DaqLab/2000 Series

Ethernet-Based Laboratory Data Acquisition **User's Manual**

A Hardware Reference Manual for:

DaqLab/2001
DaqLab/2005

Requires one of the following Operating Systems:

Windows NT
Windows 2000
Windows XP

IOtech, Inc.
25971 Cannon Road
Cleveland, OH 44146-1833
Phone: (440) 439-4091
Fax: (440) 439-4093
E-mail (Product Information): sales@iotech.com
E-mail (Technical Support): productsupport@iotech.com
Internet: www.iotech.com

DaqLab/2000 Series
User's Manual

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Warranty Information

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Phone: (440) 439-4091, fax: (440) 439-4093, e-mail: sales@iotech.com

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Refer all service to qualified personnel. This caution symbol warns of possible personal injury or equipment damage under noted conditions. Follow all safety standards of professional practice and the recommendations in this manual. Using this equipment in ways other than described in this manual can present serious safety hazards or cause equipment damage.

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This symbol indicates the message is important, but is not of a Warning or Caution category. These notes can be of great benefit to the user, and should be read.

In this manual, the book symbol always precedes the words "Reference Note." This type of note identifies the location of additional information that may prove helpful. References may be made to other chapters or other documentation.

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Specifications are subject to change without notice. Significant changes will be addressed in an addendum or revision to the manual. As applicable, IOtech calibrates its hardware to published specifications. Periodic hardware calibration is not covered under the warranty and must be performed by qualified personnel as specified in this manual. Improper calibration procedures may void the warranty.

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Your order was carefully inspected prior to shipment. When you receive your system, carefully unpack all items from the shipping carton and check for physical signs of damage that may have occurred during shipment. Promptly report any damage to the shipping agent and your sales representative. Retain all shipping materials in case the unit needs returned to the factory.

CAUTION

Using this equipment in ways other than described in this manual can cause personal injury or equipment damage. Before setting up and using your equipment, you should read *all* documentation that covers your system. Pay special attention to Warnings and Cautions.

Note: During software installation, Adobe® PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Initial navigation is as follows:

Start [Desktop "Start" pull-down menu]
⇒ **Programs**
⇒ **IOtech DaqX Software**

You can also access the PDF documents directly from the data acquisition CD by using the <**View PDFs**> button located on the opening screen.

Refer to the PDF documentation for details regarding both hardware and software.

A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.

PDF
1125-0901

DaqLab_2000 Series.pdf

Contains hardware-related and software-related material for DaqLab/2001 and DaqLab/2005. This pdf file plus the following constitute a complete set of documentation for these devices.

PDF
457-0909

DaqView_DaqViewXL.pdf

Discusses how to install and use these "out-of-the-box" data acquisition programs.

PDF
1086-0926
1086-0922

PostAcquisition Analysis.pdf

This pdf consists of two documents. The first discusses *eZ-PostView*, a post data acquisition analysis program. The application is included free as a part of product support. The second includes information regarding *eZ-FrequencyView* and *eZ-TimeView*. These two applications have more features than does *eZ-PostView* and are available for purchase. They can; however, be used freely during a 30-day trial period.

PDF
457-0905

DBK Options.pdf

The *DBK Option Cards and Modules User's Manual* discusses each DBK product. In addition, the document includes chapters on signal management, system connections, pinouts, DBK set up in software, and troubleshooting.

PDF
1008-0901

ProgrammersManual.pdf

The Programmer's Manual pertains to developing custom programs using Applications Program Interface (API) commands.

Programmers should check the **readme.file** on the install CD-ROM for the location of program examples included on the CD.

Manual Layout

Chapter 1 – Daq Systems

Chapter 2 – DaqLab/2001 and DaqLab/2005 Overviews

Chapter 3 – Block Diagram

Chapter 4 – Connectors, Indicators, Cables, & Pinouts

Chapter 5 – Software

Chapter 6 – Configuring the System for Operation

Chapter 7 – CE Compliance and Noise Considerations

Chapter 8 – Taking Measurements

Chapter 9 – Calibration

Chapter 10 – Troubleshooting and Customer Support

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Glossary

Reference Note:
Reference to additional documents of importance begins on page iv.

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Daq Systems 1

This chapter provides a brief overview of Daq devices.

Users interested in jumping straight to DaqLab information should skip directly to chapter 2.

Daq Systems, the Modular Concept

Daq equipment and software form a modular, interrelated family of products that provide great flexibility in data acquisition system design. This flexibility allows for the development of custom systems that are unique to the user, and which can be optimized for his or her specific application needs. With the Daq product line, system expansion or redesign can typically be accomplished with relative ease.

- ***Primary Acquisition Device***. This is the main data acquisition device, e.g., a DaqBook, DaqBoard, DaqLab, DaqScan, or Daq PC-Card. These devices provide a vital data conversion and communications link between the data source of transducers and signal conditioners and the data processor of the host computer.

- ***DBK Option Cards and Modules***. Over 35 DBK cards and modules (the number is constantly growing) provide various types of signal conditioning and system expansion. Note that certain DBK modules exist for the purpose of supplying power to other members of the acquisition system. The DBK options are discussed in the *DBK Option Cards and User's Manual* (p/n 457-0905).

  Note: Only *passive* DBKs, such as the DBK1 BNC module, the DBK11A screw terminal card, and the DBK40 BNC analog interface, can be used with a Daq PC-Cards.

  Reference Note:
  DBK options are discussed in the *DBK Option Cards and Modules User's Manual* (p/n 457-0905). As a part of product support, this manual is automatically loaded onto your hard drive during software installation. The default location is the Programs directory, which can be accessed through the Windows Desktop.

- ***Software***. DaqView *out-of-the-box* software provides a graphical user interface with easy to read spreadsheet formats for viewing channel data, as well as a choice of analog, digital, and bar-graph meters. Waveform analysis can be performed, when applicable. A product support option, included on the data acquisition CD, provides a means of performing post data analysis. More information is included in the software-specific PDF documents that are installed on your hard-drive as a part of product support.

  In addition to the included out-of-the-box software, Daq products can be controlled via user-written custom programs through Applications Program Interface (API). Several languages are supported, e.g., C/C++, and VisualBASIC.

  Note that third party icon-driven software, such as DASYLab and LabView, can be used with the Daq devices.

DaqView and DASYLab can only be used with one DaqLab/2000 Series device at a time.

LabView can be used with multiple Daq/2000 Series devices.

For multiple device applications (via custom programming) refer to the *Using Multiple Devices* section of the *Programmer's Manual*. During software installation from the data acquisition CD (p/n 1022-0601), a PDF version of the Programmer's Manual is automatically loaded onto your hard drive as a part of product support. The default location is the Programs directory.

Reference Note:
Programming topics are covered in the *Programmer's User Manual* (p/n 1008-0901). As a part of product support, this manual is automatically loaded onto your hard drive during software installation. The default location is the Programs directory, which can be accessed through the Windows Desktop.

DaqBooks, DaqBoards and Daq PC-Cards

Daq products typically connect to one or more DBKs on their signal input side and to a host computer on their output side. The following table categorizes the various Daq devices and provides very basic information.

Daq Data Acquisition Devices		
Category	**Device**	**Description**
Primary Data Acquisition Device	**DaqLab/2001** **DaqLab/2005**	**Ethernet-Based Laboratory Data Acquisition** **16-bit, 200 kHz** devices with Ethernet connectivity. Each can serve as host to an internal analog and/or digital DBK card. Each has a built-in AC-to-DC power circuit and can be plugged directly into a standard AC outlet.
	DaqScan/2001 **DaqScan/2002** **DaqScan/2004** **DaqScan/2005**	**Ethernet-Based Data Acquisition System Components** **16-bit, 200 kHz** devices with Ethernet connectivity. Each has a built-in AC-to-DC power circuit and can be plugged directly into a standard AC outlet. For rack mount applications.
	DaqBook/2001 **DaqBook/2005** **DaqBook/2020**	**Portable Data Acquisition** **16-bit, 200 kHz** devices with Ethernet connectivity. Make use of an external power supply, 10 to 30 VDC input.
	DaqOEM/2001 **DaqOEM/2005**	**Portable Data Acquisition, 16-bit, 200 kHz boards.** DaqOEMs are single-board components for systems. Each board has Ethernet connectivity. These boards reside external to the host PC.
	DaqBook/100 Series **DaqBook/200 Series**	**Portable Data Acquisition** 12-bit: DaqBook/100, /112, /120 16-bit: DaqBook/200, /216, /260
	DaqBook/2000A **DaqBook/2000E** **DaqBook/2000X**	**Portable Data Acquisition** **16-bit, 200 kHz** devices with Ethernet connectivity, though only the DaqBook/2000E provides for a direct Ethernet connection. These devices include a 100-pin P4 connector. Each makes use of an external AC-to-DC power supply.
	DaqBoard/2000 Series	**Plug-In Boards for PCI Bus-Slots** 16-bit, 200 kHz. Six boards identified as /2000 through /2005
	DaqBoard/2000c Series	**Plug-In Boards for Compact-PCI Bus-Slots** 16-bit , 200 kHz. Six boards identified as /2000c through /2005c
	DaqBoard (ISA types)*	**Plug-In Boards for ISA Bus-Slots** 12-bit: DaqBoard/100A, /112A 16-bit: DaqBoard/200A, /216A, /2000
	Daq PC-Card*	**Plug-In PCMCI Card** 12-bit: Daq/112B 16-bit: Daq/216B
DBK Option Cards and Modules*	**Analog Signal Conditioning**	**Cards and DBK modules used to condition Analog Signals** DBK/ 4, 7, 8, 9, 12, 13, 15, 17, 18, 19, 42, 43A, 44, 45, 50, 51, 52, 53, 54, 55, 65, 80, 81, 82, 83, 84, 85, 90, 100, 207, 207/CJC
	Analog Output	**Cards used to modify Analog Output Signals** DBK/ 2, 5
	Digital I/O and Control	**Cards and DBK modules used to condition Digital I/O** DBK/ 20, 21, 23, 24, 25, 208, 210
	Expansion Connections	**Cards and DBK modules used to expand the acquisition system.** DBK/ 1, 10, 11A, 35, 40, 41, 60, 200, 201, 202, 203, 204, 205, 206, 209
	Power Supply	DBKs: 30A, 32A, 33, 34
Software	**Included Software**	DaqView, Post Data Acquisition Analysis Program (actual application not specified), Visual Basic extensions, Application Programming Interface (API)
	Optional Software	DaqViewXL, DASYLab

* The list of DBK cards and modules continues to grow. For information regarding new and upcoming products consult out website, your sales representative, or contact the factory directly.

Using DBK Cards and Modules for Signal Conditioning

The DBK signal-conditioning cards and modules are designed for use with DaqLab, DaqScan, DaqBook, LogBook, and various data acquisition boards, i.e., ISA, PCI, and compact-PCI types. The DBKs perform best when used with an acquisition device that can dynamically select channel, gain, and range. DBK cards and modules with dynamic channel and gain/range selection allow for high channel-to-channel scan rates with a variety of transducers.

Note: Only *passive* DBKs, such as the DBK1 BNC module, the DBK11A screw terminal card, and the DBK40 BNC analog interface, can be used with Daq PC-Cards.

DBK output signals can be bipolar, e.g., -5 to +5 V, or unipolar, e.g., 0 to 10 V. The user can select a range of relevant values to correspond to the lowest signal (e.g., -5 or 0 V) and the highest signal (e.g., 5 or 10 V) signal. This type of range selection guarantees the highest resolution in 12-bit or 16-bit conversion.

DBK modules share the same footprint as the DaqBook and a typical notebook PCs; allowing for convenient stacking. The majority of these modules have their own power supply; however, several options exist for packaging and powering the DBKs.

Reference Note:
DBK options are detailed in the *DBK Option Cards and Modules User's Manual* (p/n 457-0905). As a part of product support, this manual is automatically loaded onto your hard drive during software installation. The default location is the Programs directory, which can be accessed through the Windows Desktop.

Daq Software

The Daq devices have software options capable of handling most applications. Three types of software are available:

- ready-to-use graphical programs, e.g., DaqView, DaqViewXL, and post acquisition data analysis programs such as eZ-PostView
- drivers for third-party, icon-driven software such as DASYLab and LabView
- various language drivers to aid custom programming using API

Ready-to-use programs are convenient for fill-in-the-blank applications that do not require programming for basic data acquisition and display:

- DaqView is a Windows-based program for basic set-up and data acquisition. DaqView lets you select desired channels, gains, transducer types (including thermocouples), and a host of other parameters with a click of a PC's mouse. DaqView lets you stream data to disk and display data in numerical or graphical formats. PostView is a post-acquisition waveform-display program within DaqView.
- DaqViewXL allows you to interface directly with Microsoft Excel to enhance data handling and display. Within Excel you have a full-featured Daq control panel and all the data display capabilities of Excel.
- A post acquisition data analysis programs, e.g., eZ-PostView, typically allows you to view and edit post-acquisition data.
- The Daq Configuration control panel allows for interface configuration, testing, and troubleshooting.

Each Daq system comes with an Application Programming Interface (API) via a subroutine library (DAQ) or an ActiveX/COM based library (DaqCOM). API-language drivers include: C/C++, and Visual Basic. The latest software is a 32-bit version API.

Reference Notes:

- The software document modules, *DaqView*, *DaqViewXL*, and *Post Acquisition Data Analysis User's Guide*, are not included as part of the hardcopy manual, but are available in PDF version. See the PDF Note, below.
- Programming topics are covered in the *Programmer's User Manual* (1008-0901). As a part of product support, this manual is automatically loaded onto your hard drive during software installation. The default location is the Programs directory, which can be accessed through the Windows Desktop.

PDF Note: During software installation, Adobe® PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation for details regarding both hardware and software.

A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides
a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.


Notes

Device Overviews

Overview

DaqLab/2001 and DaqLab/2005 are high-speed, multi-function, data acquisition devices for use with Ethernet PCs and Ethernet networks. Each unit connects directly to a PC's Ethernet port or network hub, and each features a 16-bit, 200-kHz A/D converter and digital calibration.

In addition, both units include an internal AC-to-DC power converter and 2 slots for the addition of optional DBK cards.

Reference Notes:
- Block diagrams are presented in chapter 3.
- Connectors and pinouts are discussed chapter 4.

I/O Comparison Matrix		
Feature	**DaqLab/2001**	**DaqLab/2005**
PC Interface	10/100BaseT Ethernet	10/100BaseT Ethernet
A/D Converter	16-bit/200 kHz	16-bit/200 kHz
Front-panel voltage inputs	8	8
Built-in expansion slots	2	2
Maximum analog channel capacity*	128	128
Analog outputs	4 channel, 16-bit/100 kHz	----------
Frequency inputs	4 channel, 16-bit/10 MHz	4 channel, 16-bit/10 MHz
Timer outputs	2 channel, 16-bit/1 MHz	2 channel, 16-bit/1 MHz
Digital I/O	30	30
Included data logging application	DaqView	DaqView
Included software support	Visual Basic, C/C++, ActiveX/COM, LabVIEW, MATLAB, DASYLab	Visual Basic, C/C++, ActiveX/COM, LabVIEW, MATLAB, DASYLab

*Up to 488 thermocouple channels can be measured with one DaqLab using DBK90 thermocouple options. Measurement speed with DBK90 is 1msec/channel.

