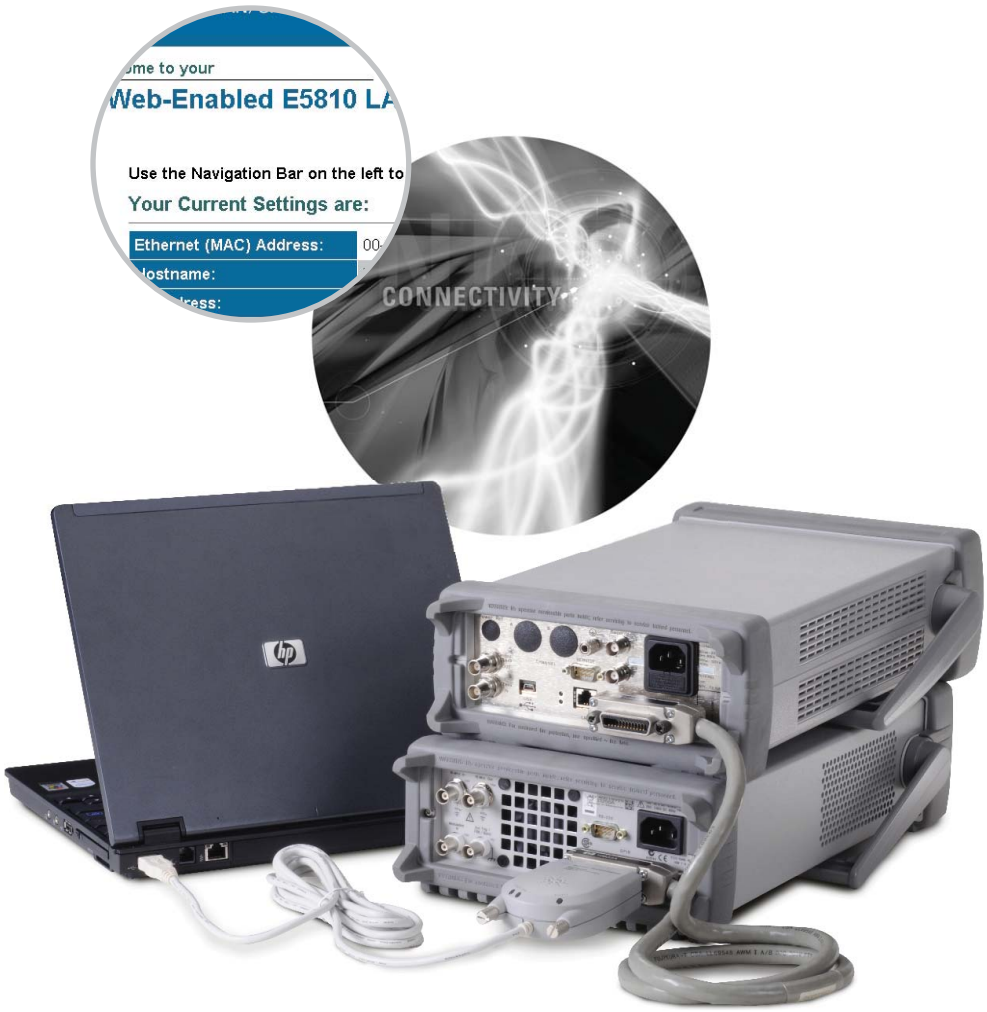
# Agilent
# Simplified PC Connections for GPIB Instruments

Application Note




Agilent Technologies

## Introduction

If you are an R&D, manufacturing or test engineer in the electronics industry, chances are you use your test instruments for more than simple benchtop measurements. At some point, most engineers need to program and control test instruments and communicate with them from a PC or laptop.

Until recently, there hasn't been a quick and easy way to physically connect test instruments to your computer, much less an easy way to get your PC and test equipment to communicate smoothly with each other. If you are like most engineers, you have wasted a lot of time and effort getting your instruments hooked up, dealing with driver issues and writing code, all in a simple quest to make your test instruments talk to each other and to your PC.

