⊕ **User's Guide**

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12 and 16 Bit Resolution, ISA Data Acquisition Boards

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WARNING: These products are not designed for use in, and should not be used for, patient-connected applications.

<table>
<tr><td colspan="2" style="background:black; color:white; text-align:center;">CAUTION</td></tr>
<tr><td>⚠</td><td>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.</td></tr>
</table>

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** directory, 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.

PDF
OMB-457-0907

DaqBoard-ISA User's Manual

Contains an overview of Daq systems, setup and startup instructions for ISA-type DaqBoards, and details regarding the on-board DIP-switch and jumpers. The following PDFs are companion documents.

PDF
OMB-457-0909

DaqView and DaqViewXL

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

PDF

Post Acquisition Data Analysis User's Guide(s)

Contains at least one user's guide that pertains to a post acquisition-data analysis program. PostView, DIAdem, and eZ-View are examples of post data analysis programs.

PDF
OMB-457-0905

DBK Option Cards and Modules User's Manual

The DBK Option Cards and Modules Manual discusses each of the DBK products available at the time of print.

PDF
OMB-1008-0901

Programmer's Manual

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.

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.

Manual Layout

Chapter 1 – *Daq Systems, a Brief Overview* discusses the "modular concept" associated with DaqBooks, DaqBoards, and DBK options.

Chapter 2 – *Setup and Startup* provides instructions for configuring and installing ISA-type DaqBoards, product support software, and electronic versions of documentation..

Chapter 3 – *A Closer Look at DaqBoard-ISA Hardware* discusses the differences between DaqBoard-ISA models, performance factors, jumpers, and connections.

DBK Basics – discusses option cards and modules (DBKs) that can be used to enhance and expand data acquisition systems. Note that *DBK Basics* is not a chapter, but an independent document module that is applicable to this user's manual, as well as others.

Appendix A – *Specifications, ISA-Type DaqBoards*

Reference Notes:
During software installation, Adobe® PDF versions of user manuals are automatically installed onto your hard drive as a part of product support. The default location is in the **Programs** directory, which can be accessed from the Windows Desktop.

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 manuals can be ordered from the factory.

➤ *DaqView and DaqViewXL* – explains the use and features of the included *out-of-the-box* data acquisition software.

➤ *Post Acquisition Data Analysis User's Guide* – contains one or more document modules pertaining to a post-acquisition analysis program. Examples of such programs are PostView, DIAdem and eZ-View.

➤ For detailed information regarding specific DBKs, refer to the *DBK Option Cards and Modules User's Manual*, p/n OMB-457-0905. Each DBK section includes device-specific hardware and software information. The document includes a chapter on power management.

➤ For programming-related information refer to the separate *Programmer's Manual*, p/n OMB-1008-0901.

02-14-02 OMB-DaqBoard-ISA User's Manual

Table of Contents

Daq Systems, a Brief Overview 1

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 or DaqBoard. 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. Note the DaqBoards can be one of three types: (1) ISA, (2) PCI, or (3) compact PCI (cPCI). The DaqBoards covered in this document are of the ISA type.

- *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 a *DBK Basics* document module and in the detailed *DBK Option Cards and User's Manual* (p/n OMB-457-0905).

  Reference Note:
  DBK options are discussed in the *DBK Option Cards and Modules User's Manual* (p/n OMB-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++, VisualBASIC, Delphi.

  Reference Note:
  Programming topics are covered in the *Programmer's User Manual* (p/n OMB-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 and DaqBoards

Daq products connect to one or more DBKs on their signal input side and a computer on their output side. Each type of Daq device connects to the computer in a different way:

- The **DaqBook** is an external module that connects to a computer's enhanced parallel port (EPP) interface or PC-Card link.

- The **DaqBoard** [**ISA type**] board is an internal card that plugs into an ISA-bus slot within a computer.

Features common to the Daq products include:

- 100-kHz channel-to-channel scan *and* gain switching (10 µs);
  200-kHz for DaqBoard/2000 Series and DaqBoard/2000c Series Boards.

- 512-location sequence memory that can be loaded with any combination of channels and gains.

- Ability to access up to 256 different channels of DBK signals while maintaining the channel-to-channel scan rate. The DBK expansion options can accommodate mixed-signal inputs from thermocouples and RTDs to isolated high-voltage inputs and strain gages.

- Ability to handle 8 differential or 16 single-ended signal inputs without DBK expansion units.

- Ability to handle fixed digital I/O up to 4 TTL lines in and 4 TTL lines out (accessible only if no analog expansion cards are in use).

The following table lists various features of DaqBooks and ISA-DaqBoards.

Daq Products, Models and Features								
Models	**A/D Resolution**	**Analog Output Channels**	**Unipolar/ Bipolar Selection**	**Single-ended/ Differential Selection**	**Programmable Digital I/O Lines**	**Program mable Counter/ Timers**	**Size (inches)**	**Power Consumption**
DaqBooks								
DaqBook/100	12 bit	2	Jumper	Jumper	16 high speed 24 gen purpose	5 ch 7 MHz	8.5×11 ×1.375	510 mA @ 12V
DaqBook/112	12 bit	2	Jumper	Jumper	N/A	N/A	8.5×11 ×1.375	360 mA @ 12V
DaqBook/120	12 bit	2	Jumper	Jumper	16 high speed 24 gen purpose	5 ch 7 MHz	8.5×11 ×1.375	510 mA @ 12V
DaqBook/200	16 bit	2	Software	Software	16 high speed 24 gen purpose	5 ch 7 MHz	8.5×11 ×1.375	620 mA @ 12V
DaqBook/216	16 bit	2	Software	Software	N/A	N/A	8.5×11 ×1.375	600 mA @ 12V
DaqBook/260	16 bit	2	Software	Software	16 high speed 24 gen purpose	5 ch 7 MHz	11×13 ×3.5	620***** mA @ 12V
ISA-DaqBoards								
DaqBoard/100A	12 bit	2	Sequencer	Software	16 high speed 24 gen purpose	5 ch 7 MHz	4.5×13.125	1330 mA @ 5V
DaqBoard/112A	12 bit	2	Sequencer	Software	N/A	N/A	4.5×13.125	970 mA @ 5V
DaqBoard/200A	16 bit	2	Sequencer	Software	16 high speed 24 gen purpose	5 ch 7 MHz	4.5×13.125	1700 mA @ 5V
DaqBoard/216A	16 bit	2	Sequencer	Software	N/A	N/A	4.5×13.125	1340 mA @ 5V

* Does not include power consumption of internal DBK options.

Using DBK Cards and Modules for Signal Conditioning

The DBK signal-conditioning cards and module are designed for use with DaqBooks, LogBooks, and various types of data acquisition boards, i.e., ISA, PCI, and compact PCI (cPCI) 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.

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 OMB-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 PostView, DIAdem, and eZ-View

- 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.

- Post acquisition data analysis programs, e.g., PostView, DIAdem, and eZ-View, typically allow 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). API-language drivers include: C/C++, Delphi, 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* (p/n OMB-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** directory, 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.

Setup and Startup 2

For DaqBoard/100A, /112A, /200A and /216A

This chapter provides instructions for getting an ISA-type DaqBoard configured, installed into a PC's ISA-slot, making board connections, and installing the appropriate software. The figure, provided near the bottom of this page, provides an overview of the steps necessary for a successful setup.

Reference Note:
The *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905) contains detailed DBK and power-related information. As a part of product support, the DBK 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.

CAUTION

Turn off power to the host PC and externally connected equipment prior to removing the PC's cover and installing a DaqBoard. Electric shock or damage to equipment can result even under low-voltage conditions.

Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.) Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.
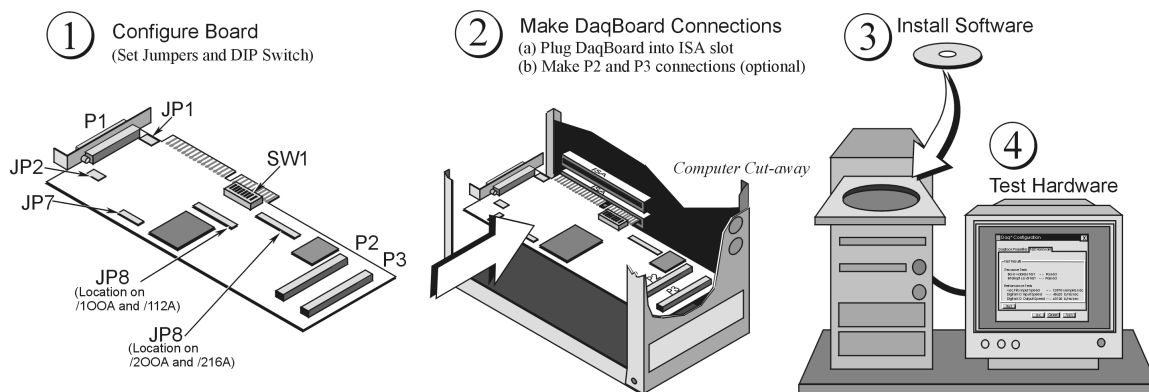

Minimum System Requirements

PC system with Pentium® Processor

Windows Operating System

RAM, as follows:
> 16 Mbytes of RAM for Windows 3.x
> 32 Mbytes of RAM for Windows 95/98/NT
> 64 Mbytes of RAM for Windows Me
> 64 Mbytes of RAM for Windows 2000
> 64 Mbytes of RAM for Windows XP

DaqBoard-ISA Installation Steps, Pictorial Overview

---

(1) Configure the ISA-DaqBoard   (Set Jumpers and Configure the DIP-Switch)

JP1 - External Analog Expansion Power

<table>
<tr><td colspan="2" align="center">CAUTION</td></tr>
<tr><td>⚠️</td><td>Placing the jumpers on JP1's OCTOUT and –OCLKIN could damage the 8254 timer chip! If either a DBK32A Auxiliary Power Supply or a DBK33 Triple-Output Power Supply Card is used, the JP1 shunt jumpers must be removed, otherwise timer chip damage will occur. Refer to the DBK32A, DBK33, and Power Management sections of the user documentation for more information.</td></tr>
</table>

If analog option cards (DBKs) are used, JP1 jumpers are set to provide +15 and -15 VDC to the cards.

If using a DBK32A or DBK33 Power Supply Card, remove all jumpers from JP1.

If no cards are being used, the counter/timer CTR0 is available, and JP1 must be set as shown in the figure.
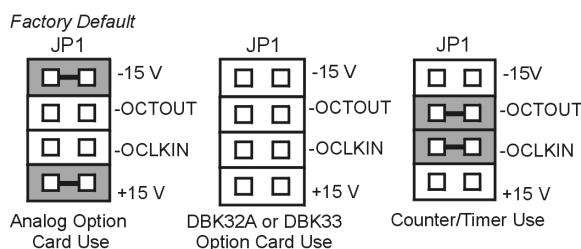
JP1 Configurations

JP2 - DAC Reference Voltage and SSH (Simultaneous Sample and Hold)

<table>
<tr><td colspan="2" align="center">CAUTION</td></tr>
<tr><td>⚠️</td><td>In regard to JP2, the SSH jumper must be removed if you are using EXT DAC0 or EXT DAC1. See the user's manual for details.</td></tr>
</table>

JP2 selects an **Internal** (*default*) or **External** reference voltage for the two separate analog outputs.

