Agilent Technologies

USB/LAN/GPIB Interfaces

Connectivity Guide

Agilent Technologies

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USB/LAN/GPIB Interfaces Connectivity Guide

CONNECTIVITY GUIDELINES

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Getting 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.

Using This Guide

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 NT 4.0, Windows 2000, or Windows XP operating systems. A summary of the guide contents follows.

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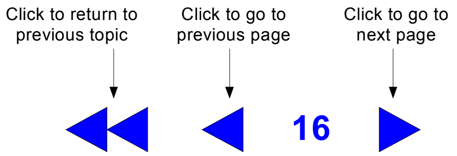
Installing I/O Software	Shows how to install I/O software on your PC
Troubleshooting Guidelines	Troubleshooting guidelines for LAN, USB, and GPIB Interfaces
TCP/IP Network Basics	Provides an overview of TCP/IP networks
Guide Information	Lists general information for this guide
Glossary	Defines some of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

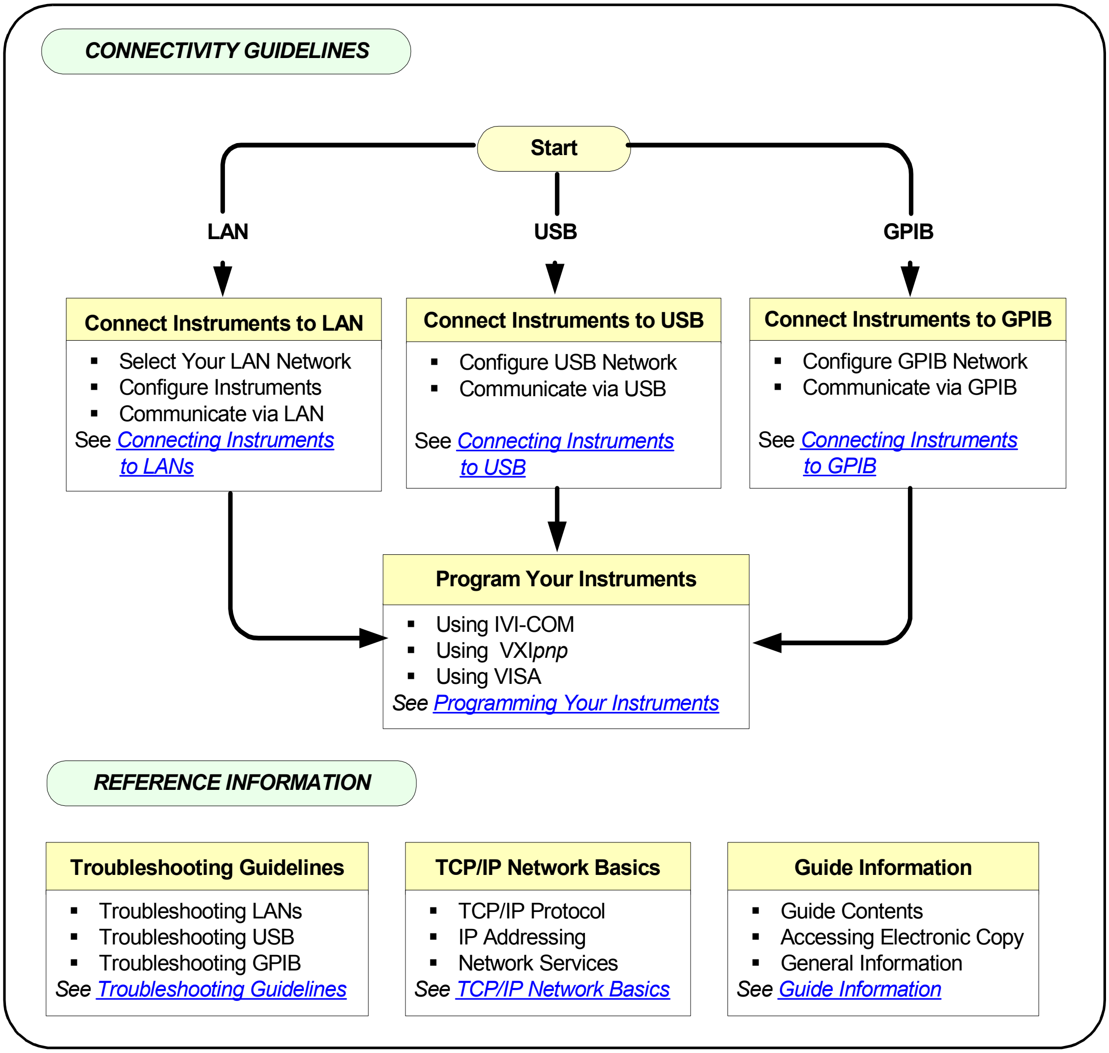
NOTE

Use the arrows next to each page number to navigate in this guide.


Click to return to previous topic
Click to go to previous page
Click to go to next page
16

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.



CONNECTIVITY GUIDELINES

Start

LAN

USB

GPIB

Connect Instruments to LAN

- Select Your LAN Network
- Configure Instruments
- Communicate via LAN

See *Connecting Instruments to LANs*

Connect Instruments to USB

- Configure USB Network
- Communicate via USB

See *Connecting Instruments to USB*

Connect Instruments to GPIB

- Configure GPIB Network
- Communicate via GPIB

See *Connecting Instruments to GPIB*

Program Your Instruments

- Using IVI-COM
- Using VXI*pnp*
- Using VISA

See Programming Your Instruments

REFERENCE INFORMATION

Troubleshooting Guidelines

- Troubleshooting LANs
- Troubleshooting USB
- Troubleshooting GPIB

See Troubleshooting Guidelines

TCP/IP Network Basics

- TCP/IP Protocol
- IP Addressing
- Network Services

See TCP/IP Network Basics

Guide Information

- Guide Contents
- Accessing Electronic Copy
- General Information

See Guide Information

- **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 LANs.
- **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.** The General Purpose Interface Bus (GPIB) should be used only in a system that is **already** using GPIB to connect instruments. GPIB is not recommended for applications such as new systems. If you select GPIB connections, go to Connecting Instruments to GPIB.

Connecting Instruments to LANs

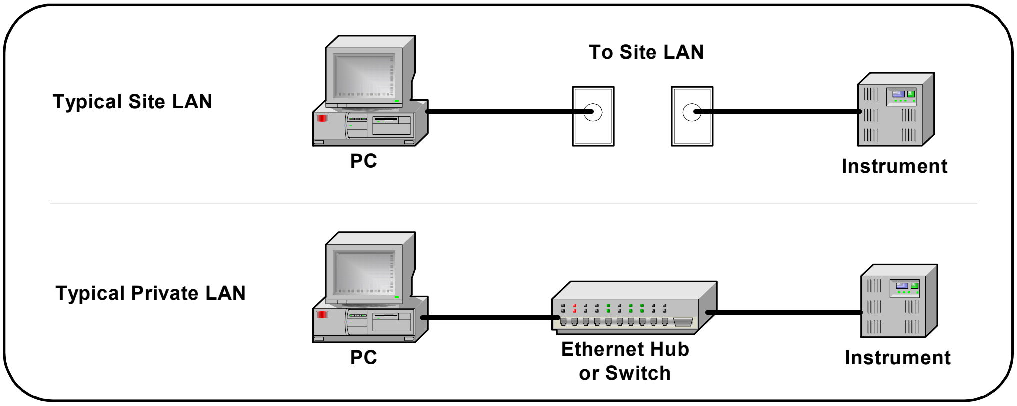
LAN Quick Start

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 98/2000/NT 4.0/Me/XP 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 98/2000/NT 4.0/Me/XP PCs are **NOT** connected to a site LAN. This figure shows example site LAN and private LAN networks.



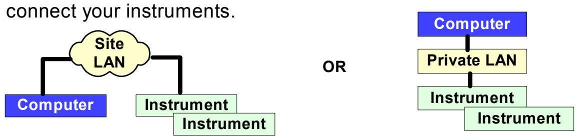
Getting Started

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. See the associated step if you need any more information.
See these sections for additional information on setting up your instruments for site LAN or private LAN operation:

- 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

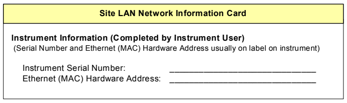
1 Select LAN Network Type

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



2 Gather Network Information

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



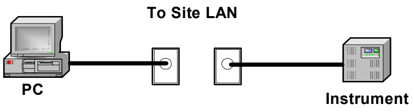
Site LAN Network Information Card

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: ______________________________

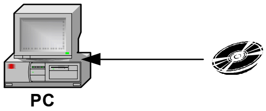
3 Connect Your Instruments

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



4 Install I/O Software on Your PC

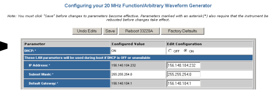
Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.



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

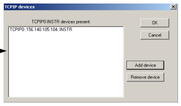
Note: You must click "Save" before changes to parameters become effective. Parameters marked with an asterisk(*) also require that the instrument be rebooted before changes take effect.

Parameter	Configured Value	Edit Configuration
DHCP: *	ON	○ OFF ● ON
These LAN parameters will be used during boot if DHCP is OFF or unavailable		
IP Address: *	156.140.104.232	156.140.104.232
Subnet Mask: *	255.255.254.0	255.255.254.0
Default Gateway: *	156.140.104.1	156.140.104.1

6 Configure the LAN Interface

Use **IO Config** to configure the **TCPIP LAN Client** interface. Then, add your instrument identifiers to the interface software.

The **TCPIP Devices** dialog box lists devices present on the interface.



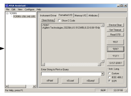
TCPIP0 INSTR devices present:

TCPIP0::156.140.105.104::INSTR

7 Communicate with Instruments

You can use applications such as *VISA Assistant* or the Telnet utility to verify communication with instruments via the LAN.

You can use *VISA Assistant* to verify communication with instruments.



8 Program Your Instruments

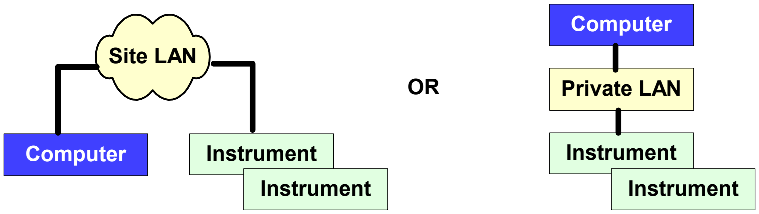
This is an optional step. As desired, you can program instruments via the LAN using applications such as IVI-COM, VXI*pnp*, or VISA.

VISA: viOpen (..."TCPIP0::instrumentHostName::INSTR"...)

Step 1: Select LAN Network Type

1 Select LAN Network Type

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

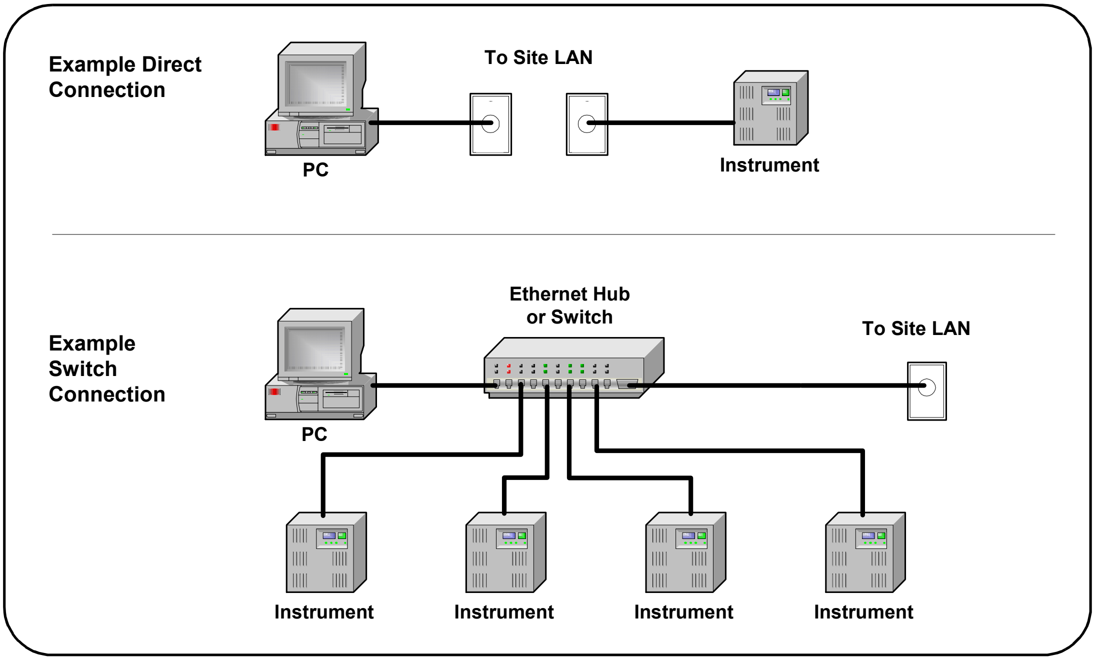


What's in This Step? The first step is to determine whether you want your instruments and your PC to be connected to a site LAN or to a private LAN. This step shows some examples of site LAN and private LAN networks. Select site LAN or private LAN connections, based on your requirements. Then, go to Step 2: 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 98/2000/NT 4.0/Me/XP PCs are connected to a site LAN (workgroup LAN, Intranet, or enterprise LAN) via (optional) routers, hubs, and/or switches. This figure shows some example site LAN networks.

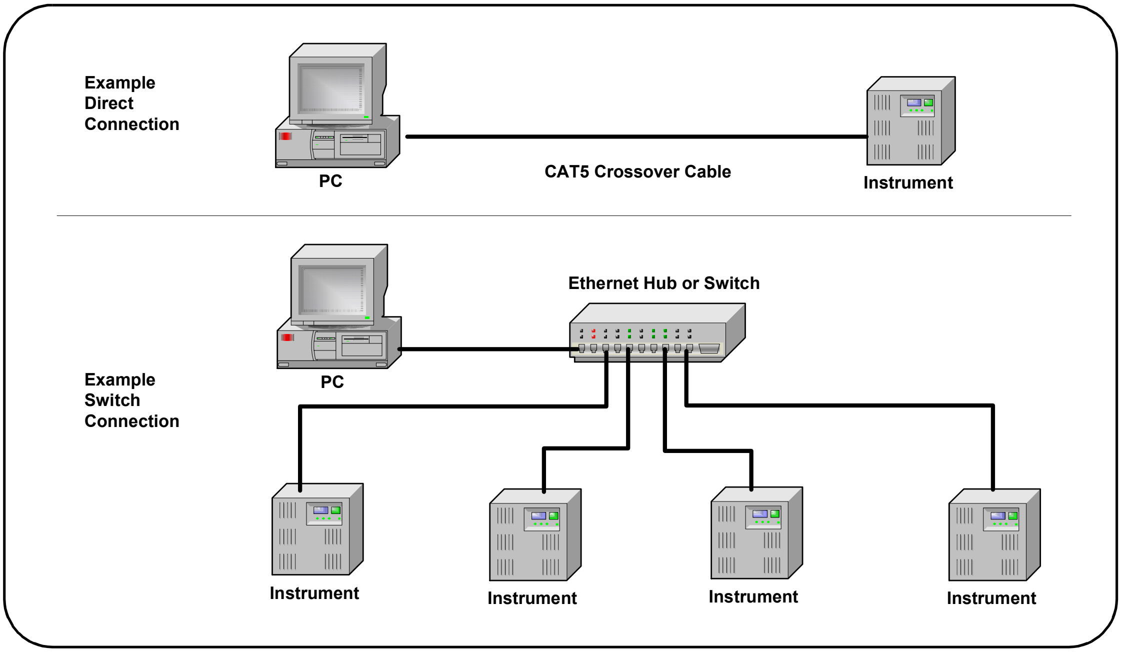


Typical Private LAN Networks

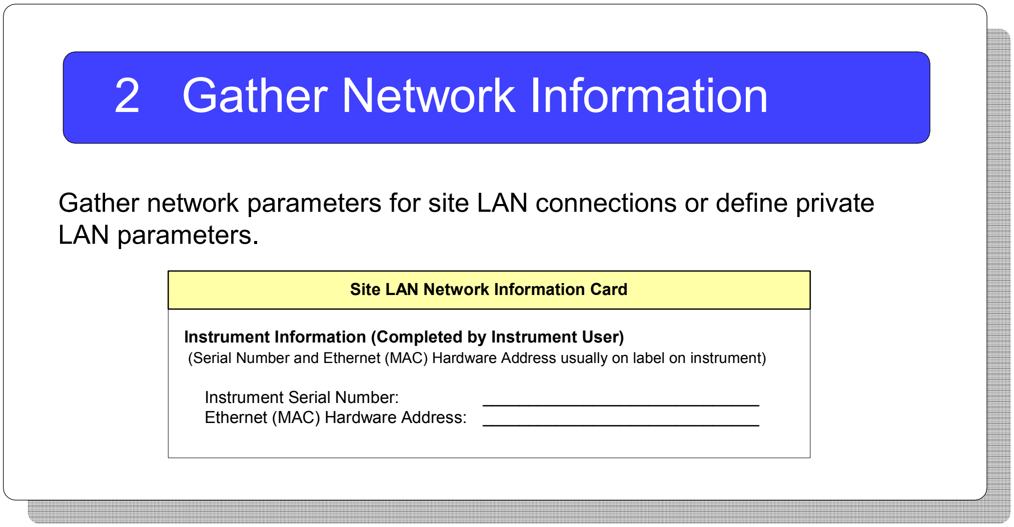
In this guide, a **private LAN network** is defined as a local area network (LAN) in which LAN-enabled instruments and Windows 98/2000/NT 4.0/Me/XP PCs are **NOT** connected to a site LAN (workgroup LAN, Intranet, or enterprise LAN). This figure shows some example private LAN networks.

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 2: Gather Network Information



2 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 3: 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 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 3: Connect Your Instruments.

OR

2 **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 3: 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 ___ No ___

If No, provide: IP Address (Static): ______.______.______.______

Subnet Mask: ______.______.______.______

Default Gateway: ______.______.______.______

Does the Network Support DNS? Yes ___ No ____

If Yes, provide: Instrument Host Name: _______________________

Instrument Domain Name: _______________________

DNS Server IP Address:______.______.______.______

Will You Allow Universal Plug&Play to be Enabled? Yes ___ No ____

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 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 3: Connect Your Instruments.

Private LAN Network Information Card

NETWORK

DHCP Enabled: Yes ___ No ____
Dynamic DNS Enabled: Yes ___ No ____
UPnP Enabled OK: Yes ___ No ____
Subnet Mask: _______._______._______._____
DNS Server IP Address: _______._______._______._____

PC

Hardware Address: ___________________________
IP Address: _______._______._______._____
Subnet Mask: _______._______._____._______
DNS Server: _______._______._____._______
Host Name: ___________________________
Domain Name: ___________________________

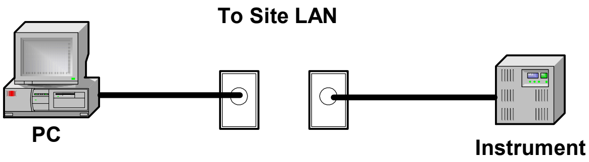
INSTRUMENT

Instrument Serial Number: ___________________________
Ethernet (MAC) Hardware Address: _____________________
IP Address: _______._______._______._____
Subnet Mask: _______._______._____._______
DNS Server: _______._______._____._______
Host Name: ___________________________
Domain Name: ___________________________
DHCP: ON___ OFF___
Auto IP: ON___ OFF___ N/A___
UPnP: Enabled___ Disabled___ N/A___

Step 3: Connect Your Instruments

3 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.

- ❑ 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.

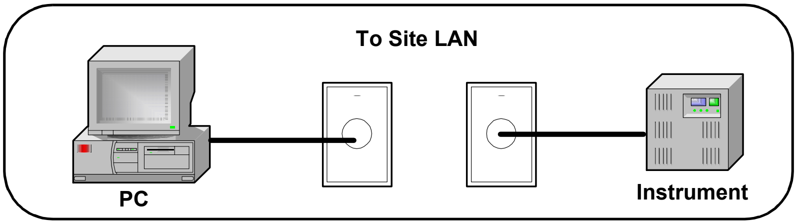
Two example network connections follow that you can use as templates to connect your instruments to the site LAN. Modify the connections as required for your application. When you have completed the instrument and device connections, go to Step 4: Install I/O Software on Your PC.

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)

This figure shows one way to directly connect instruments to a site LAN.



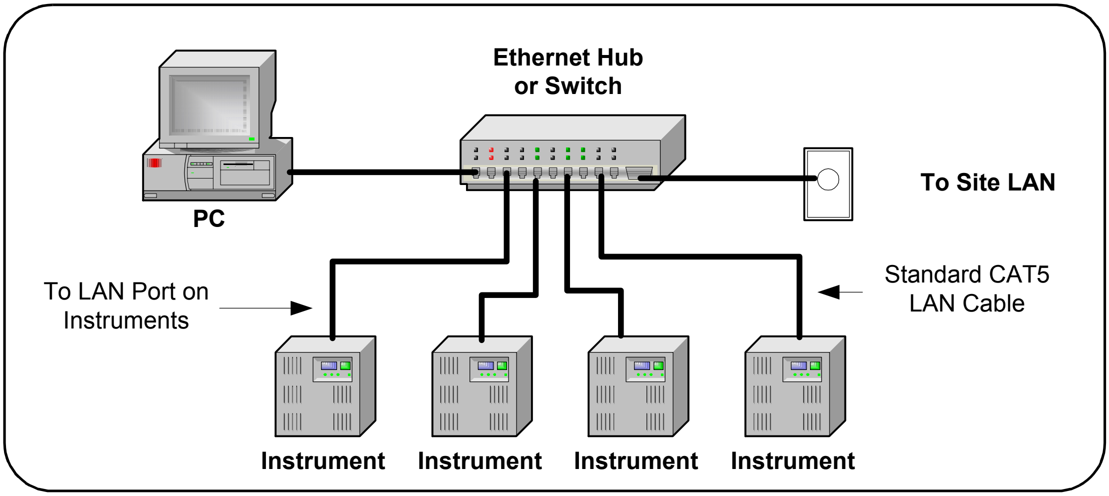
1 **Turn Power OFF.** Remove power to the instrument.

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.



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

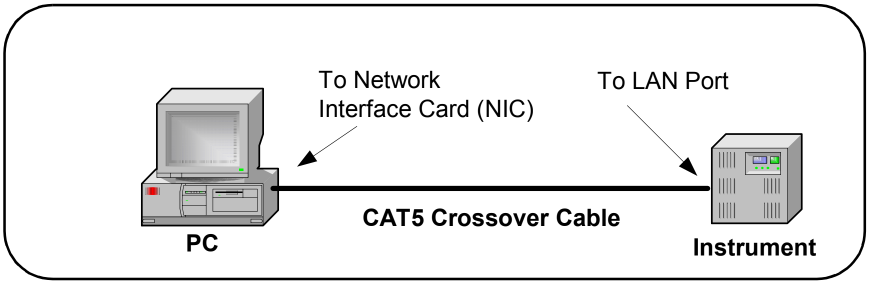
This section shows typical ways you can connect LAN-enabled instruments and interface devices such as routers, hubs, and switches to a private LAN, assuming your PC is properly configured for LAN operation.

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 4: Install I/O Software on Your PC.

> **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 98/NT/2000/Me/XP PC with a LAN-enabled instrument. Suggested connection steps follow.



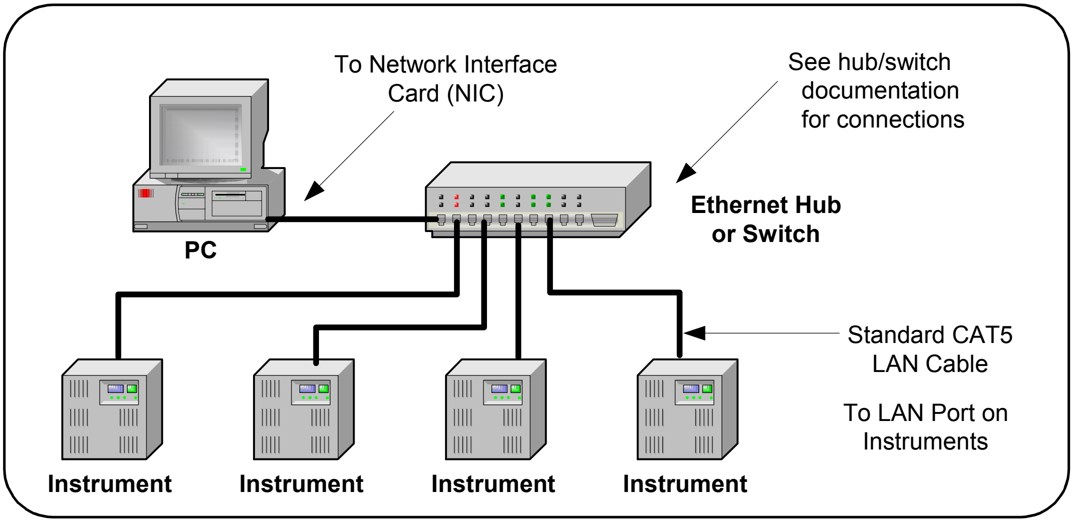
1 **Turn Power OFF.** Remove power from the instrument.

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 98/NT/2000/Me/XP PC and LAN-enabled instruments via an Ethernet hub or switch. Suggested connection steps follow.


To Network Interface Card (NIC)
See hub/switch documentation for connections
PC
Ethernet Hub or Switch
Standard CAT5 LAN Cable
To LAN Port on Instruments
Instrument
Instrument
Instrument
Instrument

1 **Turn Power OFF.** Remove power to instruments and the hub/switch.

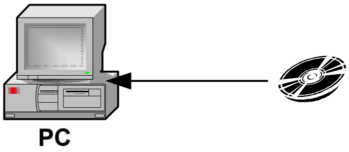
2 **Connect Instruments to Hub or Switch.** Use standard CAT5 LAN cables to connect each instrument to the hub or switch. See the hub or switch documentation for connection information.

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 4: Install I/O Software on Your PC

4 Install I/O Software on Your PC

Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.



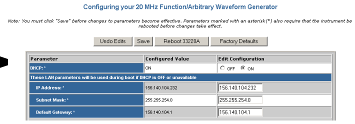
What's in This Step? This step gives guidelines to install applicable I/O software on your PC. Go to Installing I/O Software for details. After the I/O software is installed, go to Step 5: Configure Your Instruments.