There are some new solutions available to save you time with these connectivity issues so you can have more time to spend on more productive tasks. The purpose of this paper is to walk you through the choices you need to make when you are setting up your automated tests and introduce you to some of the hardware options available that can simplify your connection, communication, and programming tasks.

Making the hardware connection is just the first step in mastering the whole connectivity challenge. For assistance with other aspects of connectivity, register for free information on the Agilent Connectivity at ***www.agilent.com/find/IO.***

## Making the Physical Connection

In the past, RS-232 and GPIB have been the primary interfaces used for connecting instruments to PCs in test and measurement applications. Although RS-232 is a low cost solution, its low baud rate and connection limitations make it too slow and cumbersome for many of today's measurement needs.

GPIB technology has provided a high-performance, stable communications solution for more than 25 years. GPIB does have some drawbacks, though. For example, you have to install a GPIB card in each PC you want to use to access your test and measurement instruments. Before you can install a GPIB card, you need to have an available I/O slot — a commodity in perennial short supply. Then you must open your PC housing to install the GPIB card, an action many computer users would prefer to avoid. The hassle involved certainly makes it inconvenient to attempt to share a GPIB card among multiple users. The alternative, equipping everyone in your work group with an individual GPIB card, can be expensive.

USB and LAN connections are now built into most of today's PCs, and standard PC I/O has evolved into an acceptable alternative for automating and controlling test and measurement instruments. Early USB devices, developed for connecting PCs to peripherals such as keyboards and mice, offered limited bandwidth. Today, however, USB 1.1 interfaces offer bandwidths up to 12 Mb/s, and USB 2.0 interfaces offer up to 480 Mb/s bandwidth, adequate for most test and measurement applications. Typical LAN configurations support 10 or 100Mb/ sec (10BASE-T/ 100BASE-TX) networks. Data transfer rates, however, are determined by the amount of traffic on the network. To maximize measurement data throughput, you can use a dedicated LAN and achieve higher performance for test systems. New LAN standards go up to 1 GB/s, and before too long, we expect to see LANs migrating to even faster speeds.

Today, Agilent Technologies test and measurement instruments are equipped with USB and LAN connections and uses a mixture of interfaces. To support you during your migration to USB and LAN, Agilent offers simple solutions for connecting your legacy GPIB instruments to standard computer I/O.

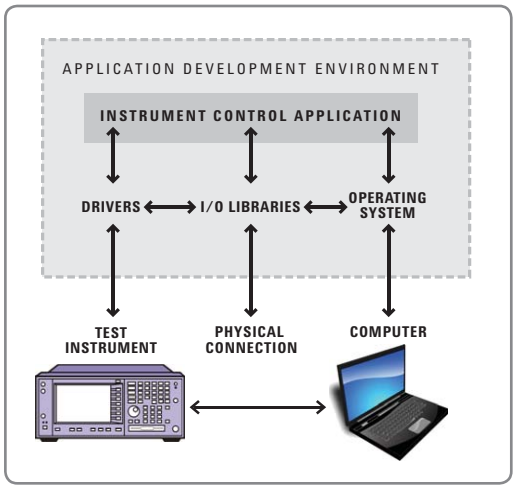



**Figure 1.** Effective connectivity requires a number of hardware and software components to work together smoothly

## Simple I/O Solutions

There are several different ways to physically connect your GPIB test and measurement instruments to your PC or laptop. One of the easiest is to use converters to connect via standard computer interfaces like USB and LAN. If you prefer, you can still use a GPIB card installed in the backplane of your computer. Each of these connection methods works well for certain applications.

## USB/GPIB Interface

The fastest and easiest way to connect instruments to a PC is to use a USB/GPIB converter — a simple cable with a GPIB plug on one end and a USB plug on the other — that provides a direct connection from the USB port on your PC to GPIB instruments. With the Agilent 82357B USB/GPIB Interface for Windows® 98 (SE)/Me/2000/XP/Vista, you can interface with up to 14 GPIB instruments from any vendor, with transfer rates over 1.15 Mb/s with large block transfers. Because the 82357B is a standard Plug and Play device, your computer automatically detects it and configures the interface.

