Keysight Modern Connectivity
Using USB and LAN I/O Converters

Application Note

IP Address
192.6.143.10

KEYSIGHT   E5810A
LAN / GPIB Gateway

Activity

Power   LAN   GPIB   RS232   Fault   Preset
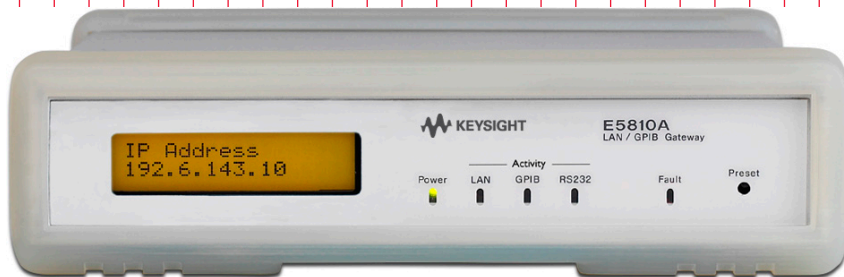
What is the best input/
output interconnect for
your application?

KEYSIGHT
TECHNOLOGIES

Introduction

GPIB has been a primary instrument Input/Output interface for over 30 years due to its proven reliability. New standard computer bus systems, USB and Ethernet (LAN), are gradually being built into modern instruments and test systems. Instrument interconnects are typically GPIB, although, using USB/GPIB and LAN/ GPIB converters may be useful in updating your test systems and taking advantage of new bus features such as easy connections, remote instrument access, and higher speed data transfers. The following document compares the USB to GPIB converter (82357B), the Keysight Technologies, Inc. GPIB PC card (82350B), and the LAN to GPIB converter (E5810A) and will help determine which I/O interconnect is best for your application needs.

You want the I/O product to integrate easily with your current test system or you may have the opportunity to build a new system taking advantage of a newer I/O interface. In either case, having details for these topics will be helpful in making the best I/O interconnect decision for your application needs.

First, here is a brief description of the three I/O interfaces that will be compared.

82350B PCI GPIB interface card

This card provides an IEEE-488 interface with software and installs into the backplane of your computer. The 82350B makes it easy to access and control instruments and exchange data.

82357B USB/GPIB interface

This interface provides a direct connection from the USB port on your laptop or desktop computer to GPIB instruments. It is a standard Plug and Play device and is automatically detected and configured when connected to the computer USB port.

E5810A LAN/GPIB gateway

This product provides a gateway between network-equipped computer systems and GPIB and/or RS-232 based instruments. The E5810A allows I/O applications to obtain measurement data either locally or remotely from GPIB and/or RS-232 instrumentation.

There are a few factors you want to consider when determining the best I/O connectivity for your test system.

- Controller and operating system
- Steps required for setup
- Data transfer rates
- Number of instruments connected
- Additional software, cables, connections
- Distance from controller to instruments
- Advantages/disadvantages

You want the I/O product to integrate easily with your current test system or you may have the opportunity to build a new system taking advantage of a newer I/O interface. In either case, having details for these topics will be helpful in making the best I/O interconnect decision for your application needs.
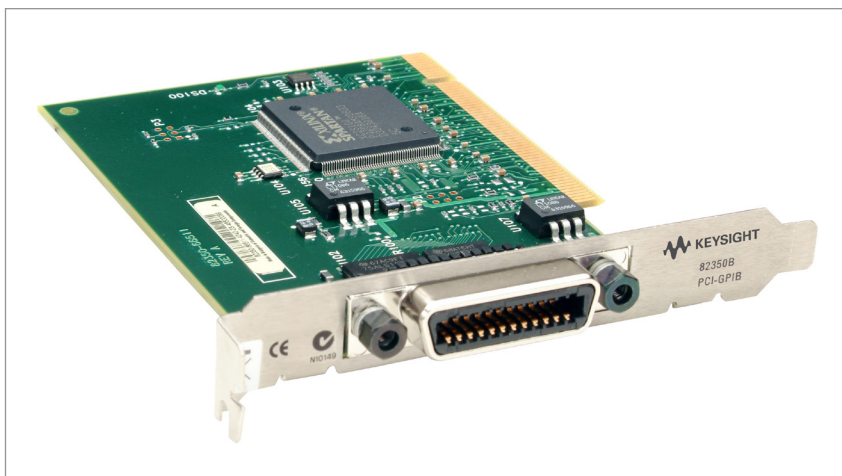
Controller and operating system

