

User's Guide



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OMB - DBK Option Cards & Modules User's Manual

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The information contained in this document is believed to be correct but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

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

Manual Layout

The *DBK Option Cards and Modules User's Manual* (457-0905) is a companion document to other user's manuals, e.g., the *DaqBook/DaqBoard [ISA]/ Daq PC-Card User's Manual* (457-0901), the *DaqBoard/2000 Series and cPCI DaqBoard/2000c User's Manual* (1033-0901), and the *LogBook User's Manual* (461-0901).

This user's manual includes several chapters and a *document module* for each DBK. Document modules are like chapters, except they are shared by other documents and are sometimes used as stand-alone documents. For these reasons, the document modules do not contain chapter headings.

Chapters

- 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, as well as the 100-pin P4 connector used by PCI and compact PCI (cPCI) boards.
- 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 - The DBK document modules are provided in alphanumeric order. Refer to the Table of Contents for a complete list.



Reference Notes:

Refer to the following documents as applicable for acquisition system or programming information that is related to use of DBK option cards and modules.

- *DaqBook/DaqBoard [ISA]/ Daq PC-Card User's Manual* (p/n 457-0901)
- *LogBook User's Manual* (p/n 461-0901)
- *Programmer's Manual* (p/n 1008-0901)
- *Post Acquisition Data Analysis User's Guide(s)*

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.

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Document Modules

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- DBK7**, 4-Ch. Frequency-To-Voltage Input Card*
- DBK8**, 8-Channel High-Voltage Input Card*
- DBK9**, 8-Channel RTD Card*
- DBK10**, 3-Slot Expansion Chassis*
- DBK11A**, Screw-Terminal & BNC Option Card*
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What are DBKs?

The term “DBK” typically refers to a card or module that is used to expand or enhance a primary data acquisition device. As can be seen from the DBK identification tables in the section that follows, 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; for example:
changing from a 100-pin P4 connector to three 37-pin DB37 connectors.

This manual is dedicated to DBK options and includes information regarding installation, configuration, and power management for typical DBK applications. The specifics for each DBK are discussed in their respective *document module*. These are presented alphanumerically for ease of reference. Note that the footers include DBK identification next to the page number.

The specific DBK document modules usually contain the following elements:

- **Overview** (usually with a block diagram) describes the basic features and operation of the DBK.
- **Hardware Setup** describes configuration and connections for both the DBK and primary acquisition device, e.g., DaqBook, DaqBoard, LogBook.
- **Hardware Function** describes special hardware concerns if beyond the scope of the *Overview*.
- **Specifications**

**Reference Notes:**

- DBK setup in *DaqView* is discussed in chapter 4.
- DBK setup in *LogView* is discussed in chapter 5.

How Do DBKs Connect to the Data Acquisition Device?