The USB/GPIB Interface is a best fit for R&D and small system applications where high system throughput is not important. Even though it offers high throughput with large block transfers (like scope and spectrum analyzer trace downloads), its small-block transfer rates are slower than a typical GPIB interface due to the first byte latency of the USB. This interface offers ease of use and flexibility, and it can be easily shared in R&D environments.

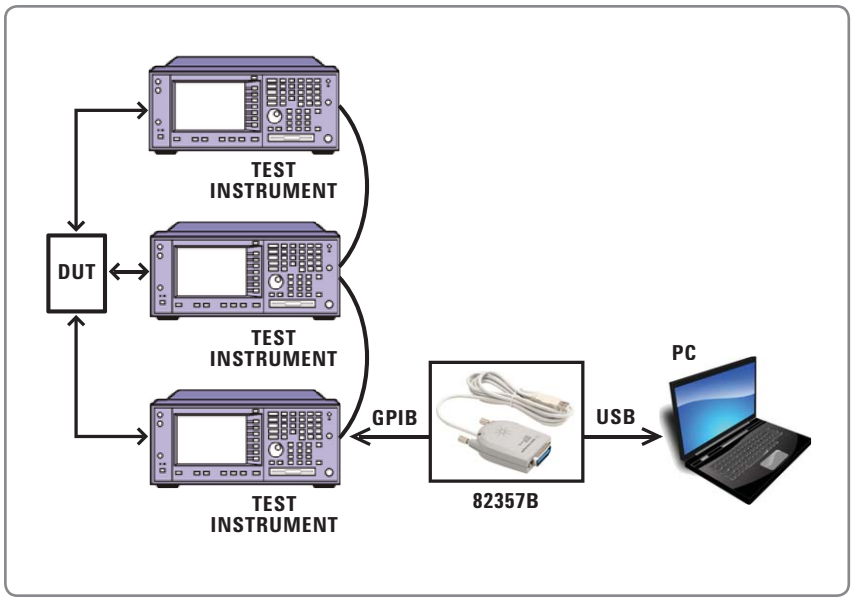



**Figure 2.** Connectivity using a USB Interface

## LAN/GPIB Interface

Sharing test instruments over your existing LAN has a number of advantages over using a local computer with a GPIB interface card. With your test instruments connected to your LAN, multiple users can control instruments from multiple locations, giving you the ability to collaborate with worldwide teams, consult with colleagues in different locations, collect data, perform measurements, share results, or monitor the progress of your tests. When you control your test instruments over the LAN, you can situate your computer remotely — at a safer or more convenient location.

Agilent offers the E5810A LAN/GPIB Gateway for remote access and control of GPIB instruments via a 10BASE-T/100BASE-TX network. The LAN/GPIB Gateway comes with a built-in digital display and Web server, so you can use your browser to easily set up and configure the Gateway. Then you can use your web browser or development application to control test instruments from anywhere in the world.

The LAN/GPIB Gateway works well for many applications. It can be used in R&D environments when engineers want to share equipment or collaborate on designs. During design verification, the Gateway makes it easy for several engineers to share a rack of expensive test equipment. In manufacturing, you can connect several test systems via a local LAN and use a single, centrally located PC to control them. You also can access these test systems remotely for troubleshooting and debug.

## PCI GPIB Interface

For applications where you need to maximize throughput for all block sizes and get the fastest response to SRQ, you can use the traditional solution, a GPIB interface card that plugs into a PCI slot in the backplane of your PC. Agilent offers the 82350B for high-performance IEEE-488 interface, 82351A PCIe, and data rates information for PCI-based PCs. This PCI card has built-in buffering that provides I/O and system performance up to 750 KB/s.

The GPIB card works best for high-performance manufacturing test applications that require the best I/O performance for all blocks sizes and the best SRQ response rate.