In order to take advantage of the new computer bus systems, your test system PC (controller) must meet the following minimal requirements: Pentium 450 MHz, 128 MB RAM, and 280 MB free disk space to effectively use the GPIB USB, and LAN I/O interfaces. For the best results you may want to use a faster computer with more memory. The I/O products referred to here have been designed to work with the many different PC operating systems being used today. See Table 1 to verify that the operating system of your controller supports the I/O you plan to use.

Steps required for set-up

The GPIB card, USB/GPIB converter, and LAN/GPIB converter require initial setup to integrate them into your test system. Before you select an I/O interface, you may want to consider the steps for installing and configuring the interface. Here is a brief description of the steps you will need to follow to install your selected I/O interface.

Table 1. Operating system support for I/O solutions

Supported operating systems

Operating system	82350B PCI GPIB interface card	82357B USB/ GPIB interface	E5810A LAN/ GPIB gateway
Windows Vista	■	■	■
Windows XP	■	■	■
Windows Me	■	■	■
Windows 2000	■	■	■
Windows 98	■	■	■
Windows NT	■		■
HPUX 11i			■*
Linux			■*

* Provided by Test & Measurement Systems Inc (TAMs) www.Tamsinc.com

82357B USB/GPIB

If keeping the set-up time to a minimum is your goal, the 87357B USB/GPIB converter is the I/O interface you are looking for. In just three steps you can be up and running without installing cards or connecting to the LAN. The steps include loading the Keysight I/O libraries on the controller, and plugging the USB connector into the computer. The Keysight I/O Config will run automatically and asks if the default settings are sufficient. I/O Config is a utility used by the Keysight I/O Libraries to automatically configure instrument I/O hardware interface. In most situations, the default settings are selected. The USB/GPIB converter is hot-swappable which means it is easy to connect, disconnect, and reconnect any time. The USB/GPIB converter is very convenient for use with laptops since it provides an I/O interface without having to install a GPIB interface in the backplane of your computer.

E5810A LAN/GPIB

The setup for the E5810A LAN/GPIB converter takes a little more work although the advantages of connecting to a LAN are well worth the extra effort. You first need a LAN, either global or private, to connect to. You may need help from your local IT group to do this. For initial setup and configuration of the E5810A, your controller needs to have a web browser such as Netscape Navigator 4.7, or Internet Explorer 4.0 and higher. If you plan to use the E5810A for programmed control of instruments, you will install and configure the Keysight I/O libraries on the controller. Connect the hardware, your LAN cable, power plug, and either GPIB or RS-232 cables to instruments. From the controller, you can enter the IP address in your web browser window to setup and communicate with the E5810A LAN/ GPIB converter and any connected instruments.

82350B PCI GPIB card

The PCI GPIB interconnect is an easy to install computer PCI card. Once the card is installed in a controller's PCI slot, you can install the Keysight I/O libraries, run Keysight's I/O Config, and connect the GPIB cable(s) to the instruments**.**

Data transfer rates

Benchmark test results were acquired to determine the difference in data transfer rates for these I/O interfaces with varying data sizes. Time required to transfer data from an instrument to a PC depends on a few factors including the I/O interface. Other factors that affect data transfer rates are the instrument's processing speed, the format and size of data being transferred, the instrument commands and overhead, and the computer's processing speed and memory size. Two instruments were selected to participate; one for its ability to make very fast individual measurements, and the other for its ability to transfer large blocks of data. Each of the three I/O interfaces was tested with both instruments. The intention for the results was to determine which of the three I/O interfaces offers a faster data transfer rate for individual readings and for large data blocks.
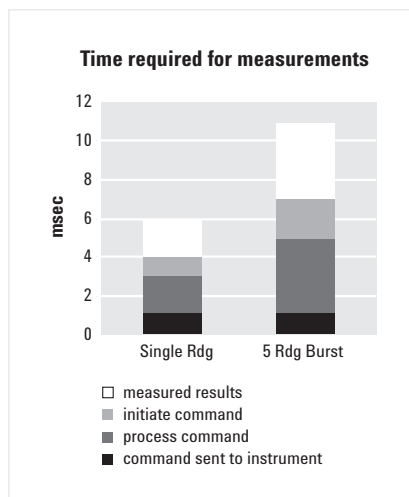
Individual reading results