JP2 also selects **SSH** (*default*) for applications using one or more of the following: DBK2, DBK4, DBK5, DBK7, DBK17, DBK50, or DBK51.

We recommend that you leave the JP2 jumpers at their factory default setting (see figure at right). Refer to the JP2 material in chapter 3 prior to making changes.
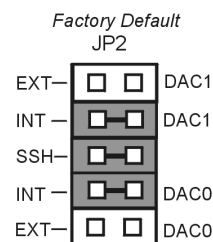
JP7 – Calibration

Leave JP7 in the default position. Only use JP7 during calibration.

JP8 – DMA and Interrupt

Interrupt Selection. ISA-type DaqBoards may be set to interrupt the PC when certain hardware conditions occur. The interrupt may be set to IRQ level 10, 11, 12, 14 or 15. DaqBoard's IRQ level cannot be shared with another device. To disable interrupt assistance and background transfers you can configure JP8 to "Open Interrupt." See the "Open Interrupt" setting in the following figure.

DMA Selection. Direct Memory Access (DMA) configuration provides for:
    (a) high-speed data transfer from the ADC FIFO, or
    (b) high-speed data transfer to the DAC FIFO.

**Note**: Only DMA channels 5-7 (of an ISA AT machine's seven channels) are available to DaqBoard.

Set DRQ and DACK jumpers to the desired DMA channels. Note that DaqBoard does not share DMA channels.

Set the DMA jumpers to OPEN when other devices will be using DMA channels 5, 6 and 7.
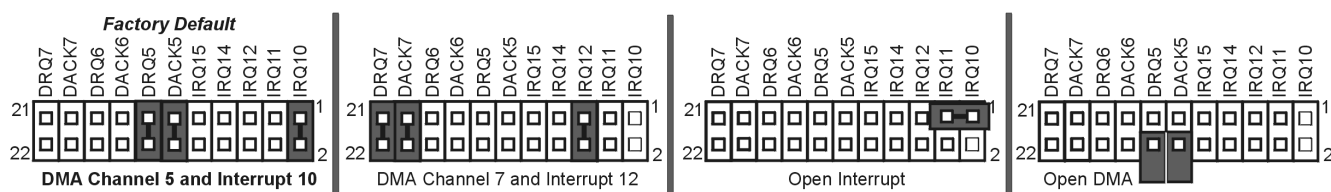
SW1 - Base Address

SW1's factory default is 300 Hex. If 300 Hex presents an address conflict, set a new SW1 address within the range of 1FF to 3FF (256 to 1023 Decimal). Note that the address must be on a 4-byte boundary.
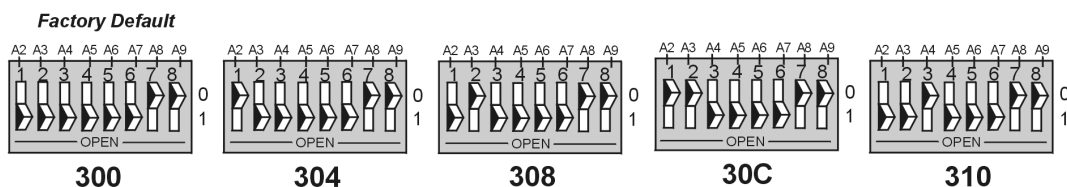
Industry Standard I/O Addresses			
Hex Range	**Device**	**Hex Range**	**Device**
000-1FF	Internal system	368-36B	PC network (high address)
200-207	Game I/O	36C-36F	Reserved
20C-20D	Reserved	378-37F	Parallel printer port 1
21F	Reserved	380-38F	SDLC, bisynchronous 2
278-27F	Parallel printer port 2	390-393	Reserved
2B0-2DF	Alternate enhanced graphics adapter	3A0-3AF	Bisynchronous 1
2E1	GPIB (Adapter 0)	3B0-3BF	Monochrome display and printer adapter
2E2 & 2E3	Data acquisition (Adapter 0)	3C0-3CF	Enhanced graphics adapter
2F8-2FF	Serial port 2	3D0-3DF	Color/Graphics monitor adapter
300-31F	Prototype card	3F0-3F7	Diskette Controller
360-363	PC network (low address)	3F8-3FF	Serial port 1
364-367	Reserved		

Notes:
(1)   SW1's address must be unique, i.e., not used by another device.
(2)   I/O addresses, hex 000 to 0FF, are reserved for system board I/O.
(3)   Hex 100 to 3FF are available on the I/O channel.
(4)   Although the above table represents industry standards, some systems may vary.

(2) Make ISA-DaqBoard Connections

Before connecting your ISA-type DaqBoard, you should review the following connector descriptions.

P1 Analog I/O. Provides 16 analog input channels, 2 analog output channels, a 16-bit counter/timer, four TTL inputs and outputs, and various signals for driving expansion cards.

P2 Digital I/O. Provides three 8-bit TTL programmable I/O ports and external interrupt input. To ensure reliable operation, for P2 expansion cables **do not exceed 14 inches per attached DBK card**.

P3 Frequency I/O. Provides five 16-bit counters and 16 high-speed digital inputs and external interrupt input.

(a) Turn power OFF to the PC and all attached equipment.

(b) Remove the PC's cover. *Refer to your PC Owner's Manual as needed*.

(c) Choose an empty 16-bit ISA slot. Loosen and remove the screw at the top of the slot's blank adapter plate. Then slide the plate up and out to remove. *Refer to your PC Owner's Manual as needed*.

(d) Align DaqBoard's edge-connector with the desired ISA slot, and with the PC's corresponding rear-panel slot. Gently press the board into the ISA slot.

(e) Secure the board by inserting the rear-panel adapter-plate screw.

(f) *If using P2, P3, or both*, connect CA-60 cables to the appropriate *on-board* P2 and/or P3 headers (see figure). Secure the P2 and P3 panel connectors to the computer's back panel, as applicable.

(g) Replace the computer's cover. Plug in all cords and cables; then apply power to the PC.
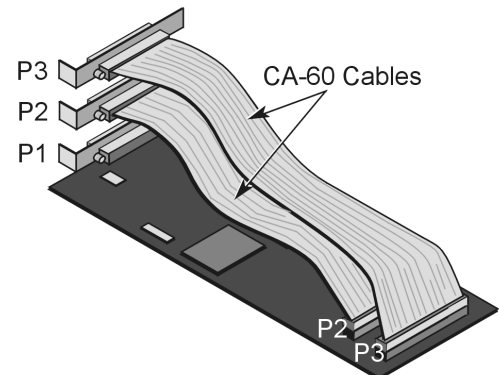
DaqBoard's I/O Connectors
If used, P2 and P3 require cable CA-60.

---

(3) Install Software and Product Support Documentation
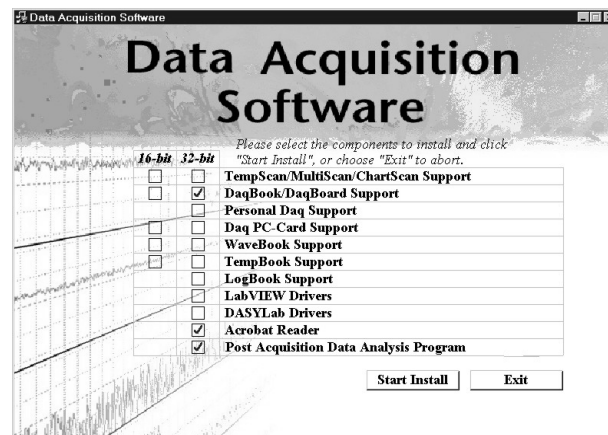
Data Acquisition Software, Master Setup Screen

(a) Remove previous version Daq device drivers, if present. You can do this through Microsoft's Add/Remove Programs feature by navigating from your desktop as follows:
Start ⟹ Settings ⟹ Control Panel ⟹ Add/Remove Programs

(b) Place the Data Acquisition CD into the CD-ROM drive. *Wait for PC to auto-start the CD. This may take a few moments, depending on your PC.* If the CD does not auto-start, use the Desktop's Start, Run, Browse feature.

(c) If a Licensing Agreement appears, read over the agreement, then click "Agree." The Data Acquisition Software Master Setup Screen appears (see previous figure).

(d) Select **DaqBook/DaqBoard Support.** *For Windows95/98/Me/NT/2000/XP*, select **32-bit**.
     If using Windows3.1, or DOS, select **16-bit** instead of 32-bit.

(e) *If you do not have Acrobat Reader version 4.0 or greater* installed on your PC, select **Acrobat
     Reader**. This will enable you to read and print documentation that is included on the install CD-ROM.
     Note that PDF versions of the documents are automatically installed onto your hard drive. The default
     location is the Programs directory. It can be accessed from the Windows Desktop via the Start button.

(f) Select **Post Acquisition Data Analysis Program**. Refer to the Post Acquisition Data Analysis
     Program document module (e.g. DIAdem, PostView, eZ-View) for information. A copy of the
     applicable document module is included in this manual.

(g) Click "**Start Install**" and follow the screen prompts.

(4) Test Hardware

Use the following steps to test your ISA-type DaqBoard.

(a) Run the **Daq Configuration** control panel applet.

(b) Click "**Add Device**."

(c) Select your DaqBoard model from the "**Device Type**" scroll box
     and click **OK**.

(d) Select your DaqBoard from the "**Device Inventory**" window and
     click "**Properties**."

(e) Ensure settings are correct, and make changes if needed.

(f) Select the "**Test Hardware"** tab.

(g) Click the "**Resource Test**" button.

(h) Click the "**Test**" button.

Test results should be displayed within a few seconds. Note that test
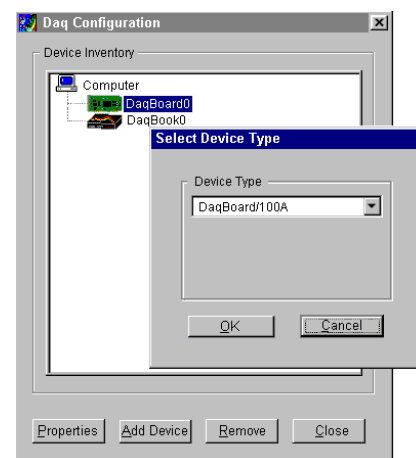results have two components: **Resource Tests** and **Performance
Tests.**

Note: Testing the DaqBoard device may, in some cases, cause the
          system to hang. If test results are not displayed in 30 seconds
          or the system does not seem to be responding, reboot the
          system. Upon power-up, re-enter the Daq Configuration and
          change DaqBoard configuration settings to those that work
          properly.

*Device Inventory and
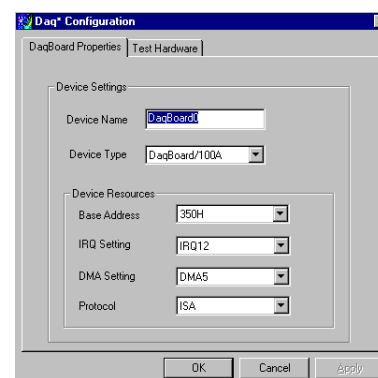Device Type Windows*

Resource Tests

The resource tests are intended to test system capability for the current
device configuration. These tests are pass/fail.
Resource test failure may indicate a lack of availability of the resource
or a possible resource conflict.

