device Manager**. From **Device Manager**, select the **USB Test and Measurement Device** and then click **Properties**.

Tab to **Driver** and click **Reinstall Driver**. This will allow the Windows Plug and Play Manager to begin searching for a driver for the instrument. Since Device Manager may have

disabled the instrument, click **Enable** to restart the instrument.

NOTE

Windows may place a misbehaving USB device in an “Unknown device” category. To see if this has happened, change the View in **Device Manager** by selecting **View > Show Hidden Devices**. Next, right-click the **Universal Serial Bus Controllers Unknown device** and select **Uninstall**. Then, select **Device Manager > Action > Scan** for hardware changes.

USB Software Checks

This section provides guidelines to make software troubleshooting checks for connected USB instruments. If you have not already done so, we suggest you start your troubleshooting sequence by performing the hardware checks in [USB Hardware Checks](#). If performing the hardware and then the software checks does not correct the problem, contact Agilent for instructions. See [Contacting Agilent](#) for addresses.

Verify Agilent IO Libraries Suite Installation

- 1 **Check Agilent IO Libraries Version.** If a version of the Agilent IO Libraries or IO Libraries Suite has been installed, a blue IO icon is normally displayed on the Windows taskbar (on the lower right side of the screen).



Figure 51 IO Control Icons for IO Libraries and IO Libraries Suite

- If the IO icon is displayed, click the icon and click **About Agilent IO Control** to display the version. The version must be M.01.00 or greater. (The next version of the IO Libraries after “M” discontinued this alphabetic naming convention, and uses *IO Libraries Suite 14.0* to designate the version immediately following M.01.01.)
- If the IO icon is not displayed, a version may still be installed. To check this, click **Start > Programs** and look for the **Agilent IO Libraries** or the **Agilent IO Libraries Suite** program group.
- If this group is displayed, click **Agilent IO Libraries > Utilities > IO Control** or **Agilent IO Libraries Suite > Utilities > IO Control** to display the IO icon. Then, click the icon and click **About Agilent IO Control** to display the installed version (must be M.01.00 or greater).
- If neither the IO icon nor the Agilent IO Libraries Suite program group is displayed, no Agilent IO Libraries are installed. In this case, or if the installed version is not M.01.00 or greater, you must install the newer version (see substep 2 following).

2 Install Agilent IO Libraries Suite (as Required). If M.01.00 or greater of the Agilent IO Libraries is not installed on your PC, use this substep. Otherwise, skip to [Verify USB Driver Installation](#).

- Remove the USB cable from the USB port on the PC.
- Uninstall the IO Libraries by using **Add/Remove Programs** in the **Control Panel**.
- Install IO Libraries Suite from the *Automation-Ready CD with Agilent IO Libraries Suite*. (Go to [Installing I/O Software](#) for more information.)
- Connect the USB cable to the PC.
- If this does not correct the problem, go to [Verify USB Driver Installation](#).

Verify USB Driver Installation

- 3 Check for USB Driver Files.** Files are listed in their default Windows directories. Verify that the driver files are installed. If they are installed, go to [Check Agilent IO Control Operation](#). If not, go to substep 2 following.

NOTE

USB ports ONLY operate properly on Windows XP when the latest Microsoft USB drivers from Windows XP Service Pack 1 or greater have been properly installed. However, upgrading your XP PC to SP1 or SP2 will not automatically update the USB drivers. See www.agilent.com/find/inst_drivers to verify if correct USB drivers are installed and to install correct drivers as required.

Windows 2000	
Program Files	C:/Program Files/Agilent/IO Libraries Suite/drivers/agusb48832.dll
Driver Files	C:/Winnt/system32/drivers/ausbtmc.sys
.inf Files	C:/Winnt/inf/ausbtmc.inf
Windows 98 (SE)/Me/XP	
Program Files	C:/Program Files/Agilent/IO Libraries Suite/drivers/agusb48831.dll
Driver Files	C:/Windows/system32/drivers/ausbtmc.sys
.inf Files	C:/Windows/inf/ausbtmc.inf

- 4 Uninstall/Reinstall the Agilent IO Libraries Suite.** If the driver files are not found, uninstall the Agilent IO Libraries Suite by inserting the *Automation-Ready CD with Agilent IO Libraries Suite* and following the instructions to install the libraries. The installation program will detect the existence of the IO Libraries Suite and offer you the option to remove it. Then reinstall the IO Libraries Suite.

Check Agilent IO Control Operation When the Agilent IO Libraries Suite was installed, an **Agilent IO Control** was created. When the **Agilent IO Control** is active, it is displayed as a blue **IO** icon on the Windows taskbar. If the **Agilent IO Control** is deactivated, SICL/VISA applications that are running with the instrument will be unable to open sessions.

By default, the **Agilent IO Control** is always active after the Agilent IO Libraries Suite is installed and the blue **IO** icon is displayed. However, the **Agilent IO Control** may be active even though the blue **IO** icon is not displayed. There are two ways that the blue **IO** icon can be hidden:

- **Clicking Hide Agilent IO Control.** Clicking the blue **IO** icon and then clicking **Hide Agilent IO Control** hides the blue **IO** icon, but does **not** deactivate the Agilent IO Control. (You can also do this from the Connection Expert View menu.)
- **Clicking Exit.** Clicking the blue **IO** icon and then clicking **Exit** causes a dialog box to appear that asks you if you want to terminate the Agilent IO Control. Clicking **Yes** hides the blue **IO** icon **and** deactivates the Agilent IO Control.