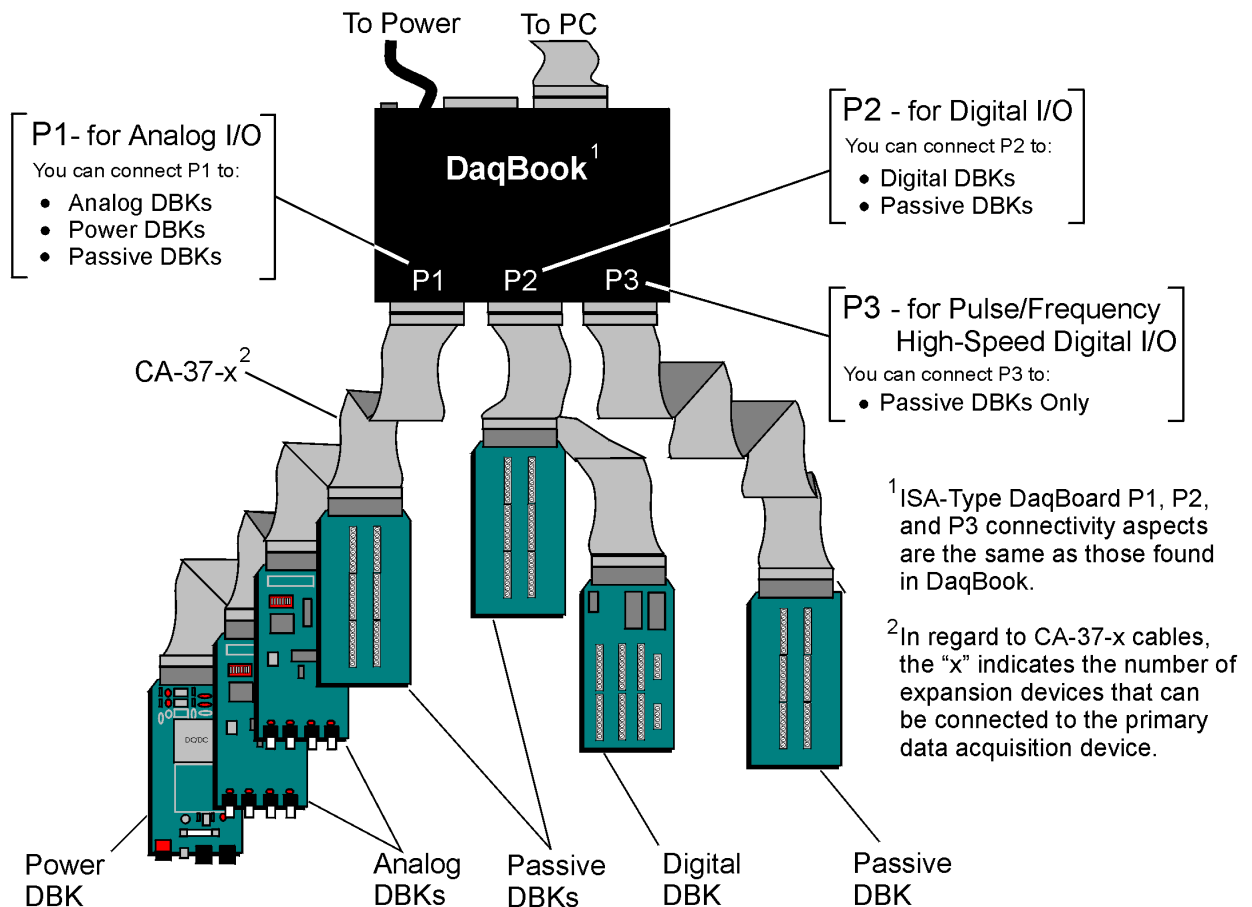
Each DBK connects to the primary data acquisition device through one of three 37-pin ports, which are designated as follows:

- 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 three figures that follow and the accompanying text.

Connecting DBKs to DaqBooks, ISA-Type DaqBoards, and LogBooks

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.



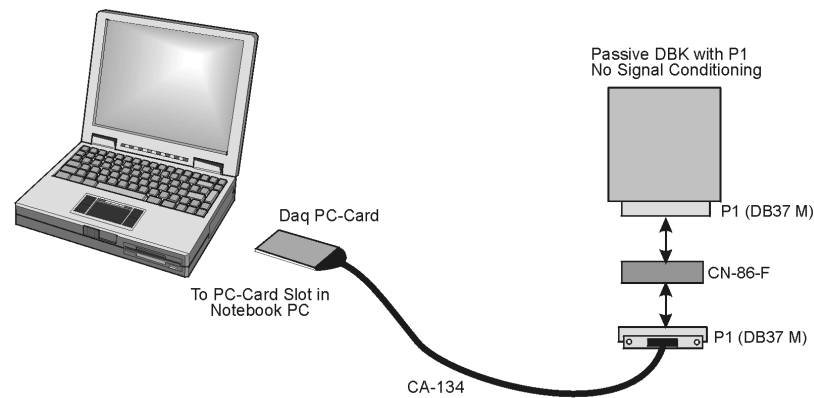
Connecting DBKs to a DaqBook

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).

Connecting DBKs to Daq PC-Cards

The Daq PC-Card is only intended for connections to a P1 connector of a single “passive” DBK card or module. A passive DBK card or module is one that provides a desired connectivity (such as BNCs or screw terminals), but performs no signal conditioning.

A CA-134 Interface Cable and a CN-86-F (dual DB37 female adapter) are used to provide the DB37 P1 connector.