- *Base Address Test* - Tests the base address for the selected
  ISA bus. Failure of this test may indicate that the bus is not
  properly configured within the system. See relevant operating
  system and computer manufacturer's documentation to correct
  the problem.

- *Interrupt Level Test* - Tests the ability of the ISA bus to
  generate interrupts. Failure of this test may indicate that the
  ISA bus may be currently unable to generate the necessary
  hardware interrupt.


DaqBoard Properties Tab

Performance Tests

Performance tests check various DaqBoard functions with the current device configuration. These tests give quantitative results for each supported functional group. The results represent maximum rates at which the various operations can be performed. Note that the rates depend on selected ISA protocol and will vary according to bus hardware capabilities.

- *ADC FIFO Input Speed* - Tests the maximum rate at which data can be transferred from the DaqBoard's internal ADC FIFO to computer memory, through the PC's ISA bus. Results are given in samples/second, where a sample (2 bytes in length) represents a single A/D value.

- *Digital I/O Input Speed* - Tests the maximum rate at which DIO input data can be transferred from DaqBoard's Digital I/O ports to computer memory, through the PC's ISA bus slot. Results are given in bytes/second.

- *Digital I/O Output Speed* – Tests the maximum rate at which DIO output data can be transferred from the computer's memory to DaqBoard's Digital I/O ports, through the PC's ISA bus slot. Results are given in bytes/second.

Test Hardware Tab
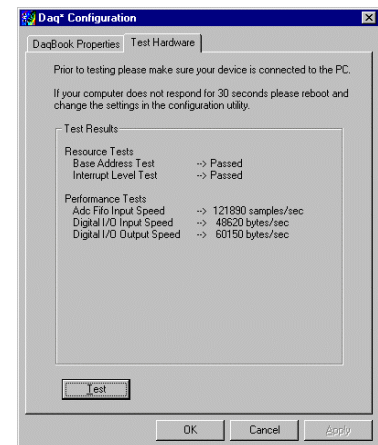
Test Results

Reference Note: If you experience difficulties, please consult other sections of this manual and to the additional user documentation before calling technical support. User documentation is included on your data acquisition CD, and is installed automatically as a part of product support, when your software is installed. The default location is in the **Programs** directory.

Note that hardcopy versions of the manuals can be ordered from the factory.

A Closer Look at DaqBoard-ISA Hardware 3

Applies to DaqBoard/100A, /112A, /200A, and /216A

Overview

The DaqBoard/100A, /112A, /200A, and /216A are 100 kHz ISA-bus plug-in boards that provide analog-to-digital conversion with a wide selection of signal-conditioning, signal expansion, and software support. ISA-DaqBoards feature an on-board 512-location sequencer that lets you select any channel and gain combination and configure each channel for unipolar or bipolar operation.

Analog input capabilities are flexible. The A/D maximum sample rate is 100 kHz (divide by number of channels for scan rate) with a 16-channel multiplexer and a programmable-gain input amplifier. Users can expand channel capacity to 256 analog inputs via expansion modules for multiplexing RTDs, thermocouples, strain gages, anti-aliasing filters, and simultaneous sample and hold amplifiers. Expansion cards and modules attach to the P1 I/O connector. Refer to the *Connections* section beginning on page 3-5. The P1 DB37 interface is compatible with multiplexers and signal conditioners from several manufacturers.

Input power for the DaqBoard comes from the host computer's bus. Output power from the P1 connector includes +5 VDC (pin 1) and ±15 VDC (pins 21 and 2). The section beginning on page 3-4 entitled, *External Analog Expansion Power* (JP1), explains how to set JP1 based on power use in the system. Related information is included in the *Power Management* section of the *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905).

Each ISA-DaqBoard provides 16 analog inputs (expandable up to 256), 2 analog outputs, and 4 digital inputs and outputs. DaqBoard/100A and DaqBoard/200A have additional digital I/O and counter/timer capabilities. The various DaqBoard models have either 12-bit or 16-bit resolution. 12-bit models include DaqBoard/100A and DaqBoard/112A. 16-bit models include DaqBoard/200A and DaqBoard/216A.

Performance Factors

The DaqBoard performs 100 kHz scan sequences and provides programmable delays from 10 µs to 12 hours. The unit's 100 kHz conversion rate fixes the time skew between channels at 10 µs. The 512-location scan sequencer allows selection of the input amplifier gain for each channel. The DaqBoard/100A and DaqBoard/200A can scan 16 digital inputs in the same sequence used for analog inputs (such inputs are thus time-correlated). Optional simultaneous-sample-and-hold (SSH) cards enable ISA-DaqBoards to sample up to 256 channels at the same instant. Scanning and timing specifications are met even with a full complement of expansion modules. All types of transducers are scanned within the same scan group without PC intervention.

ISA-type DaqBoards offer a wide selection of triggering capabilities. The scan can be triggered by software, a TTL signal, or an analog input level (including slope). The trigger is hardware-based to minimize trigger latency to less than 10 µs.

Two data transfer modes are supported:
- DMA
- Fast I/O to data memory via block move instruction REP INSW.

Real-time data can be collected at 100 K readings/s.

This following block diagram can be applied to DaqBoard-ISA models /100A, /112A, /200A, and /216A.
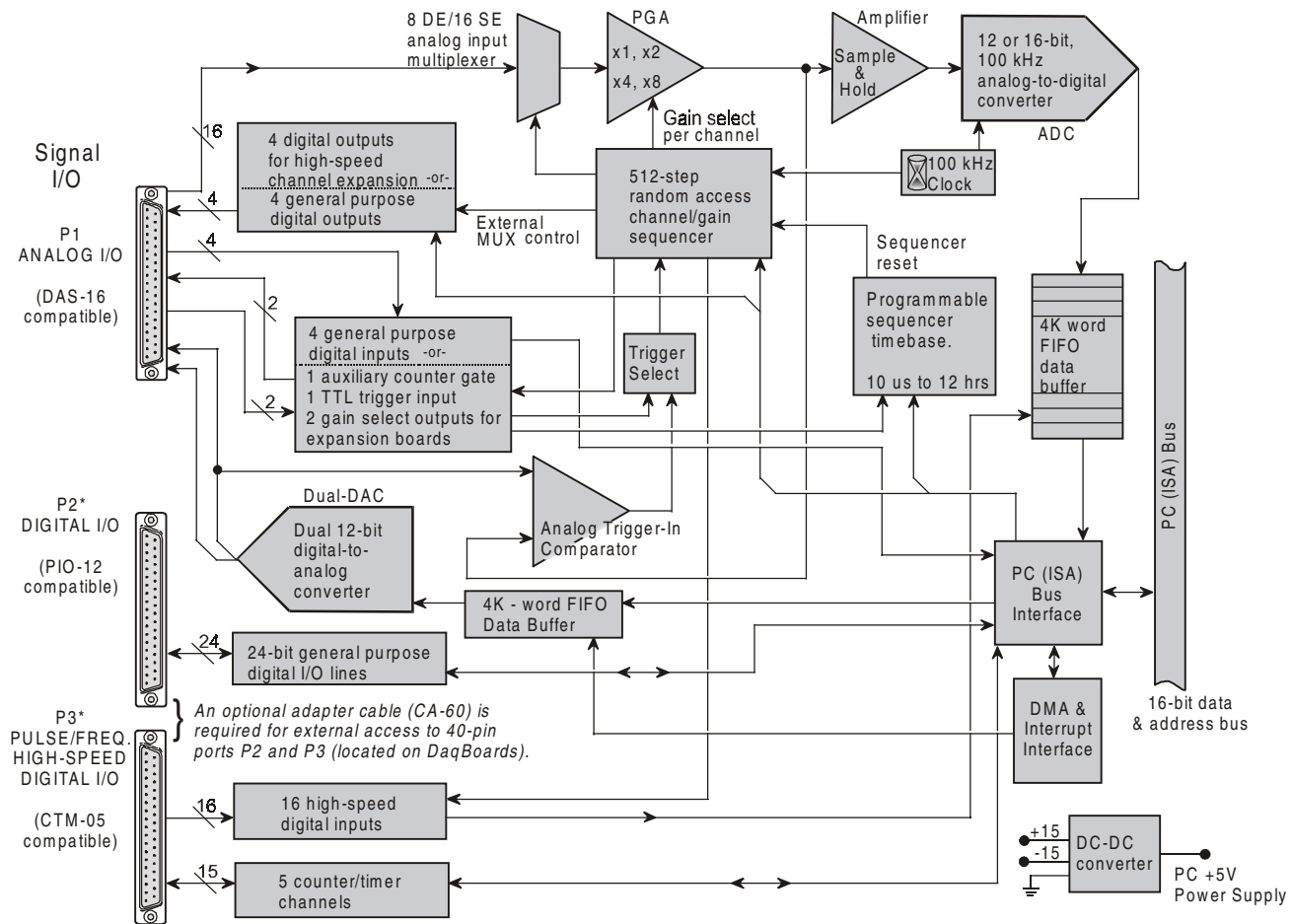
Block Diagram for DaqBoard Models /100A, 112A, 200A, and 216A

Switches and Jumpers

To ensure that the desired mode of operation is obtained, the ISA-type DaqBoards must be configured. This is accomplished via on-board jumpers and a DIP-switch. Although the configuration of all four DaqBoard-ISA models is similar, jumper locations differ, as can be seen in the following figures.

DaqBoard/100A/112A Motherboard   DaqBoard/200A/216A Motherboard

Location of DaqBoard Jumpers

The following DIP-switch and jumpers must be properly set to ensure the desired mode of operation:

- SW1 - Base Address
- JP1 - External Analog Expansion Power
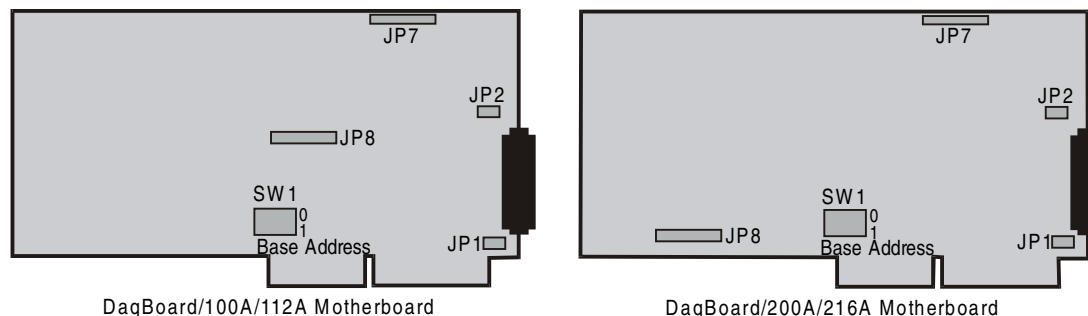- JP2 - DAC Voltage Reference Header
- JP7 –Reserved for factory use.
- JP8 - Interrupt & DMA

Base Address (SW1)

The computer must know the DaqBoard's base address. Check the base address setting (3-digit hex) on SW1, the Base Address switch. The factory default is 300 hex (within the standard range for a prototype card; see table). If the default value does not work, you must select an address within 200 to 3FF (256 to 1023 decimal). In addition, the address must be on a 4-byte boundary, and it must not conflict with addresses already in use.