Synchronous Operation Matrix		
Operation	**DaqLab/2001**	**DaqLab/2005**
Synchronous Input		
Analog Main Unit Inputs	Yes	Yes
Analog Expansion Input	Yes	Yes
Counter Inputs	Yes	Yes
Digital Main Unit Inputs	Yes	Yes
Digital Expansion Inputs	Yes	Yes
Synchronous Output		
Analog D/A Waveform Output	Yes	No
Asynchronous IO		
Main Unit Digital I/O	Yes	Yes
Expansion Digital I/O	Yes	Yes
Timer Output (Pulse Generation)	Yes	Yes
Analog Output	Yes	No

Product Features

I/O Connections

All input and output signals are accessed via two 37-pin DSUB connectors [P1 and P2] on the rear panel and three removable screw terminal blocks on the front panel. When one or two DBK options are installed, signal lines will connect to them through openings in the upper region of the front panel. The DBK options connect to the DaqLab/2000 Series device through that unit's P1 and P2 connectors [P1 for analog, P2 for digital]. Chapter 4 includes connector descriptions and pinouts.

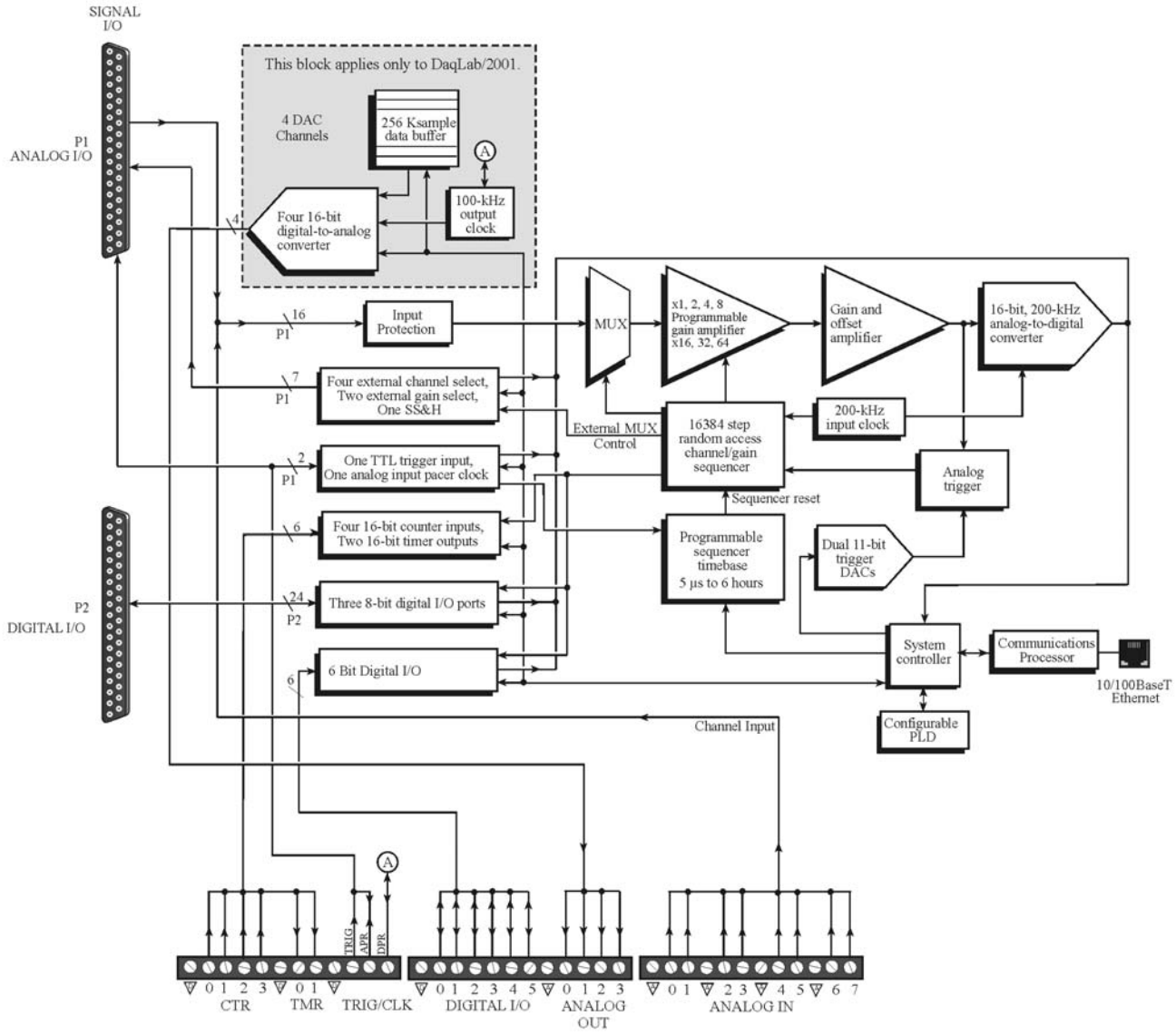
Reference Notes:
- Block diagrams are presented in chapter 3.
- Connectors and pinouts are discussed chapter 4.

General Features

- **TTL-level digital I/O lines**. There are 30 digital I/O lines. They are divided into three 8-bit ports on P2 and one 6-bit port on the front panel. The latter makes use of a removable screw terminal block.
- **Four 16-bit counters**. Each can accept frequency inputs up to 10 MHz. The counters can be cascaded into two 32-bit counters. Counter connection is via a removable screw terminal block on the front panel.
- **Two 16-bit timer outputs**. Each can generate square waves from 16 Hz to 1 MHz. Connection to the timer outputs is via a removable screw terminal block on the front panel
- **Configuration through software only**. Device settings are made via software. There are no hardware settings to be made, for example, there are no device DIP switches to be set or jumpers to be positioned. However, note that DBK expansion options may require s small degree of manual set up. Refer to the *DBK Option Cards and Modules User's Manual* (457-0905) for details. A PDF version of the document is included on the installation CD.
- **Scan Sequencing.** Each DaqLab/2000 Series device has a scan sequencer that can select up to 16384 channel/range combinations. Scan rates are programmable on a per channel basis to 5 µs/channel, 10 µs/channel, or 1000 µs/channel.

  Note: Inputs to these devices can be measured at the 5 µs/channel rate. However, some DBK expansion options require more settling time and can be measured at the slower rate of 10 µs/channel or 1000 µs/channel. All types of measurements can be mixed within the scan group.

Reference Note:
Chapter 8, *Taking Measurements*, includes information on additional product features. These include: triggering, synchronous I/O operations, and asynchronous I/O operations.



DaqLab/2001 and DaqLab/2005 Block Diagram

Note: The 4 DAC Analog Out Channels apply to DaqLab/2001. They do not apply to DaqLab/2005.


Notes

Connectors, Indicators, Cables, & Pinouts 4

DaqLab/2000 Series Hardware

DaqLab/2000 series provides for up to 128 channels of analog input expansion, or 448 TC channels. They have 30 built-in digital I/O channels. In addition DaqLab/2001 offers four DAC analog out channels.

DaqLab/2001, Front Panel

Front Panel

The DaqLab/2001 and /2005 front panels are identical. However, the screw terminals for Analog Out, though present, do not apply to the DaqLab/2005 as it has no DAC channels. The top section of the device includes a Power Switch and a Power LED. It also includes two DBK card slots for expansion. The DB37 ends of the cards will extend through slots in the rear panel where they will connect by cable to the DaqLab/2000 P1 [analog] or P2 [digital] DB37 connector, as applicable. The lower section of the device supports 3 removable screw-terminal blocks. Descriptions of front panel components follow.

POWER Switch and Power LED: A rocker-type switch with a "0" label for Power Off, and a "1" for Power On. When the unit is on and has power, the POWER LED will light. An AC to DC power converter resides within the DaqLab/2000 series device.

Removable Screw Terminal Blocks

DaqLab/2000 series devices include 3 sets of removable screw-terminal blocks. Each block has 12 screw-terminals. Aside from digital and analog ground connections, terminal connections consist of the following:

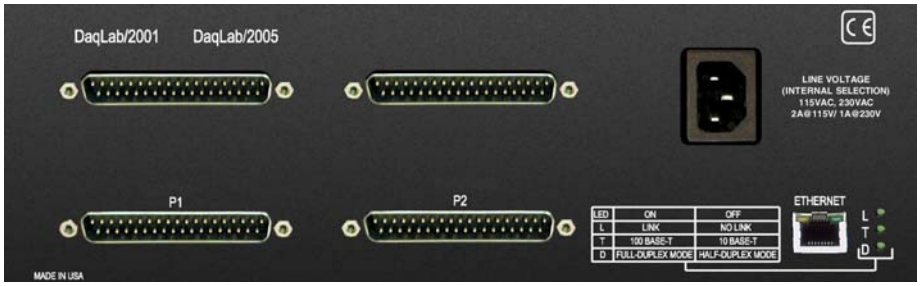
First Block:
4 counter inputs, 2 timer outputs, trigger input, ADC pacer clock input [or internal ADC pacer clock output], external DAC pacer clock input [or DAC pacer clock output] The first block includes connections for 3 digital grounds.

Second Block:
Connections for 6 digital I/O channels, one digital ground connection, one analog ground connect, and *for DaqLab/2001 only*, connection to 4 analog outputs.

Third Block:
This block provides connection for 8 analog input channels. The third block includes connections to 4 analog grounds.

CAUTION

Avoid contention between the front panel analog input channels and the rear panel expansion channels. All DBK expansion cards and modules must have their channel address set to 8, 9, 10, 11, 12, 13, 14, or 15. Otherwise the expansion card or module will be in contention with one of the front panel analog input channels. Such conflict may cause equipment damage!



DaqLab/2001, Rear Panel with two DBK Cards Installed

Rear Panel

The DaqLab/2001 and /2005 rear panels are identical. Each contains P1 and P2 DB37 connectors, a MAC Address Label, DIN5 power connector, power switch, Ethernet Port, and 5 LEDs [2 of which are on the Ethernet connector]. The top section of the device includes an AC power cord connector and two card slots: one above P1 and one above P2. The DB37 ends of the cards will extend through slots in the rear panel. Signal lines to the DBK cards connect at the DaqLab/2000 Series front panel.

P1 - DB37 Connector: Analog input port for 8 single-ended analog inputs programmable as uni-polar or bipolar. The 13 programmable ranges are from ±10 V to ±156 mV full scale. When applicable, this port is used to connect to an optional analog DBK card.

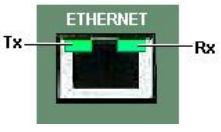
P2 - DB37 Connector: General purpose digital I/O port with 24 (3 x 8-bit) lines on P2, or digital I/O expansion port controlling up to 256 external lines. Programmable as input or output. When applicable, this port is used to connect to an optional digital DBK card.

MAC Address Label: The Media Access Control (MAC) label is located near the Ethernet connector. The label shows the device serial number in three formats: (1) Barcode, (2) base 10, and (3) hexadecimal. If prompted to enter a serial number in software, use the base 10 number. Conversion to a hexadecimal number for use in addressing will be automatic.

ETHERNET: The 10/100BaseT Ethernet port can connect to the Ethernet port of the host PC, or to an Ethernet network. Either of two Ethernet patch cables may be used to make the connection. CA-242 is a 1.5 foot cable. CA-242-7 is a 7-foot cable. Note that the Ethernet connector has two built in LEDs that indicate traffic flow. These are discussed with the three other Ethernet-related LEDs. Note that the Ethernet cable length must be <10m in order for the system to be CE Compliant.

LEDs: There are 5 ETHERNET Status LEDS. Two rectangular LEDs, Tx and Rx are built right into the frame of the Ethernet jack. The other three, located just to the right of the jack, are round and are labeled L, T, and D.

Tx – "ON" indicates traffic is being transmitted (see figure at right).
Rx – "ON" indicates that the port is receiving traffic.
L (Link) "ON" indicates a link exists. "OFF" indicates no link.
T (Transmit) "ON" indicates 100 M-Bits, "OFF" indicates 10 M-Bits.
D (Duplex) "ON" indicates full duplex, which allows simultaneous two-way data traffic. "OFF" indicates half-duplex, which only allows one-way data traffic at any given time.



Tx and Rx LEDs

POWER IN: 90 to 250 VAC, 3-prong socket for power cord.

Cables

Should you need help in regard to cables, or have any other product inquiries, please contact the factory.

Cables for use with DaqLab/2000 Series Devices		
	Description	**Part No.**
1.	Molded expansion cable. Connects a DBK module to a DaqLab, 2 in.	CA-255-2T
2.	Molded expansion cable. Connects a DBK module to a DaqLab, 4 in.	CA-255-4T
3.	DBK expansion cable. Connects a DBK module to a DaqLab, 2.5 in.	CA-37-1T
4.	DBK expansion cable. Connects a DBK module to a DaqLab, 4.5 in.	CA-37-3T
5.	Expansion-card cable. Connects DBK series expansion card options. The “x” in the part no. indicates the number of cards that can be connected via the cable.	CA-37-x
6.	Ethernet patch cable, shielded, 18 in.	CA-242
7.	Ethernet patch cable, shielded, 7 ft.	CA-242-7

Cabling Diagrams

CAUTION

Avoid contention between the front panel analog input channels and the rear panel expansion channels. All DBK expansion cards and modules must have their channel address set to 8, 9, 10, 11, 12, 13, 14, or 15. Otherwise the expansion card or module will be in contention with one of the front panel analog input channels. Such conflict may cause equipment damage!

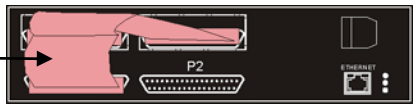
CA-255-2T
(*Two in use*)

Connecting one analog card and one digital card.

One CA-255-2T is used to connect P1 of the DaqLab to P1 of the analog card.

A second CA-255-2T is used to connect P2 of the DaqLab to P2 of the digital card.

CA-37-2



Connecting two analog cards.

One CA-37-2 cable is used to connect the DaqLab to 2 analog cards. The cable connects to all three P1 connectors.

CA-37-2

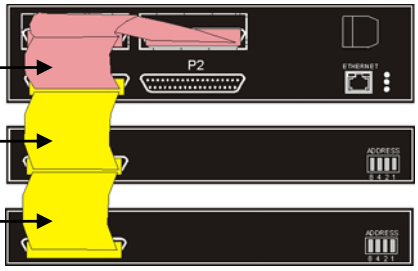
Connecting two digital cards.

One CA-37-2 cable is used to connect the DaqLab to 2 digital cards. The cable connects to all three P2 connectors.

CA-37-2

CA-255-2T

CA-255-2T



Connecting two analog cards and two analog modules.

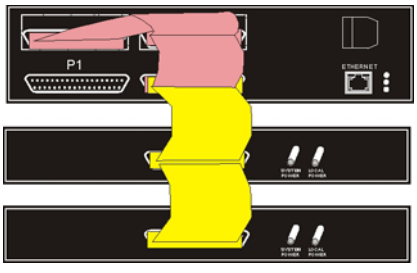
One CA-37-2 cable is used to connect the DaqLab to the 2 analog cards (housed in its expansion slots). The cable connects to three P1 connectors.

Two CA-255-2T cables are used to daisy-chain the analog expansion modules to DaqLab's P1 connector.

CA-37-2
(*upper most cable*)

CA-255-2T

CA-255-2T



Connecting two digital cards and two digital modules.

One CA-37-2 cable is used to connect the DaqLab to the 2 digital cards (housed in its expansion slots). The cable connects to three P2 connectors.

Two CA-255-2T cables are used to daisy-chain the digital expansion modules to DaqLab's P2 connector.

Pinouts

CAUTION

Turn off power to all devices connected to the system before connecting cables or setting configuration jumpers and switches. Electrical shock or damage to equipment can result even under low-voltage conditions.