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
DHCP: *	ON	○ OFF ● ON
These LAN parameters will be used during boot if DHCP is OFF or unavailable		
IP Address: *	156.140.104.232	156.140.104.232
Subnet Mask: *	255.255.254.0	255.255.254.0
Default Gateway: *	156.140.104.1	156.140.104.1

What's in This Step? *This may be an optional step.* This step shows how to manually set TCP/IP parameters for LAN-enabled instruments, using the instrument's Web Pages.

- ❑ If your LAN supports DHCP **and** you selected automatic configuration for your instruments, **skip this step** and go to Step 6: Configure the LAN Interface.
- ❑ 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: Configure the LAN Interface.

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.

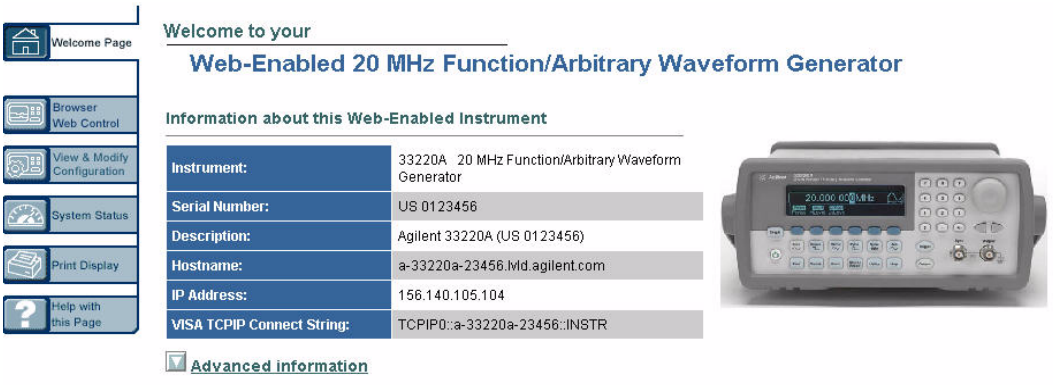
NOTE

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 TCP/IP 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**. This figure shows a typical display for the Agilent 33220A.



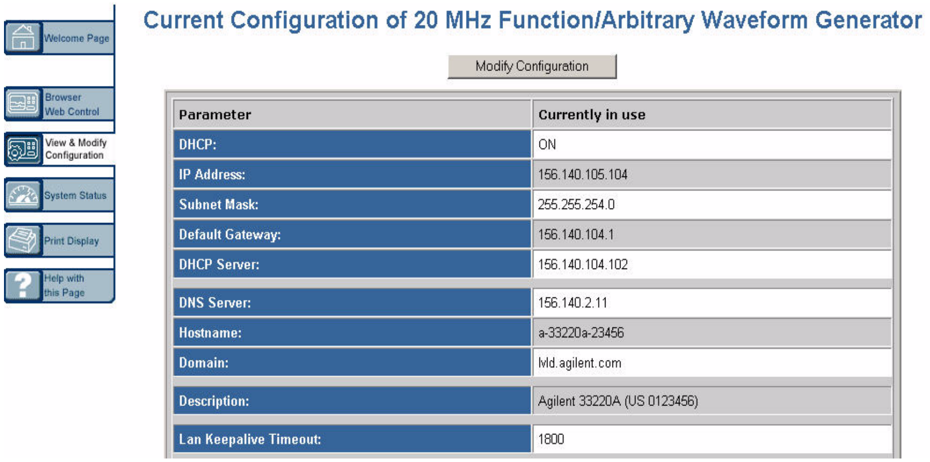
Welcome to your

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.lvld.agilent.com
IP Address:	156.140.105.104
VISA TCPIP Connect String:	TCPIP0::a-33220a-23456::INSTR

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

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:	lvld.agilent.com
Description:	Agilent 33220A (US 0123456)
Lan Keepalive Timeout:	1800

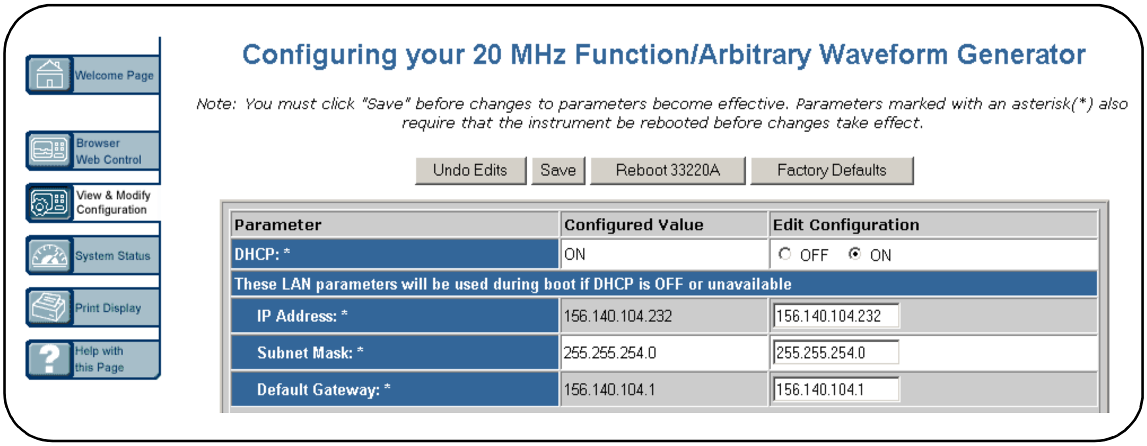
3 **Display the Configuring the *Instrument* Page.** From the **Current Configuration Page**, click the **Modify Configuration** box to display the **Configuring the *Instrument* Page**. You can then set/change instrument parameters as required

4 **Set/Change TCP/IP Parameters.** This figure shows a partial **Configuring your 20MHz Function/Arbitrary Waveform Generator Page**. For example, we will 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. To do this, we type the desired values in the **Edit Configuration** column and click **Save** to save the values. Then, we 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.*



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.

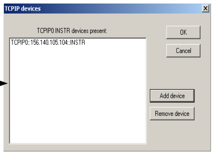
Parameter	Configured Value	Edit Configuration
DHCP: *	ON	○ OFF ● ON
These LAN parameters will be used during boot if DHCP is OFF or unavailable		
IP Address: *	156.140.104.232	156.140.104.232
Subnet Mask: *	255.255.254.0	255.255.254.0
Default Gateway: *	156.140.104.1	156.140.104.1

Step 6: Configure the LAN Interface

6 Configure the LAN Interface

Use **IO Config** to configure the **TCPIP LAN Client** interface. Then, add your instrument identifiers to the interface software.

The **TCPIP Devices** dialog box lists devices present on the interface.


TCPIP0 INSTR devices present:

TCPIP0::156.140.105.104::INSTR

What's in This Step? This step gives guidelines to use the **IO Config** utility (installed as part of the Agilent IO Libraries) to configure the LAN interface.

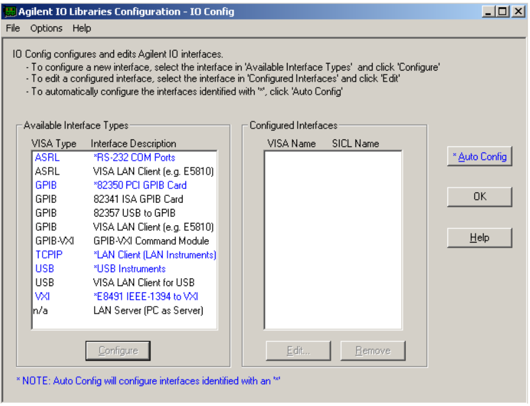
Steps to Configure the LAN Interface

For an application that uses VISA (such as *VISA Assistant*) to communicate with instruments via the LAN, you must configure the **TCPIP LAN Client** interface by using the **IO Config** utility. Suggested steps to configure the **TCPIP LAN Client** interface follow.

1 **Open the IO Config Utility.** To configure a **TCPIP LAN Client** interface, click the Agilent IO Libraries Control icon (blue IO icon on the Windows taskbar) and click **Run IO Config** to display the **IO Config** main screen.

The **I/O Config** main screen allows you to select and configure ASRL (Serial), GPIB, TCP/IP, USB, and VXI interfaces.

For this example, we will configure TCP/IP interfaces.



Agilent IO Libraries Configuration - IO Config

IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

Available Interface Types

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

Configured Interfaces

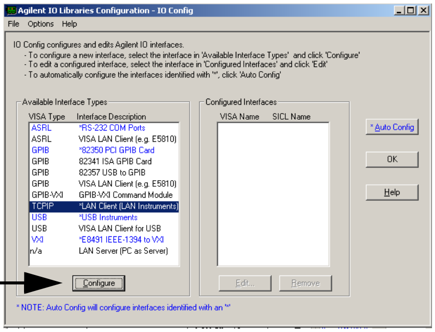
VISA Name	SICL Name

* NOTE: Auto Config will configure interfaces identified with an '*'

2 **Display the TCPIP LAN Client Dialog Box.** From the main screen, highlight the **TCPIP   LAN Client (LAN Instruments)** menu item and then click **Configure** to display the **LAN Client** dialog box.

Highlight **TCPIP LAN Client**

Click **Configure**

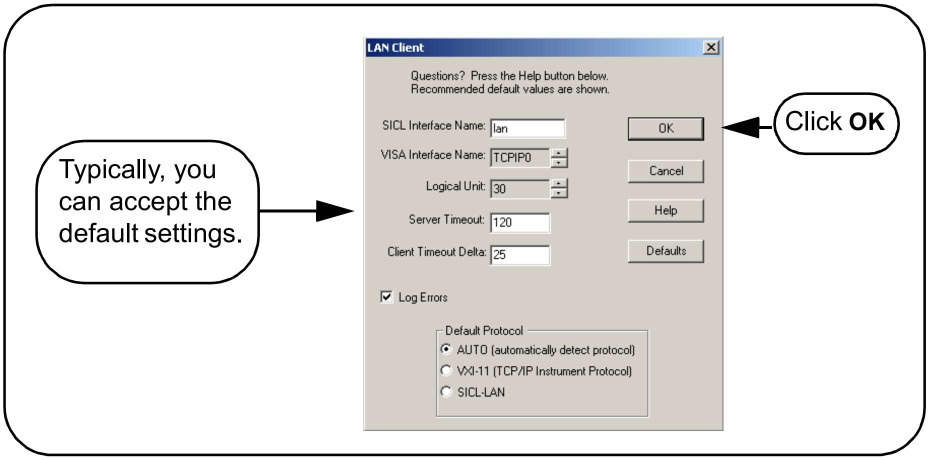


Agilent IO Libraries Configuration - IO Config

IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

* NOTE: Auto Config will configure interfaces identified with an '*'

3 **Set LAN Client Parameters.** When the **LAN Client** dialog box appears, in almost all cases, you can accept the default settings. If you need to change any items, click the **Help** button for an explanation of the items. Change items as required and then click the **OK** button to re-display the **IO Config main screen.**



LAN Client

Questions? Press the Help button below.
Recommended default values are shown.

SICL Interface Name: lan
VISA Interface Name: TCPIP0
Logical Unit: 30
Server Timeout: 120
Client Timeout Delta: 25

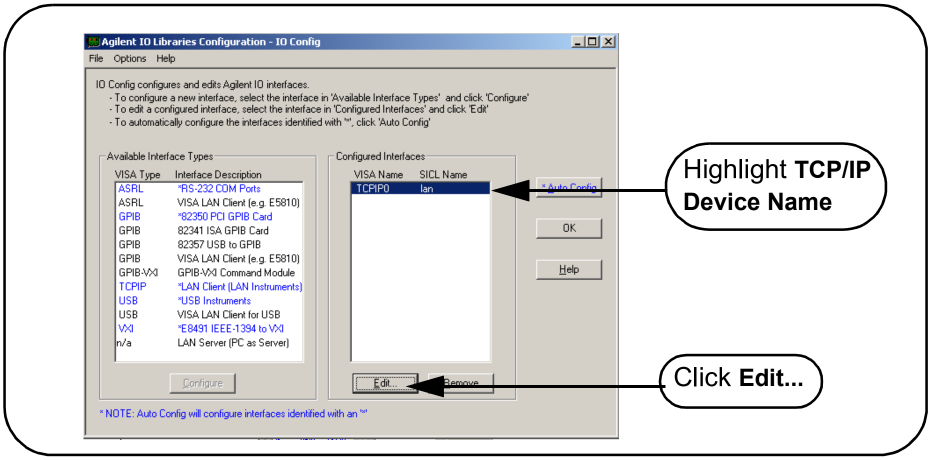
☑ Log Errors

Default Protocol
● AUTO (automatically detect protocol)
○ VXI-11 (TCP/IP Instrument Protocol)
○ SICL-LAN

Typically, you can accept the default settings.

Click **OK**

4 **Re-Display LAN Client Dialog Box.** When the **IO Config main screen** reappears, in the **Configured Interfaces** box highlight the TCP/IP device name you set in the previous step (VISA Interface Name of **TCPIP0** and SICL Interface Name of **lan** in this example). Then, click the **Edit...** button to re-display the **LAN Client** dialog box.



Agilent IO Libraries Configuration - IO Config

IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with "*", click 'Auto Config'

Available Interface Types

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

Configured Interfaces

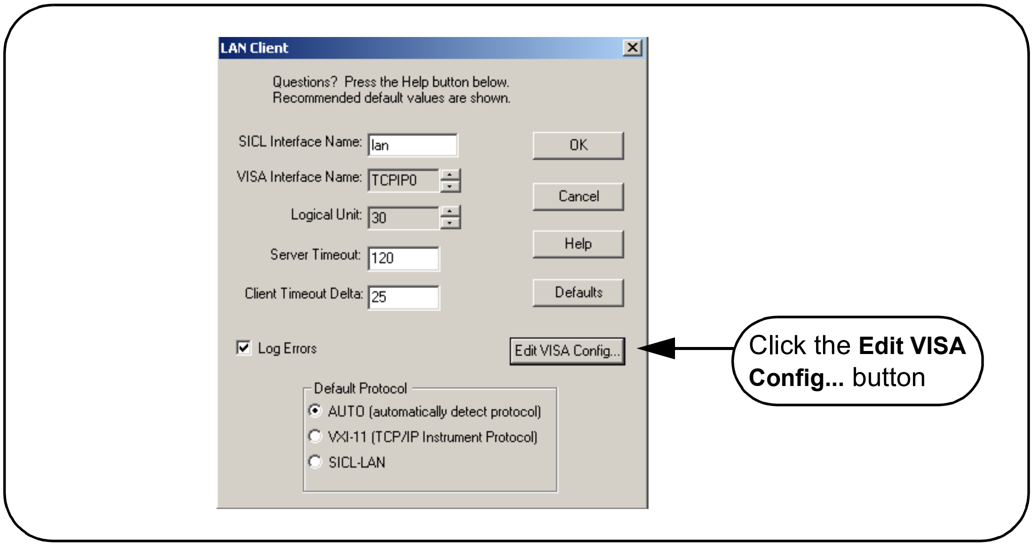
VISA Name	SICL Name
TCPIP0	lan

* NOTE: Auto Config will configure interfaces identified with an "*"

Highlight **TCP/IP Device Name**

Click **Edit...**

5 **Display the TCPIP Devices Dialog Box.** From the **LAN Client** dialog box, click the **Edit VISA Config...** button to display the **TCPIP devices** dialog box.



LAN Client

Questions? Press the Help button below.
Recommended default values are shown.

SICL Interface Name: lan

VISA Interface Name: TCPIP0

Logical Unit: 30

Server Timeout: 120

Client Timeout Delta: 25

☑ Log Errors

Default Protocol

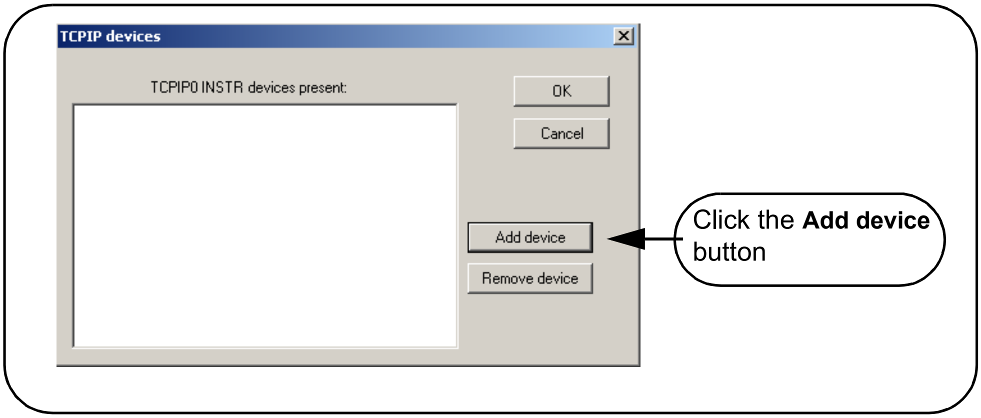
● AUTO (automatically detect protocol)

○ VXI-11 (TCP/IP Instrument Protocol)

○ SICL-LAN

Click the **Edit VISA Config...** button

6 **Display the Add a TCPIP device Dialog Box.** From the **TCPIP devices** dialog box, click the **Add device** button to display the **Add a TCPIP device** dialog box.

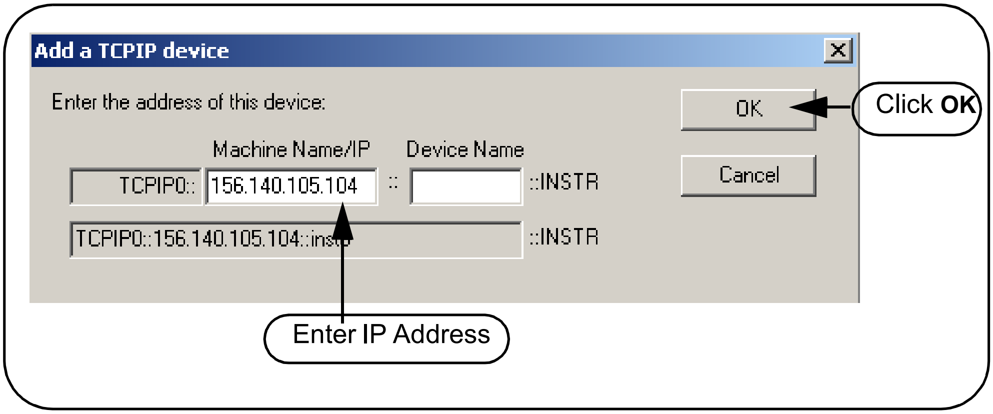


TCPIP devices

TCPIP0 INSTR devices present:

Click the **Add device** button

7 **Enter Device IP Address/Hostname.** From the **Add a TCPIP device** dialog box, enter either the IP address or hostname of the LAN instrument to be added and then click the **OK** button to re-display the **TCPIP devices** dialog box. For example, this dialog box adds a TCP/IP device at IP address 156.140.105.104.



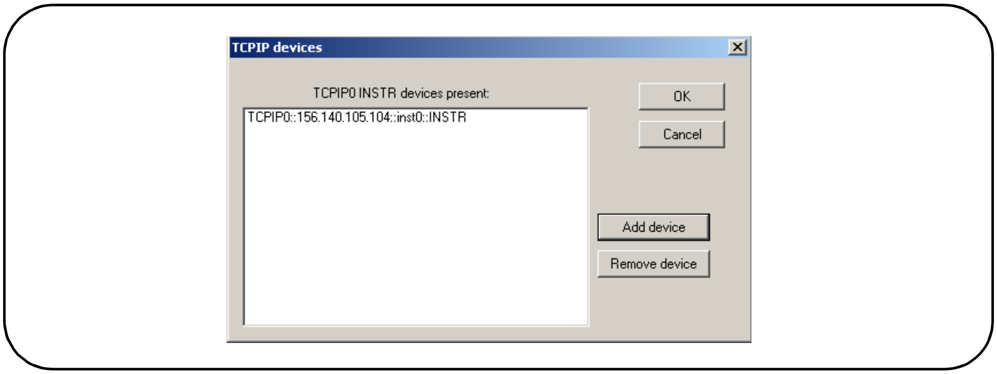
Add a TCPIP device

Enter the address of this device:

Machine Name/IP: TCPIP0:: 156.140.105.104 :: Device Name: ::INSTR

TCPIP0::156.140.105.104::inst0 ::INSTR

8 **Display Devices Present.** The **TCPIP devices** dialog box displays the TCP/IP devices present on the network. For example, this dialog box shows a device with identifier TCPIP0::156.140.105.104::inst0::INSTR is present on the network. Click the **OK** button to close this dialog box. Then, click the **OK** button on each open dialog box to close the box.



TCPIP devices

TCPIP0 INSTR devices present:

TCPIP0::156.140.105.104::inst0::INSTR

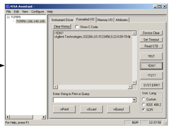
9 **Repeat for Other Instruments.** If you have more than one instrument to be added to the network, repeat the previous steps for each instrument to be added. Then, go to Step 7: Communicate with Instruments.

Step 7: Communicate with Instruments

7 Communicate with Instruments

You can use applications such as *VISA Assistant* or the Telnet utility to verify communication with instruments via the LAN.

You can use *VISA Assistant* to verify communication with instruments.



What's in This Step? This section gives guidelines to communicate with your instruments using *VISA Assistant*. When you have verified communication with your instruments (as desired), go to Step 8: Program Your Instruments.

NOTE

Communication with installed LAN instruments was established in Step 6: Configure the LAN Interface if the instrument(s) were displayed in the ***TCPIP devices*** *dialog box. Thus, this is an optional step you can use to verify communication with instruments.*

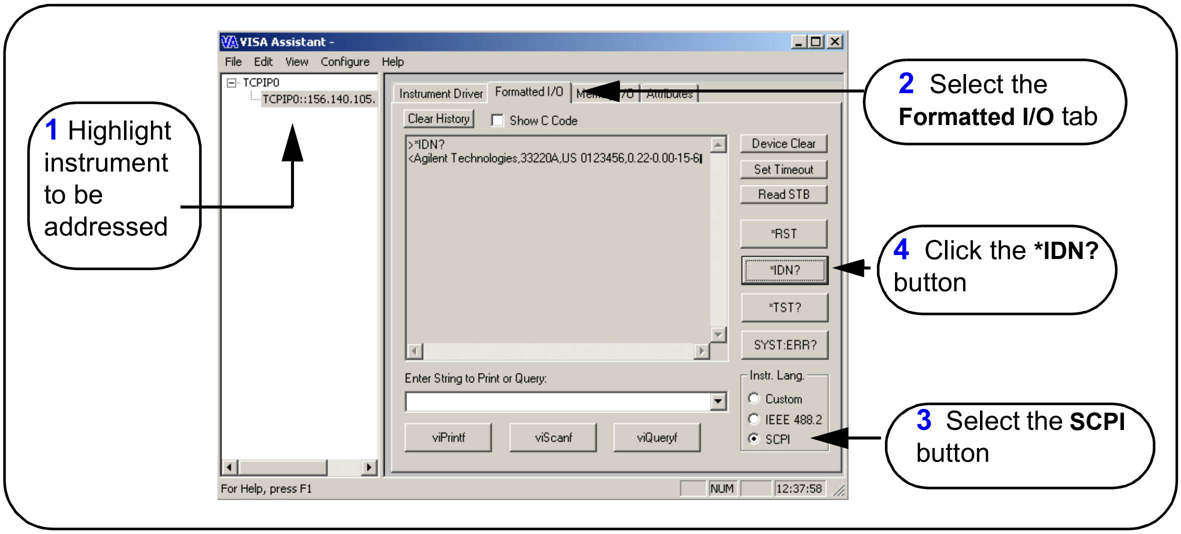
Communicating Using *VISA Assistant*

VISA Assistant is an application program that uses the Agilent IO Libraries to communicate with LAN, USB, and GPIB instruments. *VISA Assistant* can automatically detect and assign VXI*plug&play* instrument drivers to instruments.

VISA Assistant can also be used to send and receive strings to instruments which support formatted I/O. For other instruments, *VISA Assistant* allows you to read and write memory areas. An example follows to show one way to communicate with a 33220A using *VISA Assistant*.

Example: Communicating Using VISA Assistant

This example shows one way to use *VISA Assistant* to communicate with an Agilent 33220A to return the ID string for the instrument. To open *VISA Assistant*, click the **Agilent IO Libraries Control** icon (blue icon on the Windows taskbar) and click **Run VISA Assistant** to display the *VISA Assistant* main screen. Then, use the steps in this figure to return the identification string for an Agilent 33220A.



```
>*IDN?
<Agilent Technologies,33220A,US 0123456,0.22-0.00-15-6
```

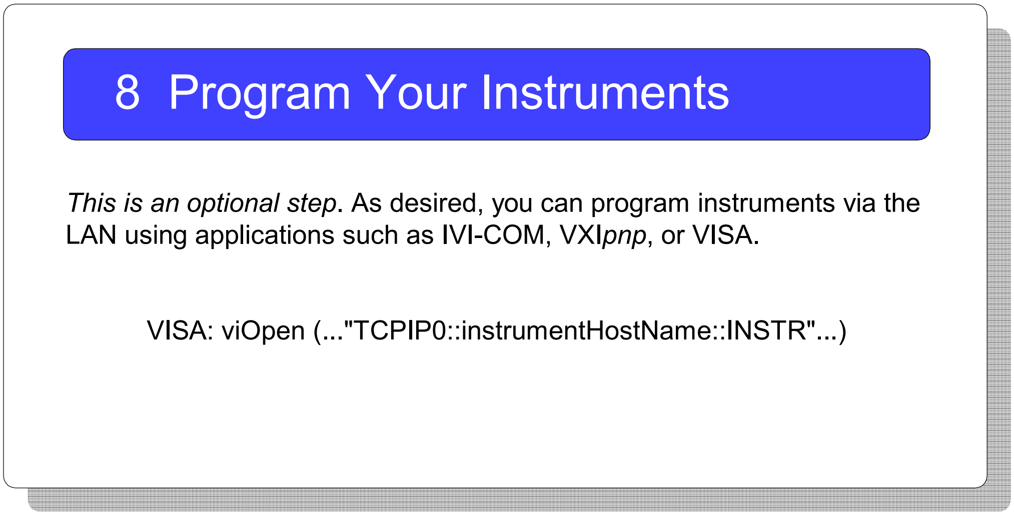
1 Highlight instrument to be addressed

2 Select the **Formatted I/O** tab

3 Select the **SCPI** button

4 Click the ***IDN?** button

Step 8: Program Your Instruments



8 Program Your Instruments

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

VISA: viOpen (..."TCPIP0::instrumentHostName::INSTR"...)