If the blue **IO** icon is not displayed, either the blue **IO** icon display has been turned off and/or the Agilent IO Control is not active. In this case, click **Start > Programs > Agilent IO Libraries Suite > Utilities > IO Control** to re-start the Agilent IO Control and to display the blue **IO** icon.

Troubleshooting GPIB Interfaces

This section shows suggested troubleshooting steps for an Agilent 82350 GPIB interface, including:

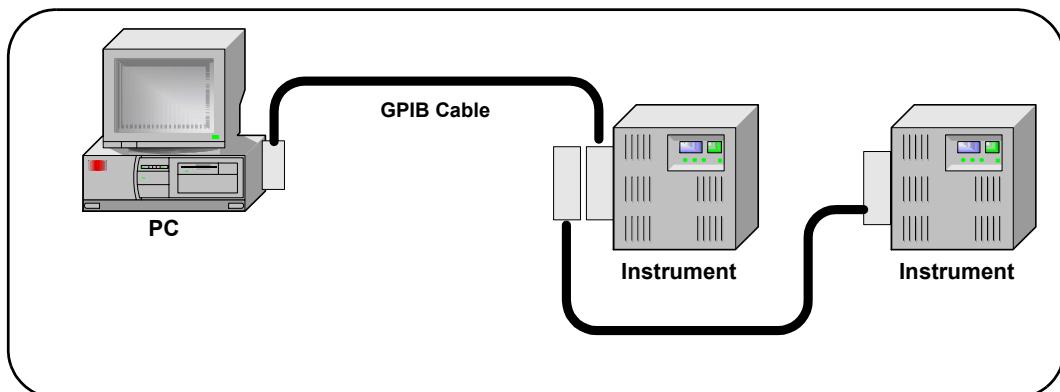
- GPIB Troubleshooting Overview
- GPIB Hardware Checks
- GPIB Software Checks
- Agilent IO Libraries Suite Checks

NOTE

The troubleshooting procedures in this section are primarily oriented toward an Agilent 82350 GPIB card and the Agilent IO Libraries Suite. Consult your instrument's User's Guide for troubleshooting details for the instrument.

GPIB Troubleshooting Overview

This figure shows a typical GPIB system with a PC and two GPIB instruments. A suggested troubleshooting flowchart for GPIB cards, installed instruments, and the Agilent IO Libraries Suite follows. We suggest you start at Step 1 and then go to Step 2 and then to Step 3, as required.



8 Troubleshooting Guidelines

1 GPIB Hardware Checks	2 GPIB Software Checks	3 Agilent IO Libraries Suite Checks
<u>Typical Causes</u> Bad GPIB cables/connections or power not ON for PC or instruments	<u>Typical Causes</u> GPIB card drivers not installed or GPIB card not properly configured.	<u>Typical Causes</u> Agilent IO Libraries Suite not installed or improper IO Libraries Suite configuration
Check cables/connections/power	Check for GPIB driver files	Check IO Libraries Suite Installation
Check Device Manager	Disable Agilent Connection Expert Auto-Detection	Check IO Control Operation
Other hardware checks	Check BIOS/interrupt settings	Install IO Libraries Suite (if GPIB already installed)
	Set 82350 Read/Write performance mode	
After doing these checks: - If the cause is not identified, see GPIB Software Checks - If the cause is identified as an 82350 hardware problem, contact Agilent to return the 82350.	After doing these checks: - If the cause is not identified, see Agilent IO Libraries Suite Checks - If the cause is identified, but the problem cannot be fixed, contact Agilent for support.	After doing these checks: - If the cause is not identified or the problem cannot be fixed, contact Agilent for support.

GPIB Hardware Checks

This section gives guidelines to make hardware troubleshooting checks for the GPIB card (such as an Agilent 82350), including:

- Check Cables/Connections/Power
- [Check Device Manager](#)
- [If Sound Card Does Not Work](#)
- [If Data Transfers to Devices Fail](#)
- [If Connection Expert Finds 82350 Card with Serial Number ffffffff](#)

Start your troubleshooting sequence by performing the following hardware checks. If the hardware checks do not solve the problem, see [GPIB Software Checks](#).

NOTE

There are no user-serviceable parts for the 82350. If you suspect a hardware failure for the 82350, contact Agilent for instructions to return the unit. See [Contacting Agilent](#) for telephone numbers/web site address.

- 1 Check GPIB Cable Connections.** Check all GPIB cables for good connection to the GPIB connector on the 82350 installed in your PC and the GPIB cable connections between all connected GPIB instruments. An improperly attached GPIB connector can cause the bus to malfunction.
- 2 Check GPIB Cables for Damage.** Check all GPIB cables for cuts/damage and check for bent/misaligned/crushed connector pins. Replace cables as required.
- 3 Disconnect/Reconnect GPIB Cables.** If Steps 1 and 2 do not solve the problem, try disconnecting and reconnecting (or replacing) GPIB cables.
- 4 Check PC/Instrument Power-on.** Verify that the PC and all connected GPIB instruments are functional and are powered ON. Verify that host computer is not in a Suspended power management state.
- 5 Reboot Your PC.** If doing Steps 1, 2, 3 or 4 does not solve the problem, reboot the PC. If this does not solve the problem, go to [Check Device Manager](#).