CAUTION

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD controlled area. Such guidelines include the use of properly grounded mats and wrist straps, ESD bags and cartons, and related procedures.

DaqLab/2001 and DaqLab/2005 each have two 37-pin connectors designated as P1 and P2. These are located on the unit's rear panel. The devices also make use of removable screw-terminal blocks, which are located on the front panel.

Signal assignment to connectors is as follows.

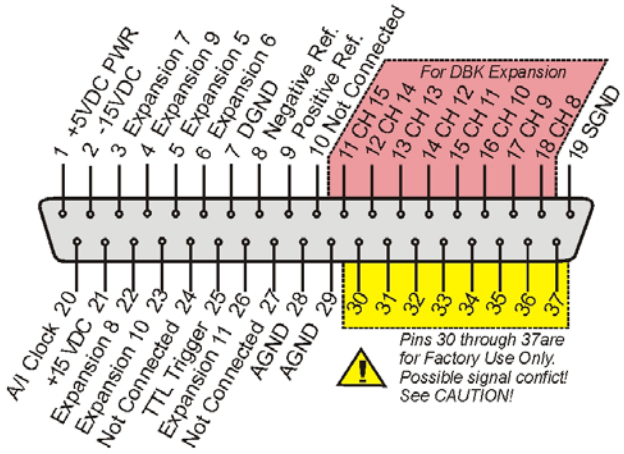
- P1 is used for Analog I/O
- P2 is used for Digital I/O
- First Terminal Block:
  4 counter inputs, 2 timer outputs, trigger input, ADC pacer clock input [or internal ADC pacer clock output], external DAC pacer clock input [or DAC pacer clock output] The first block includes connections for 3 digital grounds.
- Second Terminal Block:
  Connections for 6 digital I/O channels, one digital ground connection, one analog ground connect, and *for DaqLab/2001 only*, connection to 4 analog outputs.
- Third Terminal Block:
  This block provides connection for 8 analog input channels. The third block includes connections to 4 analog grounds.

To connect a digital I/O DBK option: (a) Mount the card in the DaqLab's central card slot. The card's P2 connector will go through the rear panel cutout. (b) connect a CA-255-xT, CA-37-xT , or a CA-37-x cable to the P2 connector on the DaqLab and (c) connect the free end of the cable to the DBK card. Cabling examples are provided on page 4-4.

To connect an analog I/O DBK option: (a) Mount the card in the DaqLab's right-hand card slot (when facing the front panel). P1 will go through the rear panel cutout. (b) connect a CA-255-xT, CA-37-xT , or a CA-37-x cable to the P1 connector on the DaqLab and (c) connect the free end of the cable to the DBK card. Cabling examples are provided on page 4-4.

If you are not familiar with DBK options, or need refreshed, refer to the *DBK Options Manual*, (p/n 457-0905).

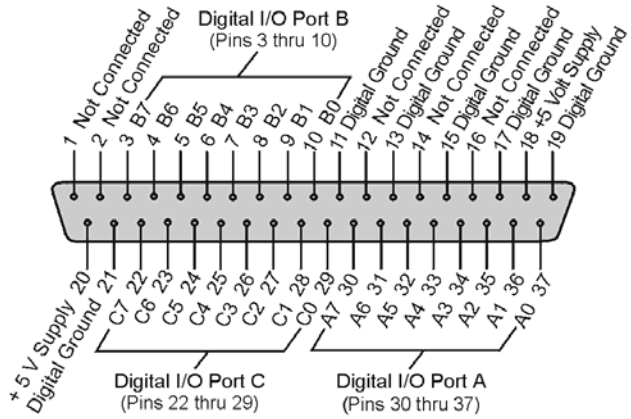
P1, DB37 Connector for DaqLab/2000 Series Devices



Pin	Signal Name	Description		Terminal*
1	+5 Volts	Expansion +5 V power		
2	-15 Volts	Expansion -15 VDC power		
3	Expansion 7	Digital OUT, external ADDRESS select bit 3		
4	Expansion 9	Digital OUT, external ADDRESS select bit 1		
5	Expansion 5	Digital OUT, external GAIN select bit 1		
6	Expansion 6	Digital OUT, external GAIN select bit 0		
7	DGND	Digital Ground		
8	Negative Reference	Analog, -5 V reference		
9	Positive Reference	Analog +5V reference		
10	Not Connected	N/A		
11	CH 15	CH 15	**For DBK Expansion**	
12	CH 14	CH 14		
13	CH 13	CH 13		
14	CH 12	CH 12		
15	CH 11	CH 11		
16	CH 10	CH 10		
17	CH 9	CH 9		
18	CH 8	CH 8		
19	Signal Ground (SGND)	Sense Common (SGND)		
20	A/I Clock	External ADC Pacer Clock Input / Internal ADC Pacer Clock Output		APR, Block 1
21	+15 Volts	Expansion +15 V power		
22	Expansion 8	Digital OUT, external ADDRESS select bit 2		
23	Expansion 10	Digital OUT, external ADDRESS select bit 0		
24	Not Connected	N/A		
25	TTL Trigger	Digital IN, External TTL Trigger Input		TRIG, Block 1
26	Expansion 11	Digital OUT, Simultaneous sample and hold (SSH)		
27	Not Connected	N/A		
28	AGND	Analog Ground		AGND, Block 3
29	AGND	Analog Ground		AGND, Block 3
30	P1 pins 30 through 37 are reserved for factory use. **See CAUTION!**	Ch 7 IN	**CAUTION**: Avoid contention between the front panel analog input channels and the rear panel expansion channels. All DBK expansion cards and modules must have their channel address set to 8, 9, 10, 11, 12, 13, 14, or 15. Otherwise the expansion card or module will be in contention with one of the front panel analog input channels. Such conflict may cause equipment damage!	CH 7, Block 3
31		Ch 6 IN		CH 6, Block 3
32		Ch 5 IN		CH 5, Block 3
33		Ch 4 IN		CH 4, Block 3
34		Ch 3 IN		CH 3, Block 3
35		Ch 2 IN		CH 2, Block 3
36		Ch 1 IN		CH 1, Block 3
37	For Channels 0 through 7 use the block 3 terminal panel [on the front panel]. **See CAUTION!**	Ch 0 IN		CH 0, Block 3

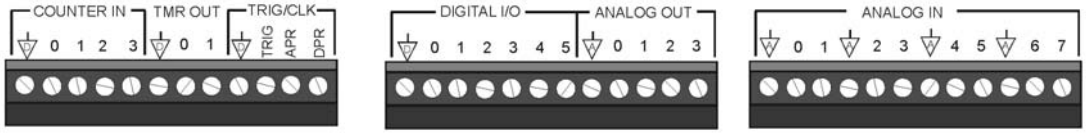
* In addition to P1 pin 20 and pin 25, DaqLab/2000 Series devices have “APR” and “TRIG” screw terminal connections on screw terminal block 1 on the front panel. Block 3 on the front panel includes analog ground connections and connections for channels 0 through 7.

P2, DB37 Connector for DaqLab/2000 Series Devices



Pin	Signal Name	Description
1	Not Connected	N/A
2	Not Connected	N/A
3	Port B - B7	Digital I/O: P2 Digital Port B, Bit 7; or, P2 Expansion Address Bit 0 Out
4	Port B - B6	Digital I/O: P2 Digital Port B, Bit 6; or, P2 Expansion Address Bit 1 Out
5	Port B - B5	Digital I/O: P2 Digital Port B, Bit 5; or, P2 Expansion Address Bit 2 Out
6	Port B - B4	Digital I/O: P2 Digital Port B, Bit 4; or, P2 Expansion Address Bit 3 Out
7	Port B - B3	Digital I/O: P2 Digital Port B, Bit 3; or, P2 Expansion Address Bit 4 Out
8	Port B - B2	Digital I/O: P2 Digital Port B, Bit 2; or, P2 Expansion RESET Output
9	Port B - B1	Digital I/O: P2 Digital Port B, Bit 1; or, P2 Expansion WRITE Output
10	Port B - B0	Digital I/O: P2 Digital Port B, Bit 0; or, P2 Expansion READ Output
11	DGND	Digital Ground
12	Not Connected	N/A
13	DGND	Digital Ground
14	Not Connected	N/A
15	DGND	Digital Ground
16	Not Connected	N/A
17	DGND	Digital Ground
18	+ 5 Volt Supply	Expansion +5 Volt Power
19	DGND	Digital Ground
20	+ 5 Volt Supply	Expansion +5 Volt Power
21	DGND	Digital Ground
22	Port C - C7	Digital I/O: P2 Digital Port C, Bit 7; or, P2 Expansion Data Bit 7
23	Port C - C6	Digital I/O: P2 Digital Port C, Bit 6; or, P2 Expansion Data Bit 6
24	Port C - C5	Digital I/O: P2 Digital Port C, Bit 5; or, P2 Expansion Data Bit 5
25	Port C - C4	Digital I/O: P2 Digital Port C, Bit 4; or, P2 Expansion Data Bit 4
26	Port C - C3	Digital I/O: P2 Digital Port C, Bit 3; or, P2 Expansion Data Bit 3
27	Port C - C2	Digital I/O: P2 Digital Port C, Bit 2; or, P2 Expansion Data Bit 2
28	Port C - C1	Digital I/O: P2 Digital Port C, Bit 1; or, P2 Expansion Data Bit 1
29	Port C - C0	Digital I/O: P2 Digital Port C, Bit 0; or, P2 Expansion Data Bit 0
30	Port A - A7	Digital I/O: P2 Digital Port A, Bit 7
31	Port A - A6	Digital I/O: P2 Digital Port A, Bit 6
32	Port A - A5	Digital I/O: P2 Digital Port A, Bit 5
33	Port A - A4	Digital I/O: P2 Digital Port A, Bit 4
34	Port A - A3	Digital I/O: P2 Digital Port A, Bit 3
35	Port A - A2	Digital I/O: P2 Digital Port A, Bit 2
36	Port A - A1	Digital I/O: P2 Digital Port A, Bit 1
37	Port A - A0	Digital I/O: P2 Digital Port A, Bit 0

Screw Terminals, Removable Blocks



The three screw terminal blocks can be removed from the front panel to facilitate easier wiring. Labeling on the chassis clearly identifies each terminal connection. Identification is further simplified by terminal categories, for example, “counter in” appears above the four counter inputs, “digital I/O” appears above the 6 digital terminations, etc.

First Terminal Block:

COUNTER IN (Counter Inputs): 1 digital ground, 4 counter inputs

TMR OUT (Timer Outputs): 1 digital Ground, 2 timer outputs

TRG/CLK (Trigger/Clock):
- 1 digital ground
- TRIG - TTL trigger input (same as P1, pin 25)
- APR - ADC pacer clock input, or internal ADC pacer clock output] (same as P1, pin 20)
- DPR - external DAC pacer clock input, or DAC pacer clock output

Second Terminal Block:

DIGITAL I/O: 1 digital ground, 6 digital I/O channels

ANALOG OUT: *Applies to DaqLab/2001 only*. 1 analog ground connection, 4 analog outputs.

Third Terminal Block:

ANALOG IN: 4 analog grounds and 8 analog input channels. The 8 channel screw terminals on block 3 are the same signal connections as found on P1, pins 30 through 37. The following CAUTION applies:

CAUTION

Avoid contention between the front panel analog input channels and the rear panel expansion channels. All DBK expansion cards and modules must have their channel address set to 8, 9, 10, 11, 12, 13, 14, or 15. Otherwise the expansion card or module will be in contention with one of the front panel analog input channels. Such conflict may cause equipment damage!

Software 5

Overview

The Daq devices have software options capable of handling most applications. Three types of software are available:

- *Out-of the-box* graphical programs, e.g., DaqView, DaqViewXL, and post acquisition data analysis programs such as eZ-PostView, eZ-TimeView, and eZ-FrequencyView.
- drivers for third-party, icon-driven software such as DASYLab and LabVIEW.
- various language drivers to aid custom programming using API; includes DaqCOM™ ActiveX/COM support.

Out-of-theBox™ Software

Out-of-the-Box programs are convenient for fill-in-the-blank applications that do not require programming for basic data acquisition and display:

- **DaqView** is a Windows-based program for basic set-up and data acquisition. DaqView lets you select desired channels, gains, transducer types (including thermocouples), and a host of other parameters with a click of a PC's mouse. DaqView lets you stream data to disk and display data in numerical or graphical formats.
- **DaqViewXL** allows you to interface directly with Microsoft Excel to enhance data handling and display. Within Excel you have a full-featured Daq control panel and all the data display capabilities of Excel.
- **eZ-PostView** provides a simple method of graphically viewing acquired waveforms from the acquisition device. Up to 8 windows can be displayed on one screen, with up to 16 channels overlaid on each window. eZ-PostView makes it simple to visually inspect acquired waveforms from multiple channels within seconds of acquiring the data. Documentation, in Adobe PDF format, is provided on the CD. Refer to the *PostAcquisition Analysis.PDF*.
- **eZ-TimeView & eZ-FrequencyView**
  eZ-TimeView and eZ-FrequencyView are optional post-acquisition analysis packages, which are related to eZ-PostView, but include more features. eZ-TimeView is targeted at time-domain analysis, including min/max, peak-peak, mean, RMS, plus a wide variety of plotting and waveform viewing capabilities. eZ-FrequencyView is targeted at post-acquisition frequency-domain analysis, including FFT's, octave - analysis, plus dozens of other analysis features. Documentation, in Adobe PDF format, is provided on the CD. Refer to the *PostAcquisition Analysis.PDF*.
- The **Daq Configuration control panel** allows for interface configuration, testing, and troubleshooting.

Reference Notes:

- The software documentation for *DaqView*, *DaqViewXL*, and *Post Acquisition Data Analysis* are not included as part of the hardcopy manual, but are available in PDF format. See the PDF Note, below.
- Programming topics are covered in the *Programmer's User Manual* (1008-0901). As a part of product support, that manual is automatically loaded onto your hard drive during software installation. The default location is the Programs directory, which can be accessed through the Windows Desktop.

PDF Note: During software installation, Adobe® PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation for details regarding both hardware and software.

Note that the PDF documents can be read directly from the CD by using the <**View PDFs**> button located on the opening install screen.

A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.

Drivers for Third-party, Icon-driven Software

LabVIEW® Support
We provide LabVIEW® support for expansion and signal conditioning modules. Our data acquisition VIs for LabVIEW are more than just simple hardware access VIs, they are complete with engineering data conversion, data display and logging capabilities.

DASYLab®
If your application requirements go beyond the scope of DaqView, you may want to consider DASYLab software, as the latter offers a greater degree of flexibility and customizing.

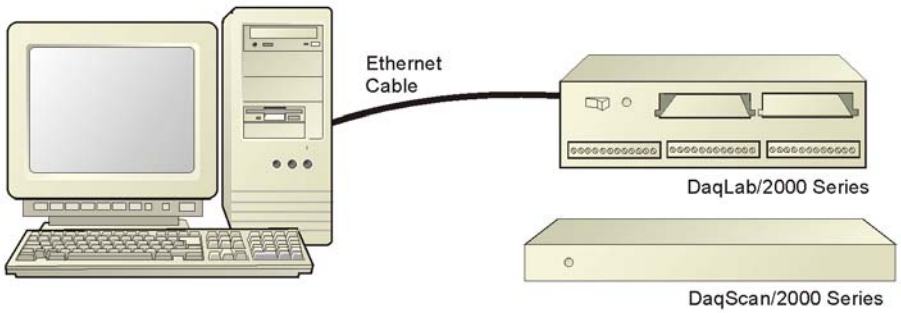
Language Drivers

Each Daq system comes with an Application Programming Interface (API). API-language drivers include: C/C++, and Visual Basic. The latest software is a 32-bit version API.