What's in This Step? *This is an optional step*. After you have set up your site or private LAN, as desired you can program LAN-enabled instruments from your PC via the LAN. See Programming Your Instruments for guidelines and examples.

Connecting Instruments to USB

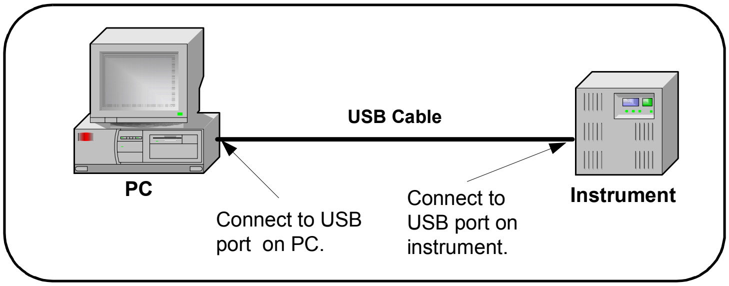
USB Quick Start

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 98 (SE)/Me/2000/XP PC or to a USB 2.0 port in a Windows XP (with Service Pack 1) PC. This figure shows a typical USB interface system with a PC and a USB instrument connected via a USB cable.


USB Cable
PC
Instrument
Connect to USB port on PC.
Connect to USB port on instrument.

Getting Started

To get started, you may want to copy the figures for Steps 1 - 6 to use as a guide as you set up your USB system. See the associated step if you need more details.

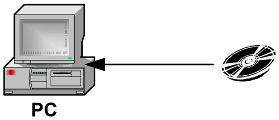
Other Information You Can Use

See these sections for additional information on setting up instruments for USB operation:

- Troubleshooting USB Interfaces for USB troubleshooting tips
- Glossary for a definition of some USB terms
- Contacting Agilent if you need to contact Agilent

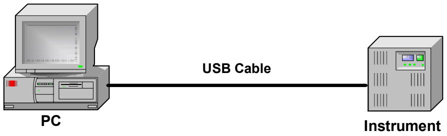
1 Install I/O Software on Your PC

Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.



2 Connect Instruments to USB

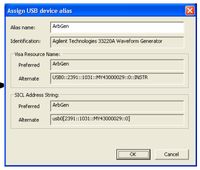
Use USB cables to connect your instruments to the USB port(s) on your PC.



3 Assign Instrument Alias Name

As desired, assign each instrument's USB Alias name from the **Assign USB device alias** dialog box.

We recommend you choose a unique, meaningful USB Alias name and enter it in this dialog box. (If you do not assign the name now, you can change it later using **IO Config**.)


Assign USB device alias

Alias name: ArbGen

Identification: Agilent Technologies 33220A Waveform Generator

Visa Resource Name:

Preferred: ArbGen

Alternate: USB0::2391::1031::MY43000029::0::INSTR

SICL Address String:

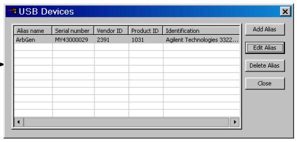
Preferred: ArbGen

Alternate: usb0[2391::1031::MY43000029::0]

4 Check Instrument Identification

As desired, use **IO Config** to display the **USB Devices** dialog box. From this dialog box, you can check instrument identification parameters.

This dialog box associates an instrument's USB Alias name with the instrument's Serial number, Vendor ID, Product ID, and Product Identification.



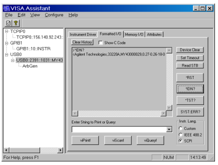
USB Devices

Alias name	Serial number	Vendor ID	Product ID	Identification
ArbGen	MY43000029	2391	1031	Agilent Technologies 3322...

5 Communicate with Instruments

You can use applications such as *VISA Assistant* to verify communication with instruments via the USB interface.

You can use *VISA Assistant* to verify communication with instruments.



VISA Assistant

```
TCPIP0
  TCPIP0::156.140.92.243::
GPIB1
  GPIB1::10::INSTR
USB0
  USB0::2391::1031::MY43
    ArbGen
```

```
>*IDN?
<Agilent Technologies,33220A,MY43000029,0.27-0.26-18-0
```

Instr. Lang.: ○ Custom ○ IEEE 488.2 ● SCPI

6 Program Your Instruments

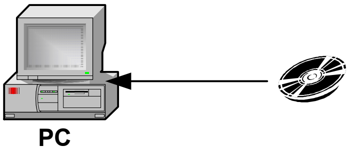
This is an optional step. As desired, you can program instruments via the USB interface using applications such as IVI-COM, VXI*pnp*, or VISA.

```
VISA: viOpen (...,"ArbGen",...)
 SICL: iopen ("ArbGen")
```

Step 1: Install I/O Software on Your PC

1 Install I/O Software on Your PC

Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.

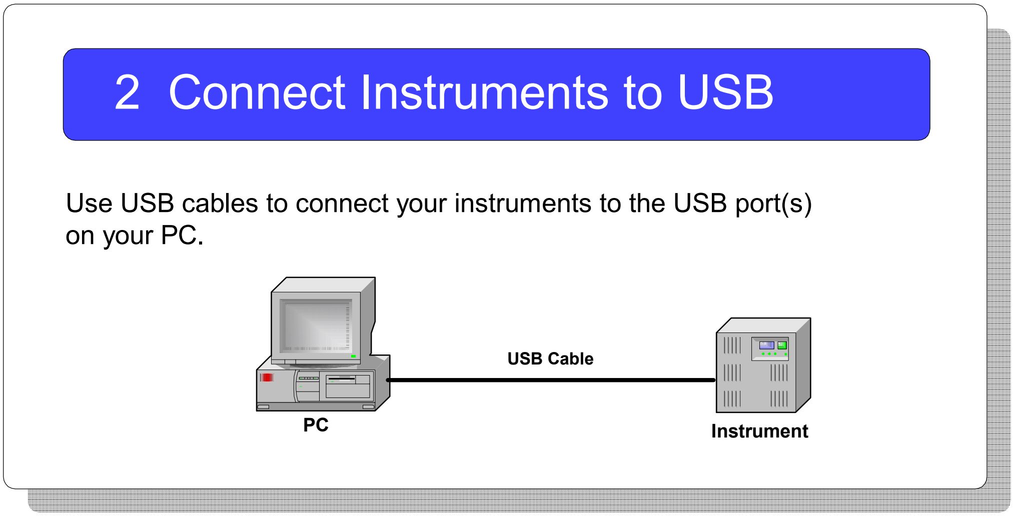


What's in This Step? As required, you should install I/O software (such as the Agilent IO Libraries), on your PC before you connect instruments to USB. See Installing I/O Software for details. Then, go to Step 2: Connect Instruments to USB.

NOTE

Version M.01.00 or later of the Agilent IO Libraries is required for USB.

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.

What's in This Step? This step shows how to connect USB Instruments to USB ports on your PC.

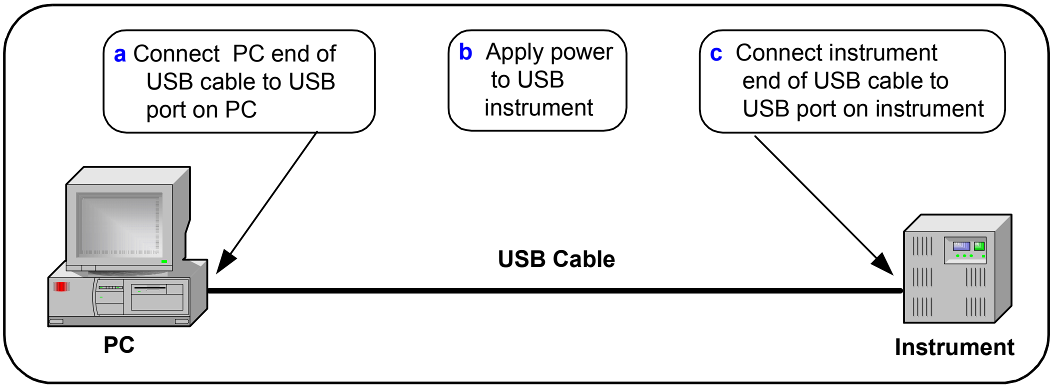
Steps to Connect USB Instruments

Use the steps in this figure to directly connect USB instruments to a Windows 98(SE)/Me/2000/XP 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: Set Instrument Alias Name.

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.

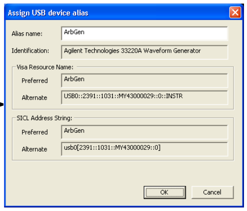

a Connect PC end of USB cable to USB port on PC
b Apply power to USB instrument
c Connect instrument end of USB cable to USB port on instrument
USB Cable
PC
Instrument

Step 3: Assign Instrument Alias Name

3 Assign Instrument Alias Name

As desired, set/change each instrument's USB Alias name from the **Assign USB device alias** dialog box.

We recommend you choose a unique, meaningful USB Alias name and enter it in this dialog box. (If you do not assign the name now, you can change it later using **IO Config**.)



Alias name: ArbGen
Identification: Agilent Technologies 33220A Waveform Generator

Visa Resource Name:
Preferred ArbGen
Alternate USB0::2391::1031::MY43000029::0::INSTR

SICL Address String:
Preferred ArbGen
Alternate usb0[2391::1031::MY43000029::0]

What's in This Step? This step shows how to assign an Alias name for USB instruments. You can use the Alias name when addressing the instrument.

Assigning an Alias Name

When you apply power to a USB instrument and then connect the USB cable between the instrument and your PC, an **Assign USB device alias** dialog box appears. From this dialog box, you can assign the instrument Alias name, as desired.

> **NOTE**
>
> *When power is applied, a* ***Found New Hardware*** *dialog box may appear. If so, follow the on-screen instructions for installation advice. Then, return to this section.*

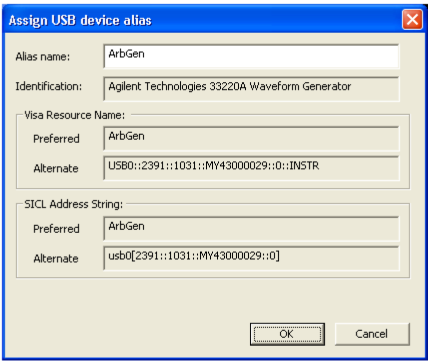
The USB Alias name associates an alias with a specific instrument. You can use the Alias name as a VISA *rsrcName* in *viOpen( )* or as a SICL *address* in *iopen( )* instead of the instrument's Vendor ID, Product ID, Serial Number, and Interface Number (see Step 4: Check Instrument Identification for details).

Example: Assigning a USB Alias Name

This figure shows an example **Assign USG device alias** dialog box for an Agilent 33220A. To change the USB Alias name, type the new name in the **Alias name** box and then click the **OK** button. The Alias name can be used as the preferred address for the VISA *rsrcName* and the SICL address.

For this example, the Alias name has been changed to **.ArbGen.** from the default **.UsbDevice1.**. Thus, **ArbGen** can be used in viOpen() as the VISA *rsrcName* parameter, rather than **.USB0::2391::1031::MY43000029::0::INSTR.**. Or, **ArbGen** can be used in iopen() as the SICL *address* parameter, rather than the alternate address of **.usb0[2391::1031::MY43000029::0].**

You can assign a USB Alias name from this dialog box. (If you do not change the name now, you can change it later by using **IO Config**.)



Assign USB device alias

Alias name: ArbGen

Identification: Agilent Technologies 33220A Waveform Generator

Visa Resource Name:
Preferred: ArbGen
Alternate: USB0::2391::1031::MY43000029::0::INSTR

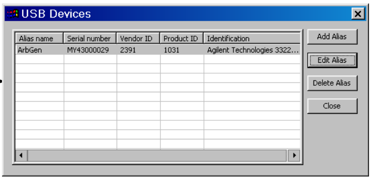
SICL Address String:
Preferred: ArbGen
Alternate: usb0[2391::1031::MY43000029::0]

Step 4: Check Instrument Identification

4 Check Instrument Identification

As desired, use **IO Config** to display the **USB Devices** dialog box. From this dialog box, you can check instrument identification parameters.

This dialog box associates an instrument's USB Alias name with the instrument's Serial number, Vendor ID, Product ID, and Product Identification.



USB Devices

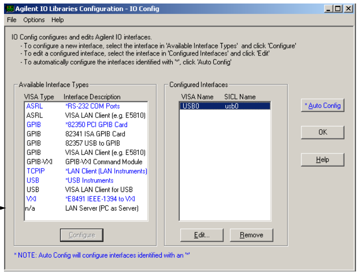
Alias name	Serial number	Vendor ID	Product ID	Identification
ArbGen	MY43000029	2391	1031	Agilent Technologies 3322...

What's in This Step? *This is an optional step* that shows suggested steps follow to check instrument identification parameters. If you do not want to check instrument identification parameters, skip to Step 5: Communicate with Instruments.

Steps to Check Identification Parameters

1 **Display the IO Config Main Screen.** Click the blue IO icon (on the Windows Taskbar) and select **Run IO Config** to display the **IO Config** main screen.

If there is no entry in the **Configured Interfaces** box for USB instruments, you can highlight **USB *USB Instruments** and click **Configure** to configure the USB interface.



Agilent IO Libraries Configuration - IO Config

IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with "*", click 'Auto Config'

Available Interface Types

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

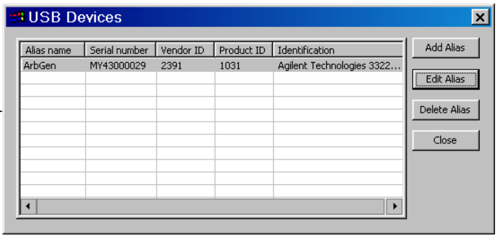
Configured Interfaces

VISA Name	SICL Name
USB0	usb0

* NOTE: Auto Config will configure interfaces identified with an "*"

2 **Display the USB Devices Dialog Box.** Highlight the USB instrument name in the **Configured Interfaces** box (VISA Name of USB0 and SICL Name of usb0 for the previous figure). Then, click **Edit...** to display the **USB Devices** dialog box.

This dialog box allows you to associate a USB Alias name with a specific instrument. The association is based on the instrument's Serial Number, Vendor ID, Product ID, and Product Identification.



USB Devices

Alias name	Serial number	Vendor ID	Product ID	Identification
ArbGen	MY43000029	2391	1031	Agilent Technologies 3322...

3 **Add/Change/Delete Aliases.** You can use the **USB Devices** dialog box to change existing USB Alias names or to add or delete Alias names. Click the **Add Alias** box to display the **Add Alias** dialog box, click the **Edit Alias** box to display the **Assign USB device alias** dialog box, or click the **Delete Alias** box to delete the highlighted alias.

NOTE

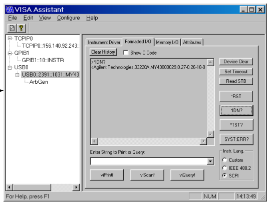
- *Multiple alias names may be associated with the same instrument.*
- *If you delete all aliases, you can restore a default alias by closing **IO Config** and cycling power on the instrument.*

Step 5: Communicate with Instruments

5 Communicate with Instruments

You can use applications such as *VISA Assistant* to verify communication with instruments via the USB interface.

You can use *VISA Assistant* to verify communication with instruments.



```
>*IDN?
<Agilent Technologies,33220A,MY43000029,0.27-0.26-18-0
```

Instr. Lang.: ○ Custom ○ IEEE 488.2 ● SCPI

What's in This Step? This is an optional step that gives guidelines to communicate with your instruments using *VISA Assistant*. When you have verified communication with your instruments (as desired), go to Step 6: Program Your Instruments.

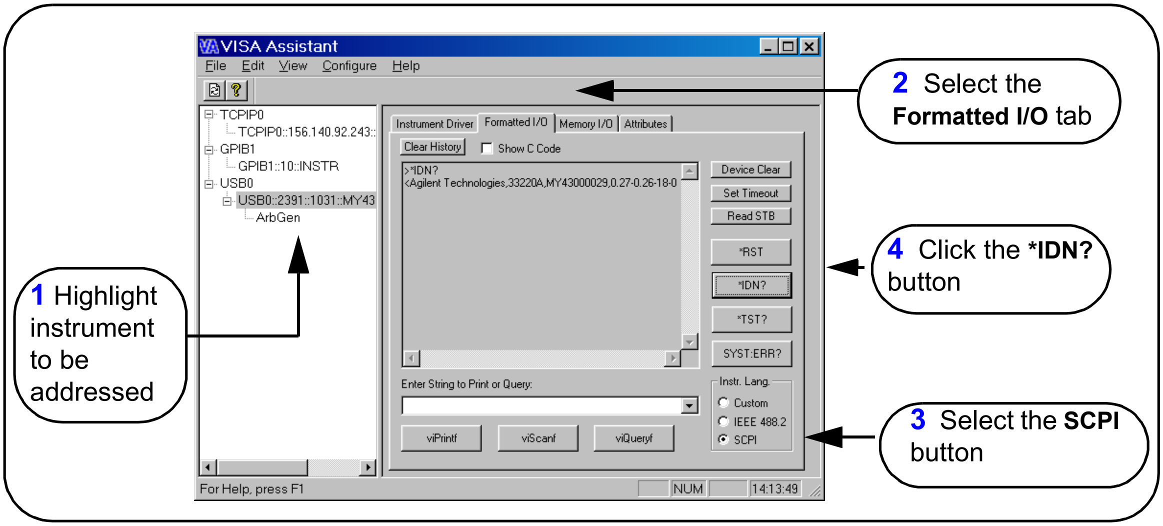
> **NOTE**
>
> *Communication with installed instruments was established in Step 2: Connect Instruments to USB. Thus, this is an optional step you can use to verify communication with instruments.*

Example: Communicating Using VISA Assistant

VISA Assistant is an application program that uses the Agilent IO Libraries to communicate with LAN, USB, and GPIB instruments. *VISA Assistant* can automatically detect and assign VXI*plug&play* instrument drivers to instruments.

VISA Assistant can also be used to send and receive strings to instruments which support formatted I/O. For other instruments, *VISA Assistant* allows you to read and write memory areas. *VISA Assistant* also describes attributes that are associated with an instrument.

This example shows one way to use *VISA Assistant* to communicate with an Agilent 33220A to return the ID string for the instrument. To open *VISA Assistant*, click the **Agilent IO Libraries Control** icon (blue **IO** icon on the Windows taskbar) and click **Run VISA Assistant** to display the *VISA Assistant* main screen. Then, use the steps in this figure to return the identification string for an Agilent 33220A.



TCPIP0
TCPIP0::156.140.92.243::
GPIB1
GPIB1::10::INSTR
USB0
USB0::2391::1031::MY43
ArbGen

□ Show C Code

```
>*IDN?
<Agilent Technologies,33220A,MY43000029,0.27-0.26-18-0
```

Enter String to Print or Query:

Instr. Lang.
○ Custom
○ IEEE 488.2
● SCPI

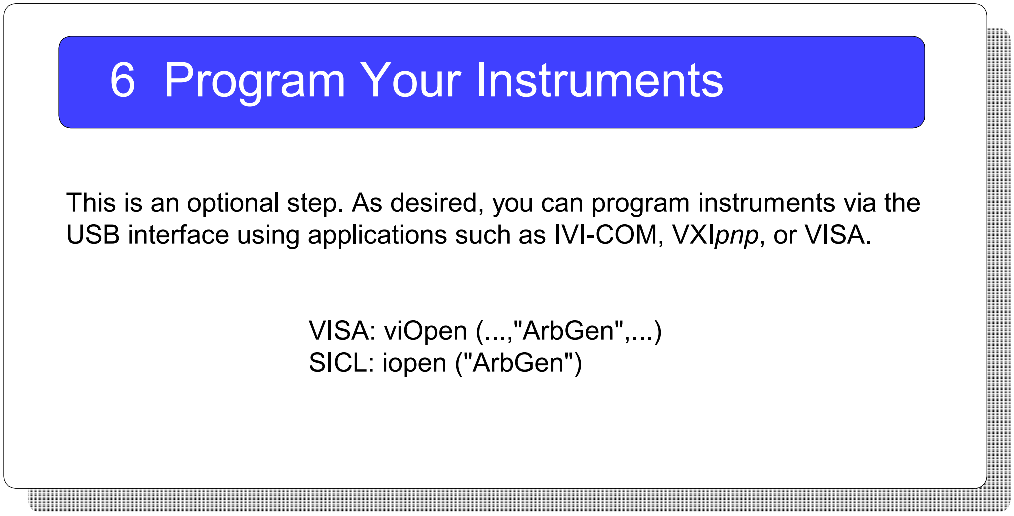
1 Highlight instrument to be addressed

2 Select the **Formatted I/O** tab

3 Select the **SCPI** button

4 Click the ***IDN?** button

Step 6: Program Your Instruments



6 Program Your Instruments

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 (...,"ArbGen",...)
SICL: iopen ("ArbGen")
```

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

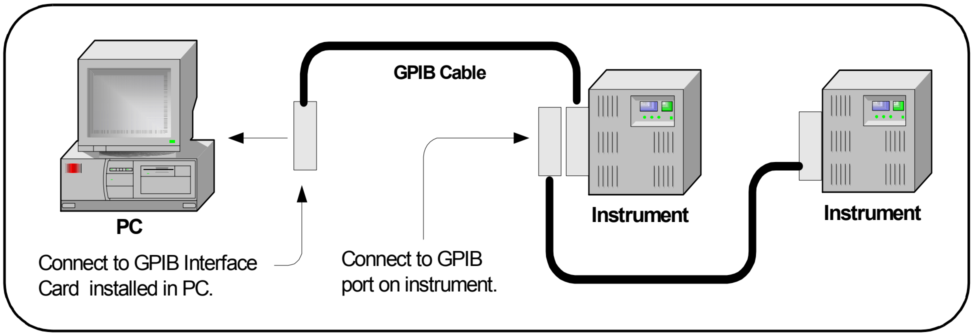
Connecting Instruments to GPIB

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 98/2000/NT 4.0/Me/XP PC via GPIB cables. This figure shows a typical GPIB interface system with a PC and two GPIB Instruments connected via GPIB cables.


GPIB Cable
PC
Instrument
Instrument
Connect to GPIB Interface Card installed in PC.
Connect to GPIB port on instrument.

Getting Started

To get started, you may want to copy the figures for Steps 1 - 6 to use as a guide as you set up your GPIB system. See the associated step if you need more details.

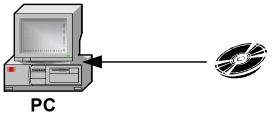
Other Information You Can Use

See these sections for additional information on setting up instruments for GPIB operation:

- Troubleshooting GPIB Interfaces for GPIB troubleshooting tips
- Glossary for a definition of some GPIB terms
- Contacting Agilent if you need to contact Agilent

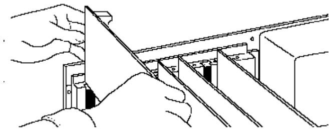
1 Install I/O Software on Your PC

Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.



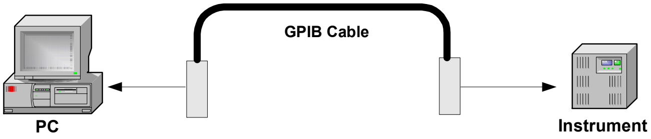
2 Install GPIB Card(s) in Your PC

As required, install one or more GPIB Interface Cards in your PC.



3 Connect Instruments to GPIB Card

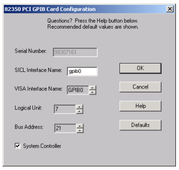
Connect your instruments to the installed GPIB Interface Card(s) using GPIB cables.



4 Configure GPIB Interface Cards

Use **IO Config** to configure installed GPIB Interface Card(s) parameters.

You can use the **GPIB Card Configuration** dialog box to configure GPIB Interface Cards installed in your PC.



82350 PCI GPIB Card Configuration

Questions? Press the Help button below.
Recommended default values are shown.

Serial Number: 99307161

SICL Interface Name: gpib0

VISA Interface Name: GPIB0

Logical Unit: 7

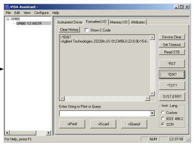
Bus Address: 21

☑ System Controller

5 Communicate with Instruments

You can use applications such as *VISA Assistant* to verify communication with instruments via the GPIB interface.

You can use *VISA Assistant* to verify communication with instruments.



VISA Assistant -