Check Device Manager You can use the Windows Device Manager to reinstall the 82350 or equivalent, as required. For example, with Windows 2000, go to **Control Panel** by selecting **Start > Settings > Control Panel**.

Then, select **System > Hardware > Device Manager**. From Device Manager, select **82350** and then **Properties**. Tab to **Driver** and click **Reinstall Driver**. This will allow the Windows Plug and Play Manager to begin searching for a driver for the 82350. Since Device Manager may have disabled the 82350 device, click **Enable** to restart the 82350. If this does not resolve the problem, go to [GPIB Software Checks](#).

If your sound card stops working after configuring interfaces, disable the auto-detection process in Connection Expert. Click **Tools > Options... .** Then de-select **Automatic discovery or refresh of I/O resources** under the **Configuration Settings** tab.

If Data Transfers to Devices Fail If devices attached to your ISA (82341) GPIB card are detected, but data transfers to those devices fail, this is usually caused either by an IRQ conflict with another card or by your system having no IRQs available for this card. If no IRQs are available, the IRQ value shown in Connection Expert will be -1.

For Windows 2000/XP: Try changing the IRQ setting to other values. You must reboot after changing the value to test it. If none work, you will have to free up other IRQs by disabling devices such as serial ports or sound cards.

For Windows 98/Me: You will have to free up other IRQs by disabling devices such as serial ports or sound cards. This is usually done in the BIOS setup for your computer.

If Connection Expert Finds 82350 Card with Serial Number ffffffff

If Connection Expert reports finding an 82350 card with serial number ffffffff, this is typically caused by getting into a situation where PCI cards are not properly configuring. Try the following:

- 1 Check BIOS Setting.**
 - 2 Upgrade your system BIOS to the latest version.** Note that even new computers tend to have new BIOS available.
 - 3 If your computer locks up or freezes after installing.**
Typically, this is caused by interrupt conflicts with other drivers in the system. PCI allows sharing of IRQs, but this also means that the drivers for cards that are sharing an IRQ must be handling interrupt chaining properly.
- Both NT and Windows 9x allow multiple drivers to install interrupt service routines (ISRs) for a single IRQ. The OS will keep a list of all the ISRs installed for each IRQ. When the IRQ is asserted, the operating system will call each ISR in turn until one of them returns TRUE (meaning that it handled the interrupt). The ISR's responsibility is to correctly return TRUE if its device was interrupting, or FALSE if not.
- 4 Perform Driver Work-Arounds.** Here are some ways to work around drivers that are not behaving properly:

- Upgrade the drivers for devices sharing an IRQ with Agilent, including but not limited to, your video drivers, your LAN drivers, Agilent IDE and/or SCSI drivers, and your sound drivers.
- Try to force the Agilent driver to be installed earlier in the ISR chain.
- For Windows 9x, change your BIOS **Installed OS** setting. Try all the different values and use the one that works.
- For Windows 9x, make sure all devices sharing an IRQ with our card have drivers installed. Right-click **My Computer** and select **Properties**, then **Device Manager**. Highlight **Computer** and click **Properties**. Find the 82350 card and check that all other cards on the same IRQ have a valid driver, not the big yellow question-mark.

- 5 **Re-Configure Your PC.** Configure your PC so as to not share IRQ lines. Many PCI cards have bugs when sharing IRQ lines. You may or may not be able to do this on all PCs. Many PCs can be configured using the setup option when the PC is first booting.
- 6 **Upgrade your system BIOS.** Note that even new computers may have a newer BIOS available.
 - Make sure the BIOS **Installed O/S** setting is set correctly. This determines what software will configure all the **VXIplug&play** cards in your system. Either the BIOS or the O/S can perform the task of querying all the cards to determine their resource needs, picking a valid configuration for all these cards, and telling the cards what their actual resource settings are.
 - If the BIOS **Installed OS** is set to **Windows 95, Windows 98, Windows 2000** or **Running a PnP OS**, the BIOS will not perform this task and will leave it to the operating system to do this. If the **Installed OS** is set to **NOT PnP OS**, or **Other**, the BIOS will perform this task.
 - For NT version 4.0 or earlier, the BIOS must perform this task as the OS does not know how to do this. For Windows 9x, either the BIOS or the OS can do this task, so try both.

GPIB Software Checks

This section provides guidelines for 82350 software checks, including:

- [Check for 82350 Driver Files](#)
- [Disable Connection Expert Auto-Detection](#)
- [Check BIOS/Interrupts Settings](#)
- [Set 82350 Read/Write Performance Mode](#)

Check for 82350 Driver Files After installing the Agilent IO Libraries Suite, check for installed 82350 driver files.

- 1 **Check for 82350 Driver Files.** Files are listed in their default directories.