DaqLab/2000 Series devices are supplied with DaqX Subroutine API Libraries. These provide complete support for all of the functionality available on each data acquisition device in Visual Basic®, and C/C++. In addition, DaqX is supported under all versions of Windows®. Over 100 program examples are included with DaqX Subroutine API Libraries. API documentation is provided in a *Programmer's Manual* (p/n 1008-0901), which is included on the installation CD.

The DaqCOM™ suite of programming allows applications developers to rapidly develop and deploy custom systems by leveraging COM (Component Object Model) technology. DaqCOM does this by providing a powerful easy-to-use interface to most programming languages including, Visual Basic®, VBA, C++, and J++. In addition, DaqCOM supports the new Windows.NET architecture and includes examples for VisualBasic.NET and C++. Support for VisualStudio.NET is accomplished via the COMInterop feature within VisualStudio.NET.

Configuring the System for Operation 6



Connecting a DaqLab/2000 Series or DaqScan/2000 Series Device to the Ethernet

The DaqLab/2000 Series and DaqScan/2000 Series acquisition devices connect directly to an Ethernet port on a PC or network hub via a built-in 10/100BaseT Ethernet interface. An Ethernet patch cable CA-242 (1.5 foot) or CA-242-7 (7 foot) cable is used to make the connection.

CAUTION

Turn off power to the system devices and externally connected equipment before connecting cables. Electric shock or damage to equipment can result even under low-voltage conditions.

Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)

Reference Note: Adobe PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. You can also access documents directly from the data acquisition CD via the <View PDFs> button located on the CD's opening screen.

Minimum System Requirements

PC system with Pentium® Processor
Windows Operating System
RAM, as follows:
32 Mbytes of RAM for Windows NT
64 Mbytes of RAM for Windows 2000
64 Mbytes of RAM for Windows XP

STEP 1 – Install the Software

1. Remove previous version Daq drivers, if present. You can do this through Microsoft's *Add/Remove Programs* feature.
2. Place the Data Acquisition CD into the CD-ROM drive. Wait for PC to auto-run the CD. This may take a few moments, depending on your PC. If the CD does not auto-run, use the Desktop's *Start/Run/Browse* feature to locate and run **Setup.exe** [from the applicable CD-ROM drive].
3. After the intro-screen appears, follow the screen prompts.

STEP 2 – Determine the type of Network Connection

To properly connect and configure the device you must determine the type of network it will become part of. This is because the type of network used has a direct bearing on the IP address of the device.

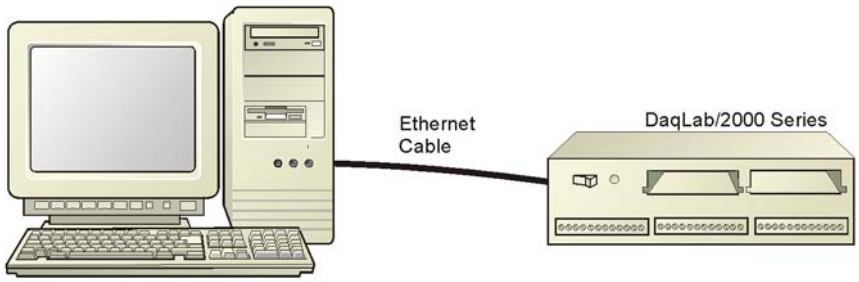
Briefly, the four network types are as follows:

- **Dedicated Network - with a direct cable connection from the PC to the device**
- **Dedicated Network - making use of a network hub or switch**
- **LAN with a DHCP server**
  (Local Area Network with a Dynamic Host Configuration Protocol)
- **LAN without a DHCP server**
  (Local Area Network with no Dynamic Host Configuration Protocol)

Brief descriptions and illustrations follow.

Dedicated Network - with a direct cable connection from the PC to the device

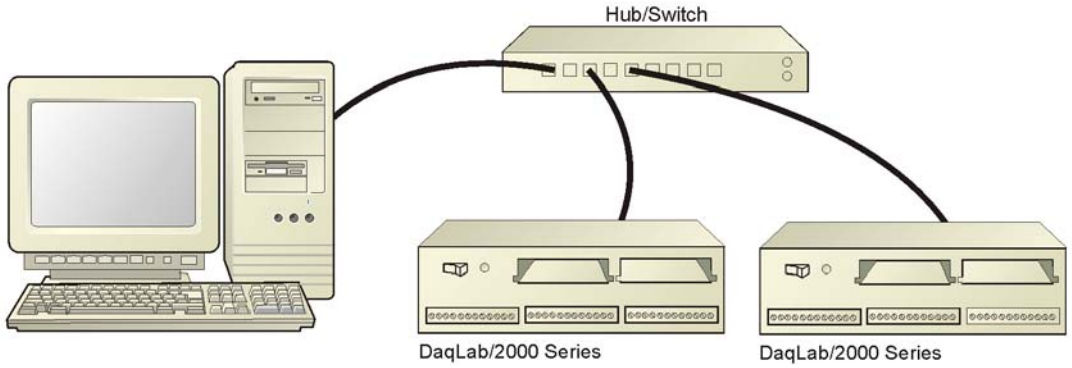
In this scenario a DaqLab/2000 Series device is connected directly to an Ethernet jack on a host computer. The following figure could just as easily portray a DaqScan/2000 Series device.



Dedicated Network using a Direct Cable Connection

Dedicated Network - making use of a network hub or switch

In the following figure a DaqLab/2000 Series device is connected to the Ethernet through a network hub/switch. At least one computer is also connected to the hub. DaqScan/2000 series devices can be connected directly to the hub/switch in the same manner.



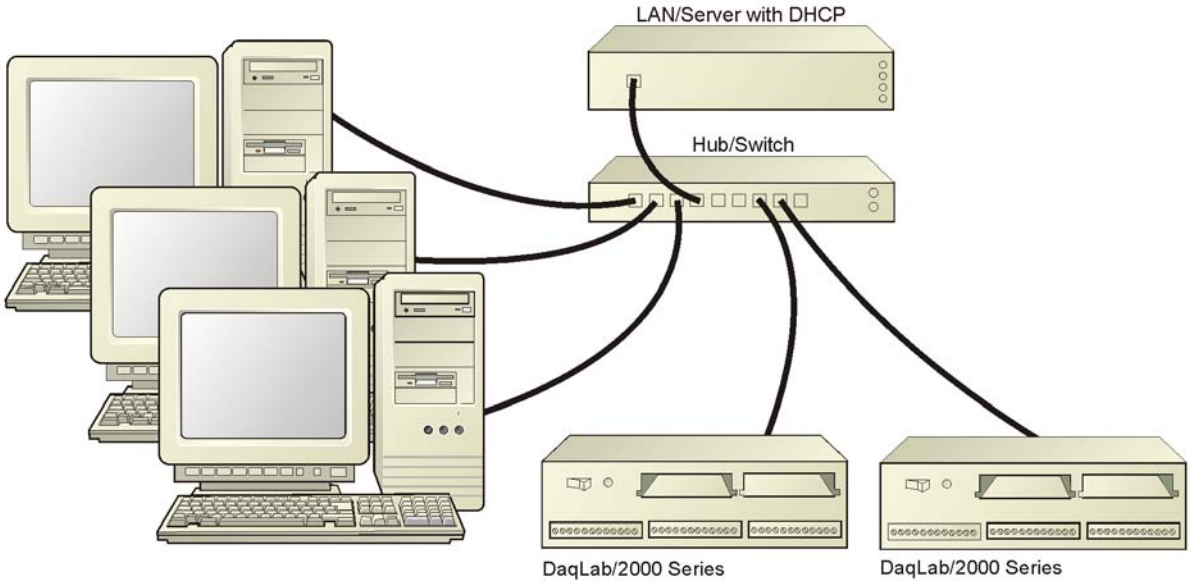
Dedicated Network using a Hub/Switch

Some network devices such as a *wireless access point* may act as a DHCP server. If this is the case, follow the instructions for the LAN with a DHCP server. For detailed information consult the documentation that is specific to your network device.

LAN with a DHCP Server

(Local Area Network with a Dynamic Host Configuration Protocol server)

Many corporations use the LAN/Server with DHCP arrangement for their networks. In this type of setup several computers are typically connected to a network that makes use of a DHCP server. In addition, the primary data acquisition device, e.g., DaqLab/2001, is connected to the network hub/switch.



LAN with a DHCP Server

Notes:

- Using a DaqLab/2000 Series or DaqScan/2000 Series device on a typical LAN may affect the speed of the network and internet data transfer. Because of this we recommend adding a network card to the computer and using one of the two dedicated network configurations.
- Contact your network administrator before connecting your device to a corporate network.

LAN with no DHCP Server

(Local Area Network with no Dynamic Host Configuration Protocol server)

This scenario looks the same as that shown in the previous illustration, except there is no Dynamic Host Configuration Protocol (DHCP). In this type of setup, one or more computers are connected to a network; and each computer has a static IP address.

STEP 3 – Connect the System Components

Reference Note:
For information regarding connections, refer to Chapter 4, *Connectors, Indicators, Cables, & Pinouts*.

What you will need to connect your DaqLab/2000 Series or DaqScan/2000 Series device to the Ethernet:

- An available connection to the Ethernet. The connection can be either
  - an Ethernet jack on a computer or
  - an Ethernet jack on a hub that is connected to the Ethernet.
- An Ethernet patch cable, e.g., a CA-242 (1.5 foot cable) or a CA-242-7 (7-foot cable).

1. Connect the Ethernet cable to the Ethernet jack on the Daq device.
2. Connect the other end of the Ethernet cable to the Ethernet jack on the host computer or network hub.

STEP 4 – Power-up the System

What you will need:

A 90 to 240 VAC power supply.

Your unit's power supply cord.

How to make the connection:

In the following steps we use the term "Daq Device" to mean a DaqLab/2000 Series device or DaqScan/2000 Series device as applicable to your system.

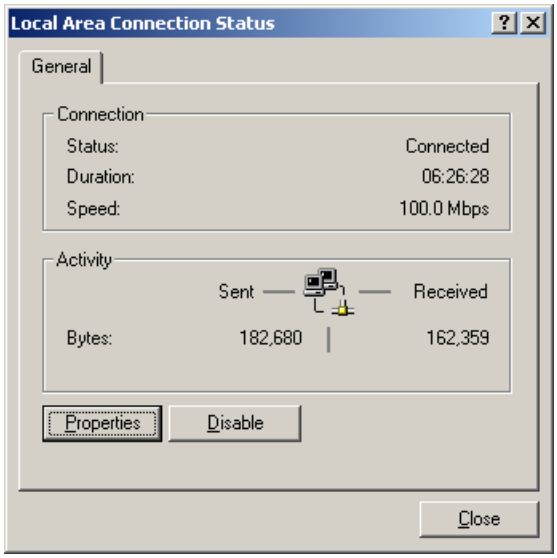
1. Using the unit's power switch, turn the Daq device "OFF." The switch will be in the "0" position and the power LED will be unlit.
2. Connect the power cord to the Power In connector on the Daq device.
3. Connect the plug to a standard AC outlet, or to the outlet of another reliable 90 to 240 VAC power supply.
4. If your power supply has a switch or breaker, close it to turn power "ON."
5. Turn ON the Daq device by placing its power switch to the "1" position. The unit's power led will light up.

STEP 5 – Configure the Computer's Network Settings [Applies to "dedicated networks" only]

If using a LAN (Local Area Network), <u>which has a DHCP server</u>, skip this section and continue with *STEP 7 - Configure and Test the System using the Daq*Configuration Applet* (page 6-10).

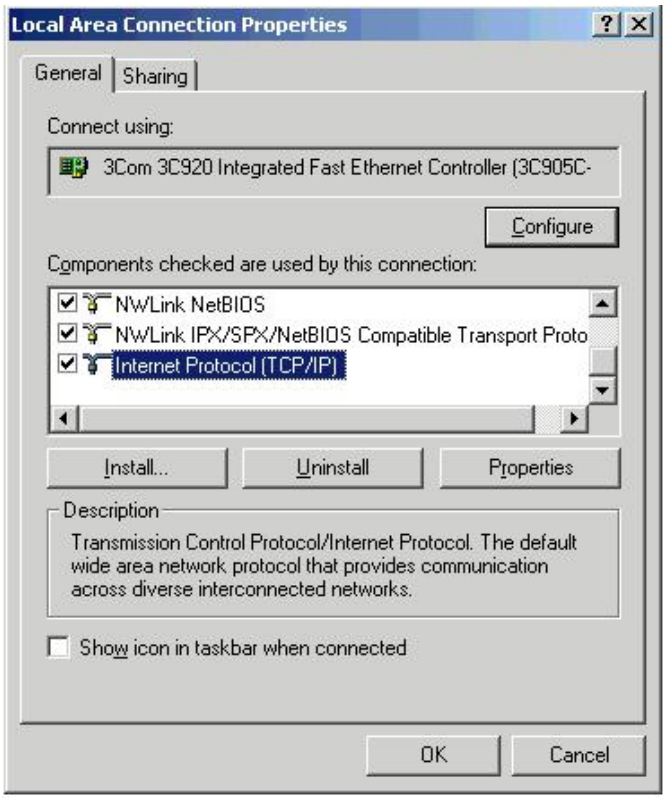
If using a LAN (Local Area Network), <u>which has no DHCP server</u>, skip this section and continue with *STEP 6 - Configure Device Network Settings using DaqIPConfig* (page 6-9).

1. Open the Control Panel by navigating from the Windows Desktop as follows: **Start Menu ⇒ Settings ⇒ Control Panel**.
2. Double-click the "Network and Dial-up Connections" icon.
3. Double-click the "Network Connection" icon for the network that the Daq device is connected to.



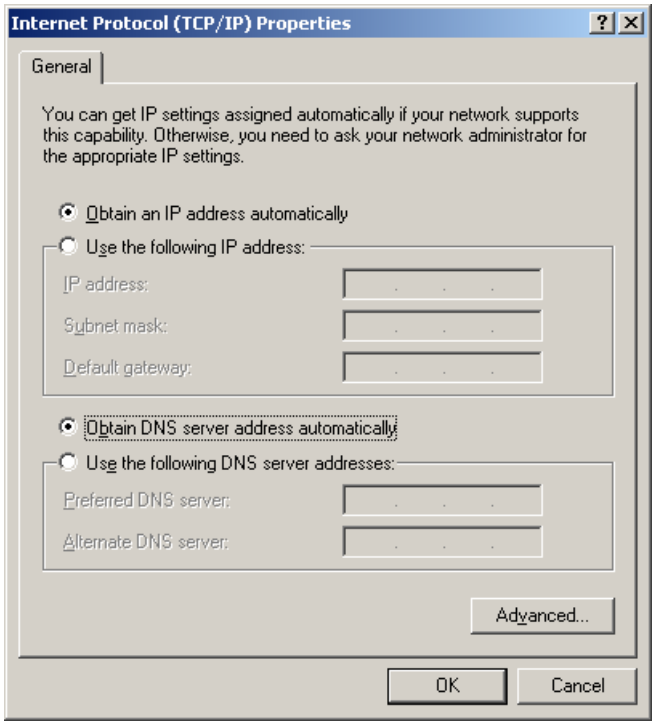
Local Area Connection Status

4. In the "Local Area Connection Status" box (previous figure), click on the <**Properties**> button. The "Local Area Connection Properties" box will appear (following figure).