A digital multimeter (Keysight 34401A) was selected for testing individual and burst[1] readings. Figures 1 & 2 below show the difference between the data transfer times of the three I/O interfaces. For a single reading, the GPIB interface can transfer data 2 milliseconds faster than the USB/GPIB interface and nearly 1 millisecond faster than the LAN/GPIB interface. That is 16% to 33% faster single readings using the standard GPIB PCI card. However, when taking multiple readings the difference in time per reading is reduced significantly. This is because the instrument's total time required for the measurement is divided between the specified number of readings as shown in Figure 3. The instrument's total measurement time includes the:

– Measurement commands to be sent to the instrument
– Instrument to process the commands
– Instrument to initiate the commands
– Instrument to send a measured result(s)

When using a 'burst' of measurements the instrument configures and initiates only once for multiple readings.
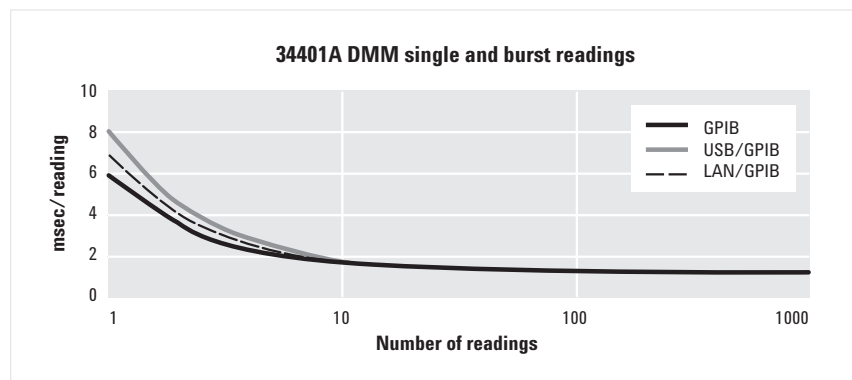

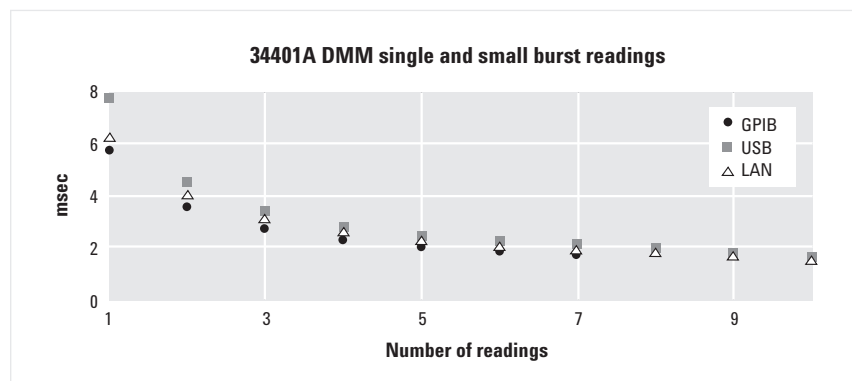Figure 1. Data transfer times for single and 'burst' readings with 34401A

Figure 3. Total instrument measurement time for single vs. burst readings

Figure 2. Data transfer times for a small range of readings

4

Large data block results

An Oscilloscope (Keysight 54622D) was selected for testing large data block transfers. The 54622D is able to transfer up to 1 megabyte files for a single waveform. Figures 4 & 5 below show the data transfer times for different size files comparing the three I/O interfaces. As you can see, there is very little difference in transfer time between the I/O interfaces. GPIB is able to transfer the largest 1 megabyte file more quickly than LAN/GPIB or USB/GPIB, although there is less than 6% difference in the transfer times of all three interfaces.