Windows 2000	
Program Files	C:/Program Files/Agilent/IO Libraries Suite/drivers/ag350i32.dll
Driver Files	C:/Winnt/system32/drivers/agt82350.sys
.inf Files	C:/Winnt/inf/agt350.inf
Windows 98 (SE)/Me/XP	
Program Files	C:/Program Files/Agilent/IO Libraries Suite/drivers/ag350i31.dll
Driver Files	C:/Windows/system32/drivers/agt82350.sys
.inf Files	C:/Windows/inf/agt350.inf

- 2 **Uninstall/Reinstall the Agilent IO Libraries Suite.** If the driver files are not found, uninstall the Agilent IO Libraries Suite by inserting the *Automation-Ready CD with Agilent IO Libraries Suite* and following the instructions to remove the libraries. Then, follow the instructions to re-install the libraries.

Disable Connection Expert Auto-Detection If your PC sound card stops working after configuring interfaces, disable the auto-detection process in Connection Expert, as the auto-detection process in Connection Expert can cause sound and other cards to stop responding. To disable the auto-detection process, click **Tools > Options...**. Then de-select **Automatic discovery or refresh of I/O resources** under the **Configuration Settings** tab.

Check BIOS/Interrupts Settings If Connection Expert reports finding an 82350 card with Serial Number ffffffff, this is typically caused by PCI cards not being configured properly. Try the following steps. If these steps do not work, remove and re-install the 82350 and then reconfigure the card.

- 1 Check BIOS Setting.**
- 2 Upgrade your system BIOS to the latest version.** New computers oftentimes have newer BIOSs available.
- 3 If your computer locks up or freezes after installing.** This is typically caused by interrupt conflicts with other drivers in the system. PCI allows sharing of IRQs, but this also means the drivers for cards which share an IRQ must be handling interrupt chaining properly. Both NT and Windows 9x allow multiple drivers to install interrupt service routines (ISRs) for a single IRQ. The OS keeps a list of all the ISRs installed for each IRQ.

When the IRQ is asserted, the OS calls each ISR in turn until one of them returns TRUE (meaning that it handled the interrupt). The ISR's responsibility is to correctly return TRUE if its device was interrupting or FALSE if not. Drivers that return TRUE, even though they did not service the interrupt, will cause problems. Try the following steps to perform driver workarounds:

- Upgrade the drivers for devices sharing an IRQ with Agilent, including, but not limited to, your video drivers, your LAN drivers, Agilent IDE and/or SCSI drivers, and your sound drivers.
- For Windows 9x, change your BIOS **Installed OS** setting. Try all the different values and use the one that works. For Windows 9x, make sure all devices sharing an IRQ with your card have drivers installed.

Right-click **My Computer** and select **Properties**, then **Device Manager**. Highlight **Computer** and click **Properties**. Find the 82350 card and check that all other cards on the same IRQ have a valid driver, not the big yellow question-mark.

- 4 **Re-Configure Your PC.** Configure your PC so as to not share IRQ lines. Many PCI cards have bugs when sharing IRQ lines. You may or may not be able to do this on all PCs. Many PCs can be configured using the setup option when the PC is first booting.
- 5 **Upgrade your system BIOS.** New computers may have a newer BIOS available. When installing a new system BIOS:
 - 6 Make sure the BIOS **Installed O/S** setting is set correctly. This determines what software will configure all the *VXIplug&play* cards in your system. Either the BIOS or the O/S can perform the task of querying all the cards to determine their resource needs, picking a valid configuration for all these cards, and telling the cards what their actual resource settings are.
 - If the BIOS **Installed O/S** is set to **Windows 95, Windows 98, Windows 2000** or **Running a PnP O/S**, the BIOS will not perform this task and will leave it to the O/S to do this. If the **Installed O/S** is set to **NOT PnP O/S**, or **Other**, the BIOS will perform this task and the system may not work properly.
 - For NT version 4.0 or earlier, the BIOS must perform this task as the O/S does not know how to do this. For Windows 9x, either the BIOS or the O/S can do this task, so try both. Set 82350 Read/Write Performance Mode

The 82350 card read and write calls use one of two modes:

- **Polling.** Bytes are transferred to/from the card, one at a time. Polling mode is advantageous for transferring a small number of bytes because the setup overhead is very low, but it does require CPU involvement for each byte transferred.
- **Interrupt.** An entire buffer is transferred to/from the card without CPU involvement. Interrupt mode is advantageous for transferring large buffers because the higher per byte transfer rate more than compensates for the relatively long interrupt setup overhead.

The default behavior of the 82350 driver is to use **Polling** mode for transfers of 256 bytes or less and to use **Interrupt** mode for larger transfers. You can modify this default behavior by doing the following:

VISA: The VISA `viSetAttribute(vi, VI_ATTR_DMA_ALLOW_EN, attrValue)` function can be called to modify the read/write behavior for a VISA session. The `VI_ATTR_DMA_ALLOW_EN` values allowed are:

- **VI_TRUE** (default value) Use Interrupt mode for transfer requests larger than 256 bytes, otherwise, use Polling mode.
- **VI_FALSE** Use the Polling mode.

SICL: The SICL `ihint(id, hint)` function can be called to modify the read/write behavior for on a SICL session. The `hint` values allowed are:

- **I_HINT_DONTCARE** (default value) Use Interrupt mode for transfer requests larger than 256 bytes, otherwise, use Polling mode.
- **I_HINT_USEPOLL** Use the Polling mode.
- **I_HINT_IO** Use the Interrupt mode.