Local Area Connection Properties

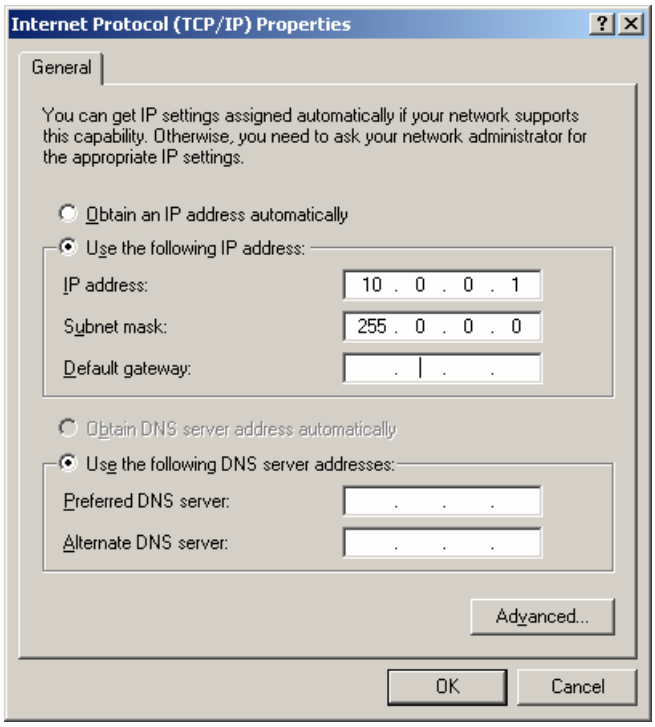
5. Double-click the “Internet Protocol (TCP/IP)” component (previous figure). The “Internet Protocol (TCP/IP) Properties” box will appear (following figure).



Internet Protocol (TCP/IP) Properties

Configure the Computer's TCP/IP settings as follows.

Make sure that each computer on the dedicated network has a unique IP address. Make sure that the IP address of the acquisition device is also unique. The computer and the device cannot use the same IP address.



Internet Protocol (TCP/IP) Properties

6. Select the "Use the following IP Address" radio button.
7. Set the IP address field to 10.0.0.x where x is some number from 1 to 255. **Make sure that each computer on the dedicated network has a unique IP address.**
8. Set the Subnet mask to 255.0.0.0. Note that the remaining fields can be left unchanged.

STEP 6 – Configure Device Network Settings using DaqIPConfig

Applies only to a LAN (Local Area Network), which has a no DHCP server.

If using a LAN (Local Area Network), which has a DHCP server, skip this section and continue with *STEP 7 - Configure and Test the System using the Daq*Configuration Applet* (page 6-10).

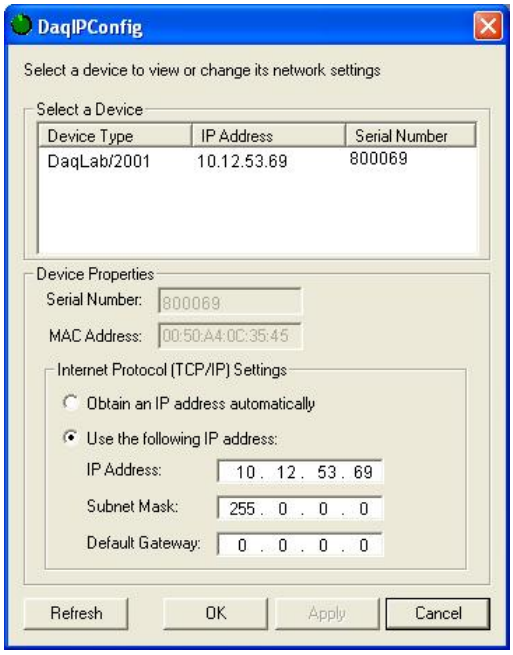
The *DaqIPConfig* applet, designed for 32-bit Windows NT/2000/XP systems, allows you to change the IP address of a device to match the address of a host computer. The applet is located in the program group for the associated device and can be accessed from the Windows Desktop via the start menu.

1. ***Locate the DaqIPConfig Applet.***

   Locate the DaqIPConfig applet by navigating from the Windows' Desktop as follows:
   Start Menu ⇒ Programs ⇒ IOtech DaqX Software ⇒ DaqIPConfig

2. ***Open the DaqIPConfig Applet.***

   Click on the DaqIPConfig selection to open the applet.



DaqIPConfig

3. ***Select the device that is to have the address change.***
   Note: In the above figure there is only one device to select, i.e., DaqLab/2001.

4. ***Set the internet protocol (TCP/IP) settings to be compatible with host computer.***

   (a) Select the radio button labeled "Use the following IP address."

   (b) Enter the new internet protocol settings. If needed, consult your network administrator for acceptable numbers.

   (c) Click the <OK> button.

5. ***Reboot the device.***

   The new IP address will not take affect until the device has been powered-off, then powered back on.

6. ***Repeat steps 3, 4, and 5 for other devices in the system.***

   After configuring the network settings for all devices, proceed to Step 7.

STEP 7 – Configure and test the System using the Daq* Configuration Applet

The *Daq* Configuration* applet, designed for 32-bit Windows NT/2000/XP systems, is located in the Windows *Control Panel*. It allows you to add or remove a device and change configuration settings. The included test utility provides feedback on the validity of current configuration settings, as well as performance summaries.

1. *Open the Daq* Configuration Applet.*

a. Open the Control Panel by navigating from the Windows' Desktop as follows: **Start Menu ⇒ Settings ⇒ Control Panel**

b. From the Control Panel, double-click the ***Daq* Configuration*** icon.

2. *Add the first-level device to the list of installed devices.*

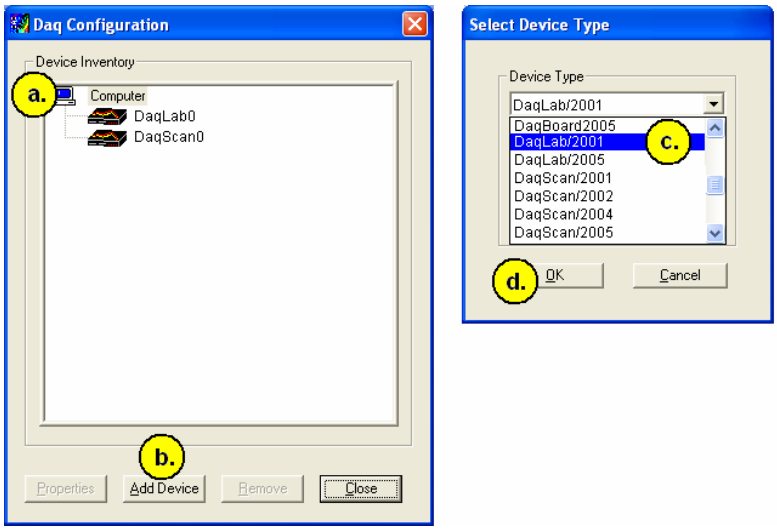
The first-level device is the device that will be connected directly to the Ethernet, via a host computer's Ethernet jack or a jack on a network hub. DaqLab/2001 is an example of a first-level device.

a. Select the Computer image in the Device Inventory configuration tree (following figure).

b. Click the <**Add Device**> button. The "Select Device Type" box will appear.

c. Select the device from the list of devices. In our example we are selecting a DaqLab/2001.

d. Click the <**OK**> button. The "Properties" box will appear for the selected device.



Using Daq Configuration's "Device Inventory" and "Select Device Type" to Add a Device

Note: Although the above figure indicates that a DaqLab/2001 was selected as the first level device, we could similarly have selected another device, for example, a DaqLab/2005 or a DaqScan/2004.

3. *Set the properties of the first-level device.*

In this step you will set the device properties according to one of the following two methods, depending on whether you have a "Dedicated Network" or a "LAN with DHCP Server Network." Illustrations of the network types are provided on page 6-3.

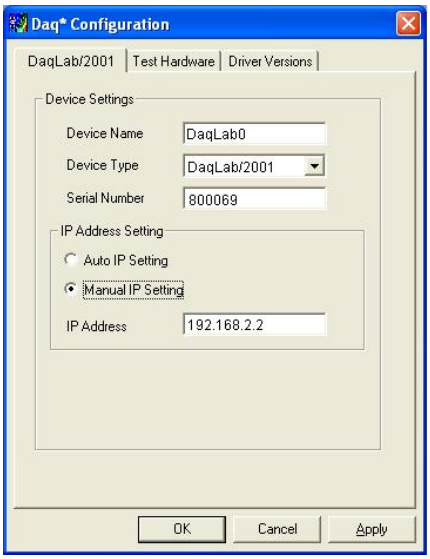
Users of Dedicated Networks follow these 2 steps.

a. Enter the **Serial Number** of the first-level device, e.g., DaqLab/2001. In the following screen shots the Serial Number is 800069.

b. Select the "**Auto IP Setting**" radio button. Note that the IP Address of the DaqLab/2001 will automatically be calculated and displayed in the IP Address field as indicated in the following left-hand figure.

c. Click the <**OK**> button.

For DEDICATED Networks



For LAN with DHCP Server Networks

Daq Configuration, Properties Dialog Boxes

Note: The above images are based on DaqLab/2001. We could similarly have selected another device.

Users of LAN with DHCP Server Networks follow these 3 steps.

The *DaqIPConfig* applet provides the Serial Number and the IP Address of the device. Users of LAN with DHCP Server Networks will need to enter both numbers in the *Daq Configuration, Properties* dialog boxes (previous right-hand figure). Page 6-9 includes instructions for accessing *DaqIPConfig*.

If needed, refer to the upper right-hand figure in regard to radio-button and data entry locations.

a. Enter the base 10 version of the **Serial Number** of the device, e.g., DaqLab/2001.

b. Select the "**Manual IP Setting**" radio button.

c. In the **IP Address** field, enter the IP address.

d. Click the <**OK**> button.

- **Provide your network administrator with the information located on the device's MAC label.**
- **Find out from the administrator if the IP Address will be changing. If so, see if you can obtain a permanent IP Address that will be dedicated specifically to your device.**

4. Test the system connections.

a. Make sure the device has been properly installed and is powered-on.

b. Make sure all cables are properly and securely connected.

c. Click the "**Test Hardware**" tab.

d. Click the <**TCP/IP Test**> button. This tests the Transmission Control Protocol / Internet Protocol. The TCP/IP test has two components: *Pinging Device and TCP Connection*.

The **Pinging Device** test is an ICMP (Internet Control Message Protocol) ping test. In addition to indicating either "Passed" or "Failed," the test displays the round-trip time of the ping, for example, <10 ms; and Packet Loss expressed as a percent of data lost.

A long ping round trip time, for example, >50 ms and/or any packet loss indicates a slow network that is not optimized.

If the Pinging Device Test *fails* a <**Details**> button will appear just above the <**Resource Test**> button. If this is the case, click the <**Details**> button to obtain possible causes and possible solutions.

The result of the **TCP (Transmission Control Protocol)** test will be either *passed* or *failed*. If the TCP test *failed* a <**Details**> button will appear just above the <**Resource Test**> button. If this is the case, click the <**Details**> button to obtain possible causes and possible solutions.

e. Upon completion of the TCP/IP test, click the <**Resource Test**> button. The Resource Test consists of two components: *Resource Tests* and *Performance Tests*.

The **Resource Test** performs a quick communications check. If the host PC can communicate with the device a message that the test *passed* is displayed.

The **Performance Tests** obtain quantitative results using the current configuration of the acquisition device. The test results represent the maximum rates at which various operations can be performed, and will vary according to port hardware capabilities.

The ADC FIFO Input Speed part of the test results in a display of the maximum rate at which data can be transferred from the tested device's internal ADC FIFO to computer memory. Results are given in samples/second, where a sample (2 bytes in length) represents a single A/D value.

When testing a DaqLab/2000 Series or a DaqScan/2000 Series device, if the unit does not respond within 30 seconds perform the following steps:

1) **reboot the system**
2) **upon power-up, re-open the *Daq Configuration* applet**
3) **select another configuration setting**
4) **reinitiate the test**

This completes the procedure for connecting a DaqLab/2000 Series or a DaqScan/2000 Series device to the Ethernet.

Reference Notes:
Depending on your application and system setup, related information can be found in the following sources:

- The *DBK Options Manual* (p/n 457-0905).
- The *Programmer's Manual*, (p/n 1008-0901).

Note: You can access PDF documents directly from the opening screen of the data acquisition CD via the <**View PDFs**> button.

CE Compliance & Noise Considerations 7

Overview

CE-compliant products bear the "CE" mark and include a *Declaration of Conformity* stating the particular specifications and conditions that apply. The test records and supporting documentation that validate the compliance are kept on file at the factory.

The European Union established CE standards in 1985. The standards include specifications for safety, EMI emissions, and immunity from electromagnetic interference. Products that are intended for placement in the European Union must meet or exceed the standards and bear the "CE" mark.

Although not required in the USA, meeting or exceeding the CE standards is considered good engineering practice, since doing so enhances safety while reducing noise and ESD problems.

In contracted and in-house testing, most Daq products met the required specifications. In many cases, products that were not originally in compliance were redesigned accordingly. In noted instances, alternate product versions, shield plates, edge guards, special connectors, or add-on kits are required to meet CE compliance.

CE Standards and Directives

The electromagnetic compatibility (EMC) directives specify two basic requirements:

1. The device must not interfere with radio or telecommunications.
2. The device must be immune from electromagnetic interference from RF transmitters, etc.

The standards are published in the *Official Journal of European Union* under direction of CENELEC (European Committee for Electrotechnical Standardization). The specific standards relevant to Daq equipment are listed on the product's *Declaration of Conformity*.

The safety standard that applies to Daq products is EN 61010-1:1993 (*Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements*). Environmental conditions include the following:

- indoor use
- altitude up to 2000 m
- temperature 5°C to 40°C (41°F to 104°F)
- maximum relative humidity 80% for temperatures up to 31°C (87.8°F) decreasing linearly to 50% relative humidity at 40°C (104°F)
- mains supply voltage fluctuations not to exceed ±10% of the nominal voltage
- other supply voltage fluctuations as stated by the manufacturer
- transient overvoltage according to installation categories (overvoltage categories) I, II and III. For mains supply, the minimum and normal category is II.
- pollution degree I or II in accordance with IEC 664

For clarification, terms used in some Declarations of Conformity include:

- **pollution degree**: any addition of foreign matter, solid, liquid or gaseous (ionized gases) that may produce a reduction of dielectric strength or surface resistivity. **Pollution Degree I** has no influence on safety and implies: the equipment is at operating temperature with non-condensing humidity conditions; no conductive particles are permitted in the atmosphere; warm-up time is sufficient to avert any condensation or frost; no hazardous voltages are applied until completion of the warm-up period. **Pollution Degree II** implies the expectation of occasional condensation.
- **overvoltage (installation) category**: classification with limits for transient overvoltage, dependent on the nominal line voltage to earth. **Category I** implies signals without high transient values. **Category II** applies to typical mains power lines with some transients.

Safety Conditions

Users must comply with all relevant safety conditions in the user's manual and the Declarations of Conformity. This manual and Daq hardware make use of the following Warning and Caution symbols: If you see either of these symbols on a product, carefully read the related information and be alert to the possibility of personal injury.

This warning symbol is used in this manual or on the equipment to warn of possible injury or death from electrical shock under noted conditions.

This warning/caution symbol is used to warn of possible personal injury or equipment damage under noted conditions.