```
>*IDN?
<Agilent Technologies,33220A,US 0123456,0.22-0.00-15-6
```

GPIB0
GPIB0::12::INSTR

□ Show C Code

Enter String to Print or Query:

Instr. Lang.: ○ Custom ○ IEEE 488.2 ● SCPI

For Help, press F1 NUM 12:37:58

6 Program Your Instruments

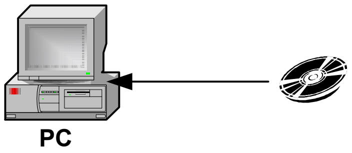
This is an optional step. As desired, you can program instruments via the GPIB interface using applications such as IVI-COM, VXI*pnp*, or VISA.

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

Step 1: Install I/O Software on Your PC

1 Install I/O Software on Your PC

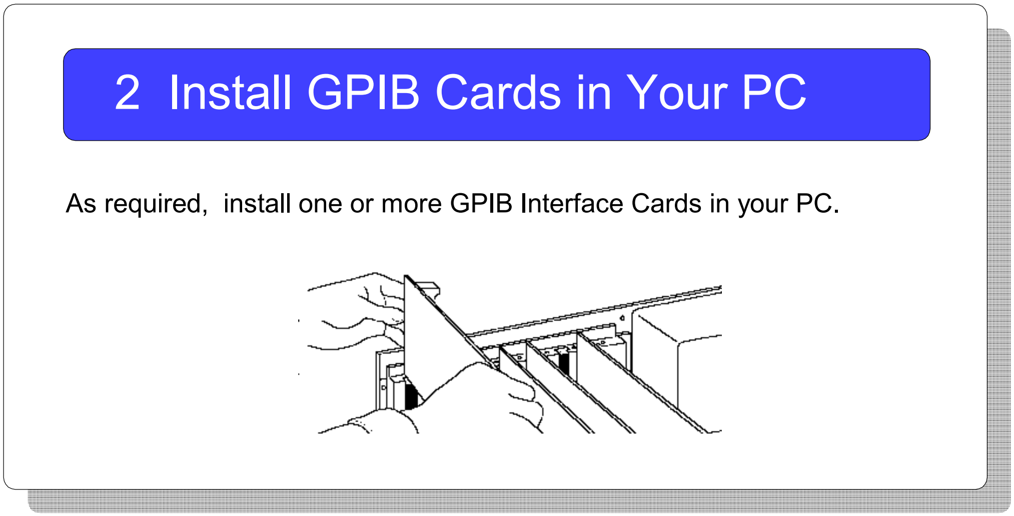
Select the I/O software to be installed on your PC. Then, install the software from a CD or from the Web.



What's in This Step?

Before you connect your instruments to GPIB, as required install I/O software, such as the Agilent IO Libraries, 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.

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.*

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.

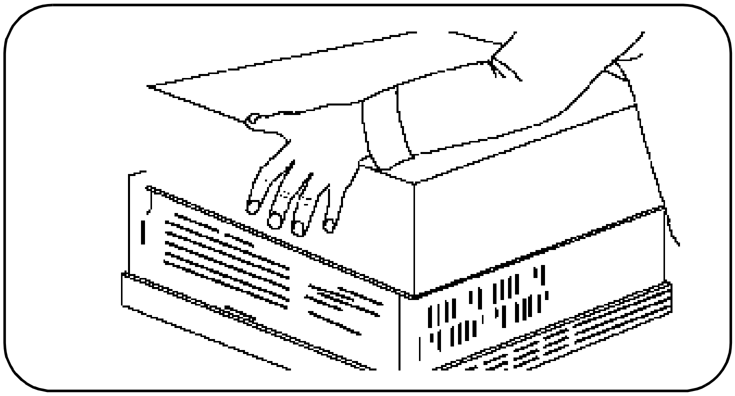
CAUTION

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

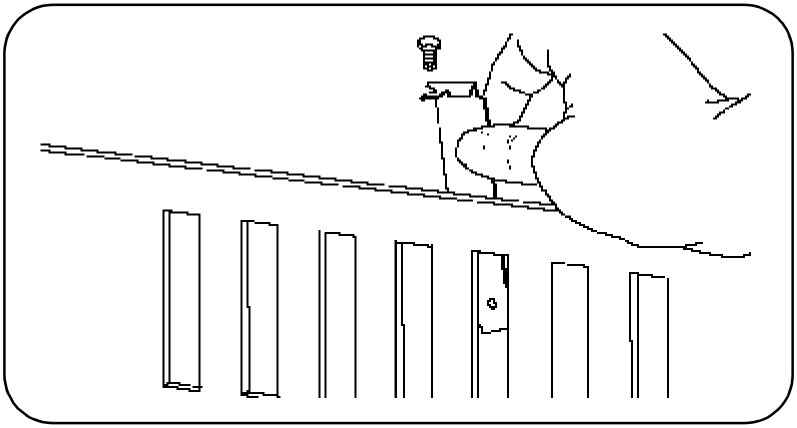
1 **Record the Card Serial Number.** Remove the card from its anti-static bag and record the Serial Number for future reference. Save the anti-static bag so you can protect the card if you need to remove the card from the PC.

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 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.

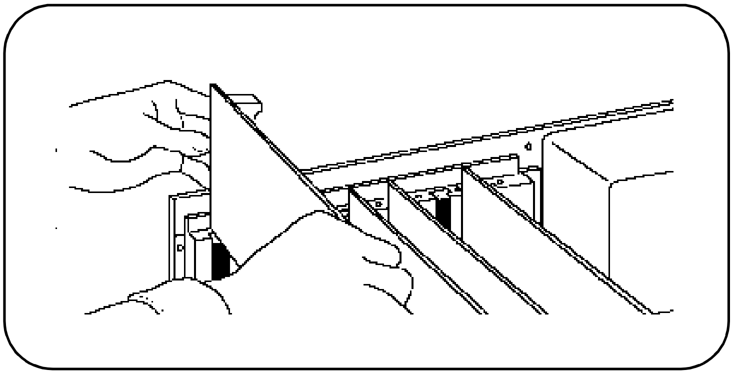


3 **Remove a Cover Plate.** Remove one of the PC back panel cover plates. The 82350B is a 5V PCI card and will not fit in a 3.3V PCI slot or in an EISA or ISA slot. Choose a 5V PCI slot that will give adequate clearance for the GPIB connector.

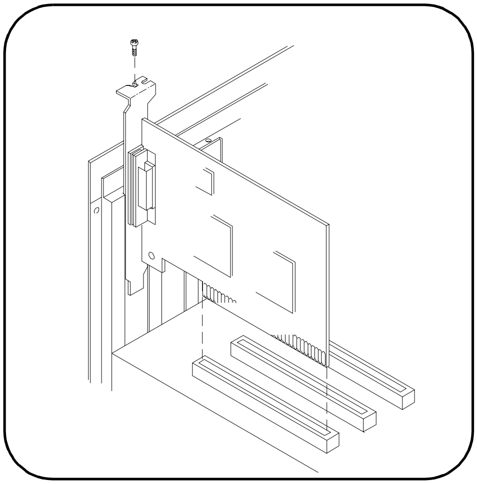


4 **Install the 82350.** Insert the 82350 Interface Card edge connector into the PCI expansion slot connector of the PC. Make sure the interface is fully seated by pushing firmly on the top edge of the card with the palm of your hand. The GPIB connector should extend through the back panel opening to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

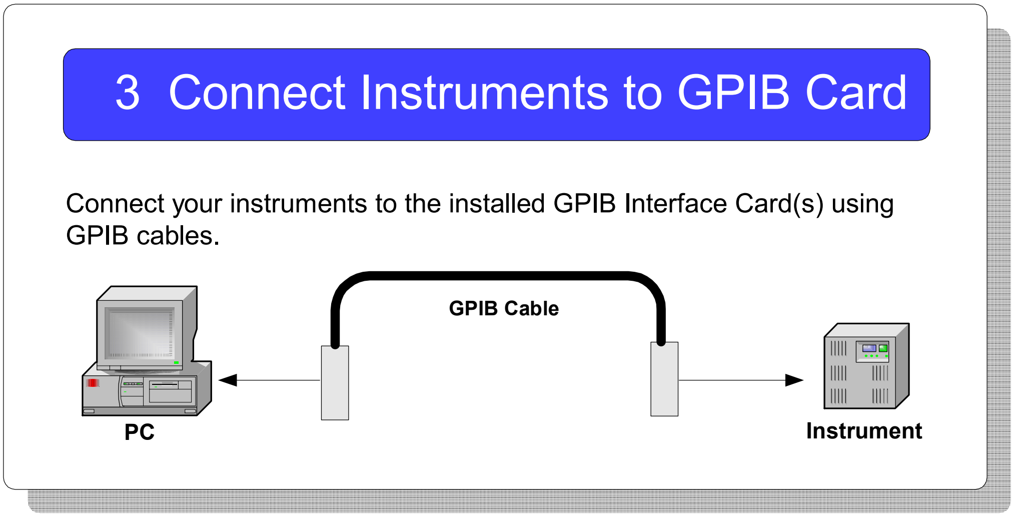
If you install more than one 82350, you may want to install the cards so there is at least one empty slot between every two 82350s. When inserting the 82350, be sure to hold the card by its edges. Also, be careful with the metal faceplate around the GPIB connector as the faceplate can be bent.



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.



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.

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 connectors 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. Systems with devices not using tri-state drivers are limited to transfer rates <250 Kbytes/sec. 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 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 length of all GPIB cables is ≤1 meter times the number of devices connected together, up to a maximum of 15 meters.

❑ The length between adjacent devices is not critical as long as the overall restriction is met. GPIB bus extenders are available that allow operation over much greater distances.

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

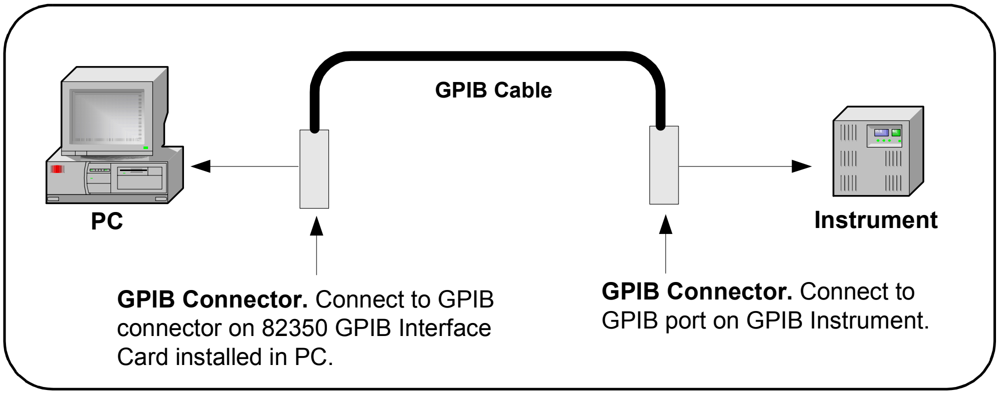
- □ 10833A (1 meter)
- □ 10833B (2 meters)
- □ 10833C (4 meters)
- □ 10833D (0.5 meter)
- □ 8120-3448 (6 meters)
- □ 8120-3449 (8 meters)
- □ Other IEEE-488 GPIB interface bus cables, as applicable

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. You may want to record the primary GPIB address of the attached instrument for future programming use. 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.



GPIB Connector. Connect to GPIB connector on 82350 GPIB Interface Card installed in PC.

GPIB Connector. Connect to GPIB port on GPIB Instrument.

Example: Connecting Multiple GPIB Instruments

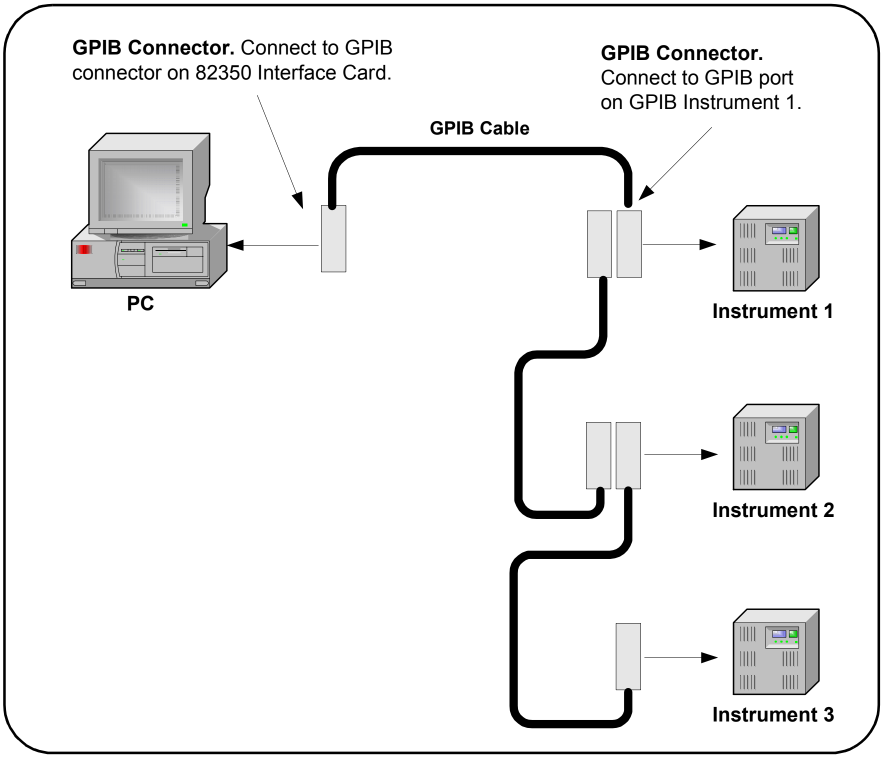
This figure shows one way to connect three GPIB instruments to an Agilent 82350 GPIB Interface Card. You may want to record the primary GPIB address of each attached instrument for future programming use. After making the connections, reconnect the PC power cord and apply power to the PC and attached peripherals/instruments.

CAUTION

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

NOTE

Although the figure shows cable connections to GPIB Instrument 1, the connection can be to any GPIB instrument in the system.

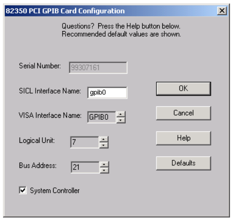

GPIB Connector. Connect to GPIB connector on 82350 Interface Card.
GPIB Connector. Connect to GPIB port on GPIB Instrument 1.
GPIB Cable
PC
Instrument 1
Instrument 2
Instrument 3

Step 4: Configure GPIB Interface Cards

4 Configure GPIB Interface Cards

Use **IO Config** to configure installed GPIB Interface Card(s) parameters.

You can use the **GPIB Card Configuration** dialog box to configure GPIB Interface Cards installed in your PC.



82350 PCI GPIB Card Configuration

Questions? Press the Help button below.
Recommended default values are shown.

Serial Number: 99307161

SICL Interface Name: gpib0

VISA Interface Name: GPIB0

Logical Unit: 7

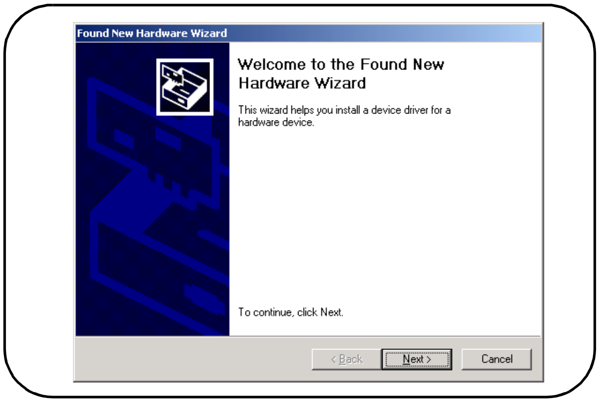
Bus Address: 21

☑ System Controller

What's in This Step? This step shows suggested actions to use the **IO Config** utility to configure a Windows 98/Me/2000/NT/XP operating system for a PC that has an Agilent 82350 GPIB Interface Card (or equivalent) installed.

Steps to Configure GPIB Interface Cards

1 **Apply Power.** Apply power to the PC and to the installed GPIB instruments. As Windows 98/Me/2000/NT/XP restarts, a **Found New Hardware Wizard** may start. This figure shows a typical Windows 2000 display. The display may be different for other operating systems.



Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

This wizard helps you install a device driver for a hardware device.

To continue, click Next.

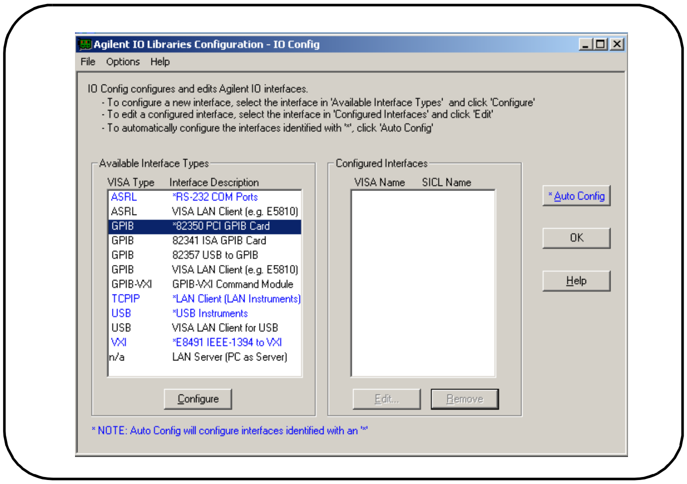
2 **Install Configuration Files.** Use this table for the actions to take for the operating systems listed.

OS	Action
98/Me	■ When the Wizard asks for the *Agilent IO Libraries* CD, click **OK.** ■ When the Wizard asks for the *hpioclas.dll* file, browse to *C:\windows\system\* and click **OK.**
2000/XP	■ Click **Next>** to accept the default suggestions. ■ Click **Finish** to complete the installation.

3 **Open IO Config.** Click the **Agilent IO Libraries Control** icon (blue **IO** icon on the Windows taskbar) and then click **Run IO Config**. When the main screen appears, highlight the **GPIB 82350 PCI GPIB Card** menu item and then click the **Configure** button to display the **82350 PCI GPIB Card Configuration** screen. (For an Agilent 82341 card, highlight **GPIB 82341 ISA GPIB Card** and then click **Configure**).

NOTE

For a description of IO Config and the Agilent IO Libraries, see the Agilent IO Libraries Installation and Configuration Guide. This guide may be included on the instrument CD or is available on the Web.



IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

Available Interface Types

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

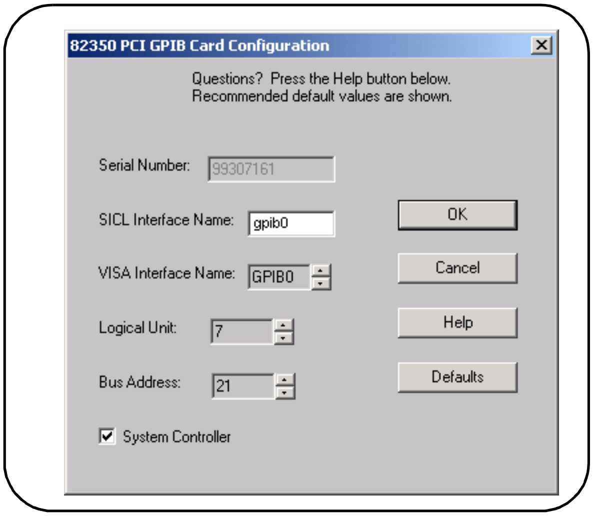
Configured Interfaces

VISA Name	SICL Name

* NOTE: Auto Config will configure interfaces identified with an '*'

4 **Configure GPIB Card Parameters.** When the **82350 PCI GPIB Card Configuration** screen appears, set the **VISA Interface Name**, **SICL Interface Name**, **Logical Unit** and **Bus 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.



Questions? Press the Help button below.
Recommended default values are shown.

Serial Number: 99307161

SICL Interface Name: gpib0

VISA Interface Name: GPIB0

Logical Unit: 7

Bus Address: 21

☑ System Controller

NOTE

After the system is configured, this screen may also display an ***Edit VISA Config...*** *button. Clicking this button allows you to manually configure the interface as desired.*

82350 GPIB Interface Card Configuration Parameters	
SICL Interface Name	Symbolic name that SICL uses to uniquely identify this GPIB interface. The default Interface Name is gpib0. The SICL Interface Name 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.
VISA Interface Name	Symbolic name that VISA uses to uniquely identify this GPIB interface. The default VISA Interface Name 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.
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 Name to properly address the GPIB interface in your SICL applications.
Bus 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.

5 **Change/Accept the Configuration Values.** If the configuration values displayed are acceptable to you, click the **OK** button. Otherwise, you can change the configuration values by clicking the arrows next to the values. If there are no arrows, you can change the configuration values by typing in the values you want.

At any time, you can click the **Defaults** button to return the dialog box to its default configuration values for the GPIB interface. When you have changed the desired values, either click the **OK** button to accept the changes or click the **Cancel** button to cancel the changes and return to the previous configuration values for the GPIB interface.

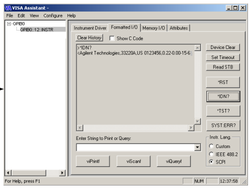
6 **Repeat Steps for Other Cards.** If you have installed more than one GPIB Interface Card in your PC, repeat these steps for the remaining cards. Then, go to Step 5: Communicate with Instruments.

Step 5: Communicate with Instruments

5 Communicate with Instruments

You can use applications such as *VISA Assistant* to verify communication with instruments via the GPIB interface.

You can use *VISA Assistant* to verify communication with instruments.



```
>*IDN?
<Agilent Technologies,33220A,US 0123456,0.22-0.00-15-6
```

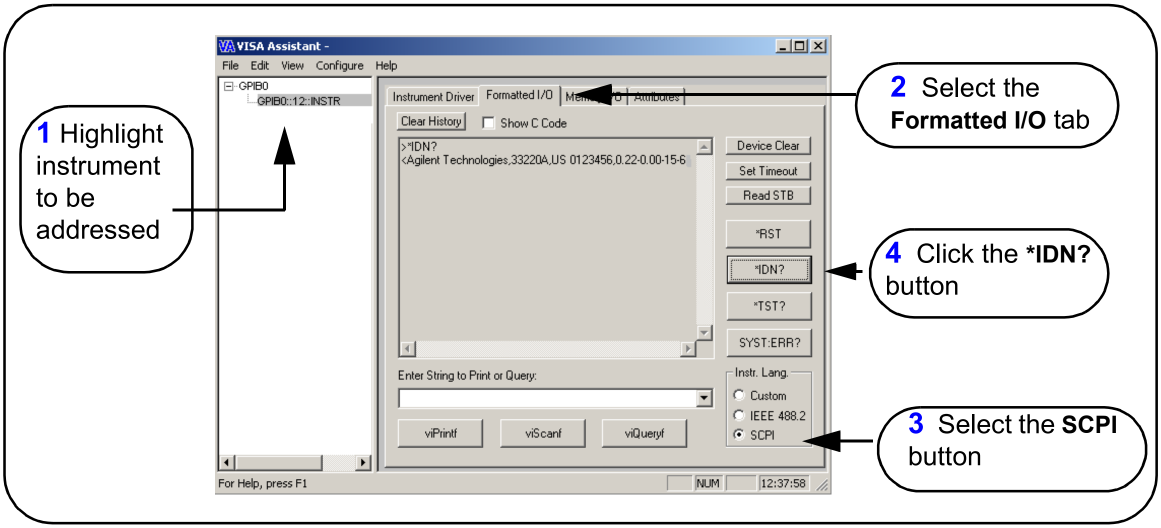
What's in This Step? This step gives guidelines to communicate with your instruments using *VISA Assistant*. When you have verified communication with your instruments (as desired), go to Step 6: Program Your Instruments.

Example: Communicating Using VISA Assistant

VISA Assistant is an application program that uses the Agilent IO Libraries to communicate with LAN, USB, and GPIB instruments. *VISA Assistant* can automatically detect and assign VXI*plug&play* instrument drivers to instruments.

VISA Assistant can also be used to send and receive strings to instruments which support formatted I/O. For other instruments, *VISA Assistant* allows you to read and write memory areas. *VISA Assistant* also describes attributes that are associated with an instrument.

This example shows one way to use *VISA Assistant* to communicate with an Agilent 33220A to return the ID string for the instrument. To open *VISA Assistant*, click the **Agilent IO Libraries Control** icon (blue **IO** icon on the Windows taskbar) and click **Run VISA Assistant** to display the *VISA Assistant* main screen. Then, use the steps in this figure to return the identification string for an Agilent 33220A.