Some additional factors to consider are:

- The settings discussed above are per session. This means you can open multiple sessions to a device and set different transfer modes for different sessions. The actual mode used will then depend on which session you are using for the read/write calls.
- In both SICL (with `hint = I_HINT_DONTCARE`) and VISA (with `VI_ATTR_DMA_ALLOW_EN = VI_TRUE`), the size of the read request (as specified by `bufsize` in a SICL `iread()` or `count` in a VISA `viRead()` function call) will determine the mode used even if the number of bytes actually read is less.

- The default formatted I/O read buffer size is 4096 so when using this default size, formatted reads in SICL (with `hint = I_HINT_DONTCARE`) and VISA (with `VI_ATTR_DMA_ALLOW_EN = VI_TRUE`) will use Interrupt mode even when a small number of bytes are expected.
- The default formatted IO write buffer size is 128 so when using this default size, formatted writes in SICL (with `hint = I_HINT_DONTCARE`) and VISA (with `VI_ATTR_DMA_ALLOW_EN = VI_TRUE`) will used Polling mode even when a large number of bytes are being sent.
- In SICL, Polling mode will always be used for the `iread()`, `ifread()` and `iscanf()` regardless of the above settings, when a `termchr` is set (`itermchr()` is not set to `-1`).
- In VISA, Polling mode will always be used for `viRead()`, `viBufRead()` and `viScanf()` regardless of the above settings, when `VI_ATTR_TERM_CHAR_EN = VI_TRUE`.

The **crossover point** at which the Interrupt mode becomes faster then the Polling mode depends on the CPU speed, with a faster CPU having a higher crossover point.

Agilent IO Libraries Suite Checks

This section gives troubleshooting guidelines for the Agilent IO Libraries Suite, including:

- Check IO Libraries Suite Installation
- Check Agilent IO Control Operation
- Install IO Libraries Suite (if 82350 was installed first)

Check IO Libraries Suite Installation Start your Agilent IO Libraries Suite troubleshooting sequence by verifying IO Libraries Suite installation. If the IO Libraries Suite is installed, go to [Check Agilent IO Control Operation](#).

1 Check Agilent IO Libraries Suite Version. If a version of the Agilent IO Libraries or Agilent IO Libraries Suite has been installed, a blue **IO** icon is normally displayed on the Windows taskbar (on the lower right-hand side of the screen).



Figure 52 IO Control Icons for IO Libraries and IO Libraries Suite

- If the **IO** icon is displayed, click the icon and click **About Agilent IO Control** to display the version. The version must be M.01.00 or greater. (The next version of the IO Libraries after "M" discontinued this naming convention, and uses *IO Libraries Suite 14.0* instead to designate the version immediately following M.01.01.)
- If the **IO** icon is not displayed, a version may still be installed. To check this, click **Start | Programs** and look for the *Agilent IO Libraries Suite* program group.
- If this group is displayed, click **Agilent IO Libraries Suite > Utilities > IO Control** to display the **IO** icon. Then, click the icon and click **About Agilent IO Control** to display the installed version (must be M.01.00 or greater).

- If neither the **IO** icon nor the Agilent IO Libraries Suite program group is displayed, no Agilent IO Libraries Suite are installed. In this case, or if the installed version is not M.01.00 or greater, you must install the newer version (see Step 2, following).
- 2 Install Agilent IO Libraries Suite (as Required).** If M.01.00 or greater is not installed on your PC, install the IO Libraries Suite. Otherwise, go to [Check Agilent IO Control Operation](#).

Check Agilent IO Control Operation When the Agilent IO Libraries Suite was installed, an Agilent IO Control was created. When the Agilent IO Control is active, it is displayed as a blue circled **IO** icon on the Windows taskbar. If the Agilent IO Control is deactivated, SICL/VISA applications that are running with the 82350 will be unable to open sessions.

By default, the Agilent IO Control is always active after the Agilent IO Libraries Suite are installed and the blue **IO** icon is displayed. However, the Agilent IO Control may be active even though the blue **IO** icon is not displayed. There are two ways that the blue **IO** icon can be hidden:

- **Clicking Hide Agilent IO Control.** Clicking the blue **IO** icon and then clicking **Hide Agilent IO Control** hides the **IO** icon, but does **not** deactivate the Agilent IO Control.
- **Clicking Exit.** Clicking the blue **IO** icon and then clicking **Exit** causes a dialog box to appear that asks you if you want to terminate the Agilent IO Control. Clicking **Yes** hides the blue **IO** icon **and** deactivates the Agilent IO Control.

If the blue **IO** icon is not displayed, either the blue **IO** icon display has been turned off and/or the Agilent IO Control (and associated **iprocsvr.exe**) is not active. In this case, click **Start > Programs > Agilent IO Libraries** and then click **Agilent IO Control** to re-start the Agilent IO Control and to display the blue **IO** icon.

Install IO Libraries Suite (if 82350 was Installed First)

NOTE

When you install the Agilent IO Libraries Suite, drivers for your 82350 GPIB card will be installed automatically. You should not need to take additional steps to install drivers. The information in this section is provided to assist you in case you have problems with your GPIB card and drivers.