Data transfer rates summary

The computer standard interfaces USB and LAN offer high-speed data transfers for devices that transfer data at or above 200kB/second. In most cases, the instruments within the test system determine the highest achievable transfer rates. For GPIB based instruments, you will experience nearly the same data transfer rates whether using GPIB, USB/GPIB or LAN/GPIB interfaces. Instruments that have integrated USB and LAN I/O connections are able to achieve much faster data transfer rates than GPIB, the USB/GPIB converter, and the LAN/GPIB converter.
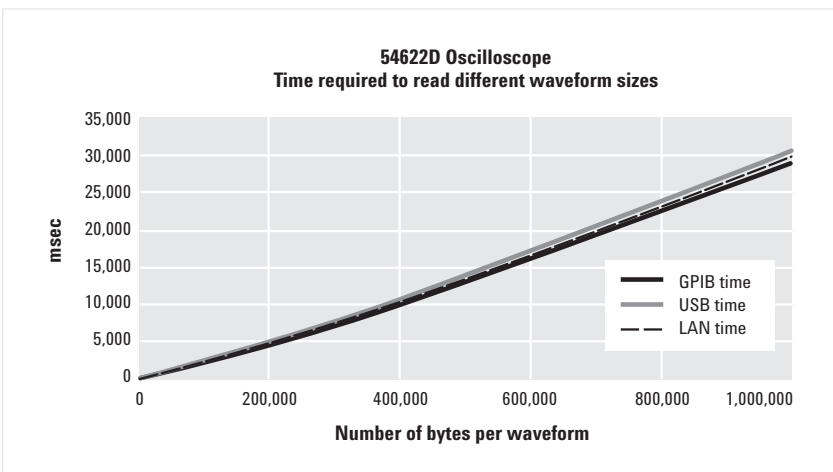
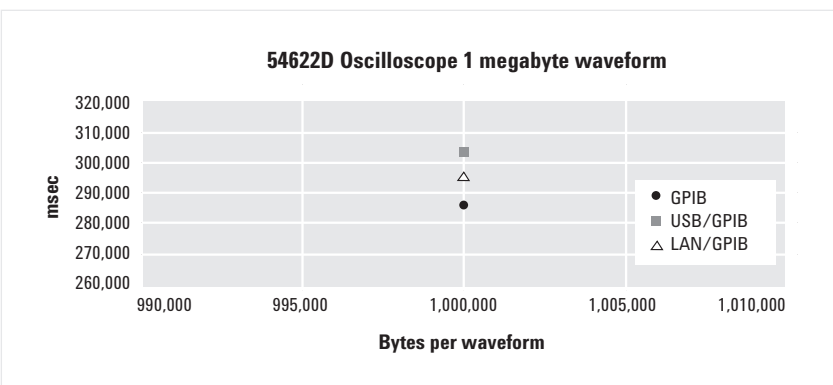*Figure 4. Data transfer time for large data files with 54622D*

Figure 5. Data transfer time for 1 megabyte waveform

Number of instruments that can be connected

The I/O products we are comparing all use or convert to the GPIB bus. The number of instruments that can be connected to each I/O interface is determined by the GPIB specification, which supports connecting up to 15 GPIB devices, 14 instruments, and 1 controller.

82357B USB/GPIB
Each USB/GPIB converter attached to the controller can support up to 14 instruments. With just two USB ports, two USB/GPIB converters, and GPIB instrument cables, the controller can easily control up to 28 instruments.

E5810A LAN/GPIB
There is no limit to how many LAN/ GPIB converters are attached to the LAN or, how many LAN/GPIB converters are controlled with one PC. Each LAN/GPIB converter connected to the LAN can support up to 14 instruments.

82350B PCI GPIB
Each GPIB PC card installed in the controller's PCI slot(s) can support up to 14 instruments using additional GPIB cables.

Additional software, cables, and connections

All of the Keysight I/O connectivity products come with a CD with the required Keysight I/O VISA/SICL libraries. Loading the libraries is easy and takes just a few minutes.

The 82350B GPIB and 82357B USB/GPIB I/O products come with everything you need to establish your controller I/O. You will need GPIB cables to connect to each of the instruments you plan to use.

The 82357B USB/GPIB can connect directly to one instrument with no additional GPIB cables required.

The E5810A LAN/GPIB requires a LAN, LAN connection, and a web browser installed on the controller in addition to the GPIB and/or RS232 cables to the instruments.