Daq PC-Card Cabling

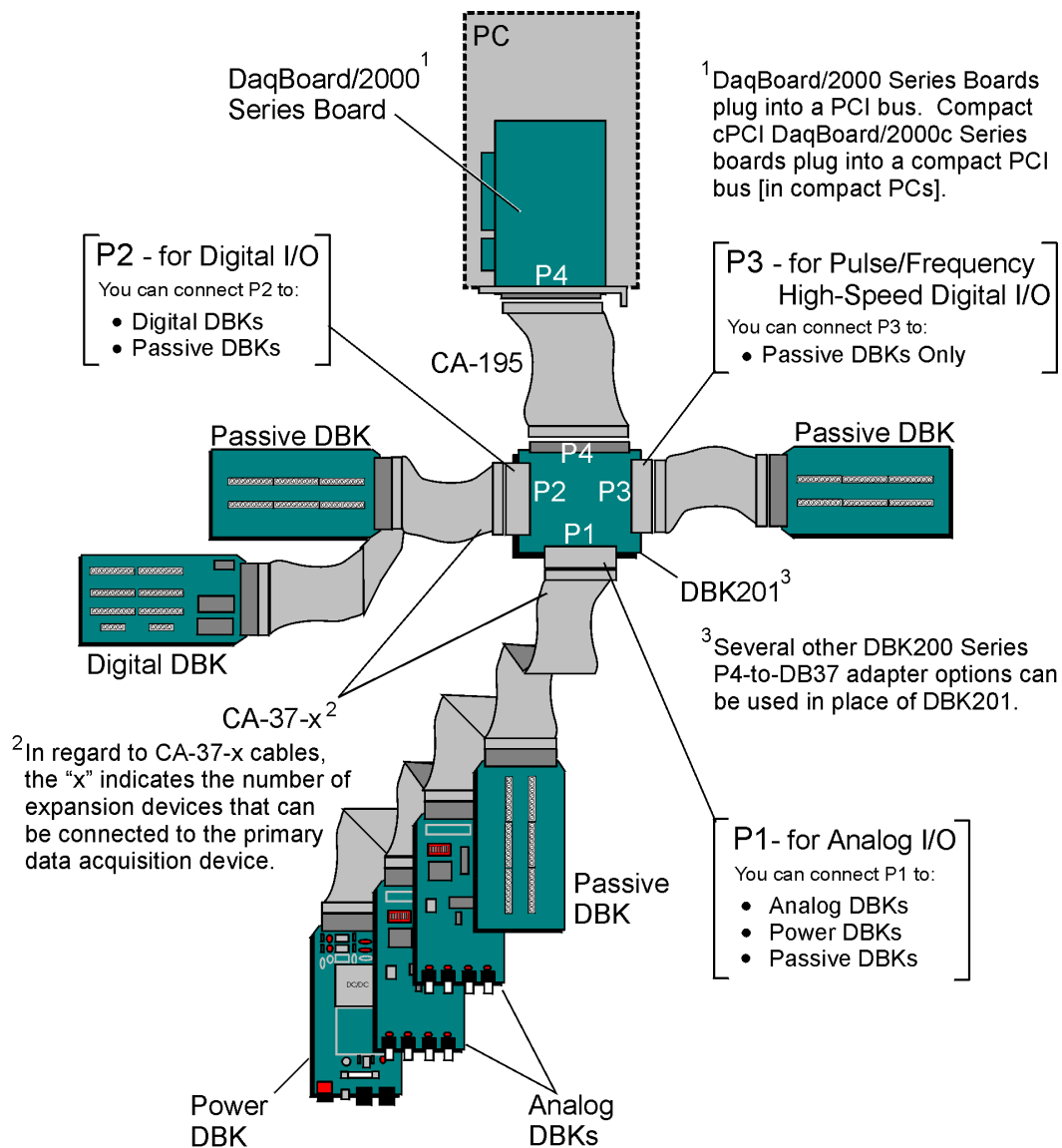
The CA-134 cable connects to a CN-86-F adapter, which then connects to a single “passive” card or module. The passive DBKs are:

- **DBK1 – 16 Connector BNC Module**
- **DBK11A – Screw Terminal Option Card**
- **DBK40 – BNC Analog Interface**

Connecting DBKs to DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards

DaqBoard/2000 Series and cPCI DaqBoard/2000 Series boards have 100-pin connectors designated as P4. The 100 pins correlate to various pins on P1, P2, and P3 DB37 connectors.* Connectivity in the system is as follows (see figure).

- The /2000 Series or /2000c Series board connects to a CA-195 cable [which has two 100-pin P4 connectors].
- The CA-195 connects to a DBK200 Series adapter board or adapter module for 100-pin to 37-pin adaptations, i.e., P4-to-P1, P2, P3; but not necessarily all three.*
- The DBK200 Series adapter connects to 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 connects to expansion DBKs, in accordance with port type. For example, Analog DBKs to port P1, Digital DBKs to port P2, and passive DBKs to port P3.



Connecting DBKs to a DaqBoard/2000 Series Board

* DaqBoard/2003 and cPCI DaqBoard/2003c are exceptions to the above connectivity method. The /2003 boards typically connect directly to a DBK205 (P4-to-Screw Terminal Adapter), as discussed elsewhere.