Daq products contain no user-serviceable parts; refer all service to qualified personnel. The specific safety conditions for CE compliance vary by product; but general safety conditions include:

- The operator must observe all safety cautions and operating conditions specified in the documentation for all hardware used.
- The host computer and all connected equipment must be CE compliant.
- All power must be off to the device and externally connected equipment before internal access to the device is permitted.
- Isolation voltage ratings: do not exceed documented voltage limits for power and signal inputs. All wire insulation and terminal blocks in the system must be rated for the isolation voltage in use. Voltages above 30 Vrms or ±60 VDC must not be applied if any condensation has formed on the device.
- Current and power use must not exceed specifications. Do not defeat fuses or other over-current protection.

Emissions/Immunity Conditions

The specific immunity conditions for CE compliance vary by product; but general immunity conditions include:

- Cables must be shielded, braid-type with metal-shelled connectors. Input terminal connections are to be made with shielded wire. The shield should be connected to the chassis ground with the hardware provided.
- The host computer must be properly grounded.
- In low-level analog applications, some inaccuracy is to be expected when I/O leads are exposed to RF fields or transients over 3 or 10 V/m as noted on the Declaration of Conformity.

CE Enhancements for DBKs

The following CE enhancements are detailed in the *DBK Cards and Modules User's Manual* (p/n 457-0905).

- DBK41/CE
- Edge Guard (for DBK5, DBK8, and DBK44)
- Applicable cables and connectors

CE Compliance for System Expansion

The Daq devices are CE compliant at the time they leave the factory, and will remain in compliance providing that the conditions stated on their respective *Declaration of Conformity* cards continue to be met.

You may want to expand your data acquisition system while having it retain its "CE Compliant" status. If so, refer to the most recent *Declaration of Conformity* for each device, prior to making any efforts to expand the system.

Connecting a *non-CE Compliant* DBK module or card to your system will make the system non-compliant.

In order to remain CE Compliant, DaqLab/2000 Series and DaqScan/2000 Series devices require the use of ferrite inductive collars and a ground line, which are included in an Ethernet CE Kit. Installation instructions for the kit follow this chapter.

General rules of thumb regarding expansion, while remaining CE Compliant, are:

- Review the most recent *Declaration of Conformity* for each device.
- Use short cables.
- When possible, use shielded cables.
- When assembling or disassembling components, take ESD precautions, including the use of grounded wrist straps.
- Ensure that the host computer is CE Compliant.
- Ensure that expansion devices are CE Compliant
- Ensure all system components are properly grounded.

Noise Considerations

Controlling electrical noise is imperative because it can present problems even with the best measurement equipment. Most laboratory and industrial environments suffer from multiple sources of electrical noise. For example, AC power lines, heavy equipment (particularly if turned on and off frequently), local radio stations, and electronic equipment can create noise in a multitude of frequency ranges.

Local radio stations are a source of high frequency noise, while computers and other electronic equipment can create noise in all frequency ranges. Creating a completely noise-free environment for test and measurement is seldom practical. Fortunately, simple techniques such as using shielded/twisted pair wires, filtering, and differential voltage measurement are available for controlling the noise in our measurements. Some techniques prevent noise from entering the system; other techniques remove noise from the signal.

While many techniques for controlling noise in signals provide a means of removing the noise that is already present, the preferred solution is to prevent the occurrence of noise in the signal in the first place.

The following practices, some of which are required for CE compliance, should be employed to minimize noise.

- **Make a solid earth ground connection**. *Required for CE Compliance*. Ensure that the chassis of the primary data acquisition device, e.g., DaqLab/2001 is connected to earth ground. This practice: (a) keeps radiated emissions low by keeping the chassis electrically quiet, (b) keeps potential common-mode voltages low, (c) improves user safety, and (d) provides a safe path for Electrostatic Discharge energy back to earth ground. Use a shielded Ethernet cable, e.g., CA-242, to connect the DaqLab or DaqScan chassis to the host computer's chassis.

- **Use short Ethernet cables**. The use of short Ethernet cables will reduce noise. The shorter the cable the better.

- **Use shielded cables**. Loose wires are effective antennae for radio frequency pickup and can form loops for inductive pickup. The use of properly connected shields will greatly reduce such noise.

- **Minimize ambient EMI**. The lower the ambient EMI, the better. Sources of electromagnetic interference include solenoids, motors, computer equipment, high power distribution wiring, etc.

- **Distance cables**. Power supply switch transients can vary in strength and frequency. Ethernet cables can radiate digital switching noise. For these reasons route the power supply and Ethernet cables such that they are as far as possible from all analog lines. The analog lines include those that connect to P1 on the front panel, as well as those that connect to the rear panel via an expansion port, or through the P4 connector.

- **Use ferrite inductive collars**. A clamp-on ferrite collar can be secured at each end of the Ethernet cable and at both ends of the power supply cable. The collars on the Ethernet cable will reduce digital switching noise. Note that the collars will not reduce the integrity of the Ethernet channel if the system is making use of shielded Ethernet cables, part number CA-242. Ferrite collars on the power cable will reduce the effects of power transients.

This partial view of the host PC shows the Ethernet cable with a ferrite collar. The PC's connection to the ground-line is also visible.

This partial view of the data acquisition device shows its connection to the ground-line. It also shows two ferrite collars, the foremost of which is clamped to the power cable. The background collar is clamped onto the Ethernet cable.

Taking Measurements 8

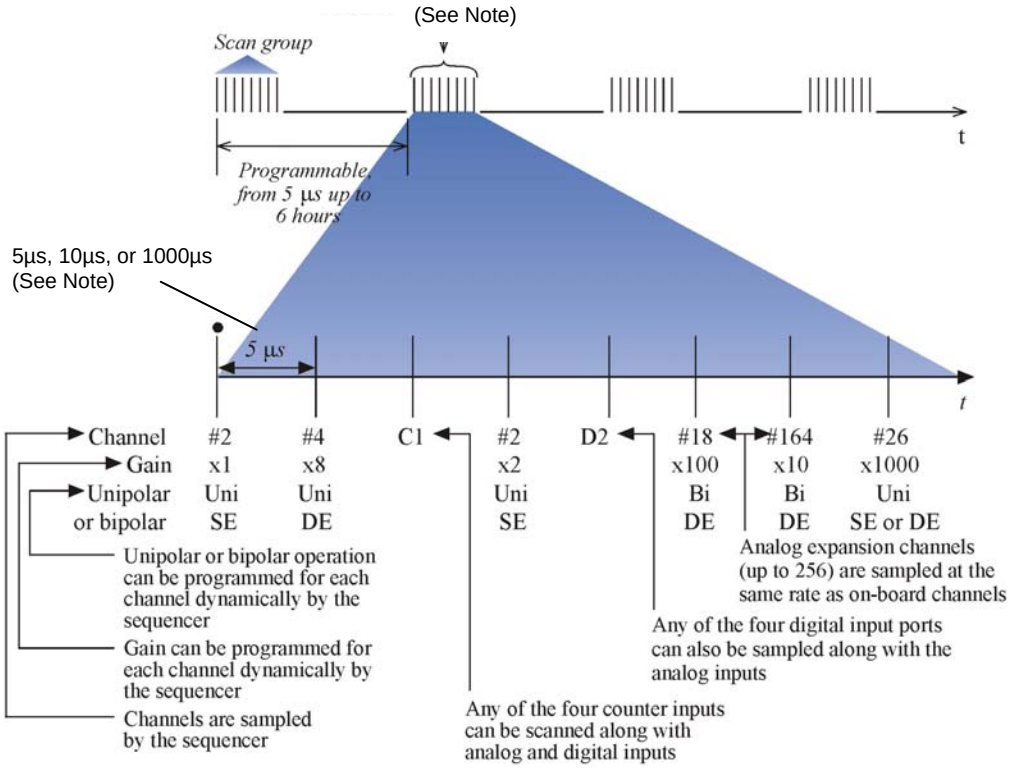
Introduction

With signal lines connected and a system up and running you can begin acquiring data. Specific connector details and pinouts are provided in chapter 4. You should refer to the software documentation applicable to your data acquisition system, for example, *DaqView*.

Scanning

DaqLab/2000 Series devices have an on-board scan sequencer that permits the user to select any combination of up to 16384 channel/range combinations. The sequencer scans all channels contained in the sequence at the rate of 5 µs/channel, 10 µs/channel, or 1000 µs/channel, depending on the speed of the DBK expansion options; thereby minimizing the time-skew from channel-to-channel. The user can also set the time between scan groups, from 0 to 6 hours. In addition to scanning analog inputs, the sequencer can scan digital inputs and counter inputs.

Digital and frequency inputs can be scanned using the same scan sequencer employed for analog inputs, enabling the time correlation of acquired digital data to acquired analog data.



Scanning Example

Note: All inputs can be measured at the 5 µs/channel rate. Some DBK expansion options require more settling time and can be measured at the slower rate of 10 µs/channel or 1000 µs/channel. All types of measurements can be mixed within the scan group.

Triggering

Triggering can be the most critical aspect of acquiring data. DaqLab/2000 Series devices support a full complement of trigger modes to accommodate a wide variety of applications.

Hardware Analog Triggering. Many data acquisition products claim analog triggering, but rely on the PC to take readings and make a decision, which leads to uncertain and potentially long latencies. DaqLab/2000 Series devices use true analog triggering, whereby the trigger level programmed by the user, sets an analog DAC, which is then compared in hardware to the analog input level on the selected channel. The result is analog trigger latency that is guaranteed to be less than 5 µs, significantly shorter than most data acquisition devices. Any analog channel can be selected as the trigger channel. The user can program both the trigger level, as well as the edge (rising or falling).

Digital Triggering (P1). A separate digital trigger input line is provided, allowing TTL-level triggering, again with latencies guaranteed to be less than 5 µs. Both the logic levels (1 or 0), as well as the edge (rising or falling), can be programmed for the discrete digital trigger input. The digital trigger input is labeled TTLTRG.

Digital Pattern Triggering (P2 and P3 [if available]**)**. The devices support digital pattern triggering, whereby the user can designate any of the digital input ports as the trigger port. The programmed digital pattern, including the ability to mask or ignore specific bits, is then compared to the actual input until a match is detected, after which the sequencer begins the scan sequence.

Counter Triggering. Triggering can be programmed to occur when one of the counters reaches, exceeds, or is within a programmed level. Any of the built-in counter/totalizer - channels can be programmed as a trigger source.

Software-Based Triggering. Software-based triggering differs from the modes described above because the readings [analog, digital, or counter] are interrogated by the PC to detect the trigger event, not in the hardware as described above. The advantage of this mode is to permit triggering based on more complex situations, such as on a specific temperature, which was derived from the acquisition of at least two analog measurements, plus the calculation of the measured temperature using linearization algorithms.

Normally software-based triggering results in long latencies from the time that a trigger condition is detected, until the actual capturing of data commences. However, circuitry circumvents this undesirable phenomenon by use of pre-trigger data. Specifically, when software-based triggering is employed, and the PC detects that a trigger condition has occurred, (which may be thousands of readings later than the actual occurrence of the signal), the Daq driver automatically looks back to the location in memory where the actual trigger-causing measurement occurred. The acquired data that is presented to the user actually begins at that point. The latency in this mode is equal to one scan cycle.

Pre- and Post-Triggering Modes. Six modes of pre- and post-triggering are supported, providing a wide variety of options to accommodate any measurement requirement. When using pre-trigger, the user must use software-based triggering to initiate an acquisition.

- ***No pre-trigger, post-trigger stop event.*** This, the simplest of modes, acquires data upon receipt of the trigger, and stops acquiring upon receipt of the stop-trigger event.
- ***Fixed pre-trigger with post-trigger stop event.*** In this mode, the user specifies the number of pre-trigger readings to be acquired, after which, acquisition continues until a stop-trigger event occurs.
- ***No pre-trigger, infinite post-trigger.*** No pre-trigger data is acquired in this mode. Instead, data is acquired beginning with the trigger event, and is terminated when the operator issues a command to halt the acquisition.
- ***Fixed pre-trigger with infinite post-trigger***. The user specifies the amount of pre-trigger data to acquire, after which the system continues to acquire data until the program issues a command to halt acquisition.
- ***Variable pre-trigger with post trigger stop event*** (driver support only). Unlike the previous pre-trigger modes, this mode does not have to satisfy the pre-trigger number of readings before recognizing the trigger event. Thus the number of pre-trigger readings acquired is variable and dependent on the time of the trigger event relative to the start. In this mode, data continues to be acquired until the stop trigger event is detected.
- ***Variable pre-trigger with infinite post trigger*** (driver support only). This is similar to the mode just described, except that the acquisition is terminated upon receipt of a command from the program.
- ***Stop Trigger***. Any of the software trigger modes described above can be used to stop an acquisition. Thus an acquisition can be programmed to begin on one event, such as a temperature level, and then stopped on another, such as a digital pattern event.

Synchronous I/O Operations

Synchronous Input Operations

The DaqLab/2000 Series devices allow synchronous scanning and acquisition of Analog Input, Digital Input and Counter Input Data at up to 200 kHz aggregate scanning rates. The Analog Input data can be either main unit or expansion modules from P1 compatible analog input modules. The Digital Input data can be main unit 8-bit P2 (8255) digital input or P2 compatible DBK digital input expansion modules. The digital and analog inputs [via the front panel screw terminals] also apply.

Analog Input Channels

P1 – Channels 0 through 15

The DaqLab/2000 Series devices allow analog input configuration of themselves, as well as for any connected P1 compatible DBK analog input expansion modules.

Channel Selection and Mode Settings

The DaqLab/2000 Series devices accept up to 8 single-ended inputs via front panel screw terminal connections. The unit's P1 connector allows for expansion of up to 128 high-speed channels, or 448 TC channels. In regard to system expansion, refer to the *DBK Option Cards & Modules User's Manual* (p/n 457-0905).

Channel Range and Polarity

DaqLab/2000 Series channels can be programmed for gain settings of 1, 2, 4, 8, 16, 32 and 64.

Channel Sampling Interval

DaqLab/2000 Series devices allow for programmable sampling intervals of 5 us, 10 us, or 1000 us on a per channel basis. This mode allows some DBK expansion channels [that change slowly for a higher degree of accuracy] to be sampled at a longer interval; and channels that change more rapidly to be sampled using a shorter interval. Each 5 µs, 10 µs, or 1000 µs interval reduces the maximum aggregate acquisition rate for the entire scan by that amount.

Digital I/O Channels

There are 30 Digital I/O channels available to DaqLab/2000 Series devices. The channels are grouped as follows:

8 Channels, A0 through **A7** from P2 Port A
8 Channels, B0 through **B7** from P2 Port B
8 Channels, C0 through **C7** from P2 Port C
6 Channels, Digital 0 through **Digital 5** from front panel screw terminals

The devices allow for either synchronous scanning of digital input channels or asynchronous I/O operations for all configured digital channels.

Counter Input Channels

Counter 0, 1, 2, 3 (CTR0, CTR1, CTR2, CTR3)

DaqLab/2000 Series devices allow synchronous scanning of four16-bit counter input channels. The 4 channels can be cascaded into two 32-bit counter channels. For either cascaded or non-cascaded counter channels each channel can be configured for:

- ***Pulse Counting Mode*** – specifies that each counter should be cleared upon being read and placed into the input scan.
- ***Totalize Counting Mode*** – specifies that each counter is to free-run and not be cleared during the input acquisition.