Distances from the controller to instrument(s)

Test systems vary from a few instruments on a bench to many instruments at various locations. The distance from the PC to the test system instruments is most often determined by the I/O product(s) used. Details of the maximum allowable distance from the controller to the instruments, for each I/O product, are listed here.

82357B USB/GPIB

The distance from the PC to one device can be up to 20 meters or, the distance between each device connected can be up to 2 meters, whichever is less. USB hubs can also be used to extend the distances between instruments and/or the controller. The length of the supplied cable for the 82357B is 2.5 meters. The 82357B can be connected directly to an instrument that is 2.5 meters or less away from the controller or to a GPIB cable which would extend this distance.

E5810A LAN/GPIB

The distance from the E5810A and the controller depends on the location of the devices and their connections to the LAN. The E5810A and controller can be at any two locations as long as they are connected to the same LAN. The instruments that are connected to the E5810A should be within 2 meters of each other since regular GPIB cables connect them.

82350B PCI GPIB

The distance from the controller to one device can be up to 20 meters or the distance between each device connected can be up to 2 meters, whichever is less.

Advantages/disadvantages of each connectivity product

There are advantages and disadvantages other than cost that may contribute to your decision of which I/O interface would be beneficial to your test application. Here is some additional information that will help you make the decision of what is the best I/O interface for your test system.

I/O Interface	Advantages	Disadvantages
82357B USB/GPIB Converter	– Easy to connect – no boards to install, no internet connection – Great for Laptops – Plug & Play – automatically detected and configured – Hot-swappable (plug-in or unplug anytime)	– WINNT does not support USB connections – Slightly slower transfer rates for single read/writes
E5810A LAN/GPIB Converter	– Remote access to instruments/systems – Longer distances between instruments and/or PC – One PC can access many instruments and/or systems – On-board instrument web server makes it easy to connect to and control instruments – If LAN switches and/or routers are used with the instruments communication can be very fast (Transmit & receive at the same time)	– Data throughput can be limited by the amount of traffic on the network – May require a dedicated LAN – Internet firewalls may be required – Instruments must be where they can connect to LAN
82350B GPIB PCI Card	– 30+ years of proven reliability – Nearly all test instruments have a GPIB interface	– The PC must be opened to install the GPIB card in a PCI slot – The number of installed GPIB cards is limited by the number of controller PCI slots available

Glossary

I/O Config — a Utility used by the Keysight I/O Libraries to configure instrument I/O hardware interfaces. I/O Config is an interactive program that searches your system for installed interfaces that VISA and SICL support. You select the interface(s) you want to configure and I/O Config selects default parameters required to configure the interface(s).

References

Other Keysight literature

Data sheets

– *82357B USB/GPIB Interface*
http://www.keysight.com/find/82357b

– *E5810A LAN/GPIB Gateway*
http://www.keysight.com/find/e5810a

– *82350B PCI GPIB Card*
http://www.keysight.com/find/82350b

Manuals

– *USB/LAN/GPIB Interface Connectivity Guide* (available at http://we.home.keysight.com/upload/cmc_upload/connectivity_guide.pdf

Conclusion

As computers, test instruments and I/O interconnects evolve, it is important to be knowledgeable of what is new and how it may make test system development or upgrades more efficient. Test instruments are gradually becoming available with the standard computer busses, USB and/or LAN. The I/O converters 82357B USB/GPIB, and E5810A LAN/GPIB enables you to migrate your current GPIB instrument to the modern bus systems USB & LAN and benefit from their advantages today.

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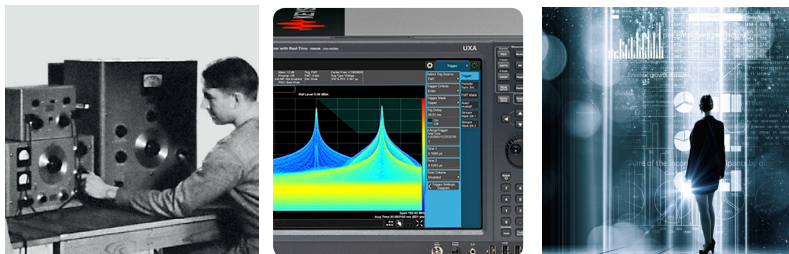
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