- If you installed the 82350 GPIB card before installing the Agilent IO Libraries Suite software, use the applicable step for your operating system to install the Agilent IO Libraries Suite. After the drivers for all new cards are installed, you can run **Setup** from the *Automation-Ready CD with Agilent IO Libraries Suite* to install and configure the Agilent IO Libraries Suite.

NOTE

On older operating systems, you may be asked to insert the 'HP I/O Libraries' CD. You should use the CD that contains the Agilent IO Libraries Suite in this case. The card will be identified as a Hewlett-Packard card. This is necessary for backward compatibility.

- **Windows 2000:** The **Found New Hardware Wizard** will identify this card as a **PCI Simple Communications Controller**. The driver is typically located in the *\Windows 2000* directory on the *instrument* CD.
- **Windows 98:** The **Add New Hardware Wizard** will identify this card as a **PCI Communication Device**.

9 Guide Information

This chapter includes:

- Guide Contents
- Related Documentation
- Accessing an Electronic Copy of This Guide
- Contacting Agilent



Guide Contents

This *Agilent Technologies USB/LAN/GPIB Interfaces Connectivity Guide* shows how to connect instruments to USB, LAN, and GPIB interfaces and how to configure and troubleshoot these interfaces on PCs with Windows 98, Windows Me, Windows 2000, or Windows XP operating systems. A summary of the guide contents follows.

NOTE

This guide does not describe LAN networks that include a gateway, such as the Agilent E5810A LAN/GPIB Gateway for Windows. See the applicable gateway documentation for information on gateway systems.

Also, this guide does not provide a detailed description of LAN, USB, or GPIB interfaces or LAN networks. Consult standard reference texts for this information.

Section	Description
CONNECTIVITY GUIDELINES	
<i>Getting Started</i>	Shows steps to get started and how to contact Agilent
<i>Connecting Instruments to LANs</i>	Gives guidelines to connect instruments to LANs
<i>Connecting Instruments to USB</i>	Gives guidelines to connect instruments to USB
<i>Connecting Instruments to GPIB</i>	Gives guidelines to connect instruments to GPIB
<i>Programming Your Instruments</i>	Gives guidelines to program instruments via LAN/USB/GPIB
REFERENCE INFORMATION	
<i>Installing I/O Software</i>	Shows how to install I/O software on your PC
<i>Troubleshooting Guidelines</i>	Troubleshooting guidelines for LAN, USB, and GPIB Interfaces
<i>TCP/IP Network Basics</i>	Provides an overview of TCP/IP networks
<i>Guide Information</i>	Lists general information for this guide
<i>Glossary</i>	Defines some of the terms used in this guide
<i>Index</i>	Index of selected items in this guide

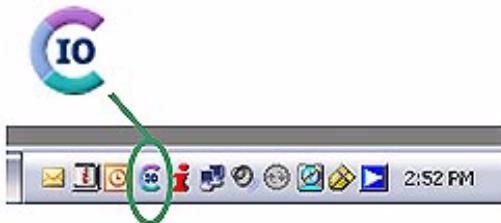
Related Documentation

Suggested related documentation you can use for interface connectivity operation follows. After Agilent IO Libraries Suite has been installed on your PC, PDF files of the *Agilent IO Libraries Getting Started Guide*, *VISA User's Guide*, and *SICL User's Guide* are available. Click the blue IO icon on the Windows taskbar and then click **Documentation**.

Product	Related Documentation
<i>Agilent IO Libraries Suite</i>	For additional information on the Agilent IO Libraries Suite, see the <i>Agilent IO Libraries Suite Getting Started Guide</i> and <i>IO Libraries Suite Online Help</i> .
<i>VISA</i>	To develop and use VISA applications, see the <i>Agilent VISA User's Guide</i> .
<i>SICL</i>	For SICL I/O applications, see the <i>Agilent SICL User's Guide</i> .
<i>T&M Toolkit</i>	To develop programs in Visual Studio.Net, see <i>Agilent T&M Toolkit</i> .

Accessing an Electronic Copy of This Guide

Access from the Agilent IO Control



After the Agilent IO Libraries Suite is installed, a blue **IO** icon appears on the right side of the Windows tray, as shown to the left. To access an electronic version of this connectivity guide, click the **IO** icon, then click **Documentation > Connectivity Guide**.

Access from the IO Libraries Suite CD-ROM

You can also access an electronic copy of this guide from the *Automation-Ready CD*. Insert the CD into your CD-ROM drive. Browse into the autorun folder to find the PDF manuals.

Contacting Agilent

You can reach Agilent Technologies at this telephone number in the United States:

Test and Measurement Contact Center: 1-800-829-4444

A list of contact information for other countries is available on the Agilent Internet site: www.agilent.com/find/assist. A list of other Agilent Web sites follows.

URL	Description
www.agilent.com/find/assist	Agilent Technologies "Contact Us" page
www.agilent.com/find/iolib	Update the Agilent IO Libraries Suite software
www.agilent.com/find/ADN	Connectivity resources all in one place
www.agilent.com/find/techsupport	Technical support information, including manuals, application notes, FAQs, and software and firmware downloads
www.agilent.com/find/connectivity	For connection, communication and control of test instruments from your computer, you can find out the latest in connectivity.