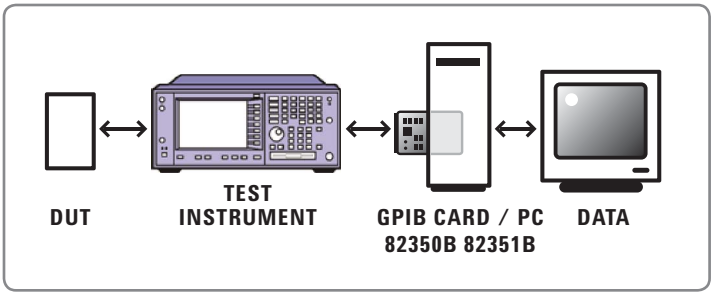



**Figure 3.** Direct Connection with GPIB Card

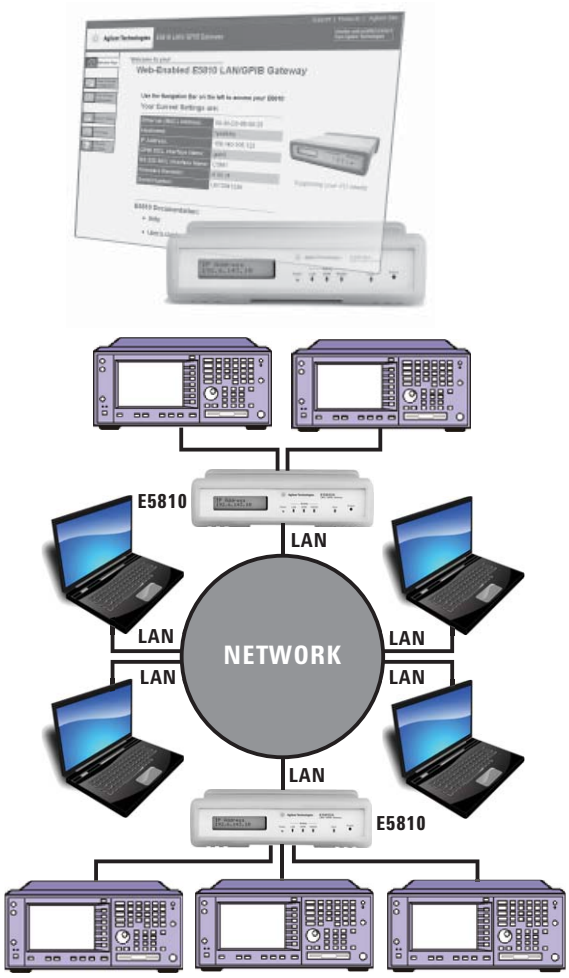



**Figure 4.** Connectivity via your LAN

## I/O Libraries Suite

To make it easy for you to upgrade your programming software without having to rewrite your code, Agilent connectivity solutions come with standards-based I/O libraries, including Virtual Instrument Software Architecture (VISA) and Standard Instrument Control Library (SICL) I/O software. The VISA standard ensures compatibility among different hardware and software vendors and provides GPIB emulation so your existing GPIB programs work immediately, with a simple re-configuration. Agilent's I/O libraries conform to the VXIplug&play standards. In addition to providing solutions for Windows 95/98/Me/ NT®/2000/ XP/Vista Frameworks for external and Agilent VXI embedded PCs, the Agilent I/O libraries support Agilent VEE, BASIC for Windows, Visual Basic, Visual C++, and now Visual Studio®.NET with the Agilent T&M Toolkit.

## Mixed Systems

Agilent Technologies test and measurement instruments are equipped with USB and LAN connectors. For legacy equipment, you can use the USB/GPIB and LAN/GPIB converters discussed above. All these interfaces are supported with the Agilent VISA/SICL I/O Libraries, which allows you to mix these various connection types and capitalize on your equipment investment while maximizing your flexibility for future expansion.