```
>*IDN?
<Agilent Technologies,33220A,US 0123456,0.22-0.00-15-6
```

1 Highlight instrument to be addressed

2 Select the **Formatted I/O** tab

3 Select the **SCPI** button

4 Click the ***IDN?** button

Step 6: Program Your Instruments

6 Program Your Instruments

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

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.

Programming Your Instruments

Programming Overview

This section provides an overview of programming instruments via LAN, USB, or 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*pnp* 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.

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 program examples 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.

- Although not included in this guide, IDSK drivers are available and are installed as part of the free IntuiLink for Arb software included on this CD or may be obtained at **http://www.agilent.com/find/intuilink**.
- VISA-COM, IVI-COM, VISA, and VXI*plug&play* drivers for the Agilent 33220A may be obtained at **http://www.agilent.com/find/33220A** in the Library under the heading **Software, Firmware, & Drivers**.
- USB ports ONLY work properly on Windows XP when the latest Microsoft USB drivers from Windows XP Service Pack 1 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 XP PC to SP1 will probably not automatically update the USB drivers. 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

If you want to modify the example programs or write your own programs and compile them, a **developer** version of the Agilent E2094 I/O Libraries software must be installed. For GPIB, the Agilent E2094 I/O Libraries software is provided with Agilent GPIB I/O products. The software should have been loaded when you installed your GPIB interface card in your PC. For USB or LAN, if you do not have a copy, you can order the Agilent E2094 I/O Libraries software on CD-ROM. You must have version M (order Agilent product number E2094M) or a later version to support USB.

NOTE

*You can obtain the Agilent I/O Libraries through the Agilent Developer Network. Go to **www.agilent.com/find/buyadn** and purchase an ADN Professional Membership. This gives you the right to download the latest version of the Agilent I/O Libraries. Look for the Agilent I/O Libraries link under "Downloads" on the ADN web site.*

Using I/O Objects in Other Visual Basic Projects

All Visual Basic programs in this guide use the Agilent VISA-COM object. To use the I/O object in another Visual Basic project, use these steps:

1. **Set the Reference.** Set the reference to include the libraries in the Project/References menu:

   ❑ "VISA COM 1.0 Type Library", corresponds to VISACOM.tlb

   ❑ "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

Addressing Instruments via LAN

To address instruments via the LAN, you must first configure the TCPIP LAN Client interface using the IO Config utility. 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 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 configuration when configuring the LAN client. The SICL-LAN protocol on Windows 98/Me/2000/NT/XP Professional 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 client and the LAN server. The server accepts device I/O requests over the network from the client and then proceeds to execute those I/O requests on a local interface (such as LAN).

By default, the LAN Client supports both protocols by automatically detecting the protocol the server is using. When a VISA `viOpen` or SICL `iopen` call is performed, the LAN Client 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 Client interface 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 TCPIP LAN Client 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`'.

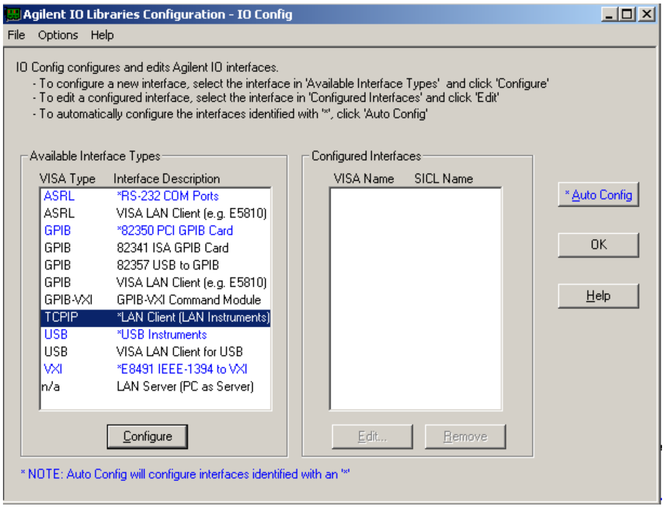
Configuring TCPIP LAN Client Interfaces

When you have configured VISA LAN Client 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 TCPIP LAN Client interface follows.

NOTE

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

1 To configure TCPIP LAN Client interfaces using the IO Config utility, click the **Agilent IO Libraries Control** icon (blue **IO** icon on the Windows taskbar) and click **Run IO Config**. When the main screen appears, highlight the **TCPIP LAN Client (LAN Instruments)** menu item and then click the **Configure** button.



IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

Available Interface Types

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

Configured Interfaces

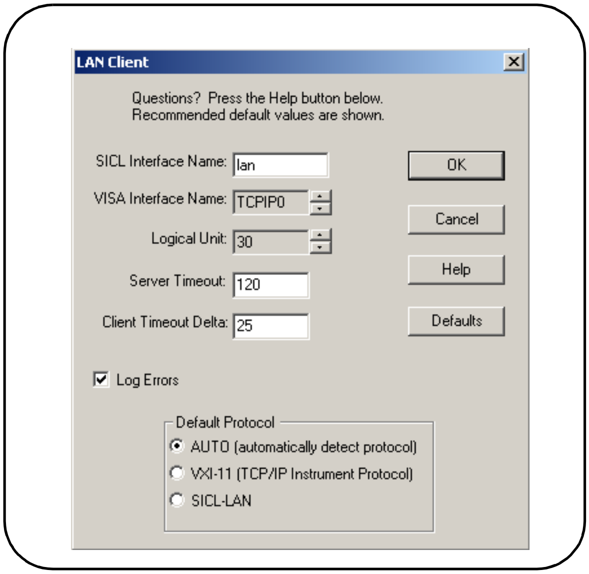
VISA Name	SICL Name

* NOTE: Auto Config will configure interfaces identified with an '*'

2 When the **LAN Client** screen appears, set the **SICL Interface Name**, **VISA Interface Name, Logical Unit number**, **Server Timeout value**, and **Client Timeout Delta** as required. Also, you can select the **Default Protocol** (**AUTO**, **VXI-11**, or **SICL-LAN**) and choose whether or not to **Log Errors**. Then, click the **OK** button.

NOTE

After the system is configured, this screen may also display an ***`Edit VISA Config...`*** *button. Clicking this button allows you to manually configure the interface as desired.*



LAN Client

Questions? Press the Help button below.
Recommended default values are shown.

SICL Interface Name: lan

VISA Interface Name: TCPIP0

Logical Unit: 30

Server Timeout: 120

Client Timeout Delta: 25

☑ Log Errors

Default Protocol
● AUTO (automatically detect protocol)
○ VXI-11 (TCP/IP Instrument Protocol)
○ SICL-LAN

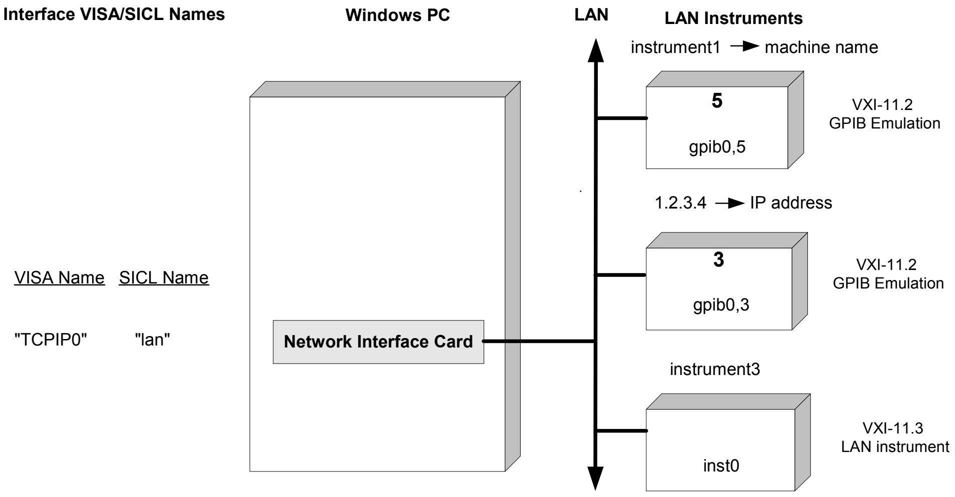
Example: Addressing LAN Instruments Using VISA/SICL

The TCPIP LAN Client 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, the IO Config utility 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).

Since unique names have been assigned by IO Config, 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.

TCPIP LAN Client Addressing



Interface VISA/SICL Names

VISA Name	SICL Name
"TCPIP0"	"lan"

Windows PC

Network Interface Card

LAN

LAN Instruments

instrument1 → machine name

5
gpib0,5

VXI-11.2
GPIB Emulation

1.2.3.4 → IP address

3
gpib0,3

VXI-11.2
GPIB Emulation

instrument3

inst0

VXI-11.3
LAN instrument

VISA/SICL Addressing (Using LAN Client)

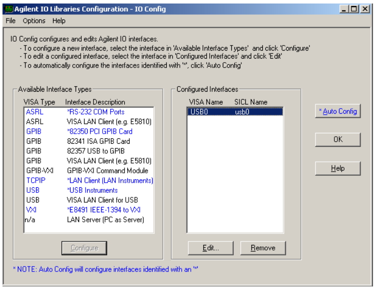
VISA: viOpen (... "TCPIP0::instrument1::gpib0,5::INSTR"...)	Open IO path to LAN instrument at address 5
viOpen (... "TCPIP0::1.2.3.4::gpib0,3::INSTR "...)	Open IO path to LAN instrument at address 3
viOpen (... "TCPIP0::instrument3::inst0::INSTR"...)	Open IO path to LAN instrument3
SICL: iopen ("lan [instrument1]:gpib0,5")	Open IO path to LAN instrument at address 5
iopen ("lan [1.2.3.4]:gpib0,3")	Open IO path to LAN instrument at address 3
iopen ("lan [instrument3]:inst0")	Open IO path to LAN instrument3

Addressing Instruments via USB

As desired, you can use an **Alias name** to address instruments via USB. The USB Alias name associates an alias with a specific instrument. You can use 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 an Alias name.

1 **Display the IO Config Main Screen.** Click the blue **IO** icon (on the Windows Taskbar) and select **Run IO Config** to display the **IO Config** main screen.

If there is no entry in the **Configured Interfaces** box for USB instruments, you can highlight **USB *USB Instruments** and click **Configure** to configure the USB interface.



IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

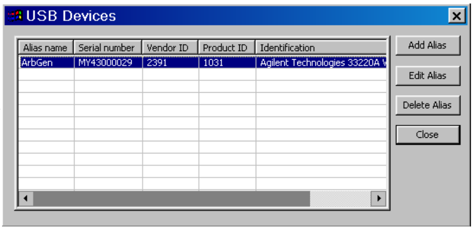
VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

VISA Name	SICL Name
USB0	usb0

* NOTE: Auto Config will configure interfaces identified with an '*'

2 **Display the USB Devices Dialog Box.** Highlight the USB instrument name in the **Configured Interfaces** box (VISA Name of USB0 and SICL Name of usb0 for the previous figure). Then, click **Edit...** to display the **USB Devices** dialog box.

This dialog box allows you to associate a USB Alias name with a specific instrument. The association is based on the instrument's Vendor ID, Product ID, Serial Number, and Interface Number.



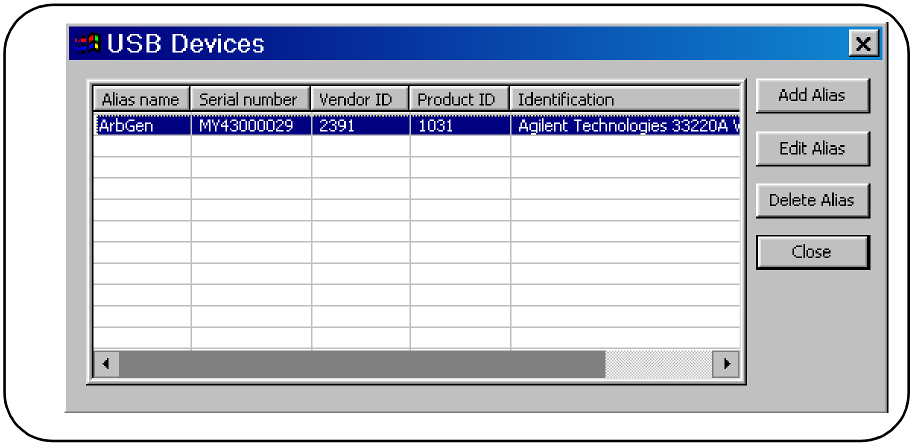
Alias name	Serial number	Vendor ID	Product ID	Identification
ArbGen	MY43000029	2391	1031	Agilent Technologies 33220A V

3 **Add/Change/Delete Aliases.** You can use the **USB Devices** dialog box to change existing USB Alias names or to add or delete Alias names.

Example: Assigning a USB Alias Name

This figure shows an example **USB Devices** dialog box for an Agilent 33220A. To change the USB Alias name, type the new name in the **Alias name** box and then click the **OK** button. The Alias name can be used as the preferred address for the VISA *rsrcName* and the SICL address.

For this example, the Alias name has been changed to **.ArbGen.** from the default **.UsbDevice1.**. Thus, **ArbGen** can be used in viOpen() as the VISA *rsrcName* parameter, rather than **.USB0::2391::1031::MY43000029::0::INSTR.**. Or, **ArbGen** can be used in iopen() as the SICL *address* parameter, rather than the alternate address of **.usb0[2391::1031::MY43000029::0].**.



USB Devices

Alias name	Serial number	Vendor ID	Product ID	Identification
ArbGen	MY43000029	2391	1031	Agilent Technologies 33220A V

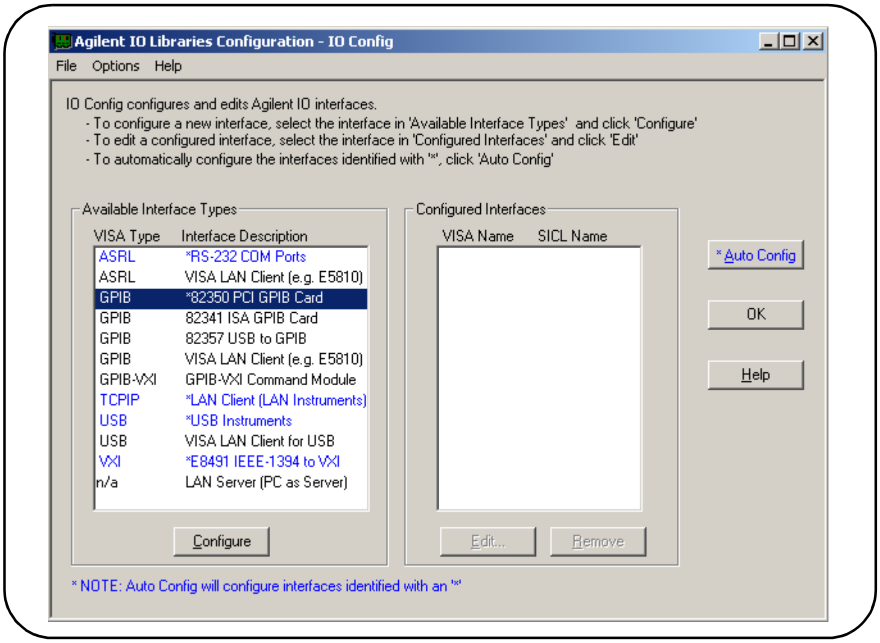
Addressing Instruments via GPIB

To address instruments via a GPIB interface, you must first configure the interface using the IO Config utility.

Steps to Configure a GPIB Interface

Steps to configure a GPIB interface for an Agilent 82350 PCI card follow. Modify the steps as required if you use an 82341 ISA card.

1 To configure GPIB (82350 PCI) interfaces using IO Config, click the **Agilent IO Libraries Control** icon (blue icon on the Windows taskbar) and click **Run IO Config**. When the main screen appears, highlight the **GPIB *82350 PCI GPIB Card** menu item (highlight **GPIB 82341 GPIB ISA Card** for an 82341 card) and then click the **Configure** button.



IO Config configures and edits Agilent IO interfaces.
- To configure a new interface, select the interface in 'Available Interface Types' and click 'Configure'
- To edit a configured interface, select the interface in 'Configured Interfaces' and click 'Edit'
- To automatically configure the interfaces identified with '*', click 'Auto Config'

VISA Type	Interface Description
ASRL	*RS-232 COM Ports
ASRL	VISA LAN Client (e.g. E5810)
GPIB	*82350 PCI GPIB Card
GPIB	82341 ISA GPIB Card
GPIB	82357 USB to GPIB
GPIB	VISA LAN Client (e.g. E5810)
GPIB-VXI	GPIB-VXI Command Module
TCPIP	*LAN Client (LAN Instruments)
USB	*USB Instruments
USB	VISA LAN Client for USB
VXI	*E8491 IEEE-1394 to VXI
n/a	LAN Server (PC as Server)

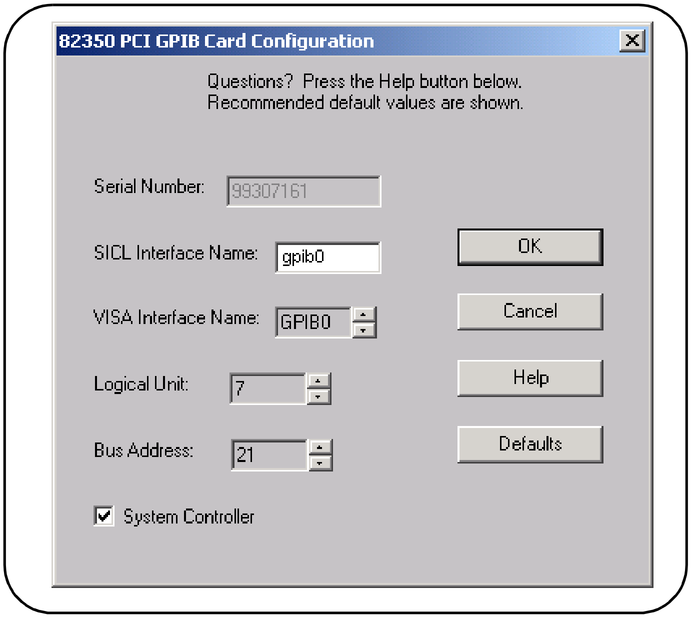
* NOTE: Auto Config will configure interfaces identified with an '*'

2 When the **82350 PCI GPIB Card Configuration** screen appears, set the **VISA Interface Name**, **SICL Interface Name**, **Logical Unit** and **Bus Address** values as required. Then, click the **OK** button.

3 If you have more than one 82350 card in your system, repeat for remaining cards.

NOTE

After the system is configured, this screen may also display an ***Edit VISA Config...*** *button. Clicking this button allows you to manually configure the interface as desired.*



82350 PCI GPIB Card Configuration

Questions? Press the Help button below.
Recommended default values are shown.

Serial Number: 99307161

SICL Interface Name: gpib0

VISA Interface Name: GPIB0

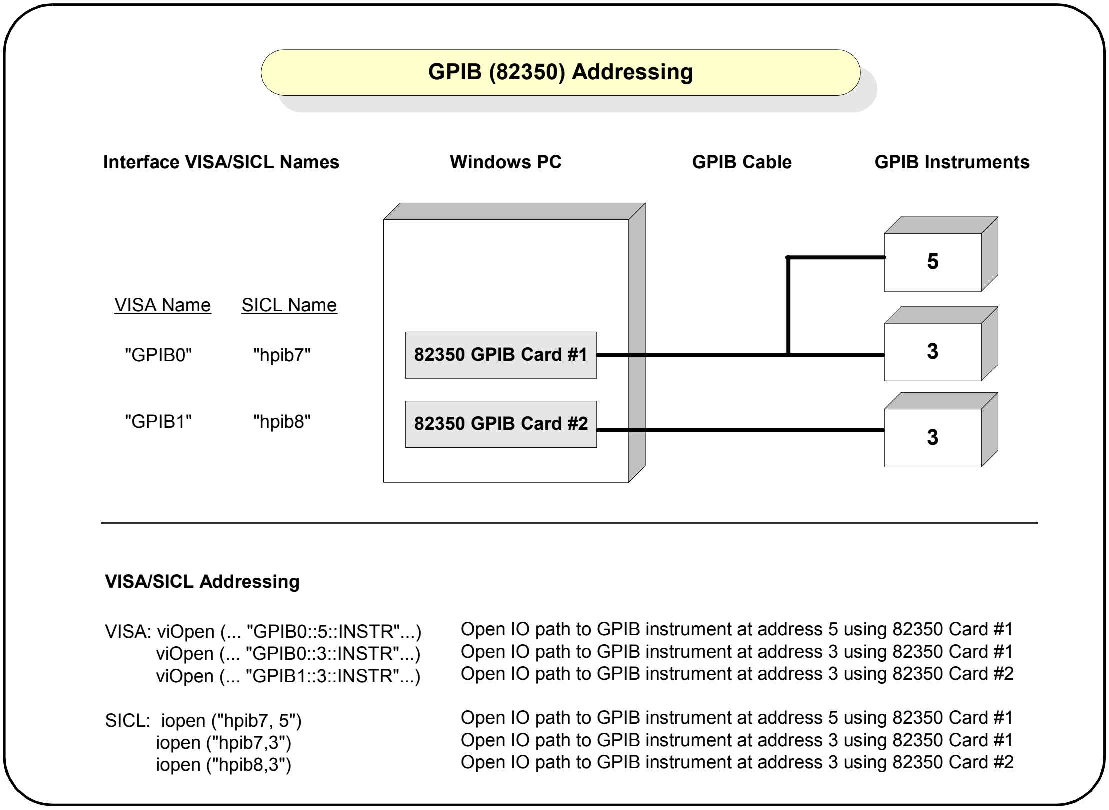
Logical Unit: 7

Bus Address: 21

☑ System Controller

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.



VISA Name	SICL Name
"GPIB0"	"hpib7"
"GPIB1"	"hpib8"

VISA/SICL Addressing

VISA: viOpen (... "GPIB0::5::INSTR"...)	Open IO path to GPIB instrument at address 5 using 82350 Card #1
viOpen (... "GPIB0::3::INSTR"...)	Open IO path to GPIB instrument at address 3 using 82350 Card #1
viOpen (... "GPIB1::3::INSTR"...)	Open IO path to GPIB instrument at address 3 using 82350 Card #2
SICL: iopen ("hpib7, 5")	Open IO path to GPIB instrument at address 5 using 82350 Card #1
iopen ("hpib7,3")	Open IO path to GPIB instrument at address 3 using 82350 Card #1
iopen ("hpib8,3")	Open IO path to GPIB instrument at address 3 using 82350 Card #2

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, the IO Config utility has been used to assign GPIB card #1 a VISA name of “GPIB0” and a SICL name of “gpib0”.

IO Config 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 IO Config, 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.

Example Programs

Four example programs follow to demonstrate sine waveform generation for an Agilent 33220A 20 Mhz Function/Arbitrary Waveform Generator. The example programs are essentially repeated to show the same functionality with different programming environments and I/O. See the *Agilent IntuiLink for the 33220A Waveform Generator* CD for other program examples. The example programs are:

- Example: Simple Sine Waveform (Visual Basic and VISA-COM)
- Example: Simple Sine Waveform (Visual C++ and IVI-COM)
- Example: Simple Sine Waveform (Visual C++ and VXI*pnp*)
- 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

' 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 (Visual C++ and IVI-COM)

This example program is intended for use with Microsoft Visual C++ 6.0 and the Agilent IVI-COM drivers. This program shows how to download an arbitrary waveform using binary data. The program generates a damped sine wave using 16,000 points.

NOTE

"VISA COM 1.0 Type Library" corresponds to VISACOM.tlb and "Agilent 33220 IVI COM Driver 1.0" corresponds to Agilent33220.DLL. Use the statement "#import "Agilent33220.dll" no_namespace" to import the Agilent 33220 IVI-COM Driver.

Create a variable of type IAgilent33220Ptr to hold the reference to the object. To create the object, use "Fgen.CreateInstance(__uuidof(Agilent33220))".

```
#include <stdio.h>
#include <math.h>

// Specify the default address
#define DEFAULT_LOGICAL_ADDRESS OLESTR("GPIB0::10::INSTR")

#import "IviDriverTypeLib.dll" no_namespace
#import "IviFgenTypeLib.dll" no_namespace
#import "VisaCom.tlb" no_namespace
#import "Agilent33220.dll" no_namespace

void main()
{
  BSTR     TxtAddress = DEFAULT_LOGICAL_ADDRESS;
  long   Ncycles = 10;     /* Define number of sinewave cycles */
  double Damp_factor = -5; /* Define damping factor */
  double pi = 3.14159;     /* Define pi */
  long   i;
  IAgilent33220Ptr Fgen;

    CoInitialize(NULL);

  Fgen.CreateInstance(__uuidof(Agilent33220));

  Fgen->Initialize(TxtAddress, VARIANT_FALSE, VARIANT_TRUE, "");
  Fgen->Utility->Reset();// Reset the function generator
  Fgen->Status->Clear();// Clear errors and status registers
  Fgen->System->TimeoutMilliseconds = 40000;  // Set timeout to 40 
seconds for long download strings
  Fgen->Output->Frequency = 5000;          // Output frequency is 5 kHz
  Fgen->Output->Load = 50; // Output termination is 50 Ohms
  Fgen->Output->Voltage->Amplitude = 5; // Output amplitude is 5 Vpp

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

  // Create an array of data

  SAFEARRAY *psa;

  // Build a SafeArray of integer values.
  SAFEARRAYBOUND bounds = {16000, 0};
```

```
   psa = SafeArrayCreate (VT_I2, 1, &bounds);

   // Populate the safearray
   SHORT* Waveform;
   SafeArrayAccessData(psa, (void**) &Waveform);

   for (i = 1; i<= 16000; i++)
   {
     if(i < 14000)
     {
       Waveform[i-1] = (short)(sin(2.0 * pi * (double)Ncycles *
(double)i / 14000) * 2047
         * exp(Damp_factor * (double)i / 14000) + 0.5);
     }
     else
     {
       Waveform[i-1] = 0;
     }
   }

   SafeArrayUnaccessData(psa);

   // Download data points to volatile memory
   fprintf(stderr,"Downloading Arb...\n");

     Fgen->ArbitraryWaveform->SetDataDAC(&psa);

     Fgen->System->IO->WriteString("*OPC?", VARIANT_TRUE);
     Fgen->System->IO->ReadString();

   fprintf(stderr,"Download Complete\n");
     // Download data points to volatile memory

     Fgen->ArbitraryWaveform->CopyData("DAMP_SIN"); // Copy arb to
      non-volatile memory
    Fgen->ArbitraryWaveform->User = "DAMP_SIN";    // Select the active
      arb waveform
    Fgen->Output->Function = Agilent33220OutputFunctionUser; // Output
the selected arb waveform
     Fgen->Output->State = VARIANT_TRUE;// Enable Output
   Fgen->Close();
   exit(0);
}
```

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

This example program is intended for use with Microsoft Visual C++ 6.0 and requires VISA revision 2.0 and the Agilent Technologies 33220A VXI*pnp* instrument driver installed. This program shows how to download an arbitrary waveform using binary data. The program generates a damped sine wave using 16,000 points.

```
#include <string.h>
#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include "ag33250a.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   vi;
  ViRsrc      TxtAddress = DEFAULT_LOGICAL_ADDRESS;
  ViInt16  Waveform[16000];
  long   Ncycles = 10;     /* Define number of sinewave cycles */
  double Damp_factor = -5; /* Define damping factor */
  double pi = 3.14159;     /* Define pi */
  long   i;
  ViInt16  reply;
  CHECK(ag33250a_init(TxtAddress, 0, 0, &vi));
  /* This funcion initializes the instrument */

  CHECK(ag33250a_reset(vi));/* Reset the function generator */
  CHECK(ag33250a_dcl(vi));/* Clear errors and status registers */
    CHECK(ag33250a_formBord(vi, ag33250a_ARB_WAV_FORM_BOR_SWAP));
```

```
/* Swap data bytes (send LSB first) */
    CHECK(ag33250a_freq(vi, 5000));
/* Output frequency is 5 kHz */
   CHECK(ag33250a_outpLoad(vi, ag33250a_OUTPUT_LOAD_50));
/* Output termination is 50 Ohms */
    CHECK(ag33250a_volt(vi, 5));
/* Output amplitude is 5 Vpp */

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

  /* Calculate data points */
  for (i = 1; i<= 16000; i++)
  {
    if(i < 14000)
    {
      Waveform[i-1] = (short)(sin(2.0 * pi * (double)Ncycles *
(double)i / 14000) * 2047
         * exp(Damp_factor * (double)i / 14000) + 0.5);
    }
    else
    {
      Waveform[i-1] = 0;
    }
  /* Download data points to volatile memory from array */

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

  CHECK(ag33250a_dataDacVolatile(vi, 16000, Waveform));
    CHECK(ag33250a_opc_Q(vi, &reply));

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

    CHECK(ag33250a_dataCopy(vi, "DAMP_SIN"));
/* Copy arb to non-volatile memory */
    CHECK(ag33250a_funcUserName(vi, "DAMP_SIN"));
/* Select the active arb waveform  */
    CHECK(ag33250a_funcShap(vi, ag33250a_OUTPUT_FUNC_USER));
/* Output the selected arb waveform */
CHECK(ag33250a_outpSetup(vi, ag33250a_OUTPUT_SETUP_ON));
/* Enable output */
  CHECK(ag33250a_close(vi));
}
```

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));
  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));
}
```

Installing I/O Software

Pre-Installation Checks

Before you install I/O software on your PC, verify that your system meets the minimum hardware and software requirements to install and use the Agilent IO Libraries for the USB, LAN, or GPIB interface. Adding additional RAM may improve system performance. For example, this table shows minimum hardware and software requirements to install the software contained on the *Agilent IntuiLink for the 33220A Waveform Generator* CD.