Industry Standard I/O Addresses **Note**: Systems vary. This is only a guide.	
Hex Range	**Device**
000-1FF	Internal system
200-207	Game I/O
20C-20D	Reserved
21F	Reserved
278-27F	Parallel printer port 2
2B0-2DF	Alternate enhanced graphics adapter
2E1	GPIB (Adapter 0)
2E2 & 2E3	Data acquisition (Adapter 0)
2F8-2FF	Serial port 2
300-31F	Prototype card
360-363	PC network (low address)
364-367	Reserved
368-36B	PC network (high address)
36C-36F	Reserved
378-37F	Parallel printer port 1
380-38F	SDLC, bisynchronous 2
390-393	Reserved
3A0-3AF	Bisynchronous 1
3B0-3BF	Monochrome display and printer adapter
3C0-3CF	Enhanced graphics adapter
3D0-3DF	Color/Graphics monitor adapter
3F0-3F7	Diskette Controller
3F8-3FF	Serial port 1
Note: I/O addresses, hex 000 to 0FF, are reserved for the system board I/O. Hex 100 to 3FF are available on the I/O channel.	
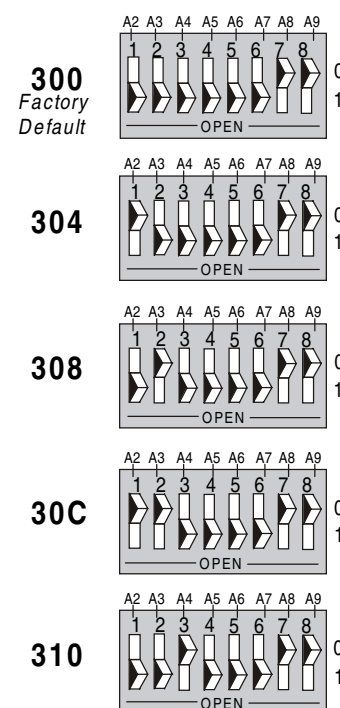
Sample Base Addresses on SW1

External Analog Expansion Power (JP1)

The JP1 4×2 header has 3 possible settings. If analog option cards (DBKs) are used, the JP1 pins are set to provide ±15 VDC to the cards. If such cards are not used, the counter/timer CTR0 is available, and JP1 must be set accordingly. The default setting is for use of analog option cards.

Factory Default
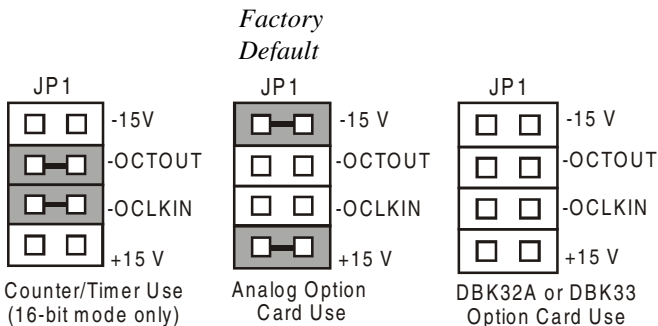
JP1 External Analog Expansion Settings

CAUTION

If using a DBK32A Auxiliary Power Supply or a DBK33 Triple-Output Power Supply Card, the JP1 shunt jumpers must be entirely removed. Placing the jumpers on -OCTOUT and -OCLKIN will damage the 8254 timer chip.

Reference Note:
Refer to the *Power Management* section of the *DBK Option Cards and Modules User's Manual* (p/n OMB- 457-0905), as needed.

DAC Reference Selection (JP2)

The JP2 5×2 header allows you to select internal or external voltage references for the two separate analog outputs. If the internal -5 VDC reference is selected, either DAC can output from 0 to +5 VDC as the register count varies from 0 to 4095 (12-bit). If an external voltage reference is desired (up to 10 VDC in either polarity), the shunt jumpers must be set accordingly. There is also a provision to allow the outputting of a simultaneous Sample-Hold command signal on the DAC1-REFIN pin with the DAC1 set up for an internal reference.

CAUTION

The SSH setting cannot be used at the same time as a DAC1 external reference due to a potentially damaging conflict on P1 pin #26. The defaults are both DAC0 and DAC1 set to Internal Reference.

Reference Note:
The SSH setting is used with DBKs: 2, 4, 5, 7, 17, 50, and 51. In regard to specific DBK information, refer to the *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905), as needed.

Factory Default
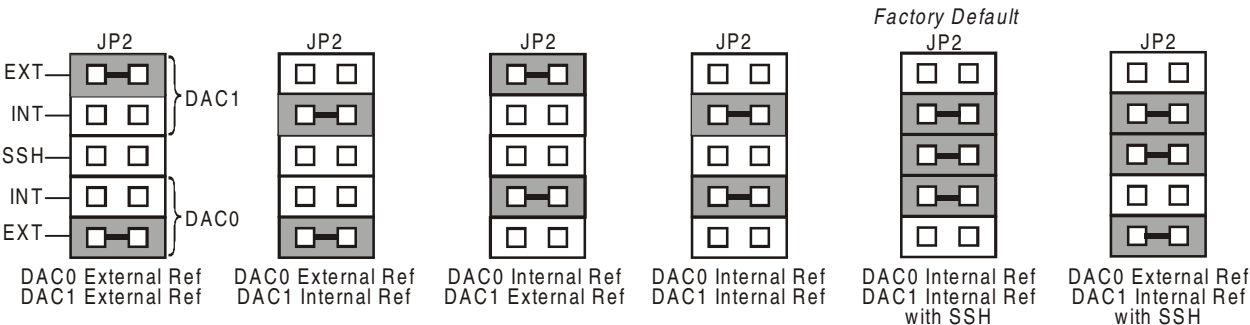
JP2 DAC Reference Settings

DMA and Interrupt Selection (JP8)

The JP8 11×2 header determines both the interrupt IRQ level and the Direct Memory Access (DMA) channel for control of background data transfers. The preset default is for DMA channel 5 and for Interrupt 10 (see figure).

- **Interrupt Selection**. The DaqBoard may be set to interrupt the PC when certain hardware conditions occur. The main board interrupt may be set to IRQ level 10, 11, 12, 14 or 15. The DaqBoard's IRQ level cannot be shared with any other device. Setting the JP8 interrupt jumper to OPEN can disable interrupt assistance and background transfers.

- **DMA Selection**. Direct Memory Access allows high-speed data transfer either from the ADC FIFO or to the DAC FIFO. Only DMA channels 5, 6, and 7 (of an ISA AT machine's seven channels) are available for the DaqBoard. Set both the DRQ and DACK jumpers to the desired DMA channel (the DaqBoard does not share DMA channels). Set the DMA jumpers to OPEN when other devices use DMA channels 5, 6 and 7.
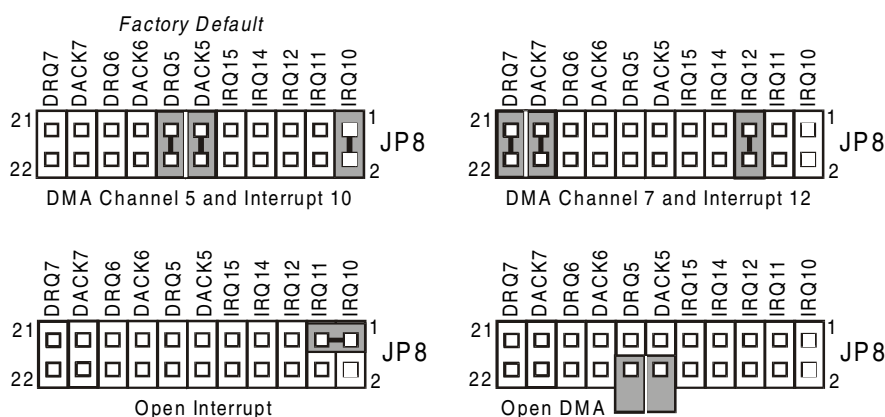
JP8 DaqBoard DMA and Interrupt Selection

Connections

Reference Notes:
➢ This section pertains to connections and pinouts for ISA-type DaqBoard applications.
➢ For installation instructions, refer to chapter 2, *Setup and Startup*.
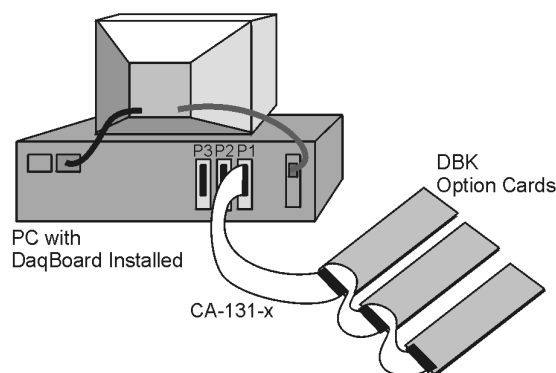
DaqBoard [ISA type] Multi-Card Cabling

Expansion cards connect to the ISA-type DaqBoards via one externally accessible P1 DB37 I/O connector, or by two on-board 40-pin headers [for P2 and P3 connections] on the DaqBoard/100A and the DaqBoard/200A. The DBK option cards can be used without an enclosure, or can be installed in a multi-card enclosure such as the DBK10, DBK41, or DBK60. The multi-card enclosures can be stacked, making it possible for a system to accommodate a large number of cards.

The P1 connector on the DaqBoard and on each DBK is a DB37 male connector. Connecting DBKs to a DaqBoard is accomplished with a CA-131-x cable, where the x is the number of option cards to be connected; for example, a CA-131-3 cable would be used to attach three DBK option cards to a DaqBoard. Such connections are often referred to as a "daisy-chain." Note that the CA-131-x cables consist of female DB37 connectors.

CAUTION

Before connecting DBKs to the DaqBoard, power-down all connected units. Failure to do so could result in damage to the DBK or DaqBoard.

CAUTION

Do not confuse connectors. Ensure that you only connect P1 I/Os to P1, P2 I/Os to P2, and P3 I/Os to P3. Improper connection may result in equipment damage.

In addition to P1 ports, DaqBoard/100A and DaqBoard/200A devices have P2 and P3 ports. For these devices a CA-60 cable is required to connect the DaqBoard 40-pin headers with a DB37 connector outside the PC, and then to the DBK option card.
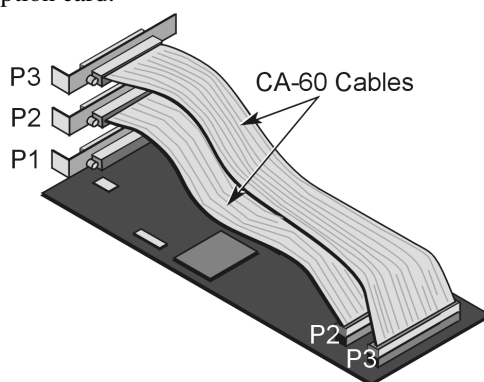

A DaqBoard with CA-60 Cables for P2 and P3

- **P1 Analog I/O**. Provides sixteen analog input channels, two analog output channels, a 16-bit counter/timer, four TTL inputs and outputs, and various signals for driving expansion cards.
- **P2 Digital I/O**. Provides three 8-bit TTL programmable I/O ports and external interrupt input.

P2 expansion cables must be kept relatively short to ensure reliable operation. Do not exceed 14 inches per attached DBK card.

- **P3 Frequency I/O**. Provides five 16-bit counters and sixteen high-speed digital inputs and external interrupt input.