Synchronous Input Acquisition Clocking

A / I Clock

DaqLab/2000 Series devices allow clocking of the synchronized inputs either by an internal, programmable pacer clock or by external clocking. These products use a sequencer to implement a multiplexing approach to gathering the input data. This means that with either internal or external clocking the entire channel scan (including the sampling time for each channel) may not exceed the maximum aggregate rate of 200 kHz.

Synchronous Output Operations (DaqLab/2001 only)

DaqLab/2001 allows synchronous output of any D/A channels available at up to 100 kHz for each channel. All D/A channels may have output clocked out synchronously.

Output Channel Configuration

***Analog Output Channels** (DaqLab/2001 only)*

Each of DaqLab/2001's four D/A channels can be configured for waveform output individually. If the D/A channel is not configured for waveform output it then is available for asynchronous output operations.

Synchronous Output Clocking (DaqLab/2001 only)

A / O Clock

DaqLab/2001 allows clocking of the synchronized output by the acquisition clock source, an internal, programmable pacer clock or by an external clock source. When the clock source generates a new clock signal all outputs are updated concurrently. Regardless of the clock source, the clock may not exceed the maximum update rate of 100 kHz.

Synchronous Output Data Source (DaqLab/2001 only)

DaqLab/2001 allows the data source for synchronized DAC output operations to be that of an internal memory-based buffer. The output data, for all channels, is contained in the buffer.

Asynchronous I/O Operations

Each DaqLab/2000 Series device allows asynchronous input of any counter or digital channel that is not currently configured for synchronous acquisition. The circuitry allows for asynchronous output to any D/A channels that are not currently configured for waveform output. Likewise, the digital port can be used for both asynchronous input and output operations. In addition, the timer outputs can be programmed at any time regardless of the current state of synchronous or asynchronous operations on other channels.

Digital I/O Channels

Local 8255 Channels (P2: Port A, Port B, Port C)
The devices have an implemented Intel 8255 core in the digital I/O logic on the P2 port. With the Intel 8255 there are three 8-bit wide ports available for I/O and one 8-bit wide port for configuration purposes. The configuration port is used to configure the other three 8-bit ports for either input or output operations.

Local 6-bit (Digital 0 through Digital 5)
The 6-bit digital port [via screw terminal on the front panel can be used as either an input or output port. With this port, no configuration is required. The port simply outputs when written to and inputs when read.

Expansion Digital I/O
The devices have the ability to expand their digital I/O capabilities via the P2 port and the connection of applicable digital I/O expansion modules. These modules are discussed in the *DBK Option Cards & Modules User's Manual* (p/n 457-0905). When using the digital I/O expansion modules the local P2 Intel 8255 digital I/O becomes inaccessible in lieu of the expansion modules. These expansion modules provide additional Intel 8255 ports as well as input isolation for applications that require the expanded capabilities.

Pulse Stream Output Using Timers (Timer0, Timer1)

Each device allows for the generation of output pulses based upon a programmable setting. These output timers can be set at any time regardless of the state of any synchronous or asynchronous operations which are currently taking place on other channels.

The timer outputs are through screw terminals on the front panel.

Analog Output Channels (DaqLab/2001 only)

DaqLab/2001 can output analog data to any of the four D/A channels. Each D/A channel may be asynchronously updated by an application if the D/A channel is not currently being used for waveform output operations. The four analog outputs are via screw terminal connectors on the front panel.

Counter Input Channels (CTR0, CTR1, CTR2, CTR3)

DaqLab/2000 Series devices have counter input capabilities and have the ability to read counter input providing that the counter channel is not configured for synchronous acquisition. As in the case of synchronous operations the four 16-bit counter input channels can be used individually or cascaded into two 32-bit counter channels. For either cascaded or non-cascaded counter channels each channel can be configured for:

- ***Clear on Read Mode*** - specifies that each counter should be cleared (reset to 0) upon being read.
- ***Continuous Totalize Mode*** – specifies that each counter is to *free-run* and not be cleared during the read operation.

Using DBK Cards and Modules for Signal Conditioning

The DBK signal-conditioning cards and module are designed for use with DaqLabs, DaqScans, DaqBooks, LogBooks, and various types of data acquisition boards, i.e., ISA, PCI, and compact-PCI types. The DBKs perform best when used with an acquisition device that can dynamically select channel, gain, and range. DBK cards and modules with dynamic channel and gain/range selection allow for high channel-to-channel scan rates with a variety of transducers.

Note: Only *passive* DBKs, such as the DBK1 BNC module, the DBK11A screw terminal card, and the DBK40 BNC analog interface, can be used with Daq PC-Cards.

DBK output signals can be bipolar, e.g., -5 to +5 V, or unipolar, e.g., 0 to 10 V. The user can select a range of relevant values to correspond to the lowest signal (e.g., -5 or 0 V) and the highest signal (e.g., 5 or 10 V) signal. This type of range selection guarantees the highest resolution in 12-bit or 16-bit conversion.

DBK modules share the same footprint as most Daq devices and approximate the footprints of many notebook PCs. The footprint factor allows for convenient stacking. The majority of these modules have their own power supply; however, several options exist for packaging and powering the DBKs.

An important note about avoiding signal conflict between expansion cards or modules and the DaqLab/2000 Series' third terminal block:

The third terminal block is for Analog Input (ANALOG IN). It consists of 4 analog grounds and 8 analog input channels. **The 8 channel screw terminals on block 3 are the same signal connections as found on P1, pins 30 through 37**. For this reason, the following CAUTION applies:

CAUTION

Avoid contention between the front panel analog input channels and the rear panel expansion channels. All DBK expansion cards and modules must have their channel address set to 8, 9, 10, 11, 12, 13, 14, or 15. Otherwise the expansion card or module will be in contention with one of the front panel analog input channels. Such conflict may cause equipment damage!

Reference Note:
DBK options are detailed in the *DBK Option Cards and Modules User's Manual* (p/n 457-0905). As a part of product support, the manual is automatically loaded onto your hard drive during software installation. The default location is the Programs group, which can be accessed through the Windows Desktop. A PDF version of the document can be read directly from the data acquisition CD via the introduction screen's <View PDFs> button.

Calibration 9

Overview

The DaqLab/2000 Series devices are digitally calibrated at the factory. The digital method involves storing a correction factor on the circuit board for each range at the time of calibration. Whenever a particular range is selected, the appropriate calibration constant is automatically applied to a compensating DAC, thereby calibrating the specific range. The result is that readings generated by the A/D are already calibrated, and do not require additional processing.

This is significantly better than the calibration method in which readings are adjusted in software after they are transferred to the host PC. That method reduces the dynamic range of the A/D, and can adversely affect the speed at which the PC obtains a calibrated reading.

DaqLab/2000 Series devices include a user-cal mode, whereby the user can adjust the calibration of the unit's board, without destroying the supplied factory calibration. This is accomplished with two distinct calibration tables in the unit's on-board EPROM, one which contains the factory calibration factors, and the other which is available for user calibration.

Using DaqCal.exe

When calibration adjustments are needed they should be completed in the following order:

1. PGA Input and Output Offset
2. Sample/Hold Offset
3. A/D Offset and Gain
4. VDC Voltage Reference
5. DAC0 Full-Scale[1]
6. DAC1 Full-Scale[1]
7. DAC2 Full-Scale[1]
8. DAC3 Full-Scale[1]

[1]DAC Full-Scale only applies to DaqLab/2001.

A Windows-based program, DaqCal.exe, is used to calibrate Daq systems, including analog expansion cards. DaqCal.exe is used in conjunction with:

- a 4.5 digit, digital multi-meter
- an adjustable voltage calibrator
- an ambient temperature meter

To use the calibration program:

1. Launch **DaqCal**.

   Note: DaqCal is installed automatically from your data acquisition CD as a part of product support. This takes place during software installation. DaqCal's default location is the **IOtech DaqX Software** folder, in the **Programs** group.

2. When DaqCal opens you will be prompted to select your device from a list. After doing so, simply follow the illustrated on-screen instructions.


Notes

Troubleshooting and Customer Support 10

Electrostatic Discharge (ESD), Handling Notice

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. Such guidelines include the use of properly grounded mats and wrist straps, ESD bags and cartons, and related procedures.

Product Care

Daq products and DBK options are essentially maintenance free and require a minimal amount of care. They should be treated much like any other high-tech equipment. In general:

- Keep them clear of harsh chemicals and abrasive elements.
- Avoid exposing the products to extreme heat, for example, avoid setting up a Daq system near a boiler or furnace.
- Avoid extreme shock and vibration.
- Avoid subjecting the units to liquids and extremely fine air particulate, such as silica dust.
- Never touch circuit boards without proper ESD (Electrostatic Discharge) measures in place.

A “common-sense” approach to handling your data acquisition equipment will go a long way in protecting it from inadvertent damage.

Note that you can use lint-free rags and Isopropyl Alcohol (Rubbing Alcohol) to clean the outer plate surfaces of Daq devices and optional DBK modules.

ReadMe Files and the Install CD-ROM

The Install CD-ROM includes ReadMe Files. These files often contain late-breaking information that may not appear in the user documentation. During installation you should review the ReadMe files when prompted to by the program.

The Install CD-ROM includes:

- DaqBook/2000 Series[1] Windows NT/2000/XP driver
- **DaqX.DLL** (32-bit API)
- Microsoft C/C++ API support
- Microsoft VB API support
- Daq Configuration Control Panel Applet
- User documentation in Adobe® PDF format
- DaqView

Upon installation, the user needs to run the *Daq Configuration* Control Panel applet. The applet is used to configure the Daq device for an appropriate Ethernet Port. This must be performed in order for the application to access the device through the Windows NT/2000/XP driver.

[1] DaqBook/2000 Series drivers also apply to DaqLab/2000 Series devices.

Driver Support

The daqX API can be used with WaveBook, DaqBook, DaqBoard, DaqLab, DaqScan, Daq PC Card and TempBook product lines. All daqX functions share the **daq** prefix.

The API support examples can be found in the installed directory:
<Install> ProgrammingLanguageSupport\DAQ

Refer to the *Programmer's Manual*, p/n 1008-0901.

DaqCOM Issues

DaqCOM support is contained within the Help file support, which is installed with DaqCOM. It is located within the DaqCOM program group.

DaqCOM support will not be available unless it has been specifically installed with the product. If the DaqCOM program group is not listed under programs (which can be accessed via the Windows desktop), then you will need to install it from the data acquisition CD, or download it from our website.

Ethernet Problems

- Make sure the Ethernet network is not experiencing technical problems. Check with your Network Administrator.
- Ensure that your system is properly configured in the Daq Configuration Applet [located in the Windows' Control Panel]. If a device is not configured correctly it will not be accessible from an application.
- Verify that the correct MAC (Media Access Control) number is reflected by the software.
- If communications cannot be established with the Daq device or, if trying to connect causes the system to hang or crash, try the following:
    - Verify that the device power switch is set to ON and that the POWER ON indicator is lit.
    - Ensure that all physical device interface connections are correct. This includes Ethernet connections from the Daq device to the host PC's Ethernet jack, or Ethernet Network hub.
    - Run the *Daq Configuration* applet from the Windows Control Panel. Make sure the device is configured to the appropriate Ethernet port with the appropriate protocol. Run the device test and if it fails try other protocols for the device. Be sure to click on **<Apply>** to apply the settings, before re-running the test.
- If problems persist, notify your Network Administrator. If he or she can't solve the problem, contact the factory.

Frequently Asked Questions

(1) Topic: Environmental Factors

Question: What environments are the products intended for?

Answer: Refer to the product specifications in regard to operating and storage temperature ranges, and relative humidity. Note that system components are not intended to be exposed to harsh environments and should always be protected from snow, rain, extreme dust, and harsh sun.

(2) Topic: DaqX

Question: What is DaqX software?

Answer: DaqX software is low-level software support for application development. DaqX is installed during the installation of the DaqView application. DaqX supports Visual C++ and Visual Basic programming environments.

Question: Where can I get the latest version of DaqX software?

Answer: You can download the latest versions from our website. This service is free.

(3) Topic: Calibration

Question: Should I calibrate my Daq device when I receive it?

Answer: No, because each Daq-related product is factory-calibrated to its rated accuracy before it leaves the factory.

Question: When is calibration required?

Answer: Depending on your operating guidelines, your equipment will require periodic calibration to ensure the original accuracy is maintained. We recommend that you have your DaqLab system calibrated at least once a year.

(4) Topic: Computers for Data Acquisition

Question: What type of computer do you recommend for use with data acquisition devices such as the DaqLab/2001 or DaqLab/2005?

Answer: The PC should have built in Ethernet capabilities and use an operating system of Windows NT, 2000, XP, or later.

Customer Support

If you want to Expand or Enhance Your Daq System . . .

You can visit our internet site at **http//:www.iotech.com** to find the latest accessories, expansion cards and modules. You can also call our sales department directly at (440) 439-4091.

If you need to Report Problems or Request Product Support

Note: **Please do not return any equipment to the factory unless it has an RMA number (Return Merchandise Authorization number). RMA numbers are issued by the factory.**

To report problems or request support, contact our applications department or your service representative. Contact information follows shortly. When you contact us, please have the following information available, as applicable:

- Hardware model numbers and software version numbers.
- Operating system, type of computer, and device information in the Windows control panel, such as interrupts and address settings for our hardware and others.
- Results of tests, such as the Daq Configuration control panel.
- Hardware setup and software configuration.
- Information on input signals, including voltage ranges, signal impedance ranges, noise content, and common mode voltages.
- The name of a contact person from your company who can discuss the problems encountered.
- Instructions for return shipping.
- All troubleshooting notes and comments on tests performed, and all problem-related conditions.
- If your problem is Ethernet related, discuss the problem with your Network Administrator prior to contacting the factory. Please provide us with your administrator's comments, if applicable.

Note: Before calling for assistance, take a few minutes to read all parts of the manual that may be relevant to the problem. Also, please review the troubleshooting material.

You can reach IOtech by one of the following means:

Phone: **(440) 439-4091** Ask for the Applications Department.

Fax: **(440) 439-4093**

E-mail (Product Information/Sales): **sales@iotech.com**

E-mail (Technical Support): **productsupport@iotech.com**

Internet: **http//:www.iotech.com**

Mail: **IOtech, Inc. ● 25971 Cannon Road ● Cleveland, Ohio 44146-1833**

All equipment returned to the manufacturer must have an RMA (Return Material Authorization) number. You can obtain an RMA number by calling the Applications Department. When returning the equipment, use the original shipping container (or equivalent) to prevent damage. Put the RMA number on your shipping label to ensure that your shipment will be handled properly. After receiving your equipment, we will fax a confirmation form that summarizes the charges (if applicable) and expected return date.


Notes

DaqLab/2001 and DaqLab/2005

General

Supply Voltage Range: 90 to 250 VAC

Power Required: 15W, assuming no DBK options
Power Available for External Signal Conditioning & Expansion Options:
5V at 1A, ±15V at 500 mA, not to exceed 10W
Operating Temperature: 0°C to + 50°C (32°F to 122°F)
Storage Temperature: -40°C to +80°C (-40° to 176°F)
Relative Humidity: 0 to 95% non-condensing
Vibration: MIL STD 810E, Categories 1 and 10

Signal I/O Connectors:
DB37 connectors: P1, P2 on rear panel
removable screw-terminal blocks (3 sets of 12 terminals) on front panel

Dimensions: 285 mm W x 220 mm D x 90 mm H (11" x 8.5" x 3.5")

Weight: 2.3 kg (5 lbs.)