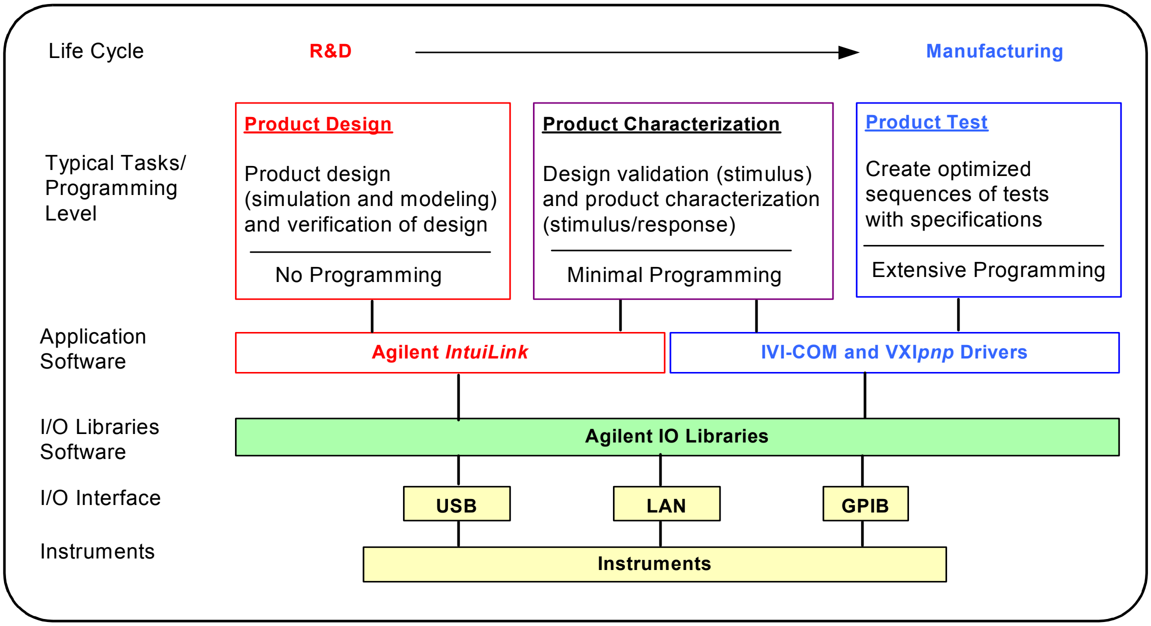
Hardware	**Minimum Requirements**	
PC Operation/Memory	Pentium 200 MHz operation and 64 MBytes RAM	
Free Disk Space	80 MBytes	
Ethernet Connections (LAN)	10BASE-T or 100BASE-TX compliant	
PCI Bus Slot (GPIB)	At least one PCI Bus Slot (to install Agilent 82350B)	
ISA Bus Slot (GPIB)	At least one ISA Bus Slot (to install Agilent 82341A)	
USB Port (USB)	At least one USB Port	
Software	**Minimum Requirements**	
Operating System	Windows 98/Me/NT 4.0 (SP5 or greater)/2000/XP (LAN/GPIB) Windows 98 (SE)/Me/2000/XP (USB)	
Web Browser (Optional)	Internet Explorer 5.0 or higher. (Internet Explorer 5.5 or higher is recommended.)	
Agilent IO Libraries Installation Sizes	- Core Installation (LAN only) - Run-Time Installation (adds hardware drivers) - Full Installation (without manuals) - Full Installation (with manuals) - Add Adobe Acrobat Reader (version 5.05)	5 Mb 9 Mb 14 Mb 34 Mb 11 Mb (addl)

Installing Your Software

Suggested steps follow to select and install I/O software for your application.

1 **Determine Your Application Tasks.** One way to select the I/O software for your application is to use the product life cycle approach. As shown in this figure, as the product life cycle moves from R&D to Manufacturing, tasks for the product typically change from Product Design to Product Characterization to Product Test. The associated programming levels range from no programming to minimal programming to extensive programming.

Agilent *IntuiLink* is typically used for Product Design or Product Characterization, while IVI-COM and VXI*pnp* drivers are typically used for Product Characterization or Product Test. For any software application that uses VISA (such as Agilent *IntuiLink*), a version of the Agilent IO Libraries (developer or runtime) is required.


Life Cycle
R&D
Manufacturing
Typical Tasks/ Programming Level
Product Design
Product design (simulation and modeling) and verification of design
No Programming
Product Characterization
Design validation (stimulus) and product characterization (stimulus/response)
Minimal Programming
Product Test
Create optimized sequences of tests with specifications
Extensive Programming
Application Software
Agilent IntuiLink
IVI-COM and VXIpnp Drivers
I/O Libraries Software
Agilent IO Libraries
I/O Interface
USB
LAN
GPIB
Instruments
Instruments

2 **Select Application and Agilent IO Libraries Software.** The next step is to select the I/O software application(s) and Agilent IO Libraries version you want to install on your PC. This table gives guidelines for using IO software and Agilent IO Libraries version (developer or runtime). See substep 3, following, to select the Agilent IO Libraries version.

Use This Software:	When You Want to:
Instrument Web Browser *(Product Design or Product Characterization)*	
Provides a “soft front panel” displayed on your Web Browser that you can use to control the instrument.	Remotely communicate with instruments from your PC, but do not need to program the instruments. (The IO Libraries are not required.)
Agilent *IntuiLink* *(Product Design or Product Characterization)*	
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 *(Product Characterization or Product Test)*	
Interchangeable Virtual Instruments (IVI)-COM Drivers provide hardware-independent programming syntax for instruments that perform the same function (DMMs, Counters, Switches, etc.).	Develop new applications using Visual Basic, Visual C++, etc. and the IVI-COM drivers. In most cases, new code must be developed for programs using IVI-COM drivers.
VXI*plug&play* Drivers *(Product Characterization or Product Test)*	
VXI*plug&play* functions provide a set of instrument-specific functions you can use for programming instruments using Visual Basic, Visual C++, etc.	Develop or modify existing applications using Visual Basic, Visual C++, etc. You can use existing code if the same driver (or update) is supported on both the old and new instrument.
Agilent IO Libraries (Developer) (All Tasks)	
The developer version of the Agilent IO Libraries allows you to program your instruments using Visual Basic, Visual C++, etc. and to communicate with instruments via USB, LAN, or GPIB.	Use the developer version when you want to develop or modify existing applications using Visual Basic, Visual C++, etc. and VISA. Applications written with VISA for other instruments can be ported to your instruments with little or no modification.
Agilent IO Libraries (Runtime) (All Tasks)	
The runtime version of the Agilent IO Libraries is a subset of the Developer version. With the runtime version of the libraries, you can communicate with instruments, but you cannot program the instruments using VISA.	Use the runtime version when you want to run existing applications that use VISA to communicate with instruments, but you do not need to modify or develop the instrument communication code in the application program.

3 **Select the Agilent IO Libraries Version.** As noted, there are two versions of the Agilent IO Libraries: developer and runtime. Use the **developer version** if you want to communicate with instruments and to program instruments using VISA. Use the **runtime version** if you want to communicate with instruments, but do not need to program the instruments.

This table shows the version of the Agilent IO Libraries required for LAN, USB, and GPIB interfaces and typical programming methods.

Interface	When to Use this Interface:	Programming Method	Need Developer IO Libraries	Need Run-Time IO Libraries	No IO Libraries Needed
LAN	A LAN is the recommended method to connect instruments together in applications such as new test systems.	Sockets			■
		IVI-COM		■	
		VXI*plug&play*		■	
		VISA	■		
USB	USB is a quick and easy way to connect instruments to PCs on a benchtop. Typically, you can use USB to connect instruments to a PC for benchtop R&D testing.	IVI-COM		■	
		VXI*plug&play*		■	
		VISA*	■		
GPIB	GPIB should be used only in a system that is **already** using GPIB to connect instruments. GPIB is not recommended for new systems.	IVI-COM		■	
		VXI*plug&play*		■	
		VISA	■		

* Revision M.01.00 or later of the Agilent IO Libraries is required for USB

4 **Install Your Software.** This table shows the media you can use to install your selected I/O software on your PC for both runtime and developer environments. Follow the instructions on the media to install the software.

NOTE

Installing Agilent IntuiLink or the IVI-COM drivers also automatically installs a runtime version of the Agilent IO Libraries. Revision M.01.00 or later of the Agilent IO Libraries is required for programming via USB.

For This Environment:	Use This Media:	That May Include:	To Get This Media:
Runtime (cannot program instruments)	Instrument CD	- Agilent *IntuiLink* - IVI-COM Drivers - VXI*pnp* Drivers - Agilent IO Libraries (runtime) - Agilent VEE evaluation copy	Ships with the Instrument. Check the instrument CD to see which items are included on the CD.
	Web	- Agilent IO Libraries (runtime)	Download the libraries from **www.agilent.com/connectivity**
Developer (can program instruments)	E2094M	- Agilent IO Libraries (developer)	Order the E2094M product from Agilent. See Contacting Agilent for addresses.

Example: Installing Software from the 33220A CD

For example, the *Agilent IntuiLink for the 33220A Waveform Generator* CD that ships with the 33220A instrument includes these items that you can install on your PC, as desired:

- *IntuiLink* Waveform Editor
- ActiveX Software Components
- VXI *plug&play* Driver
- IVI-COM Driver
- Agilent IO Libraries (runtime)
- Programming Examples
- Manuals
- Agilent VEE (evaluation copy)

For this CD, installing Agilent *IntuiLink* or the IVI-COM Drivers also automatically installs a **runtime** version of the Agilent IO Libraries. (If you want to install a **developer** version of the Agilent IO Libraries, you must install the libraries from the CD included in the E2094M product.

Troubleshooting Guidelines

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

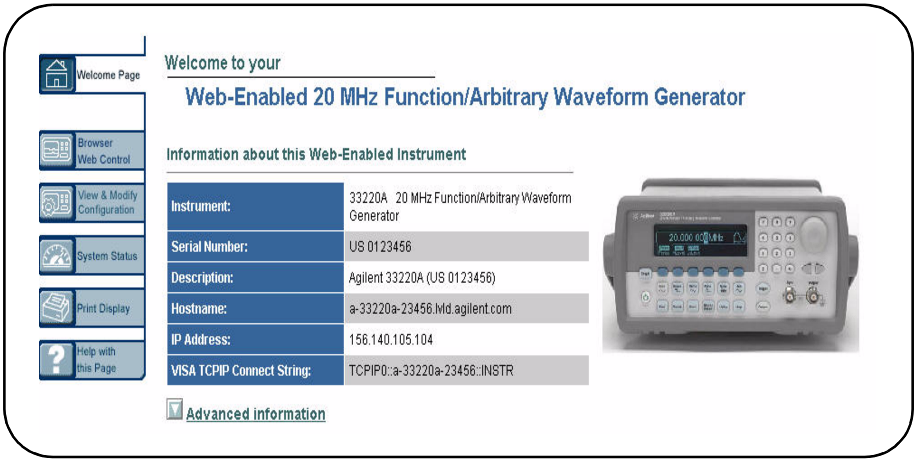
Before beginning LAN troubleshooting steps, you should first check to see what symptoms appear when you attempt to connect to instruments via the LAN. To see if your PC has network access to an instrument, open the Web Browser on the PC and type in the instrument's IP address (or Hostname, if known)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

Example: Using a Web Browser

Since the 33220 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.



Welcome to your

Web-Enabled 20 MHz Function/Arbitrary Waveform Generator

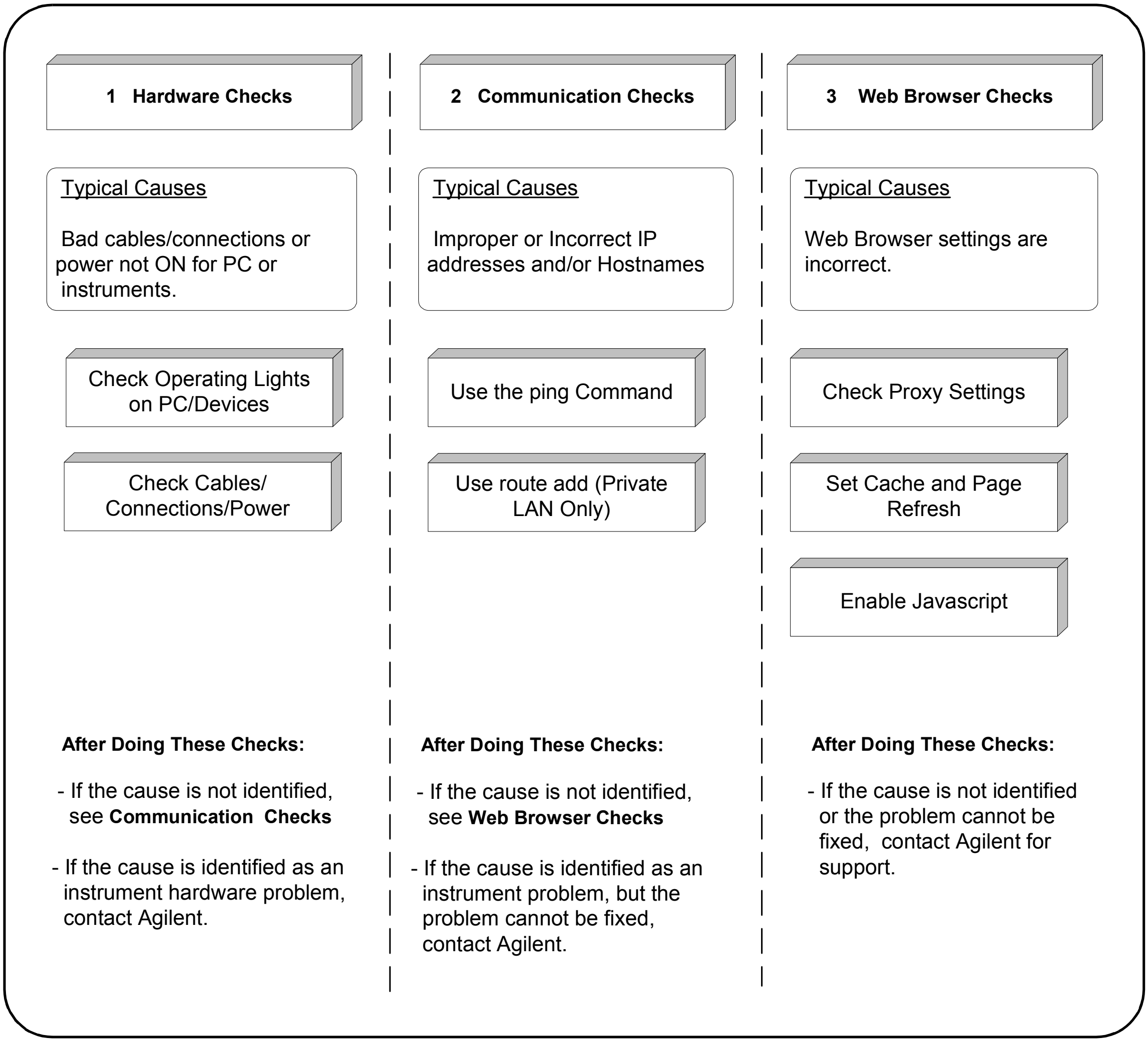
Information about this Web-Enabled Instrument

Instrument:	33220A 20 MHz Function/Arbitrary Waveform Generator
Serial Number:	US 0123456
Description:	Agilent 33220A (US 0123456)
Hostname:	a-33220a-23456.lvld.agilent.com
IP Address:	156.140.105.104
VISA TCPIP Connect String:	TCPIP0::a-33220a-23456::INSTR

Advanced information

Troubleshooting Flowchart

If normal operation cannot be established, see this flowchart for suggested troubleshooting steps. We suggest you start at Hardware Checks.



1 Hardware Checks

Typical Causes

Bad cables/connections or power not ON for PC or instruments.

Check Operating Lights on PC/Devices

Check Cables/ Connections/Power

After Doing These Checks:

- If the cause is not identified, see **Communication Checks**
- If the cause is identified as an instrument hardware problem, contact Agilent.

2 Communication Checks

Typical Causes

Improper or Incorrect IP addresses and/or Hostnames

Use the ping Command

Use route add (Private LAN Only)

After Doing These Checks:

- If the cause is not identified, see **Web Browser Checks**
- If the cause is identified as an instrument problem, but the problem cannot be fixed, contact Agilent.

3 Web Browser Checks

Typical Causes

Web Browser settings are incorrect.

Check Proxy Settings

Set Cache and Page Refresh

Enable Javascript

After Doing These Checks:

- If the cause is not identified or the problem cannot be fixed, contact Agilent for support.

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.

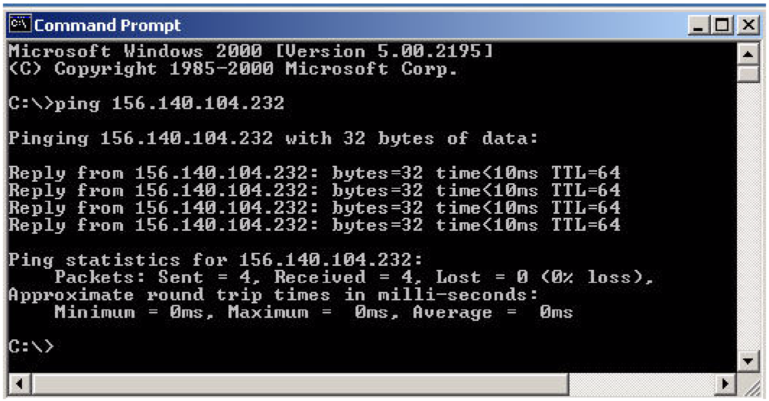
Using the **ping** Command

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).*

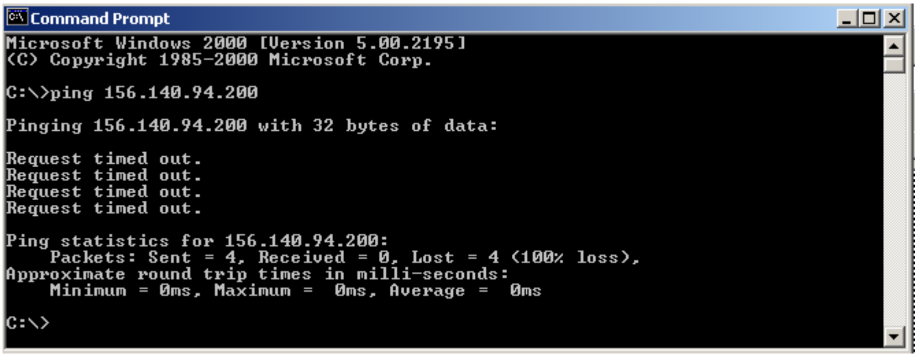
Example: Verifying Communication Using the ping Command

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.



```
Microsoft 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
Reply from 156.140.104.232: bytes=32 time<10ms TTL=64
Reply from 156.140.104.232: bytes=32 time<10ms TTL=64
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.



```
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 use the **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, and 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.

Suggesed 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 was 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 OK for Internet Explorer 5.5 and >)

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 enble 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 **Securities** 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 prompted for “**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 changes active.

Troubleshooting USB Interfaces

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

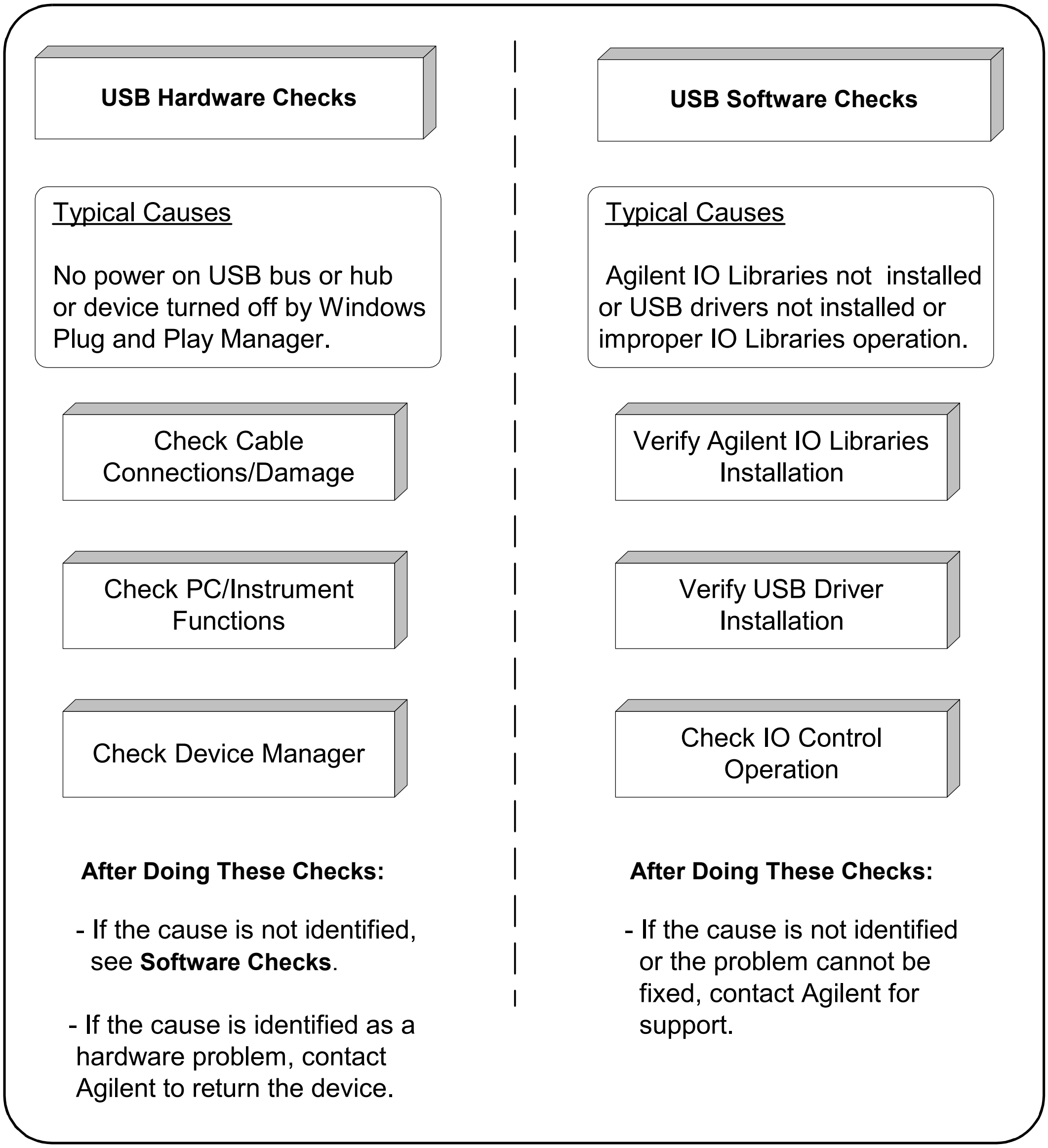
- USB Troubleshooting Overview
- USB Hardware Checks
- USB Software Checks

NOTE

The troubleshooting procedures in this section are primarily oriented toward USB instruments and the Agilent IO Libraries. 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 follows. We suggest you start at USB Hardware Checks and then go to USB Software Checks, as required.



USB Hardware Checks

Typical Causes

No power on USB bus or hub or device turned off by Windows Plug and Play Manager.

Check Cable Connections/Damage

Check PC/Instrument Functions

Check Device Manager

After Doing These Checks:

- If the cause is not identified, see **Software Checks**.

- If the cause is identified as a hardware problem, contact Agilent to return the device.

USB Software Checks

Typical Causes

Agilent IO Libraries not installed or USB drivers not installed or improper IO Libraries operation.

Verify Agilent IO Libraries Installation

Verify USB Driver Installation

Check IO Control Operation

After Doing These Checks:

- If the cause is not identified or the problem cannot be fixed, contact Agilent for support.

USB Hardware Checks

This section gives guidelines to make hardware troubleshooting checks for connected USB instruments. We suggest you 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

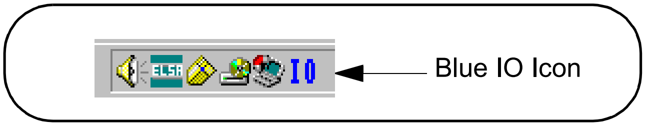
*Windows may place a misbehaving USB device in an "Unknown device" category. To see if this has happened, change the View in **Device Manager** by selecting **View | Show Hidden Devices**. Next, right-click the **Universal Serial Bus Controllers Unknown device** and select **Uninstall**. Then, select **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 Installation

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



❑ If the IO icon is displayed, click the icon and click **About Agilent IO Libraries Control** to display the version. The version must be M.01.00 or greater.

❑ 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** program group.

❑ If this group is displayed, click **Agilent IO Libraries | IO Control** to display the IO icon. Then, click the icon and click **About Agilent IO Libraries Control** to display the installed version (must be M.01.00 or greater).

❑ If neither the IO icon nor the Agilent IO Libraries 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 (as Required).** If Version 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.

a Remove the USB cable from the USB port on the instrument.

b Uninstall the IO Libraries from the **Agilent IO Libraries Control** (blue **IO** icon)

c Re-attach the USB cable to the USB port on the instrument.

d If this does not correct the problem, go to Verify USB Driver Installation.

Verify USB Driver Installation

1 **Check for USB Driver Files.** Files are listed in their default directories for Windows 2000 and Windows 98 (SE)/Me/XP. Verify that the driver files are installed. If they are installed, go to Check 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 have been properly installed. However, upgrading your XP PC to SP1 will probably not automatically update the USB drivers. See ***www.agilent.com/find/connectivity*** *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/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/drivers/agusb48831.dll*
Driver Files	*C:/Windows/system32/drivers/ausbtmc.sys*
.inf Files	*C:/Windows/inf/ausbtmc.inf*

2 **Uninstall/Reinstall the Agilent IO Libraries.** If the driver files are not found, uninstall the Agilent IO Libraries by inserting the *Instrument CD* and following the instructions to remove the libraries. Then, install Version M.01.00 or greater of the Agilent IO Libraries.

Check IO Control Operation

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

By default, the **IO Control** is always active after the Agilent IO Libraries are installed and the blue **IO** icon is displayed. However, the **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 Libraries Control**. Clicking the blue **IO** icon and then clicking **Hide Agilent IO Libraries Control** hides the blue **IO** icon, but does **not** deactivate the 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 Libraries Control. Clicking **Yes** hides the blue **IO** icon **and** deactivates the IO Control.