Glossary

A

address

A string uniquely identifying a particular interface or a device on that interface to identify the interface or device.

B

bridge

In telecommunication networks, a bridge is a product that connects a local area network (LAN) to another local area network that uses the same protocol (for example, Ethernet or token ring). You can envision a bridge as being a device that decides whether a message from you to someone else is going to the local area network in your building or to someone on the local area network in the building across the street. A bridge examines each message on a LAN, "passing" those known to be within the same LAN, and forwarding those known to be on the other interconnected LAN (or LANs).

C

client

Part of the client/server model used in distributed computing. A client is a computer system that requests services from a server computer system, such as I/O application requests, networking requests, etc.

controller

A computer used to communicate with a remote device such as an instrument. In the communications between the controller and the device, the controller is in charge of and controls the flow of communication that is, it does the addressing and/or other bus management).



D

device

A unit that receives commands from a controller. Typically a device is an instrument but could also be a computer acting in a non-controller role, or another peripheral such as a printer or plotter.

DHCP

Short for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network.

In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without manually assigning it a unique IP address. DHCP client support is built into Windows 98 and NT workstations.

DNS

Short for Domain Name System (or Service), an Internet service that translates domain names into IP addresses. Because domain names are alphabetic, they are easier to remember. The Internet, however, is really based on IP addresses. Every time you use a domain name, therefore, a DNS service must translate the name into the corresponding IP address.

For example, the domain name **www.example.com** might translate to 198.105.232.4. The DNS system is a distributed system. If one DNS server does not know how to translate a particular domain name, it asks another one, and so on, until the correct IP address is returned.

E

Ethernet (MAC) address

The Media Access Control Address, also known as the link-level address, the Ethernet (station) address, the LANIC ID, and the hardware address. This is a unique 48-bit address assigned by the

manufacturer for each Ethernet device. It is usually displayed as 12 hexadecimal characters, sometimes with colon or dash separators between every two characters, such as "00:03:d3:00:00:17" or "00-03-d3-00-00-17".

G

gateway

Hardware that permits a network connection between the LAN that your computer understands and the instrument specific interface that your device understands.

gateway IP address

This parameter is the IP address of the default subnet gateway that allows an instrument to communicate with systems that are not on the local subnet. Thus, this is the default subnet gateway where packets are sent that are destined for a device not on the local subnet, as determined by the subnet mask setting. Only one default subnet gateway can be configured. A value of 0.0.0.0 indicates that no subnetting is to be done.

H

hub

A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

- **Passive hubs** serve simply as a conduit for the data, enabling it to go from one device (or segment) to another.
- **Intelligent hubs** include additional features that enables an administrator to monitor the traffic passing through the hub and to configure each port in the hub. Intelligent hubs are also called manageable hubs.
- **Switching hubs** actually read the destination address of each packet and then forward the packet to the correct port.

I

instrument

A device that accepts commands and performs a test or measurement function.

interface

A connection and communication media between devices and controllers, including mechanical, electrical, and protocol connections.

IP address

An Internet Protocol (IP) address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address.

Within an isolated network, you can assign IP addresses at random as long as each one is unique. However, connecting a private network to

the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates. The four numbers in an IP address are used in different ways to identify a particular network and a host on that network. The InterNIC Registration Service assigns Internet addresses from the following three classes.

- Class A - supports 16 million hosts on each of 127 networks
- Class B - supports 65,000 hosts on each of 16,000 networks
- Class C - supports 254 hosts on each of 2 million networks

L**LAN**

Local Area Network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it also is able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can

also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

There are many different types of LANs, Ethernets being the most common for PCs. Most Apple Macintosh networks are based on Apple's AppleTalk network system, which is built into Macintosh computers. The following characteristics differentiate one LAN from another:

topology : The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.

protocols: The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.

media: Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line. However, the distances are limited and there is also a limit on the number of computers that can be attached to a single LAN.

lock

A state that prohibits other users from accessing a resource, such as a device or interface.

logical unit

A logical unit is a number associated with an interface. In Agilent SICL, a logical unit uniquely identifies an interface. Each interface on the controller must have a unique logical unit.

N

network

A group of two or more computer systems linked together. There are many types of computer networks, including:

local-area networks (LANs) : The computers are geographically close together (that is, in the same building).

wide-area networks (WANs) : The computers are farther apart and are connected by telephone lines or radio waves.

campus-area networks (CANs): The computers are within a limited geographic area, such as a campus or military base.

metropolitan-area networks (MANs): A data network designed for a town or city.

home-area networks (HANs): A network contained within a user's home that connects a person's digital devices.

In addition to these types, the following characteristics are also used to categorize different types of networks:

topology : The geometric arrangement of a computer system.

Common topologies include a bus, star, and ring. See the Network topology diagrams in the Quick Reference section of Webopedia.

protocol : The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

architecture : Networks can be broadly classified as using either a peer-to-peer or client/server architecture.

Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers

network protocols

The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called *Ethernet*. A description of the ARP, DHCP, DNS, FTP, HTTP, ICMP, and RPC protocols follows.

ARP: Short for Address Resolution Protocol, a TCP/IP protocol used to convert an IP address into a physical address (called a DLC address), such as an Ethernet address.