To gain access to the DaqBoard port connectors, signals can be connected via CA-131-x cable through a D-shell 37-pin female connector or a DBK11 screw-terminal option card with component sockets.

Reference Notes: You must set up *DaqView* for the particular DBKs in your system. If you are unfamiliar with the method of setting up DBKs in *DaqView*, or if you need a refresher, refer to one or more of the following:

➢ the DaqView document module
➢ the *DBK Set Up in DaqView* chapter of the DBK Option Cards and Modules User's Manual.
➢ The DBK document modules, for hardware configuration aspects that require setup in software.

Note: As new DBKs become available, be sure to use the latest revision of *DaqView* with the proper configuration options.

P1, DB37 Pinout   Analog I/O Connections for ISA-Type DaqBoards
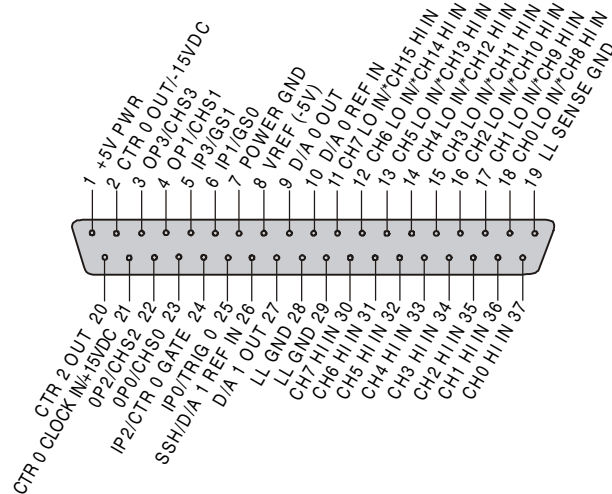
Pin	Signal Name	Description for P1 Pin Use
1	+5 PWR	+5 V supply (Refer to *Power Management*, in the DBK manual).
2	CTR 0 OUT/-15 VDC	Counter 0 output (8254 chip)/ -15 V supply (Refer to *Power Management*, in the DBK manual).
3	OP 3/CHS 3	Digital out bit 3/channel select line for expansion cards
4	OP 1/CHS 1	Digital out bit 1/channel select line for expansion cards
5	IP 3/GS 1	Digital in bit 3/gain select line for expansion cards
6	IP 1/GS 0	Digital in bit 1/gain select line for expansion cards
7	POWER GND	Digital ground
8	VREF (-5V)	-5 V supply @ 10 mA max
9	D/A 0 OUT	Digital to analog converter output ch 0
10	D/A 0 REF IN	Digital to analog converter reference in ch 0 (must invert)
11	CH 7 LO IN/CH 15 HI IN	Ch 7 LO IN (differential mode)/ch 15 HI IN (single-ended mode)
12	CH 6 LO IN/CH 14 HI IN	Ch 6 LO IN (differential mode)/ch 14 HI IN (single-ended mode)
13	CH 5 LO IN/CH 13 HI IN	Ch 5 LO IN (differential mode)/ch 13 HI IN (single-ended mode)
14	CH 4 LO IN/CH 12 HI IN	Ch 4 LO IN (differential mode)/ch 12 HI IN (single-ended mode)
15	CH 3 LO IN/CH 11 HI IN	Ch 3 LO IN (differential mode)/ch 11 HI IN (single-ended mode)
16	CH 2 LO IN/CH 10 HI IN	Ch 2 LO IN (differential mode)/ch 10 HI IN (single-ended mode)
17	CH 1 LO IN/CH 9 HI IN	Ch 1 LO IN (differential mode)/ch 9 HI IN(single-ended mode)
18	CH 0 LO IN/CH 8 HI IN	Ch 0 LO IN (differential mode)/ch 8 HI IN (single-ended mode)
19	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
20	CTR 2 OUT	Counter 2 output (8254 chip)
21	CTR 0 CLOCK IN/+15 VDC	Counter 0 clock in (8254 chip)/+15 V supply (Refer to *Power Management*, in the DBK manual).
22	OP 2/CHS 2	Digital output bit 2/ channel select line for expansion cards
23	OP 0/CHS 0	Digital output bit 0/channel select line for expansion cards
24	IP 2/CTR 0 GATE	Digital input bit 2/counter 0 gate (16-bit support only)
25	IP 0/TRIG 0	Digital input bit 0/trigger 0
26	D/A 1 REF IN/SSH	Digital-to-analog converter reference in ch 1 (must invert)/ SSH
27	D/A 1 OUT	Digital-to-analog converter output ch 1
28	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
29	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
30	CH 7 HI IN	Ch 7 HI IN (single-ended mode or differential mode)
31	CH 6 HI IN	Ch 6 HI IN (single-ended mode or differential mode)
32	CH 5 HI IN	Ch 5 HI IN (single-ended mode or differential mode)
33	CH 4 HI IN	Ch 4 HI IN (single-ended mode or differential mode)
34	CH 3 HI IN	Ch 3 HI IN (single-ended mode or differential mode)
35	CH 2 HI IN	Ch 2 HI IN (single-ended mode or differential mode)
36	CH 1 HI IN	Ch 1 HI IN (single-ended mode or differential mode)
37	CH 0 HI IN	Ch 0 HI IN (single-ended mode or differential mode)

Notes:
(1) Software configuration commands determine P1 digital I/O pin functions.
(2) Actual shunt-jumper placement is required to provide ±15 VDC to expansion cards or disconnect internal DAC references to allow externally selected DAC references.
(3) Digital I/O is not available with DBKs due to line use for addressing. "/" indicates the pin can be used for either function but not both at the same time.
(4) DaqBoard [ISA-Type] P1 is compatible with Metrabyte DAS-16.
(5) The pinout is for ISA-type DaqBoards. It does not apply to PCI or cPCI type DaqBoards.
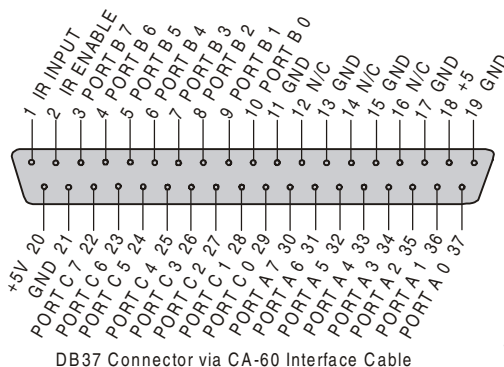
P2, DB37 Pinout   Digital I/O Connections for ISA-Type DaqBoards
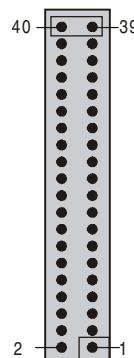

The DaqBoard [ISA-Type] P2 interface is available on:

DaqBoard/100A
DaqBoard/200A

DB37 Connector via CA-60 Interface Cable

The P2 40-pin header does not have a direct pin-to-pin correlation with the P2 DB37 connector.

Pin	Signal Name	Description for P2 Pin Use
1	IR INPUT	Interrupt line input (no functions to access this)
2	IR ENABLE	Interrupt line enable (no functions to access this)
3	PORT B 7	Digital input/output - port B bit 7
4	PORT B 6	Digital input/output - port B bit 6
5	PORT B 5	Digital input/output - port B bit 5
6	PORT B 4	Digital input/output - port B bit 4
7	PORT B 3	Digital input/output - port B bit 3
8	PORT B 2	Digital input/output - port B bit 2
9	PORT B 1	Digital input/output - port B bit 1
10	PORT B 0	Digital input/output - port B bit 0
11	GND	Digital ground
12	N/C	Pin not connected/not used
13	GND	Digital ground
14	N/C	Pin not connected/not used
15	GND	Digital ground
16	N/C	Pin not connected/not used
17	GND	Digital ground
18	+5 V	+5 V supply (Refer to *Power Management*, in the DBK manual).
19	GND	Digital ground
20	+5 V	+5 V supply (Refer to *Power Management,* in the DBK manual).
21	GND	Digital ground
22	PORT C 7	Digital input/output - port C bit 7
23	PORT C 6	Digital input/output - port C bit 6
24	PORT C 5	Digital input/output - port C bit 5
25	PORT C 4	Digital input/output - port C bit 4
26	PORT C 3	Digital input/output - port C bit 3
27	PORT C 2	Digital input/output - port C bit 2
28	PORT C 1	Digital input/output - port C bit 1
29	PORT C 0	Digital input/output - port C bit 0
30	PORT A 7	Digital input/output - port A bit 7
31	PORT A 6	Digital input/output - port A bit 6
32	PORT A 5	Digital input/output - port A bit 5
33	PORT A 4	Digital input/output - port A bit 4
34	PORT A 3	Digital input/output - port A bit 3
35	PORT A 2	Digital input/output - port A bit 2
36	PORT A 1	Digital input/output - port A bit 1
37	PORT A 0	Digital input/output - port A bit 0

Note: No local lines are available if digital expansion cards are in use.
.

 P2 expansion cables must be kept relatively short to ensure reliable operation. Do not exceed 14 inches per attached DBK card.
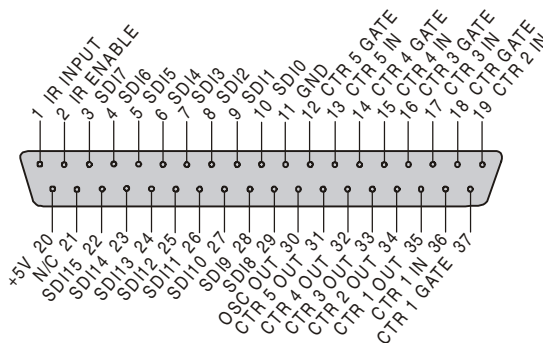
Note: The pinout is for ISA-type DaqBoards. It does not apply to PCI or cPCI type DaqBoards.

P3, DB37 Pinout   Pulse/Frequency/High-Speed Digital I/O for ISA-Type DaqBoards
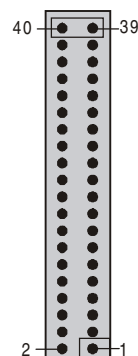
The DaqBoard P3 interface is available on:

DaqBoard/100A
DaqBoard/200A

DB37 Connector via CA-60 Interface Cable

The P3 40-pin header does not have a direct pin-to-pin correlation with the P3 DB37 connector.