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

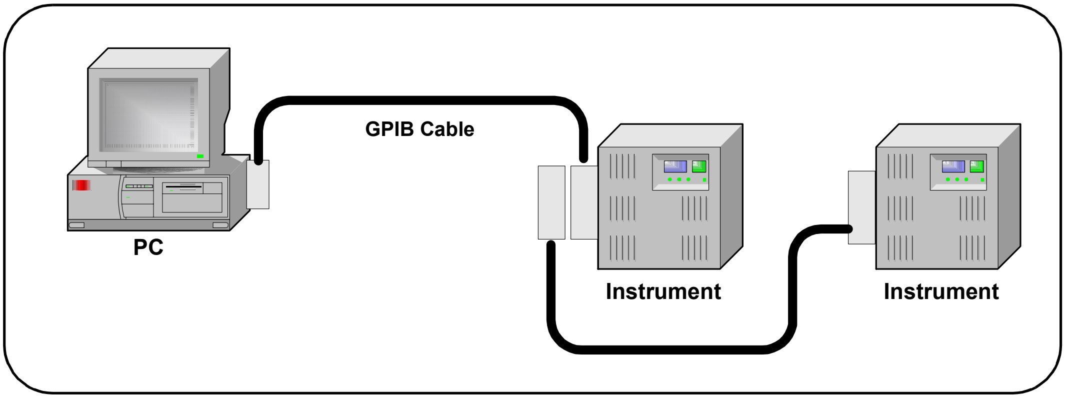
- GPIB Troubleshooting Overview
- GPIB Hardware Checks
- GPIB Software Checks
- Agilent IO Libraries Checks

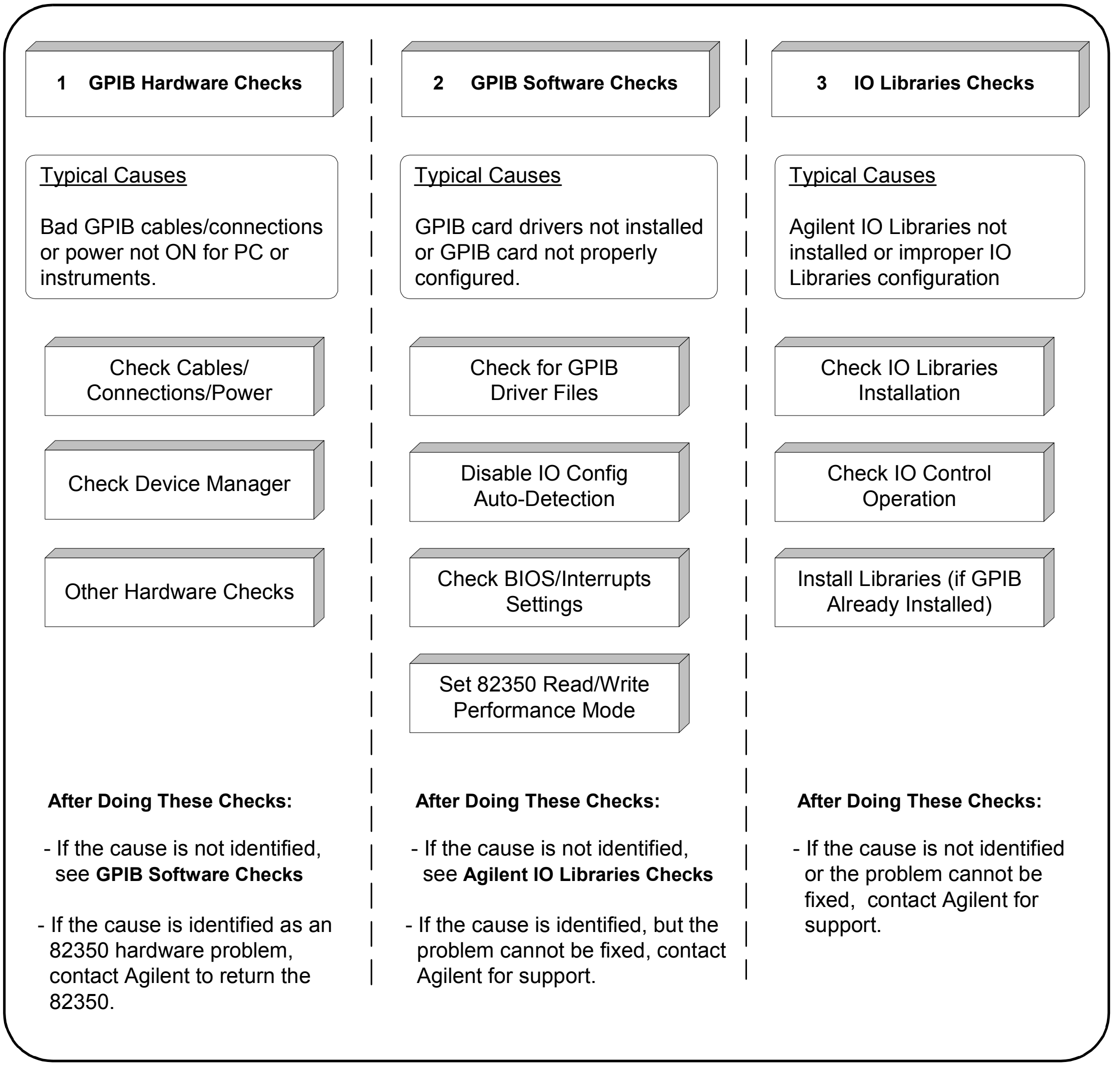
NOTE

The troubleshooting procedures in this section are primarily oriented toward an Agilent 82350 GPIB card and the Agilent IO Libraries. 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 follows. We suggest you start at Step 1 and then go to Step 2 and then to Step 3, as required.





1 GPIB Hardware Checks

Typical Causes

Bad GPIB cables/connections or power not ON for PC or instruments.

Check Cables/ Connections/Power

Check Device Manager

Other Hardware Checks

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.

2 GPIB Software Checks

Typical Causes

GPIB card drivers not installed or GPIB card not properly configured.

Check for GPIB Driver Files

Disable IO Config Auto-Detection

Check BIOS/Interrupts Settings

Set 82350 Read/Write Performance Mode

After Doing These Checks:

- If the cause is not identified, see **Agilent IO Libraries Checks**
- If the cause is identified, but the problem cannot be fixed, contact Agilent for support.

3 IO Libraries Checks

Typical Causes

Agilent IO Libraries not installed or improper IO Libraries configuration

Check IO Libraries Installation

Check IO Control Operation

Install Libraries (if GPIB Already Installed)

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 IO Config Finds 82350 Card with Serial Number ffffffff

Check Cables/ Connections/Power

We suggest you 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-servicable 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 Sound Card Does Not Work

If your sound card stops working after configuring interfaces, disable the auto-detection process in IO Config. The auto-detection process in IO Config can cause sound and other cards to stop responding. To disable the auto-detection process, edit *c:\Program Files\agilent\IO Libraries\intfcfg\intfcfg.txt* and follow the instructions to set all GPIB cards to be manually detected by IO Config.

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 IO Config will be -1.

For Windows NT/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 IO Config Finds 82350 Card with Serial Number ffffffff

If IO Config 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.** For Windows NT, make sure the BIOS **Operating System** setting is set to **Not PnP OS** or to **Running Windows NT** or to **Other.** It should not be set to **Running Windows 95**, **Running Windows 98**, **Running Windows 2000**, or **PnP O/S**

2. **Upgrade your system BIOS to the latest version.** Note that even brand new computers tend to have new BIOSs available.

3 **If your computer locks up or freezes after installing.** Typically, this is mostly interrupt conflicts with other drivers in the system. PCI allows sharing of IRQs, but this also means that the drivers for cards with which we 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 OS 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 NT, Click **Control Panel | Devices**. Select the **HP350i32**. Select **Startup...** and set to **System** instead of the default **Automatic**. (Running IO Config will set this back to **Automatic**.)
- ❑ 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 VXI*plug&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 **Windows NT**, **NOT PnP O/S**, or **Other**, the BIOS will perform this task.

❑ 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.
If you are running Windows NT, set to **Running Windows NT**, **Not VXI*plug&play* OS** or **Other**.

GPIB Software Checks

This section provides guidelines for 82350 software checks, including:

- Check for 82350 Driver Files
- Disable IO Config Auto-Detection
- Check BIOS/Interrupts Settings
- Set 82350 Read/Write Performance Mode

Check for 82350 Driver Files

After installing the Agilent IO Libraries, 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/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/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.** If the driver files are not found, uninstall the Agilent IO Libraries by inserting the *Instrument CD* and following the instructions to remove the libraries. Then, follow the instructions to re-install the libraries.

Disable IO Config Auto-Detection

If your PC sound card stops working after configuring interfaces, disable the auto-detection process in IO Config, as the auto-detection process in IO Config can cause sound and other cards to stop responding. To disable the auto-detection process, edit *C:\Program Files\agilent\IO Libraries\intfcfg\intfcfg.txt* and follow the instructions (comments in the *intfcfg.txt* file) to set all GPIB cards to be manually detected by IO Config.

Check BIOS/ Interrupts Settings

If IO Config reports finding an 82350 card with Serial Number ffffffff, this is typically caused by PCI cards not properly configuring. 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.** For Windows NT, make sure the BIOS **Operating System** setting is set to **Not PnP OS** or to **Running Windows NT** or to **Other.** It should not be set to **Running Windows 95**, **Running Windows 98**, **Running Windows 2000**, or **PnP O/S**

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 NT, Click **Control Panel | Devices**. Select the **HP350i32**. Select **Startup...** and set to **System** instead of the default **Automatic**. (Running IO Config will set this back to **Automatic**.)

   - ❑ 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:

❑ Make sure the BIOS **Installed O/S** setting is set correctly. This determines what software will configure all the VXI*plug&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 **Windows NT**, **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. If you are running Windows NT, set to **Running Windows NT**, **Not VXI*plug&play* OS** or **Other**.

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:

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.

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.

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 IO 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 Checks

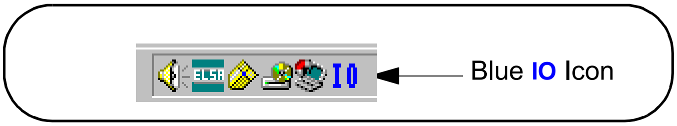
This section gives guidelines to make troubleshooting checks for the Agilent IO Libraries, including:

- Check IO Libraries Installation
- Check IO Control Operation
- Install IO Libraries (if 82350 Was Installed First)

Check IO Libraries Installation

Start your Agilent IO Libraries troubleshooting sequence by verifying IO Libraries installation. If the IO Libraries are installed, go to Check IO Control Operation.

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



- ❑ If the **IO** icon is displayed, click the icon and click **About Agilent IO Libraries Control** to display the version. The version must be M.01.00 or greater.

- ❑ 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* program group.

- ❑ If this group is displayed, click **Agilent IO Libraries | IO Control** to display the **IO** icon. Then, click the icon and click **About Agilent IO Libraries Control** to display the installed version (must be M.01.00 or greater).

- ❑ If neither the **IO** icon nor the Agilent IO Libraries 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 Step 2, following).

2 **Install Agilent IO Libraries (as Required).** If Version M.01.00 or greater of the Agilent IO Libraries is not installed on your PC, install the libraries. Otherwise, go to Check IO Control Operation.

Check IO Control Operation

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

By default, the IO Control is always active after the Agilent IO Libraries are installed and the blue **IO** icon is displayed. However, the 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 Libraries Control**. Clicking the blue **IO** icon and then clicking **Hide Agilent IO Libraries Control** hides the **IO** icon, but does **not** deactivate the 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 Libraries Control. Clicking **Yes** hides the blue **IO** icon **and** deactivates the IO Control.

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

Install IO Libraries (if 82350 was Installed First)

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

NOTE

On older operating systems, you may be asked insert the 'HP I/O Libraries' CD. You should use the CD that contains the Agilent IO Libraries 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 NT 4.0:** Since Windows NT is not a VXI*plug&play* OS, all necessary driver installation and configuration is performed when you install the Agilent IO Libraries.

- ❑ **Windows 98:** The **Add New Hardware Wizard** will identify this card as a **PCI Communication Device.** The files needed for this device are typically located at the root of the *Instrument* CD.

TCP/IP Network Basics

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.

LAN Interface Overview

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

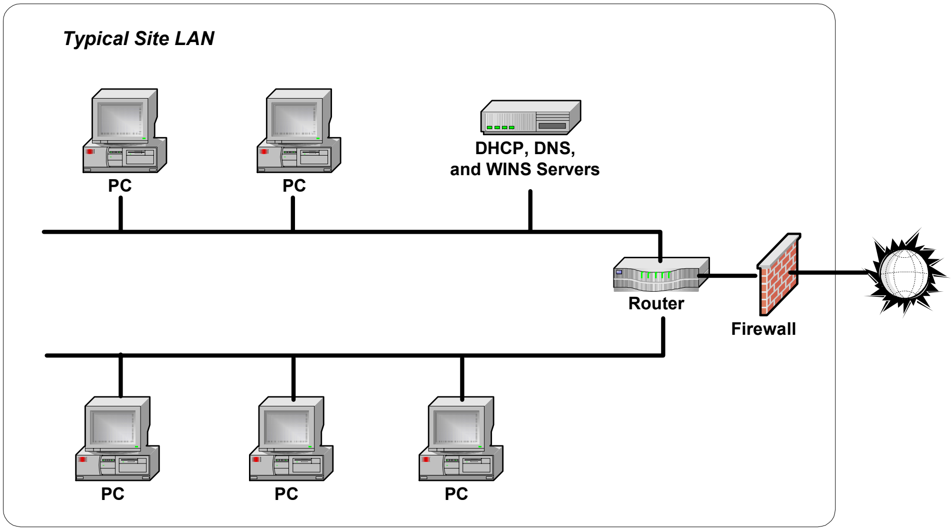
- Typical Network Topologies
- LAN Hardware Architecture

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. This figure shows a 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**.

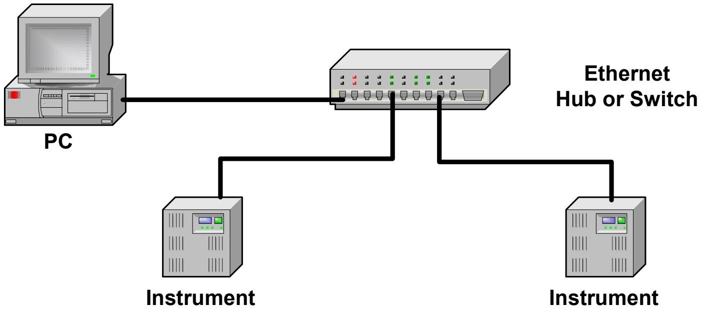
Communication among devices on the Site LAN is controlled by **routers**. A router is a host that interfaces with other networks and can move data (called packets) from one network to another or can move data within the network, depending on the IP addresses of the hosts that are communicating with each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

Typical Private LAN



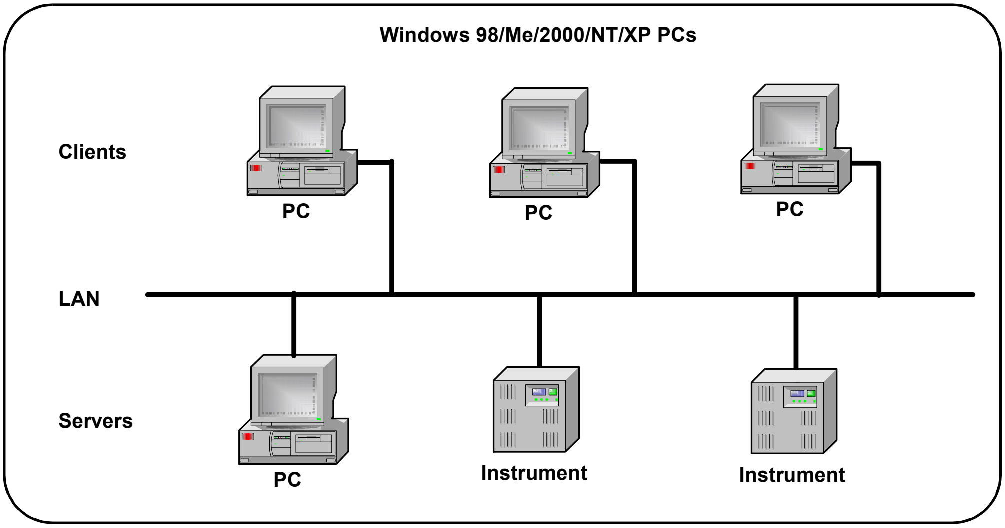
LAN Hardware Architecture

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 the Agilent **IO Config** utility provided with the Agilent IO Libraries.

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

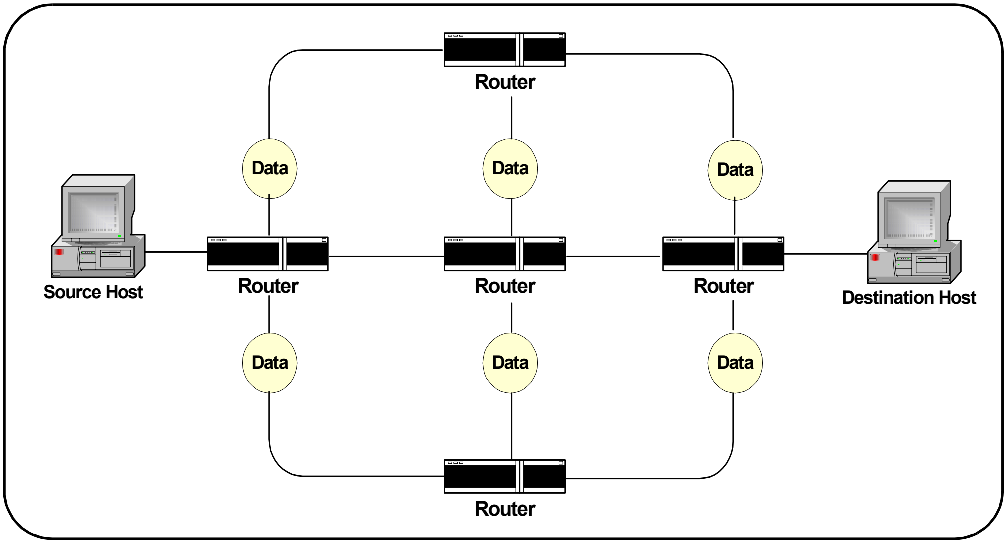
As shown in this figure, a LAN client, such as a PC, makes requests over the network to a LAN server, such as a PC or a LAN-enabled instrument. For example, in this figure the Server PC and the instruments can act as LAN servers. Once the LAN server has completed the requested operation on the instrument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



Packet Switching

A TCP/IP network is a **packet-switched** network. This figure shows an example 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.



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:

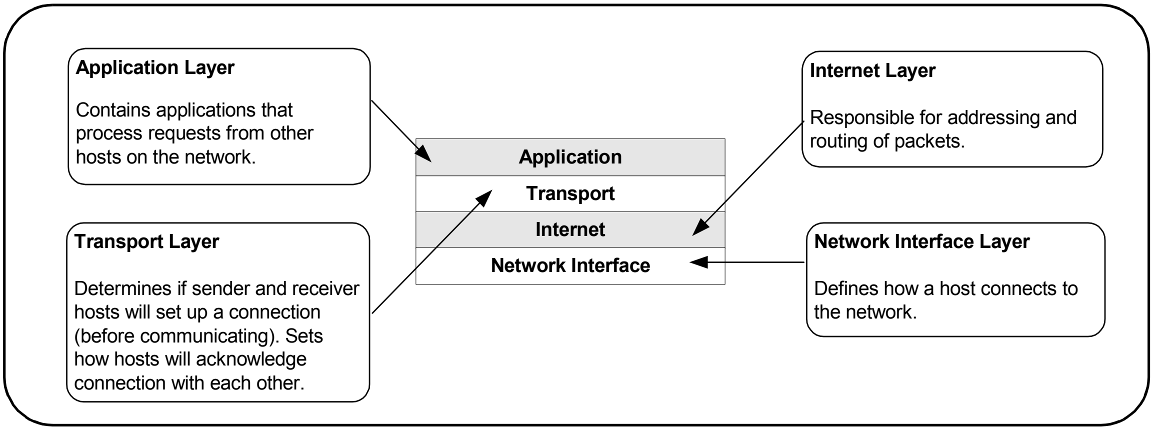
- The TCP/IP Network Model
- The Network Interface Layer
- The Internet Layer
- The Transport Layer
- The Application Layer

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. This figure summarizes the functions of the layers in the model.



Application Layer

Contains applications that process requests from other hosts on the network.

Transport Layer

Determines if sender and receiver hosts will set up a connection (before communicating). Sets how hosts will acknowledge connection with each other.

Internet Layer

Responsible for addressing and routing of packets.

Network Interface Layer

Defines how a host connects to the network.

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
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)