A/D Specifications

Type: Successive approximation

Resolution: 16 bit

Conversion Time: 5 µs

Maximum Sample Rate: 200 kHz

Nonlinearity (Integral): ±1 LSB

Nonlinearity (Differential): ± 2 LSB

Missing Codes: None, over full operating temperature range

Analog Inputs

Channels:

8 single-ended analog inputs, via front panel screw terminals
Up to 128 high-speed channels, or 448 TC channels with system expansion via rear panel P1

Connectors:
screw-terminals (ANALOG IN: 0, 1, 2, 3, 4, 5, 6, 7) front panel removable block
37-pin DSUB (P1) on rear panel for analog expansion

Bandwidth: 500 kHz

Settling Time: 5 µs maximum to 1 LSB for full-scale step

Temperature Coefficient: ±(10ppm +0.3 LSB)/°C outside the range of 0° to 35°C

Input Impedance: 10 MΩ for single-ended; 20 MΩ for differential

Bias Current: <1nA at 0° to 35°C

Common Mode Rejection: 86 dB, DC to 60 Hz for gains $\leq$ 8; >100 dB for gains $\geq$16

Maximum Input Voltage: +11V relative to analog common

Over-Voltage Protection: ±35V

Crosstalk: -100 dB DC to 60 Hz; -86 dB @ 10 kHz

Ranges: Software programmable via sequencer on a per-channel basis.

Voltage Range (Note 1)	Accuracy (Note 2) One Year, 0 to 35°C ±(% reading + % range)	Input Noise (Note 3) (LSB rms) 10 Hz to 200 kHz
	Absolute	Typical
0 to +10 V	0.015 + 0.005	1
0 to +5 V	0.015 + 0.005	1
0 to +2.5 V	0.015 + 0.005	1
0 to +1.25 V	0.015 + 0.008	2
0 to +0.625 V	0.015 + 0.008	2
0 to +0.3125 V	0.015 + 0.008	2
-10 to +10 V	0.015 + 0.005	1
-5 to +5 V	0.015 + 0.005	1
-2.5 to +2.5 V	0.015 + 0.005	1
-1.25 to +1.25 V	0.015 + 0.005	2
-0.625 to +0.625 V	0.015 + 0.008	2
-0.3125 to +0.3125 V	0.015 + 0.008	3
-0.156 to +0.156 V	0.020 + 0.008	3

Notes:

1) Specifications assume differential input single channel scan, 200 kHz scan rate, unfiltered.
2) Accuracy specification is exclusive of noise. Measurements were taken at P1.
3) Inputs shorted to Signal Ground (SGND). 8192 samples.

Input Sequencer

Analog, digital and counter inputs can be scanned synchronously based either on an internal programmable timer, or an external clock source. Analog and digital outputs can be synchronized to either of these clocks.

Scan Clock Sources: 2

- Internal, programmable from 5 μs to 5.96 hours maximum in 1 μs steps
- External, TTL level input up to 200 kHz maximum; available on front panel terminal block

Programmable parameters per scan: channel (random order), gain, unipolar or bipolar

Depth: 16,384 locations

On-board Channel to channel scan rate: 5 or 10 μs per channel, programmable

Expansion Channel Scan Rate: 5 or 10 μs per channel, programmable; 1 ms with DBK90 or DBK100

External Acquisition Scan Clock Input

Maximum Rate: 200 kHz

Clock Signal Range: 0V to +5V

Minimum Pulse Width: 50 ns high, 50 ns low

Triggering

Trigger Sources: 6, individually selectable for starting and stopping an acquisition. Stop acquisition can occur on a different channel than start acquisition; stop acquisition can be triggered via modes 2, 4, 5, or 6 described below. Pre-trigger is supported with fixed or variable pre-trigger periods.

1. Single-Channel Analog Hardware Trigger.
Any analog input channel, including any of the analog expansion channels, can be software programmed as the analog trigger channel.

Input Signal Range: -10V to +10V max
Trigger Level: Programmable, 11-bit resolution
Hysteresis: Programmable, 11-bit resolution
Latency: 5 µs max

2. Single-Channel Analog Software Trigger.
Any analog input channel, including any of the analog expansion channels, can be selected as the software trigger channel. If the trigger channel involves a calculation, such as with temperature, then the driver automatically compensates for the delay required to calculate the reading, resulting in a maximum latency of one scan period.

Input Signal Range: Anywhere within the range of the selected trigger channel
Trigger Level: Programmable, 16-bit resolution, including "window triggering"
Hysteresis: Programmable, 16-bit resolution
Latency: One scan period max.

3. Single-Channel Digital Trigger: A separate digital input is provided for digital triggering.

Input Signal Range: -15V to +15V max.
Trigger Level: TTL
Minimum Pulse Width: 50 ns high, 50 ns low
Latency: 5 µs max.

4. Digital Pattern Triggering: 8 or 16-bit pattern triggering on any digital input. Programmable for trigger on equal, above, below, or within or outside of a window. Individual bits can be masked for "don't care" condition.

Latency: One scan period maximum.

5. Counter/Totalizer Triggering: Counter/totalizer inputs can trigger an acquisition. User can select to trigger on a frequency or on total counts that are equal, above, below, or within/outside of a window.

Latency: One scan period maximum.

6. Software Triggering: Trigger can be initiated under program control.

Analog Outputs (DaqLab/2001 only)

For DaqLab/2001 only, 4 analog output channels are updated synchronously relative to scanned inputs, and clocked from either an internal onboard clock, or an external clock source. Analog outputs can also be updated asynchronously, independent of any other scanning in the system.

Channels: 4 DAC channels; numbered 0, 1, 2, and 3

Connectors: screw terminals (ANALOG OUT: 0, 1, 2, 3) on front panel removable block

Resolution: 16 bits

Data Buffer: 256 Ksample

Output voltage range: ±10 V

Output current: ±10 mA

Offset error: ±0.0045 V maximum

Gain error: ±0.01%

Digital Feedthru: 50 mV when updated

Update rate: 100 kHz maximum, 1.5 Hz minimum (no minimum with external clock)

Settling Time: 10 µs maximum to 1 LSB for full-scale step

Clock Sources: 4 programmable

1. Onboard D/A clock, independent of scanning input clock
2. Onboard scanning input clock
3. External D/A input clock, independent of external scanning input clock; available via screw-terminal on front panel removable block
4. External scanning input clock; available via screw-terminal on front panel removable block

Digital I/O

Channels: 30

Input Scanning Modes: 2 programmable

1. Asynchronous, under program control at any time relative to input scanning
2. Synchronous with input scanning

Ports: 3 x 8-bit (82C55 emulation), and 1 x 6-bit. Programmable as input or output.

Connectors:

37-pin DSUB (P2) on rear panel: for three 8-bit ports (24-bits)
screw-terminals (DIGITAL I/O: 0, 1, 2, 3, 4, 5) on front panel removable block: for 6-bit port

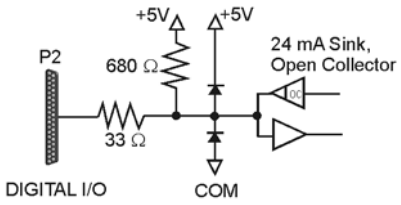
Input Characteristics: See following Digital I/O figures

Input protection: ±8 kV ESD clamp diodes parallel

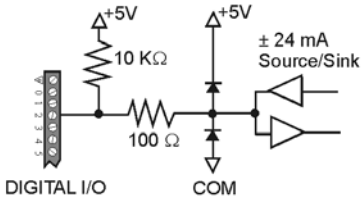
I/O levels: TTL

Sampling Rate: 200 kHz maximum

Output Characteristics: See following Digital I/O figures



Typical of 24 Digital I/O Signals via P2



Typical of 6 Digital I/O Signals via Terminal Block

Frequency/Pulse Counters

Counter inputs can be scanned synchronously along with analog and digital scanned inputs, based either on internal programmable timer, or an external clock source. Counters can be configured to clear when read, or to totalize and clear under program control.

Channels: 4 x 16-bit, cascadable as 2 x 32-bit

Frequency Measurement Rate: 10 MHz maximum

Connectors: screw terminals (COUNTER IN: 0, 1, 2, 3) on front panel removable block

Input Signal Range: -15 V to +15 V

Trigger Level: TTL

Input Characteristics: 2.7 kΩ series in parallel with 20 pF to common and 10 kΩ to +5 V

Input protection: ±8 kV ESD clamp diodes parallel

Minimum pulse width: 50 ns high, 50 ns low

Timer Outputs

Channels: 2 x 16-bit

Connectors: screw terminals (TMR OUT) on front panel removable block

Output Waveform: Square wave

Output rate: 1 MHz base rate divided by 1 to 65535 (programmable)

High level output voltage: 2.0 V minimum @ -3.75 mA, 3.0 V minimum @ -2.5 mA

Low level output voltage: 0.4 V maximum @ 2.5 mA

Accessories and Cables

Cables for use with DaqLab/2000 Series Devices		
	Description	**Part No.**
1.	Molded expansion cable, 2 in.	CA-255-2T
2.	Molded expansion cable, 4 in.	CA-255-4T
3.	DBK expansion cable, not-molded, 2.5 in.	CA-37-1T
4.	DBK expansion cable, not-molded, 4.5 in.	CA-37-3T
5.	Expansion-card cable. Connects DBK series expansion card options. The "x" in the part no. indicates the number of cards that can be connected via the cable.	CA-37-x
6.	Ethernet patch cable, shielded, 18 in.	CA-242
7.	Ethernet patch cable, shielded, 7 ft.	CA-242-7

Manuals

Manual Set (Set #1125-0900). This is a hardcopy set of manuals that is available for purchase. The set includes the following three manuals:

DaqLab/2000 Series User's Manual (p/n 1125-0901)

Programmer's Manual for developing custom programs using API commands. (p/n 1008-0901)

DBK Option Cards & Modules User's Manual. (p/n 457-0905)

Software

DaqViewXL for seamless execution of DaqView from within Microsoft Excel's tool palette.

DASYLab icon-based data acquisition graphics, control, and analysis software.

eZ-TimeView post-acquisition time-domain analysis software

eZ-FrequencyView post-acquisition frequency domain analysis software

Glossary

Acquisition — A collection of scans acquired at a specified rate as controlled by the sequencer.

Analog — A signal of varying voltage or current that communicates data.

Analog-to-Digital Converter (ADC) — A circuit or device that converts analog values into digital values, such as binary bits, for use in digital computer processing.

API — Application Program Interface. The interface program within the Daq system's driver that includes function calls specific to Daq hardware and can be used with user-written programs (several languages supported).

Bipolar — A range of analog signals with positive and negative values (e.g., -5 to +5 V); see *unipolar*.

Buffer — *Buffer* refers to a circuit or device that allows a signal to pass through it, while providing isolation, or another function, without altering the signal. *Buffer* usually refers to:

(a) A device or circuit that allows for the temporary storage of data during data transfers. Such storage can compensate for differences in data flow rates. In a FIFO (First In - First Out) buffer, the data that is stored first is also the first data to leave the buffer.

(b) A follower stage used to drive a number of gates without overloading the preceding stage.

(c) An amplifier which accepts high source impedance input and results in low source impedance output (effectively, an impedance buffer).

Buffer Amplifier — An amplifier used primarily to match two different impedance points, and isolate one stage from a succeeding stage in order to prevent an undesirable interaction between the two stages. (Also see, *Buffer*).

Channel — In reference to Daq devices, *channel* simply refers to a single *input*, or *output* entity.

In a broader sense, an *input channel* is a signal path between the transducer at the point of measurement and the data acquisition system. A channel can go through various stages (buffers, multiplexers, or signal conditioning amplifiers and filters). Input channels are periodically sampled for readings.

An *output channel* from a device can be digital or analog. Outputs can vary in a programmed way in response to an input channel signal.

Common mode — Common mode pertains to signals that are identical in amplitude and duration; also can be used in reference to signal components.

Common mode voltage — Common mode voltage refers to a voltage magnitude (referenced to a common point) that is shared by two or more signals. *Example*: referenced to common, Signal 1 is +5 VDC and Signal 2 is +6 VDC. The common mode voltage for the two signals is +5.5 VDC [(5 + 6)/2].

Crosstalk — An undesired transfer of signals between systems or system components. Crosstalk causes signal interference, more commonly referred to as *noise*.

Digital — A digital signal is one of discrete value, in contrast to a varying signal. Combinations of binary digits (0s and 1s) represent digital data.

Digital-to-Analog Converter (DAC) — A circuit or device that converts digital values (binary bits), into analog signals.

DIP switch — A DIP switch is a group of miniature switches in a small *Dual In-line Package* (DIP). Typically, users set these switches to configure their particular application.

Differential mode — The differential mode measures a voltage between 2 signal lines for a single channel. (Also see *single-ended mode*).

Differential mode voltage

Differential mode voltage refers to a voltage difference between two signals that are referenced to a common point. Example: Signal 1 is +5 VDC referenced to common. Signal 2 is +6 VDC referenced to common.

If the +5 VDC signal is used as the reference, the differential mode voltage is +1 VDC (+ 6 VDC - +5 VDC = +1 VDC).

If the +6 VDC signal is used as the reference, the differential mode voltage is -1 VDC (+ 5 VDC - +6 VDC = -1 VDC).

ESD

Electrostatic discharge (ESD) is the transfer of an electrostatic charge between bodies having different electrostatic potentials. This transfer occurs during direct contact of the bodies, or when induced by an electrostatic field. ESD energy can damage an integrated circuit (IC).

Excitation

Some transducers [e.g. strain gages, thermistors, and resistance temperature detectors (RTDs)] require a known voltage or current. Typically, the variation of this signal through the transducer corresponds to the condition measured.

Gain

The degree to which an input signal is amplified (or attenuated) to allow greater accuracy and resolution; can be expressed as ×n or ±dB.

Isolation

The arrangement or operation of a circuit so that signals from another circuit or device do not affect the *isolated* circuit.

In reference to Daq devices, *isolation* usually refers to a separation of the direct link between the signal source and the analog-to-digital converter (ADC). Isolation is necessary when measuring high common-mode voltage.

Linearization

Some transducers produce a voltage in linear proportion to the condition measured. Other transducers (e.g., thermocouples) have a nonlinear response. To convert nonlinear signals into accurate readings requires software to calibrate several points in the range used and then interpolate values between these points.

Multiplexer (MUX)

A device that collects signals from several inputs and outputs them on a single channel.

Sample (reading)

The value of a signal on a channel at an instant in time. When triggered, the ADC reads the channel and converts the sampled value into a 12- or 16-bit value.

Scan

A series of measurements across a pre-selected sequence of channels.

Sequencer

A programmable device that manages channels and channel-specific settings.

Simultaneous Sample-and-Hold

An operation that gathers samples from multiple channels at the same instant and holds these values until all are sequentially converted to digital values.

Single-ended mode

The single-ended mode measures a voltage between a signal line and a common reference that may be shared with other channels. (Also see *differential mode*).

Trigger

An event to start a scan or mark an instant during an acquisition. The event can be defined in various ways; e.g., a TTL signal, a specified voltage level in a monitored channel, a button manually or mechanically engaged, a software command, etc. Some applications may use pre- and post-triggers to gather data around an instant or based on signal counts.

TTL

Transistor-Transistor Logic (TTL) is a circuit in which a multiple-emitter transistor has replaced the multiple diode cluster (of the diode-transistor logic circuit); typically used to communicate logic signals at 5 V.

Unipolar

A range of analog signals that is always zero or positive (e.g., 0 to 10 V). Evaluating a signal in the right range (unipolar or bipolar) allows greater resolution by using the full-range of the corresponding digital value. See *bipolar.*