Pin	Signal Name	Description for P3 Pin Use
1	IR INPUT	Interrupt line input (used with counters)
2	IR ENABLE	Interrupt line enable (used with counters)
3	SDI 7	High-speed digital input bit 7 (low byte)
4	SDI 6	High-speed digital input bit 6 (low byte)
5	SDI 5	High-speed digital input bit 5 (low byte)
6	SDI 4	High-speed digital input bit 4 (low byte)
7	SDI 3	High-speed digital input bit 3 (low byte)
8	SDI 2	High-speed digital input bit 2 (low byte)
9	SDI 1	High-speed digital input bit 1 (low byte)
10	SDI 0	High-speed digital input bit 0 (low byte)
11	GND	Digital ground
12	CTR 5 GATE	Counter 5 gate (9513 chip)
13	CTR 5 IN	Counter 5 input (9513 chip)
14	CTR 4 GATE	Counter 4 gate (9513 chip)
15	CTR 4 IN	Counter 4 input (9513 chip)
16	CTR 3 GATE	Counter 3 gate (9513 chip)
17	CTR 3 IN	Counter 3 input (9513 chip)
18	CTR 2 GATE	Counter 2 gate (9513 chip)
19	CTR 2 IN	Counter 2 input (9513 chip)
20	+5 V	+5 V supply (Refer to *Power Management,* in the DBK manual).
21	D IN STROBE	NC
22	SDI 15	High-speed digital input bit 15 (high byte)
23	SDI 14	High-speed digital input bit 14 (high byte)
24	SDI 13	High-speed digital input bit 13 (high byte)
25	SDI 12	High-speed digital input bit 12 (high byte)
26	SDI 11	High-speed digital input bit 11 (high byte)
27	SDI 10	High-speed digital input bit 10 (high byte)
28	SDI 9	High-speed digital input bit 9 (high byte)
29	SDI 8	High-speed digital input bit 8 (high byte)
30	OSC. OUT	Oscillator output - fout (9513 chip)
31	CTR 5 OUT	Counter 5 output (9513 chip)
32	CTR 4 OUT	Counter 4 output (9513 chip)
33	CTR 3 OUT	Counter 3 output (9513 chip)
34	CTR 2 OUT	Counter 2 output (9513 chip)
35	CTR 1 OUT	Counter 1 output (9513 chip)
36	CTR 1 IN	Counter 1 input (9513 chip)
37	CTR 1 GATE	Counter 1 gate (9513 chip)

Note: The pinout is for ISA-type DaqBoards. It does not apply to PCI or cPCI type DaqBoards.

Notes

DBK Basics

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.

Introduction

The term "DBK" typically refers to a card or module that is used to expand or enhance a primary data acquisition device, such as a DaqBook, DaqBoard, or LogBook. As will be seen in the upcoming DBK identification tables, DBKs provide a wide variety of data acquisition functions. Depending on the DBKs used, one or more of the following can be realized:

- signal conditioning
- analog output
- digital I/O
- channel expansion
- supplying powering to another acquisition device
- providing an interface for different connectivity.

Reference Notes: 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** directory, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation, especially the *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905) for details regarding both hardware and software in relevant to DBKs.

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

How Do DBKs Connect to the Data Acquisition Device?

Each DBK connects to the primary data acquisition device; e.g., a DaqBook, DaqBoard, or LogBook, through one of three 37-pin ports, which are designated as follows:

- P1 – Analog I/O
- P2 – Digital I/O
- P3 – Pulse/Frequency/High-Speed Digital I/O

Depending on the primary data acquisition device, connectivity issues differ slightly. This will be made clear by the figures and accompanying text that follow.

For DaqBooks, ISA-Type DaqBoards, and LogBooks, DBK connections are not made directly to the port, but through a CA-37-x ribbon cable, where "x" indicates the number of expansion devices that can be connected. For example, in addition to providing a DB37 connector to interface with the primary data acquisition device, a CA-37-3 cable includes three additional DB37 connectors. These provide a means of adding three DBKs to one port. Use of a CA-37-16 cable will allow up to 16 DBKs to be added. The CA-37-x cable system is excellent for DaqBooks, LogBooks, and ISA-type DaqBoards.
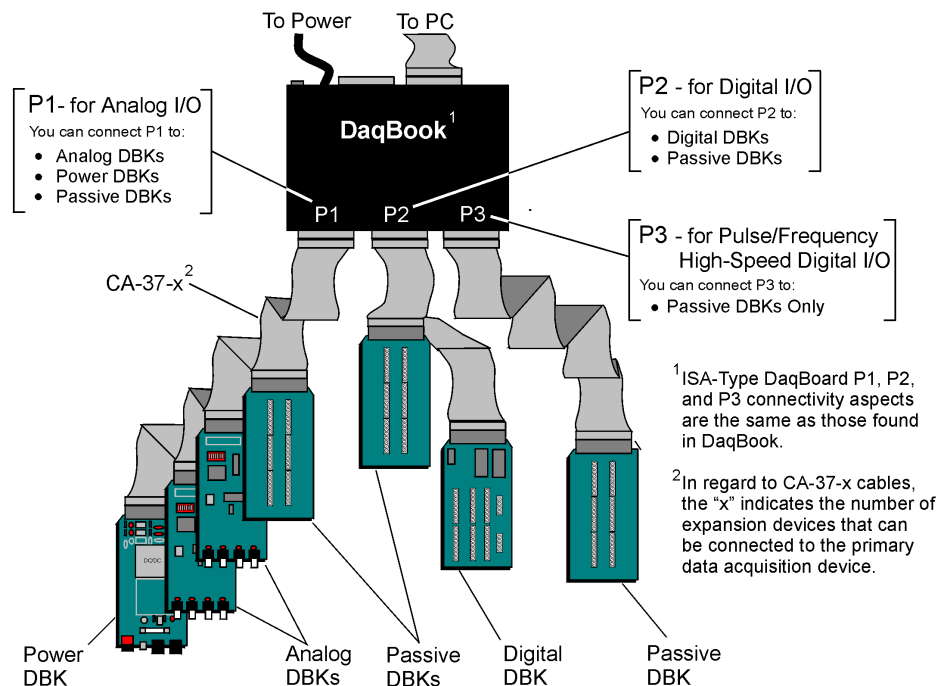
Connecting DBKs to a DaqBook

The above figure applies to LogBooks, DaqBooks, and ISA-type DaqBoards. As will be seen elsewhere in the documentation, some models do not include all three connectors (P1, P2, and P3).

DBK Identification Tables

Analog Output DBKs

Analog Output			
Product	**Name/Description**	**I/O**	**Conectivity**
DBK2	Voltage Output Card	4 channels	P1
DBK5	Current Output Card	4 channels	P1

Digital I/O Control DBKs

Digital I/O / Control			
Product	**Name/Description**	**I/O**	**Conectivity**
DBK20	General-Purpose Digital I/O Card (Screw Terminals)	48 channels	P2
DBK21	General-Purpose Digital I/O Card (DB37 Connectors)	48 channels	P2
DBK23	Optically Isolated Digital-Input Module	24 channels	P2
DBK24	Optically Isolated Digital-Output Module	24 channels	P2
DBK25	Relay Output Card	8 channels	P2

Analog Signal Conditioning DBKs

The DBKs that are used for analog signal conditioning attach to transducers and condition their outputs into analog voltages.   An A/D converter, located in the primary acquisition device, measures the analog voltages. There are many signal-conditioning solutions available (and more are in development). Note that DBK high-capacity modules require more circuitry than can fit on a compact card.

Analog Signal Conditioning			
Product	**Name/Description**	**I/O**	**Connectivity**
DBK4	Dynamic Signal Input Card	2 channels	P1
DBK7	Frequency-to-Voltage Input Card	4 channels	P1
DBK8	High-Voltage Input Card	8 channels	P1
DBK9	RTD Measurement Card	8 channels	P1
DBK12	Low-Gain Analog Multiplexing Card	16 channels	P1
DBK13	High-Gain Analog Multiplexing Card	16 channels	P1
DBK15	Universal Current/Voltage Input Card	16 channels	P1
DBK16	Strain-Gage Measurement Card	2 channels	P1
DBK17	Simultaneous Sample & Hold Card	4 channels	P1
DBK18	Low-Pass Filter Card	4 channels	P1
DBK19	Thermocouple Card	14 channels	P1
DBK42	5B Isolated Signal-Conditioning Module	16 channels	P1
DBK43A	Strain-Gage Measurement Module	8 channels	P1
DBK44	5B Isolated Signal-Conditioning Card	2 channels	P1
DBK45	SSH and Low-Pass Filter Card	4 channels	P1
DBK50	Isolated High-Voltage Input Module	8 channels	P1
DBK51	Isolated Low-Voltage Input Module	8 channels	P1
DBK52	Thermocouple Input Module	14 channels	P1
DBK53	Low-Gain Analog Multiplexing Module	16 channels	P1
DBK54	High-Gain Analog Multiplexing Module	16 channels	P1
DBK80	Differential Voltage Input Card with Excitation Output	16 channels	P1
DBK81	Thermocouple Card, High-Accuracy	7 channels	P1
DBK82	Thermocouple Card, High-Accuracy	14 channels	P1
DBK83	Thermal Couple Card, High-Accuracy; uses Connection Pod	14 channels	POD-1
DBK84	Thermocouple Module, High-Accuracy	14 channels	P1

Expansion and Terminal Panel Connection DBKs

The following DBKs offer provide various expansion and connection options. The stackable 3-slot DBK10 low-profile enclosure can be used for up to three DBKs. If a system has more than 3 DBKs, the 10-slot DBK41 can be used. Several DBK41s can be daisy-chained to accommodate many DBKs in one system.

Expansion and Connection, General			
Product	**Name/Description**	**I/O**	**Connectivity**
DBK1	16-Connector BNC Adapter Module	16 connectors	P1
DBK10	3-Slot Expansion Chassis	3 cards	P1, P2, or P3
DBK11A	Screw-Terminal Option Card (DB37-Screw Terminal Block)	Component sockets	P1
DBK40	BNC Interface	18 connectors	P1 or P3
DBK41	Analog Expansion Enclosure	10 cards	P1 or P2
DBK60	Expansion Chassis with Termination Panels	3 cards	P2

Termination Panels, Connectivity for DaqBoard/260			
Product	**Name/Description**	**I/O**	**Connectivity**
DBK601	Termination Panel - blank rear panel	none	none
DBK602	Termination Panel - BNC rear panel	16 connectors	BNC
DBK603	Termination Panel - Safety Jacks, single ended	16 connectors	Safety Jacks
DBK604	Termination Panel - Safety Jacks, differential	8 differential (16)	Safety Jacks
DBK605	Termination Panels - Thermal Couple, differential panels; specify type: B, J, K, R, S, or T	16 differential	T/C Connectors
DBK606	Termination Panel – 3 Terminal Blocks; 16 connections per TB	48 connectors	Screw Terminal
DBK607	Termination Panel – strain relief clamp	none	none
DBK608	Termination Panel – 3 female DB37 connectors	three DB37	DB37

Power Supply DBKs

Power supply type DBKs are typically used in laboratory, automotive, and field applications. Input power can come from any +10 to +20 VDC source, or from an AC source by using an appropriately rated AC-to-DC adapter. The DBK30A rechargeable power supply can power DBK modules where AC mains are not available (the DBK30A outputs 28 V for powering transducers). For a large number of DBK cards, the DBK32A or DBK33 can be installed into an expansion slot. The DBK33 is used when +5 V is required in addition to ±15 VDC. The DBK34 provides a steady 12 or 24 VDC while working with vehicle electrical systems that may be turned on or off during testing.

Power Supply		
Product	**Name/Description**	**Power**
DBK30A	Rechargeable Battery/Excitation Module	+12-14, 24-28 VDC (3.4 A-hr @ 14 VDC)
DBK32A	Auxiliary Power Supply Card	±15 V @ 500 mA
DBK33	Triple-Output Power Supply Card	±15 V @ 250 mA; +5 V @ 1 A
DBK34	Vehicle UPS Module	12/24 VDC (5 A-hr @12 VDC)
DBK34A	UPS Battery Module	12/24 VDC (5 A-hr @12 VDC)

Tips on Setting up a Data Acquisition System

A successful installation involves setting up equipment and setting software parameters. In addition to this manual, you may need to consult your Daq device or LogBook user's manual.