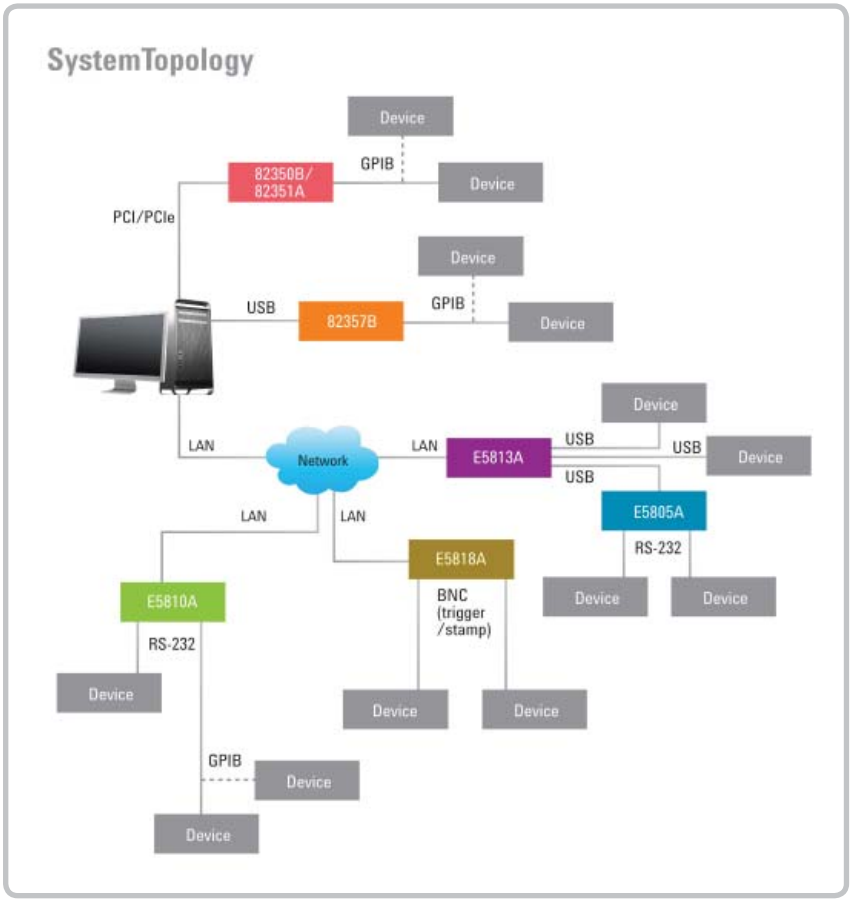



**Figure 5.** Mixed System

## Which I/O Technology Should You Use?

Each type of I/O has its advantages and disadvantages. Here is a brief overview of which type works bests for various situations:

- Use the USB/GPIB Interface when ease of use is your primary concern. The USB/GPIB Interface also gives you better performance with large block transfers.
- Use the LAN/GPIB Gateway when you want to share instruments and collaborate with colleagues in different locations. The LAN/GPIB Gateway is also an excellent choice when you want to program/control your test instruments from a remote location or when you want to implement a distributed test environment.
- Use the PCI GPIB Interface for applications where you need to maximize throughput for all block sizes and you want the fastest response to SRQs.

### With all of these choices, here's help figuring out which I/O technology to use:

| Use: | When your primary concern is: |
|---|---|
| 82357B USB/GPIB Interface | • Ease of use<br>• Better performance with large block transfers<br>• Flexibility and small size |
| E5810A LAN/GPIB Interface | • Sharing instruments<br>• Collaborating with colleagues in different locations<br>• Programming and controlling test instruments/systems from remote locations |
| 82350B PCI GPIB Interface | • Maximizing throughput for all block sizes |