DHCP: See DHCP

DNS: See DNS

FTP: Abbreviation of File Transfer Protocol, the protocol used on the Internet for sending files.

HTTP: Short for HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how

messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.

ICMP: Short for Internet Control Message Protocol, an extension to the Internet Protocol (IP) defined by RFC 792. ICMP supports packets containing error, control, and informational messages. The ping command, for example, uses ICMP to test an Internet connection.

RPC: Abbreviation of remote procedure call, a type of protocol that allows a program on one computer to execute a program on a server computer. Using RPC, a system developer need not develop specific procedures for the server. The client program sends a message to the server with appropriate arguments and the server returns a message containing the results of the program executed.

P

proxy server

A server that sits between a client application, such as a web browser, and a real server. It intercepts all requests to the real server to see if it can fulfill the requests itself. If not, it forwards the request to the real server. Proxy servers have two main purposes:

Improve performance: Proxy servers can dramatically improve performance for groups of users, since a proxy server saves the results of all requests for a certain amount of time. Consider the case where both user X and user Y access the Web through a proxy server. First user X requests a certain Web page, which we will call Page 1. Sometime later, user Y requests the same page.

Instead of forwarding the request to the Web server where Page 1 resides, which can be a time-consuming operation, the proxy server returns the Page 1 it already fetched for user X. Since the proxy server is often on the same network as the user, this is a much faster operation. Real proxy servers support hundreds or thousands of users.

Filter requests: Proxy servers can also be used to filter requests. For example, a company might use a proxy server to prevent its employees from accessing a specific set of Web sites.

R

router

A device that connects any number of LANs. Routers use headers and a forwarding table to determine where packets go. They use Internet Control Message Protocol (ICMP) to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers. Routers do not care about the type of data they handle. Routers often have DHCP Server capability.

S

server

Part of the client/server model used in distributed computing. The server is a computer system designated to act as a main servicer of requests from other client computer systems, such as I/O application requests, networking requests, and so forth.

SICL

The Agilent Standard Instrument Control Library, which is software used for I/O application programming.

SRQ

Service Request. An asynchronous request (an interrupt) from a remote device indicating that the device requires servicing.

subnet

A portion of a network that shares a common address component. On TCP/IP networks, subnets are defined as all devices whose IP addresses have the same prefix. For example, all devices with IP addresses that start with 100.100.100. would be part of the same subnet. Dividing a network into subnets is useful for both security and performance reasons. IP networks are divided using a subnet mask.

subnet mask

A mask used to determine to what subnet an IP address belongs. An IP address has two components: the network address and the host address. For example, consider the IP address 150.215.017.009. Assuming this is part of a Class B network, the first two numbers (150.215) represent the Class B network address and the second two numbers (017.009) identify a particular host on this network.

Subnetting enables a system administrator to further divide the host part of the address into two or more subnets. In this case, a part of the host address is reserved to identify the particular subnet.

For example, the full address for 150.215.017.009 is 10010110.11010111.00010001.00001001. The Class B network part is 10010110.11010111 and the host address is 00010001.00001001. If this network is divided into 14 subnets, the first four bits of the host address (0001) are reserved for identifying the subnet.

The subnet mask is the network address plus the bits reserved for identifying the subnetwork. (By convention, the bits for the network address are all set to 1, though it would also work if the bits were set exactly as in the network address.) In this case, the subnet mask is 1111111.1111111.1110000.00000000.

It is called a mask because it can be used to identify the subnet to which an IP address belongs by performing a bitwise AND operation on the mask and the IP address. The result is the subnetwork address:

Subnet Mask 255.255.240.000	1111111.1111111.1110000.00000000
IP Address 150.215.017.009	10010110.11010111.00010001.00001001
Subnet Address 150.215.016.000	10010110.11010111.00010000.00000000

switch

A device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs. A hub connects all the devices on its "ports" together.

A switch is a bit smarter, as it understands when two devices (out of four, five, eight, sixteen, or even more) want to talk to each other and gives them a switched connection.

symbolic name

A name corresponding to a single interface. This name uniquely identifies the interface on a controller or gateway. If there is more

than one interface on the controller or gateway, each interface must have a unique symbolic name.

U

Universal Plug and Play

Universal Plug and Play (UPnP) is an open industry standard that uses Internet and Web protocols to enable devices such as PCs, peripherals, intelligent appliances, and wireless devices to be plugged into a network and automatically know about each other.

UPnP is an architecture for pervasive peer-to-peer network connectivity of PCs and intelligent devices or appliances. UPnP builds on Internet standards and technologies, such as TCP/IP, HTTP, and XML, to enable LAN devices to automatically connect with one another and work together.

With UPnP, when a user plugs a device into the network, the device will configure itself, acquire a TCP/IP address, and use a discovery protocol based on the Internet's Hypertext Transfer Protocol (HTTP) to announce its presence on the network to other devices. UPnP devices use Extensible Markup Language (XML) to establish a common language, or "protocol negotiation", to talk to each other and determine capabilities.

V

VEE

The Agilent Visual Engineering Environment, which is software used for I/O application programming.

VISA

The Agilent Virtual Instrument Software Architecture library, which is software used for I/O application programming. Agilent VISA is part of the IO Libraries Suite product.

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