DBKs should be configured before connections are made and power is applied. This sequence can prevent equipment damage and will help ensure proper operation on startup. Many DBKs have on-board jumpers and/or DIP switches that are used for setting channels and other variables. You will need to refer to the individual DBK document modules to ensure that the DBKs are properly configured for you application.

Prior to designing or setting up a custom data acquisition system, you should review the following tips. After reviewing the material you can write out the steps to setup a system that will best meet your specific application needs.

1. The end use of the acquisition data should be used to determine how you set up and program your acquisition system. Prior to creating the system you should understand its layout and know how you are going to assign the channels. If you can answer the following questions you are off to a good start. If not, you need to find the answers.

   - What engineering units, ranges, sampling rates, etc. are best for your data?
   - Will the data be charted graphically, statistically processed, or exported to other programs?
   - How will the data be used?
   - How will the data be saved?
   - What are your system' power requirements? Using several DBKs or transducers that require excitation current may require an extra power supply, e.g., a DBK32A.

2. Assign channel numbers.

3. Plan the location of transducers, cable runs, DBKs, the acquisition device [LogBook or Daq device], and the computer. Label your transducers, cables, and connectors to prevent later confusion.

4. When configuring your LogBook or Daq device(s) consider the following:

   - LogBook calibration is typically performed automatically through LogView software; however, some DBKs may require manual calibration.

   - **The DaqBook and DaqBoard (ISA type) have internal jumpers and switches that you must set manually to match your application.**

   - Some DaqBook models are partially configured in software.

   - Daq PC-Cards are configured entirely in software.

   - You may need to refer to other documentation, such as Quick Starts, Installation Guides, User's Manuals, and pertinent DBK document modules.

5. Perform all hardware configurations before connecting signal and power. Remember to configure all the DBK cards and modules for your application. Several jumpers and DIP switches may need to be set (channel, gain, filters, signal mode, etc).

6. Setting up channel parameters often requires both hardware and software setup.

7. Route and connect all signal and power cables while all power is turned OFF.

8. To minimize electrical noise, route all signal lines away from any RF or high-voltage devices.

9. Follow your device's specific installation instructions. For certain devices software should be installed first; for others, hardware should be installed prior to software installation.

10. **After software is loaded, remember to set the software parameters as needed for your application. The software must recognize all the hardware in the system. Measurement units and ranges should be checked to verify that they meet your application requirements.**

11. Remember to set all channels to the proper mode for your DBK or other signal source.

12. After your system is up and running, verify proper data acquisition and data storage.

13. Verify system accuracy; adjust ranges or calibrate as needed.

14. Device specific information regarding system setup and expansion can be found in the Daq and LogBook User's manuals; and in the applicable DBK document modules of this manual.

15. **If you are considering system expansion**, review the DBK10, DBK41, and DBK60 document modules. The best option depends on the number of DBK cards in your system. For just a few cards, use the stackable 3-slot DBK10 low-profile expansion enclosure. For more than six cards, use the 10-slot DBK41. DBK41s can be daisy-chained to one-another to handle a large number of DBKs.

16. **In regard to power management**, you should review the DBK30A, DBK32A, and DBK33 document modules.   For portable applications, the compact DBK30A rechargeable power supply can provide power to the DBK10 or DBK41. The DBK30A also includes a 28 V output for powering 4 to 20 mA transducers. For applications with many DBK cards (initially or in future expansion), the DBK32A or DBK33 can be installed into any expansion slot. The DBK32A provides ±15 VDC and the DBK33 provides ±15 VDC *and* +5 VDC.

Power Supplies and Connectors

Power supplies convert the raw power they receive into a lower DC voltage and/or current for use by devices with various power demands. Many of the power supplies that are used to power data acquisition equipment are of the *switching-mode* type. These devices provide a regulated output whether the power supply's input is, for example, 60 Hz, 120 VAC as in the United States or, 50 Hz, 220 VAC as found in European countries. Small power supplies, that do not switch, consist of simple transformer/rectifiers and filtered capacitors; and operate over a smaller voltage range.
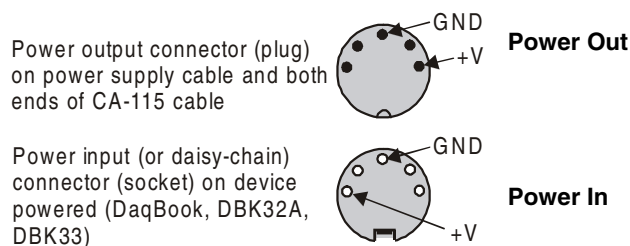
LogBooks - The switching-mode power supply commonly used with LogBook systems uses an input range of 100 VAC to 240 VAC at 50 Hz to 60 Hz. The power supply's output [to the LogBook] is 15 VDC @ 2.7 amps via a DIN5 connector.

DaqBooks - Power supplies that are used with DaqBooks are typically of the transformer/rectifier type. They supply the DaqBook with 15 VDC @ 900 mA via a DIN5 connector.

DBKs – The following table indicates the type of power supply that is typically used with certain DBKs.

| 15 VDC @ 2700 mA *Switching-Mode* **Type Power Supply** The DBKs in this column use up to 15 VDC @ 2700 mA. This *switching-mode* power supply receives power from a 100 to 240 VAC source, at 50 to 60 Hz, and converts it to the required value.		15 VDC @ 900 mA *Transformer/Rectifier* **Type, Unregulated Power Supply** The DBKs in this column use up to15 VDC @ 900 mA. This transformer/rectifier type power supply receives power from a 110 to 125 VAC source, at 60 Hz, and converts it to the required value.	
DBK	**Description**	**DBK**	**Description**
DBK32A	Auxiliary Power Supply Card	DBK23	Optically Isolated Digital-Input Module
DBK33	Triple-Output Power Supply Card	DBK24	Optically Isolated Digital-Output Module
DBK42	5B Isolated Signal Conditioning Module	DBK43A	Strain Gage Measurement Module
		DBK50	Isolated High-Voltage Input Module
		DBK51	Isolated Low-Voltage Input Module

The DIN5 is the system's basic power connector (see the following figure). The CA-115 is a 6-in. cable with a plug (male) DIN5 connector on both ends. The CA-115 is used to connect DBK32As [or DBK33s] in parallel when they are to be powered by the same power supply.

Power output connector (plug) on power supply cable and both ends of CA-115 cable

Power Out

Power input (or daisy-chain) connector (socket) on device powered (DaqBook, DBK32A, DBK33)

Power In

DIN5 Power Connectors

Note: DIN5 connectors for LogBook, DBK34, and DBK34A have threaded retaining rings.

Note: The following figure shows the pinout for the DBK34 and DBK34A Power Out DIN5 connector. The 28 V pin is only active when the device is in the 28 VDC mode; however, the 14 V pin is active regardless of the mode selected.
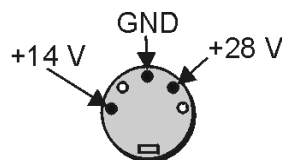
DIN5 Power Out
On a DBK34 and DBK34A

An Introduction to Power-Related DBKs

The power-related DBK options are the DBK30A, DBK32A, DBK33, DBK34, and DBK34A. From the standpoint of providing reliable power, these DBKs have proven convenient in laboratory, automotive, and field applications.

Input power for these devices can come from any 10 to 20 VDC source, or from an AC source via an appropriate AC-to-DC adapter.

A brief synopsis of the DBK power options follows. Refer to the respective document modules for complete information.

DBK30A module - provides power at 14 and 28 VDC with a rated capacity of 3.4 A-hr @ 14 VDC.
The DBK30A's 28 V output will power 4 to 20 mA transducers. The module's rechargeable power supply can power DBK modules in situations where AC mains are not available.

Note: Some transducers (e.g., 2-wire 4-20 mA transmitters, bridge-configured sensors, etc) require an excitation voltage in order to work properly. The DBK30A supplies 14 and 28 VDC. Consult transducer documentation before applying power.
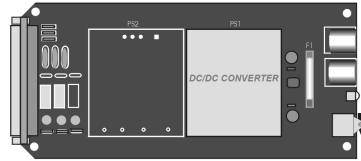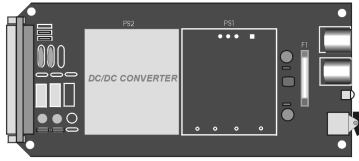
DBK32A - provides ±15 VDC @ 500 mA.   **DBK33** - provides ±15 VDC @ 250 mA *and* +5 VDC @ 1000 mA.

The DBK32A and DBK33 power cards attach directly to the P1 analog expansion bus where they supply power to DBK analog expansion cards. The DBK32A and the DBK33 can be powered from an included AC adapter, an optional DBK30A battery module, or from a +10 to +20 VDC source such as a car battery.

When installed in a DBK10 three-slot expansion chassis, the DBK32A or DBK33 supplies power to the analog DBK [that is to receive power] via a CA-37-x cable.

If used with the DBK41 ten-slot expansion enclosure, the DBK32A or DBK33 installs into one of the analog expansion slots on the DBK41's backplane. A power card in any DBK41slot (other than the leftmost, when viewed from the rear) will power the other cards that are connected to the DBK41's backplane.

CAUTION

If using a DBK32A or a DBK33 with a DaqBook or DaqBoard [ISA type], you must entirely remove the shunt jumpers from JP1. Failure to do so will result in damage to the 8254 timer chip. Refer to the power card document modules and to the *Daq device Hardware* sections of the DaqBook and DaqBoard [ISA] user's manuals for JP1 location and configuration.
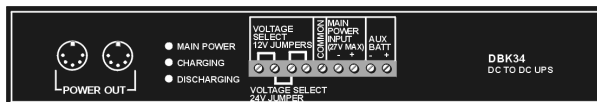
DBK34 module – provides 12 or 24 VDC with a 5.0 or 2.5 A-hr capacity (respectively). This module is an Uninterruptable Power Supply (UPS) that can be used for in-vehicle testing where the vehicle's electrical system will not affect acquisition device power during starter-current surge, or power-off.
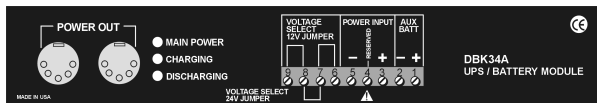
DBK34A module – provides 12 or 24 VDC with a 5.0 or 2.5 A-hr capacity (respectively). This device is classified as a UPS / Battery module. It is an improved version of the earlier DBK34. Like the DBK34, the DBK34A can be used for in-vehicle testing where the vehicle's electrical system will not affect acquisition device power during power during starter-current surge, or power-off.

Calculating Your System's Power Needs

Use the chart below and the worktable on the next page to ensure your system will have sufficient power. If the load (calculated in the worktable) exceeds available power (from the chart at the right), you must add a power card or a module such as a DBK32A or DBK33.