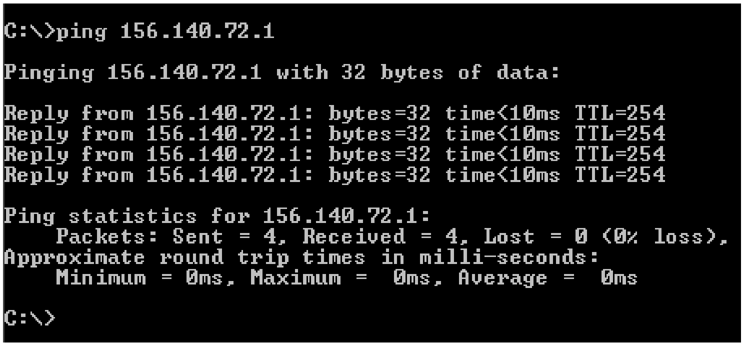
Address Resolution Protocol (ARP) is a protocol used to **resolve** (translate) a **logical address** to a physical (hardware) address. ARP is used when a source host wants to communicate with a destination host, but has only the IP address. After the hardware address is resolved, ARP maintains that 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
Reply from 156.140.72.1: bytes=32 time<10ms TTL=254
Reply from 156.140.72.1: bytes=32 time<10ms TTL=254
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:\>
```

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)

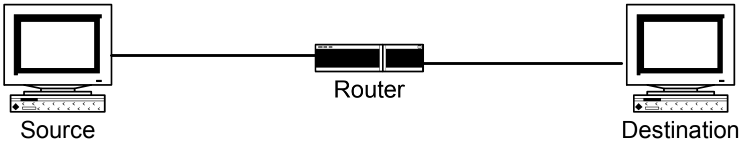
Transmission Control Protocol (TCP)

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.

TCP Communication



Steps

1. Source sends a packet to destination to set up communication.
2. Destination sends acknowledgement to establish communication.
3. Source sends another packet that confirms connection.
4. Source sends a data packet and waits for destination acknowledgement.
5. If acknowledgement is not received, source re-sends the packet.
   If acknowledgement is received, source sends the next packet.

User Datagram Protocol (UDP)

User Datagram Protocol (UDP) is used for connectionless, non-guaranteed communication. Unlike TDP, 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

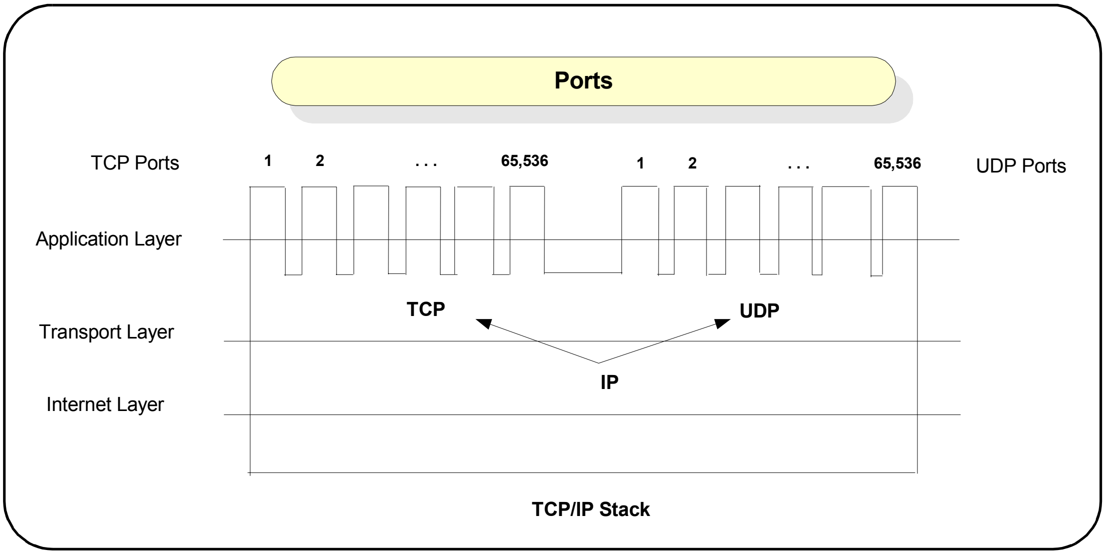
The Application Layer is the layer where requests for data or services are processed. Applications at this layer are waiting for requests to process and all applications are "listening" at their respective **port**. The Application Layer has two protocols:

- 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

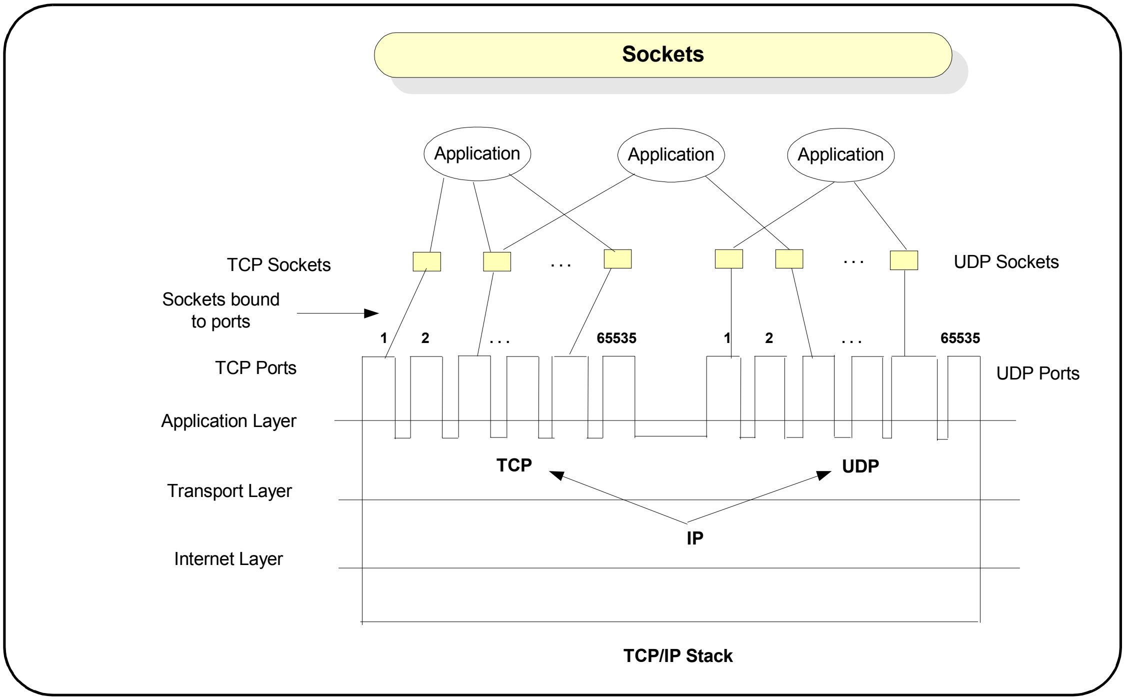
This figure shows the TCP/IP protocol stack. In the stack, TCP and UDP each have access to 65,536 ports at the Application Layer. As a packet moves up the stack, IP directs the packet to either a TCP port or to a UDP port. Since all applications are listening at their respective ports, when the packet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



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.



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
C	192 - 223	24	**NNNN 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
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

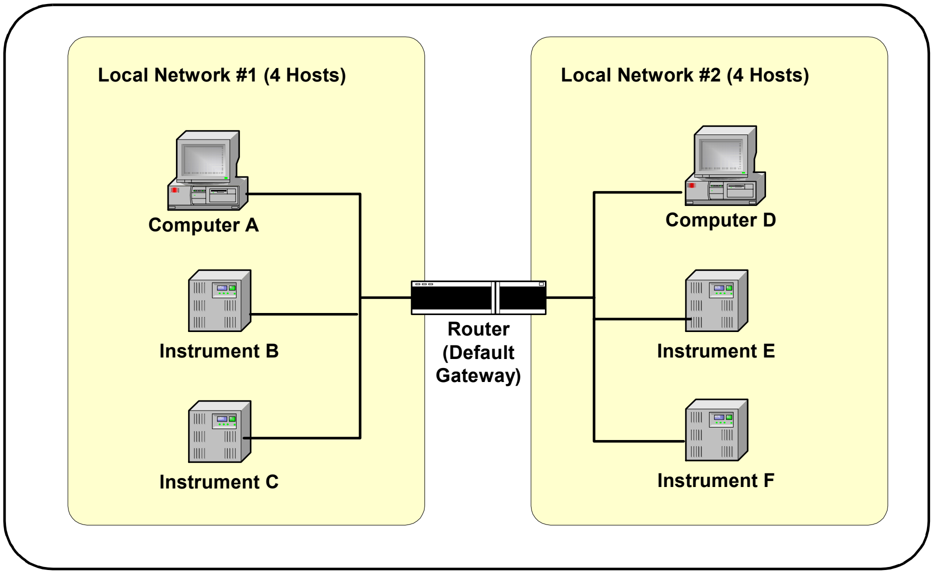
For every packet sent from a source host, IP must determine if the destination host is on the same **local network** or is on a **remote network**. If the destination host is on the same local network as the source host, IP directly gets the hardware address of the destination host. If the destination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


Local Network #1 (4 Hosts)
Computer A
Instrument B
Instrument C
Router
(Default
Gateway)
Local Network #2 (4 Hosts)
Computer D
Instrument E
Instrument F

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 applicablility 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 is 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.

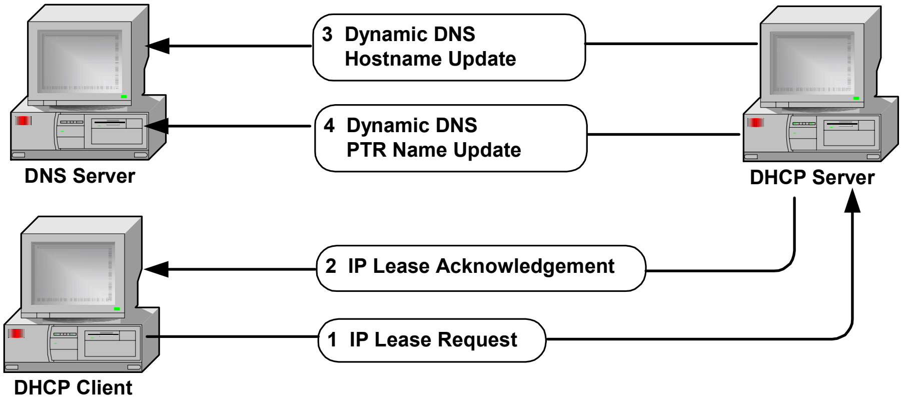
Device hostname services can be divided into two categories: automatic hostname services and manual hostname services. This table shows the applicablility of these services to various network topologies.

	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.


3 Dynamic DNS Hostname Update
4 Dynamic DNS PTR Name Update
DNS Server
DHCP Server
2 IP Lease Acknowledgement
1 IP Lease Request
DHCP Client

1 IP Lease Request
To begin, the DHCP Client has no IP address and only a hostname that is to be registered. The client sends a DHCP request to the DHCP server that provides the server with the hostname to be registered.

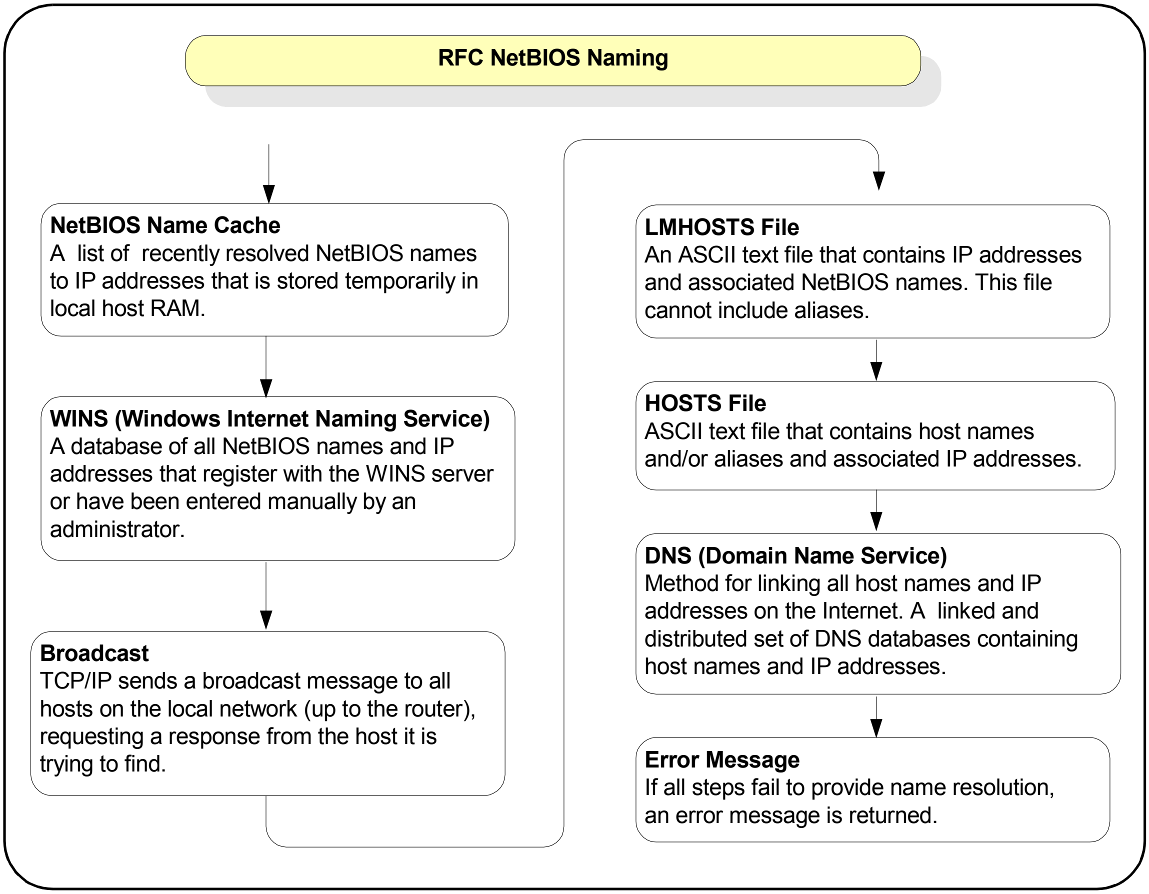
2 IP Lease Acknowledgement
The DHCP Server responds by sending an IP address and other TCP/IP information to the DHCP Client. The client now has an IP address as well as a hostname.

3 Dynamic DNS Hostname Update
The DHCP Server attempts to register the newly allocated IP address and desired hostname for the DHCP Client with the DNS Server.

4 Dynamic DNS PTR (Pointer) Name Update
The DHCP Server attempts to register the newly allocated IP address and desired pointer (PTR) name for the DHCP Client with the DNS Server.

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.



RFC NetBIOS Naming

NetBIOS Name Cache
A list of recently resolved NetBIOS names to IP addresses that is stored temporarily in local host RAM.

WINS (Windows Internet Naming Service)
A database of all NetBIOS names and IP addresses that register with the WINS server or have been entered manually by an administrator.

Broadcast
TCP/IP sends a broadcast message to all hosts on the local network (up to the router), requesting a response from the host it is trying to find.

LMHOSTS File
An ASCII text file that contains IP addresses and associated NetBIOS names. This file cannot include aliases.

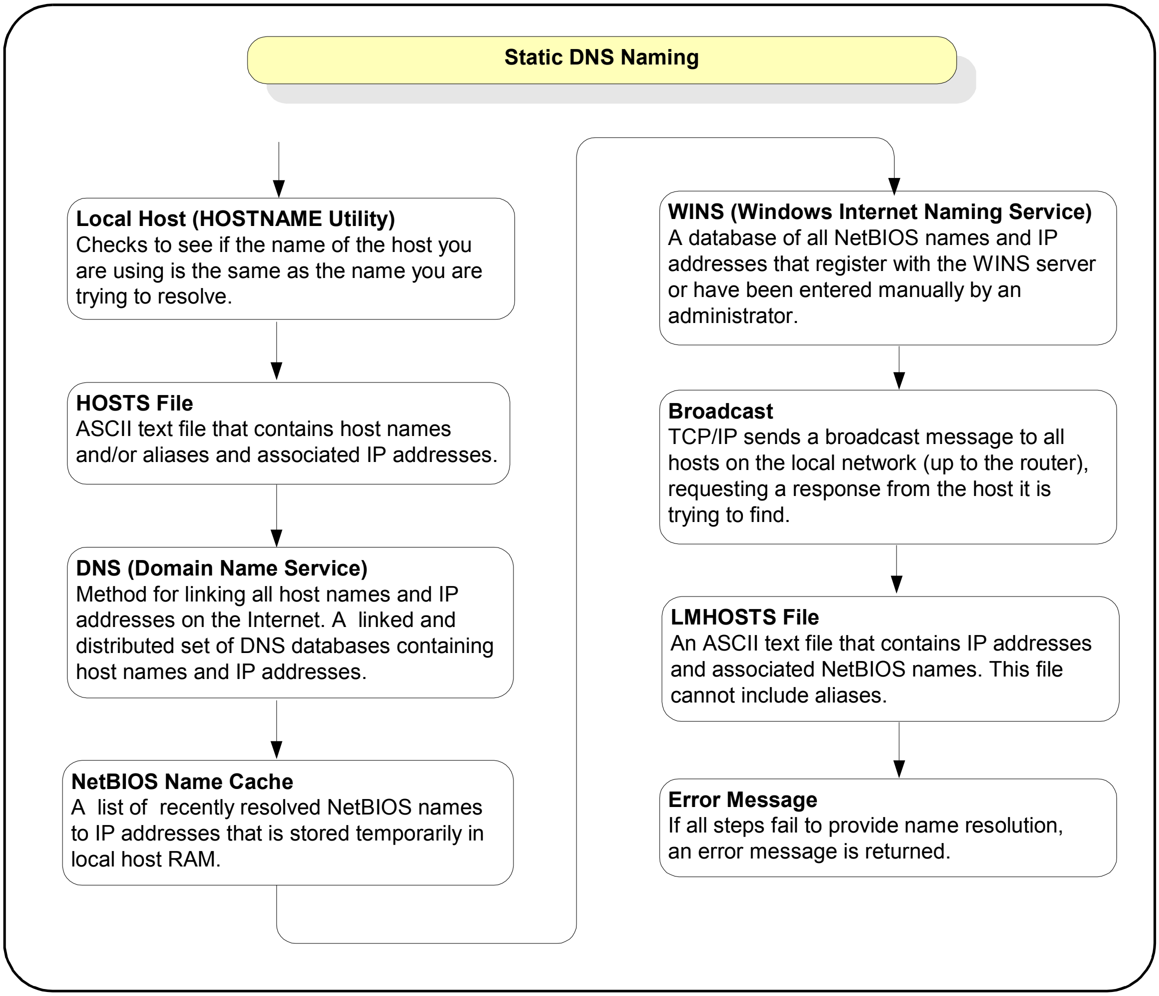
HOSTS File
ASCII text file that contains host names and/or aliases and associated IP addresses.

DNS (Domain Name Service)
Method for linking all host names and IP addresses on the Internet. A linked and distributed set of DNS databases containing host names and IP addresses.

Error Message
If all steps fail to provide name resolution, an error message is returned.

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, as shown in this figure. 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.



Static DNS Naming

Local Host (HOSTNAME Utility)
Checks to see if the name of the host you are using is the same as the name you are trying to resolve.

HOSTS File
ASCII text file that contains host names and/or aliases and associated IP addresses.

DNS (Domain Name Service)
Method for linking all host names and IP addresses on the Internet. A linked and distributed set of DNS databases containing host names and IP addresses.

NetBIOS Name Cache
A list of recently resolved NetBIOS names to IP addresses that is stored temporarily in local host RAM.

WINS (Windows Internet Naming Service)
A database of all NetBIOS names and IP addresses that register with the WINS server or have been entered manually by an administrator.

Broadcast
TCP/IP sends a broadcast message to all hosts on the local network (up to the router), requesting a response from the host it is trying to find.

LMHOSTS File
An ASCII text file that contains IP addresses and associated NetBIOS names. This file cannot include aliases.

Error Message
If all steps fail to provide name resolution, an error message is returned.

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:

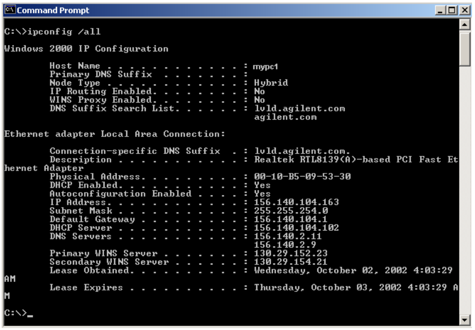
- Checking PC Settings
- Installing Network Interface Cards
- Installing TCP/IP on Your PC
- Setting PC IP Address
- Setting PC Hostname

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. This figure 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  . . . . . . . :
        Node Type . . . . . . . . . . . . : Hybrid
        IP Routing Enabled. . . . . . . . : No
        WINS Proxy Enabled. . . . . . . . : No
        DNS Suffix Search List. . . . . . : lvld.agilent.com
                                            agilent.com

Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . : lvld.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. . . . . . . . . . . . : 156.140.104.163
        Subnet Mask . . . . . . . . . . . : 255.255.254.0
        Default Gateway . . . . . . . . . : 156.140.104.1
        DHCP Server . . . . . . . . . . . : 156.140.104.102
        DNS Servers . . . . . . . . . . . : 156.140.2.11
                                            156.140.2.9
        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 A
M

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

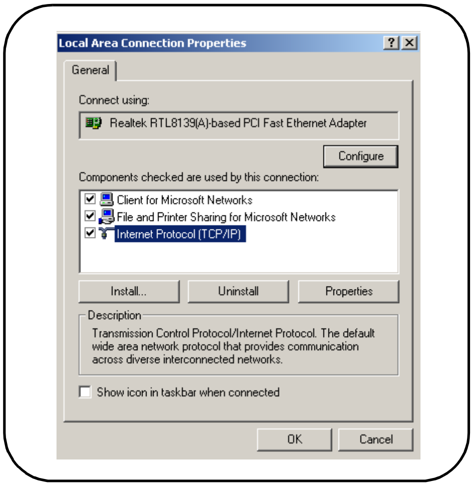
To configure a network interface card, the TCP/IP protocol must be installed and configured. See the following examples for a Windows 2000 PC or for a Windows XP PC. Modify the steps as required for your operating system.

Example: Installing TCP/IP (Windows 2000)

1. Click **Start | Settings | Network and Dial-up Connnections** to display the **Network and Dial-up Connnections** 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**.



Local Area Connection Properties

General

Connect using:
Realtek RTL8139(A)-based PCI Fast Ethernet Adapter

Components checked are used by this connection:
☑ Client for Microsoft Networks
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol (TCP/IP)

Description
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

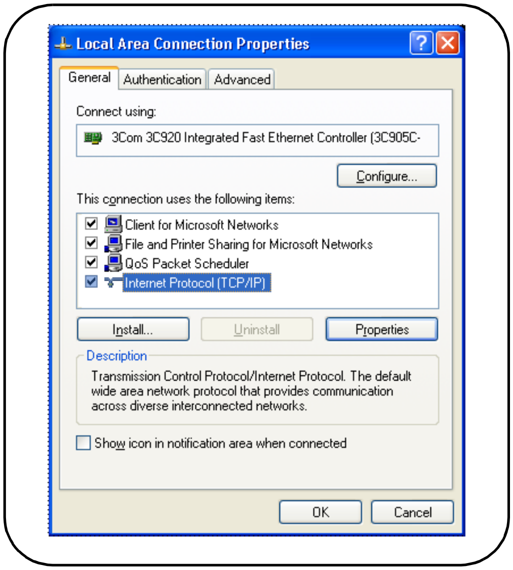
☐ Show icon in taskbar when connected

Example: Installing TCP/IP (Windows XP)

1 Click **Start | Network| Internet Connnections.** 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.**



Connect using:

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-

This connection uses the following items:

☑ Client for Microsoft Networks
☑ File and Printer Sharing for Microsoft Networks
☑ QoS Packet Scheduler
☑ Internet Protocol (TCP/IP)

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

☐ Show icon in notification area when connected

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.*

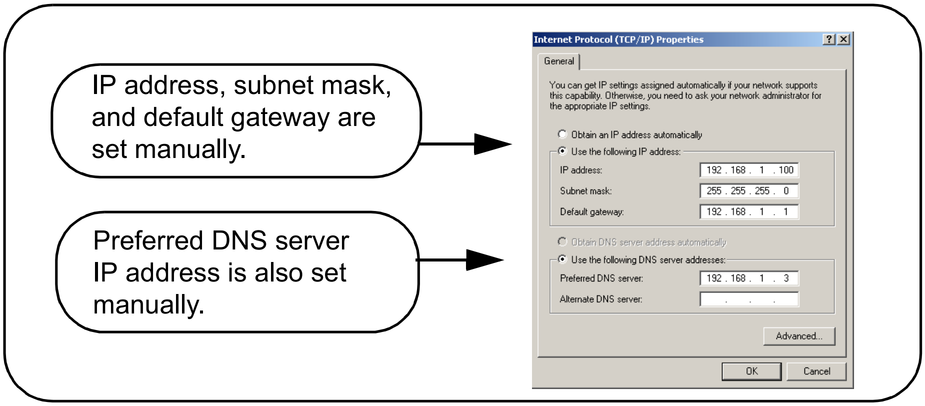
Example: Setting PC IP Address (Windows 2000)

1 Click **Start | Settings | Network and Dial-up Connnections** to display the **Network and Dial-up Connnections** 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.



IP address, subnet mask, and default gateway are set manually.

Preferred DNS server IP address is also set manually.

Internet Protocol (TCP/IP) Properties

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:
IP address: 192 . 168 . 1 . 100
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 192 . 168 . 1 . 1

○ Obtain DNS server address automatically
● Use the following DNS server addresses:
Preferred DNS server: 192 . 168 . 1 . 3
Alternate DNS server: . . .

Example: Setting PC IP Address (Windows XP)

1 Click **Start | Network| Internet Connnections**.

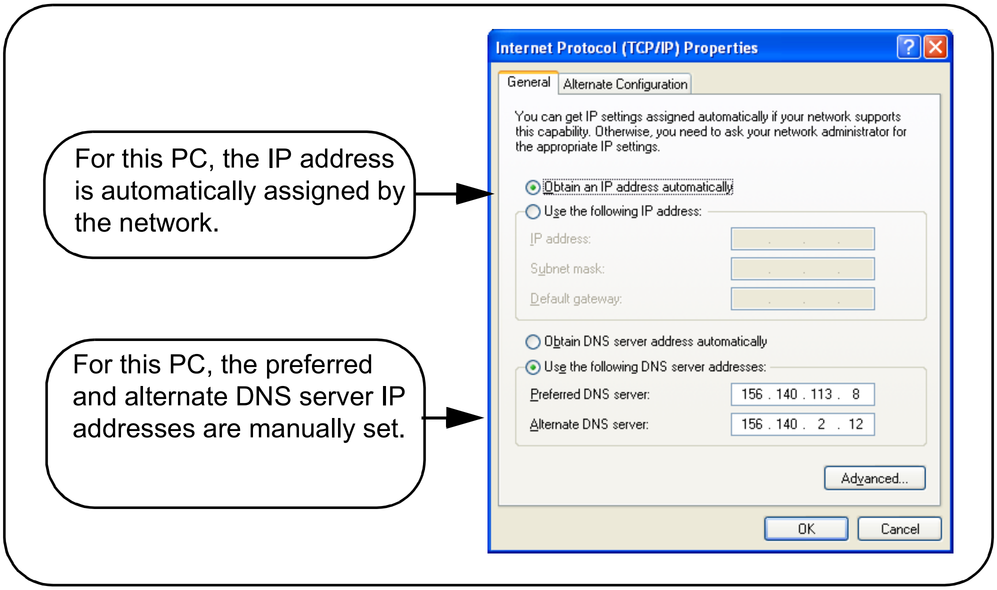
2 From the “or pick a control panel icon”, select **Network Connections.**

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.



For this PC, the IP address is automatically assigned by the network.

For this PC, the preferred and alternate DNS server IP addresses are manually set.

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server: 156 . 140 . 113 . 8

Alternate DNS server: 156 . 140 . 2 . 12

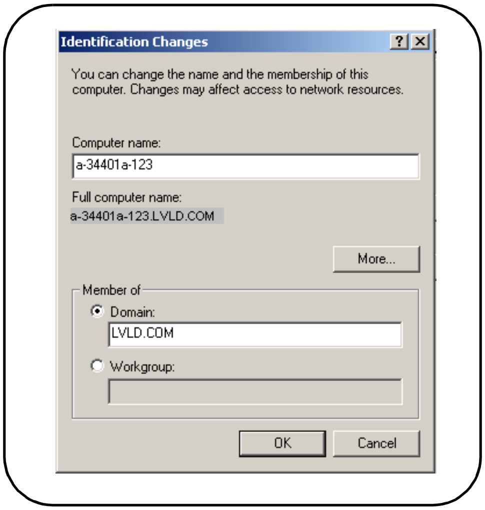
Setting PC Hostname

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.



Identification Changes

You can change the name and the membership of this computer. Changes may affect access to network resources.

Computer name:
a-34401a-123

Full computer name:
a-34401a-123.LVLD.COM

Member of
● Domain:
LVLD.COM
○ Workgroup:

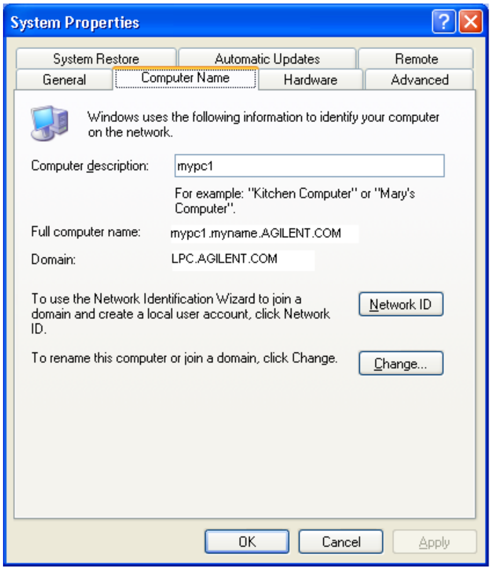
Example: Setting PC Hostname (Windows XP)

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.



Windows uses the following information to identify your computer on the network.

Computer description: mypc1

For example: "Kitchen Computer" or "Mary's Computer".

Full computer name: mypc1.myname.AGILENT.COM

Domain: LPC.AGILENT.COM

To use the Network Identification Wizard to join a domain and create a local user account, click Network ID.

To rename this computer or join a domain, click Change.

Guide Information

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 NT 4.0, 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 TCP/IP networks. Consult standard reference texts for this information.

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

Related Documentation

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

Product	Related Documentation
Agilent IO Libraries	For additional information on the Agilent IO Libraries, see the *Agilent IO Libraries Installation and Configuration Guide for Windows.*
VISA	To develop and use VISA applications, see the *Agilent VISA User's Guide*.
SICL	For SICL I/O applications, see the *Agilent SICL User's Guide for Windows*.
Programmer's Toolkit	To develop programs in Visual Studio.Net, see the *Agilent T&M Programmer's Toolkit for Visual Studio.NET*

Accessing an Electronic Copy of This Guide

Access from the IO Control

After the Agilent IO Libraries are installed, a blue **IO** icon appears on the right hand side of the Windows toolbar. To access an electronic version of this connectivity guide, click the **IO** icon, then click **View Documentation** and then click **Connectivity Guide**.

Access from the CD

You can access an electronic copy of this guide from the *Documentation and Software (or equivalent title)* CD that shipped with your instrument. To access an electronic version of this guide, insert the CD into your CD-ROM drive. Then, from Windows Explorer, navigate to **<*drive*>/Manuals** (where **<*drive*>** is your CD-ROM drive) and click **connectivity.pdf**.

Access from the IO Libraries CD

You can also access an electronic copy of this guide from the *Agilent IO Libraries for Instrument Control* CD. Insert the *Agilent IO Libraries for Instrument Control* CD into your CD-ROM drive. When the InstallShield Wizard appears, quickly click **Cancel**. Then, navigate to **<*drive*>/Manuals** (where **<*drive*>** is your CD-ROM drive) and click **connectivity.pdf**.

General Information for This Guide

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Americas Call Center:	1-800-452-4844
Canada Call Center:	1-877-894-4414
European Call Center:	+31-20-547-9900
Japan Call Center:	+81-426-56-7832

For other countries, contact your country's Agilent support organization. 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 Websites follows.

URL	Description
www.agilent.com/find/assist	Agilent Technologies “Contact Us” page
www.agilent.com/find/iolib	Update the Agilent IO Libraries software
www.agilent.com/find/iolib_support	The latest customer support information
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 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 11111111.11111111.11110000.00000000.

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
    11111111.11111111.11110000.00000000
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.

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