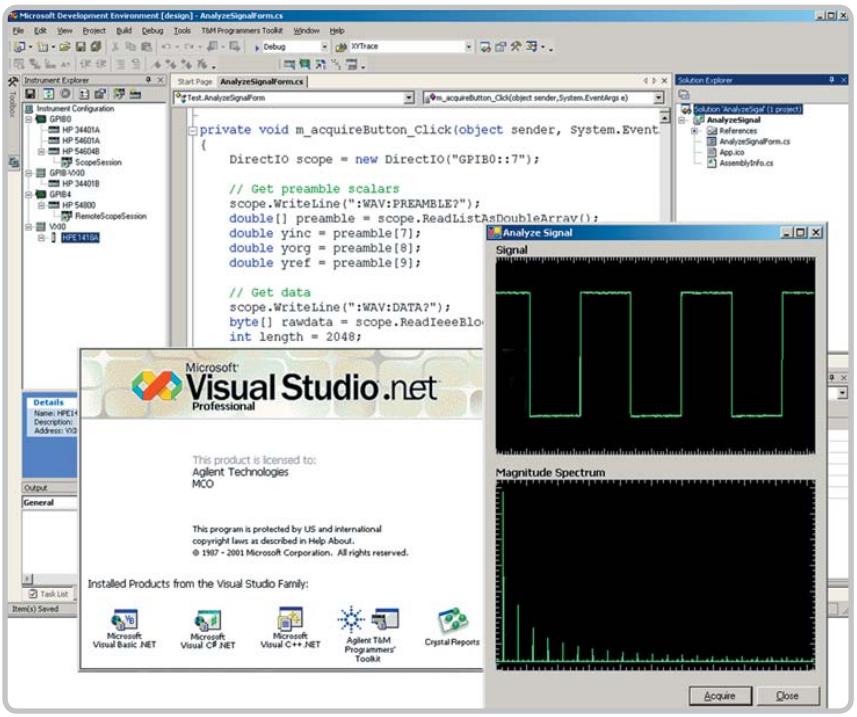
## Programming Software

Selecting an appropriate mechanism for the physical connection is only half the battle. You also must decide which programming software to use. Engineers using test and measurement equipment have used a variety of languages and development environments unique to test, measurement, data acquisition, and automation applications to develop their programs.

In the past, the implications of your choice of programming environment/ language for your test and measurement instrument control applications were different from what they are today. With the introduction of Agilent's VEE, T&M Programmers Toolkit for Microsoft®
Visual Studio.NET, the ground rules have changed for selecting and using programming tools.

The T&M Programmers' Toolkit delivers the power and ease of use of the open, standard Microsoft's Visual Studio .NET platform to the test and measurement world. The toolkit's integrated software tools and components make Visual Studio .NET an easy place for you to write code for automating measurement tasks and displaying data.

For details, go to:
***www.agilent.com/find/IO***




## Summary

There are several different ways to physically connect your test and measurement instruments to your desktop or laptop PC. USB and LAN connections are now built into most of today's PCs, and standard PC I/O has evolved into an acceptable alternative for automating and controlling test and measurement instruments. There are converters available that make it easy to connect your GPIB test instruments via these standard computer interfaces. Or if you prefer, you can still use a GPIB card installed in the backplane of your computer. Each of these connection methods works well for certain applications.

## Glossary

**GPIB** — General Purpose Interface Bus. Used for instrument control

**LAN** — Local Area Network

**SICL** — Standard Instrument Control Library. A platform independent API for software to control GPIB test instruments conforming to IEEE 488 specifications. This standard preceded the VXIplug&play standard (VISA)

**SCPI** — Standard Commands for Programmable Instrumentation. SCPI defines a standard set of commands to control programmable test and measurement devices in instrumentation systems. Learn more at *http://www.scpiconsortium.org*

**USB** – Universal Serial Bus. A standard bus on today's PCs

**VISA** — Virtual Instrument Software Architecture

**VXIplug&play** — A hardware and software standard that allows interoperability between instruments made by different manufacturers. Learn more at *http://www.vxipnp.org*

## Related Agilent Literature

Data Sheet:
Agilent Connectivity Suite,
pub. no. 5988-5756EN

Data Sheet:
Agilent 82357B USB/GPIB Interface for Windows,
pub. no. 5988-5028EN

Data Sheet:
Agilent E5810A LAN/GPIB Gateway,
pub. number 5988-5810EN

Data sheet:
Agilent 82350B PCI GPIB Interface,
pub. no. 5966-2720E

To download this literature, go to ***www.agilent.com/find/IO***

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Agilent Open simplifies the process of connecting and programming test systems to help engineers design, validate and manufacture electronic products. Agilent offers open connectivity for a broad range of system-ready instruments, open industry software, PC-standard I/O and global support, which are combined to more easily integrate test system development.

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