Available Power Chart—Supply	
Product	**Available Power**
LogBook	+5 VDC @ 0.10 A from P1-1, P2-18, P2-20, P3-20 +15 VDC @ 0.15 A from P1-21 +15 VDC @ 0.05 A from P3-19 -15 VDC @ 0.15 A from P1-2 -15 VDC @ 0.05 A from P3-37
DaqBook/100	2100 mW
DaqBook/112	2400 mW
DaqBook/120	2100 mW
DaqBook/200	4000 mW
DaqBook/216	4000 mW
DaqBook/260	4000 mW
DaqBoard/100A	3300 mW
DaqBoard/112A	3300 mW
DaqBoard/200A	3000 mW
DaqBoard/216A	3000 mW
DaqBoard/260A	3000 mW
DBK32	7500 mW
DBK32A	15000 mW
DBK33	7500 mW
DBK34	5 A-hr in 12 V mode; fused at 8 A
DBK34A	5 A-hr in 12 V mode; fused at 8 A

Use the following procedure and table to calculate the required system power.

1. In the Quantity column (5th), list the number of DBKs of that type in your system.

2. In the Sub Total column (7th), enter the product of column 5 and column 6 (mW).

3. Add the Sub Total column, and enter the sum at the bottom right of the table.
   This result is your power requirement in mW.

Note! **DBK32, DBK32A, and DBK34 cannot supply +5 VDC.**
In cases that require +5 VDC, if the +5 VDC requirement exceeds 500 mW from a LogBook or Daq device, then a DBK33 must be used. Note that DBK33 can supply 1000 mW at +5 VDC.

Note: The DBK34 has an 8 amp fuse, and has a capacity of 5 A-hr when in the 12V mode, and a capacity of 2.5 A-hr when in the 24V mode.

DBK Power Requirement Worktable—Demand						
DBK	**Voltage Reference**			**Calculation**		
Options	**+15 VDC**	**-15 VDC**	**+5 VDC**	**Quantity**	**× mW**	**= Sub Total**
DBK1	0	0	0		0	
DBK2	18 mA	18 mA	5 mA		565	
DBK4	95 mA	80 mA	25 mA		2750	
DBK5	2 mA	2 mA	15 mA		135	
DBK7	14 mA	8 mA	18 mA		420	
DBK8	15 mA	15 mA	<1 mA		455	
DBK9	21 mA	16 mA	<1 mA		560	
DBK11A	0	0	0		0	
DBK12	15 mA	15 mA	<1 mA		455	
DBK13	15 mA	15 mA	<1 mA		455	
DBK15	16 mA	16 mA	<1 mA		485	
DBK16	37 mA	32 mA	<1 mA		1040	
DBK17	30 mA	30 mA	<1 mA		905	
DBK18	36 mA	36 mA	<1 mA		1085	
DBK19	6 mA	7 mA	<1 mA		200	
DBK20	0	0	<10 mA		50	
DBK21	0	0	<10 mA		50	
DBK23***	0	0	<2 mA		10	
DBK24***	0	0	<2 mA		10	
DBK25	0	0	<2 mA		10	
DBK40	0	0	0		0	
DBK41	0	0	0		0	
DBK42	<1 mA	<1 mA	<1 mA		35	
DBK43A***	<1 mA	<1 mA	<1 mA		35	
DBK44	<1 mA	<1 mA	60 mA (Note 1)		330	
DBK45	52 mA	52 mA	<1 mA		1565	
DBK50***	<1 mA	<1 mA	<1 mA		35	
DBK51***	<1 mA	<1 mA	<1 mA		35	
DBK52	6 mA	7 mA	<1 mA		200	
DBK53	15 mA	15 mA	<1 mA		455	
DBK54	15 mA	15 mA	<1 mA		455	
DBK80	25 mA	25 mA	<1 mA		755	
DBK81	35 mA	35 mA	<2 mA		1060	
DBK82	60 mA	60 mA	<2 mA		1810	
DBK83	60 mA	60 mA	<2 mA		1810	
DBK84	60 mA	60 mA	<2 mA		1810	
Total Power Requirement in mW						

Note 1: DBK44's 60 mA value is based on 30 mA for each of two 5B modules. This value will be higher if using 5B module 5B38 (200 mA for each 5B38), or if using 5B39 (170 mA for each 5B39). Refer to the DBK44 document module for more information.

Note 2: DBK2 and DBK5 are not used with LogBook.

*** Three asterisks indicate that the DBK is a module with internal power supply; powered separately.

Additional Reading

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** directory, 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.

You should refer to the following documents, as applicable, for acquisition system and programming information.

➤ *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905)

➤ *DaqBoard [ISA] User's Manual* (p/n OMB-457-0907)

➤ *DaqBook User's Manual* (p/n OMB-457-0906)

➤ *LogBook User's Manual* (p/n OMB-461-0901)

➤ *Programmer's Manual* (p/n OMB-1008-0901)

➤ *Post Acquisition Data Analysis User's Guide*

Of the above listed documents, the most relevant to the DBKs is the *DBK Option Cards and Modules User's Manual* (p/n OMB-457-0905). A synopsis of the contents follows:

1 – *Introduction to DBKs*. Explains what DBKs are and uses tables to identify the various types of DBKs. The chapter includes tips for setting up a data acquisition system, discussions of signal management and signal conditioning, and CE compliance information.

2 – *Power Management*. Explains how to determine system power requirements and discusses various power options.

3 – *System Connections and Pinouts*. Provides instructions for connecting a DBK option to a Daq or LogBook device. Pinouts are included for the P1, P2, and P3 DB37 connectors.

4 – *DBK Set Up in DaqView*. Provides instruction for setting up analog and digital DBKs in *DaqView's Hardware Configuration* screen.

5 – *DBK Set Up in LogView*. Provides instruction for setting up analog and digital DBKs in *LogView's Hardware Configuration* window.

6 – *Troubleshooting*. Explains solutions to common noise, wiring, and configuration problems.

DBK Document Modules – Includes DBK-specific documentation for the card and module options listed on pages 3 and 4 of this document.

Notes

General

Power Consumption
   DaqBoard/200A: 1.7A @ 5 VDC
   DaqBoard/216A: 1.34A @ 5 VDC
Operating Temperature: 0° to 50°C
Storage Temperature: 0° to 70°C
Humidity: 0 to 95% RH, non-condensing
Dimensions
   DaqBoard/200A and DaqBoard/216A:
   340 mm W x 117 mm H (13.125" x 4.5")

A/D Specifications

Type: Successive approximation
Resolution
   DaqBoard/200A and DaqBoard/216A: 16 bit
Conversion Time: 8 µs
Monotonicity: No missing codes
Linearity: ±1 bit
Zero Drift: ±10 ppm/°C max
Gain Drift: ±30 ppm/°C max
Sample & Hold Amplifier
   Acquisition Time: 2 µs
   Aperture Uncertainty: 100 ps

Analog Inputs

for DaqBoard/200A and DaqBoard/216A

Channels: 16 single-ended, 8 differential, expandable up to 256 differential; single-ended/differential operation is software programmable
Connector: DB37 male, P1
Resolution: 16 bits
Accuracy: ±0.025% FS
Ranges
   Unipolar/bipolar operation is sequencer selectable on a per-channel basis
   Unipolar: 0 to +10V, 0 to +5V,0 to +2.5V, 0 to +1.25V
   Bipolar: ±5V, ±2.5V, ±1.25V, ±0.625V
Maximum Overvoltage: 30 VDC
Input Current
   Differential: 150 pA typ; 0.2 µA max
   Single-Ended: 250 pA typ; 0.4 µA max
Input Impedance: 100M Ohm in parallel with 100 pF
Gain Temp. Coefficient: 3 ppm/°C typ
Offset Temp. Coefficient: 12 µV/°C max

Triggering

Analog Trigger
   Programmable Level Range: 0 to ±5V
   Trigger to A/D Latency: 10 µs max
Digital Trigger
   Logic Level Range: 0.8V low/2.2V high
   Trigger to A/D Latency: 10 µs max
Software Trigger
   Trigger to A/D Latency: Dependent on PC speed
   Pre-Trigger: Up to 65,536 scans

Sequencer

Randomly programmable for channel and gain, as well as for unipolar/bipolar ranges
Depth: 512 location
Channel-to-Channel Rate: 10 µs/channel, fixed
Maximum Repeat Rate: 100 kHz
Minimum Repeat Rate: 12 hours
Expansion Channel Sample Rate:
   Same as on-board channels, 10 µs/channel

Analog Outputs

Channels: 2
Connector: DB37 male, mates with P1
Resolution: 12 bits
FIFO Depth: 4 Kword (2K per channel)
Voltage Ranges: 0 to 5 VDC with built-in reference; 0 to ±10 VDC with external reference
Maximum Output Current: 10 mA
Maximum Update Rate: 2 channels, 500 Ksamples/s; 1 channel, 1 Msamples/s
Memory: 2K words/channel on a per-channel basis
Maximum Analog Bandwidth: 500 kHz

General Purpose Digital I/O

for DaqBoard/200A

Number of Lines: 24 I/O lines, expandable up to 192
Connector: DB37 male, P2 (on-board 40-pin DIN is externally accessible via DB37 with optional CA-60)
Device: 82C55
Output Voltage Levels
   Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing
   Maximum "0" Voltage: 0.4 @ 2.5 mA sinking
Output Current
   Maximum Source Current: 2.5 mA
   Maximum Sink Current: -2.5 mA
Input Voltage Levels
   Minimum Required "1" Voltage Level: 2V
   Maximum Allowed "0" Voltage Level: 0.8V
Output Float Leakage Current: 10 µA

Note: Specifications are subject to change without notice.

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High-Speed Digital Inputs
for DaqBoard/200A

16 input lines

Connector: DB37 male, P3 (on-board 40-pin DIN is externally accessible via DB37 with optional CA-60)

Maximum Sampling Rate: 100 kHz

Input Low Voltage: 0.8V max

Input High Voltage: 2V min

Input Low Current: 10 nA

Input High Current: -10 µA

Counter/Timer
for DaqBoard/200A

5 counter/timer channels

Connector: DB37 male, P3 (on-board 40-pin DIN is externally accessible via DB37 with optional CA-60)

Frequency/Pulse Counting Mode:
   Up or down, binary or BCD

Maximum Pulse Count: 80-bit binary; (5 channels cascaded)

Maximum Input Rate: 7 MHz

Minimum High Pulse Width: 70 ns

Minimum Low Pulse Width: 70 ns

On-board Time Base: 1 MHz

Input Low Voltage: 0.8V max

Input High Voltage: 2.0V min

Input Low Current: -0.1 mA

Input High Current: 20 µA max

Frequency/Pulse Generating Mode
   Maximum Output Frequency: 1 MHz

Duty Cycle: Variable between limits of approximately 0.0015% and 99.99%

Output High Voltage: 2.4V min @ 15 mA

Output Low Voltage: 0.5V max @ 24 mA

Cable Information	Part No.
Adapter cable for the DaqBoard/200A P2 or P3 port	CA-60
Ribbon cable (6 ft) with a female DB37 connector on one end, unterminated on the other. This cable provides convenient wiring to DaqBoard P1, P2, & P3 ports. **Note**: For a cable distance of more than 6 feet, attachment to a DaqBoard/200A P2 or P3 requires the use of an optional CA-60 cable.	CA-113
Expansion cable from ISA DaqBoard to DBK expansion products	CA-131-1T
Shielded expansion cable from DaqBoard to DBK41; 7 in.	CA-143-7
Shielded expansion cable from DaqBoard to DBK41; 18 in.	CA-143-18

Note: Specifications are subject to change without notice.

Notes

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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