DBK Identification Tables

Analog Output DBKs

| Analog Output | | | |
|----------------------|---------------------|------------|--------------|
| Product | Name/Description | I/O | Connectivity |
| 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 | Connectivity |
| 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 |
| DBK208 | Carrier board for Opto-22 Compatible Solid-State-Relay Digital Modules. | Two 8-bit banks of SSR modules | Two P2s P4 |

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 ¹ |
| 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 Note 2 | 16 channels | P1 |
| DBK13 | High-Gain Analog Multiplexing Card Note 2 | 16 channels | P1 |
| DBK15 | Universal Current/Voltage Input Card Note 2 | 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 Note 2 | 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 Note 2 | 14 channels | P1 |
| DBK53 | Low-Gain Analog Multiplexing Module Note 2 | 16 channels | P1 |
| DBK54 | High-Gain Analog Multiplexing Module Note 2 | 16 channels | P1 |
| DBK70 | Vehicle Network Interface, Analog Multiplexer 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 |
| DBK207 | Carrier Board for 5B Compatible Analog Input Modules | 16 channels | Two P1s / P4 |
| DBK207/CJC | Carrier Board for 5B Compatible Analog Input Modules. DBK207/CJC includes cold junction compensation (CJC) | 16 channels | Two P1s / P4 |

Note 1: P1, P2, and P3 DB37 connectors do not exist on the DaqBoard/2000 Series or /2000c Series boards, but are obtained by using P4 adapters (DBK200 series). These adapters typically connect to the DaqBoard/2000 Series [/2000c Series] 100-pin P4 connector via a CA-195 cable.

Note 2: For DaqBoard/2000 and cPCI DaqBoard/2000 Series boards, internal clocks should be set to 100 kHz when used with any of the following DBK options: DBK12, DBK13, DBK15, DBK19, DBK52, DBK53, and DBK54. See specific DBK section for details.

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 ¹ |
| 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 |

Several signal connection options were developed primarily for use with DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards. The DBK200 Series P4-Adapter documentation provides the basic connection concepts. That information, along with the related DBK subsections should enable you to set up your desired configuration.

| P4 Adaptive Connection for DaqBoard/2000 Series and cPCI DaqBoard/2000c Series | | | |
|--|---|--------------|---------------------------|
| Product | Name/Description | I/O | Connectivity ¹ |
| DBK200 | P4-to-P1 Adapter Board | P1 | P4 |
| DBK201 | P4-to-P1/P2/P3 Adapter Board | P1, P2, P3 | P4 |
| DBK202 | P4-to-P1/P2/P3 Adapter Board with Screw-Terminals | P1, P2, P3 | P4 |
| DBK203 | A module version of DBK202 | P1, P2, P3 | P4 |
| DBK204 | A module version of DBK202 with an included CE cable kit. | P1, P2, P3 | P4 |
| DBK205 | P4-to-TB1 12-slot Screw Terminal Block for DaqBoard/2003. | TB1, 12-slot | P4 |
| DBK206 | P4-to-P1/P2/P3 Adapter Board with Screw-Terminals | P1, P2, P3 | P4 |
| DBK209 | P4-to-P1/P2/P3 Mini-Adapter Board | P1, P2, P3 | P4 |

Note 1: P1, P2, and P3 DB37 connectors do not exist on the DaqBoard/2000 Series, or /2000c Series boards, but are obtained by using P4 adapters (DBK200 series). These adapters typically connect to the DaqBoard/2000 Series [/2000c Series] 100-pin P4 connector via cable.

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 an AC source by using the included 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 your 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's 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.
 - DaqBoard/2000 Series boards are PCI type boards. They have no jumpers or switches and are configured entirely through software.
 - cPCI DaqBoard/2000c Series boards are *compact* PCI (cPCI) type boards. They have no jumpers or switches and are configured entirely through 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.

Signal Management

Signal Modes

Input signals come in one of two modes, *single-ended* or *differential*. Expansion modules, LogBook, and Daq device default setting use the single-ended mode. Some DBKs use differential inputs for certain kinds of transducers; but DBK output is always single-ended. The following text briefly describes the two signal modes.

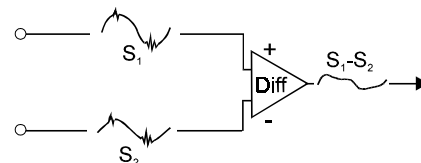
Note: For DaqBook/100, /112, /120, jumper settings determine the signal mode. Single-ended is the factory-set default. For DaqBoard and Daq PC-Card, choosing between differential and single-ended inputs is made by software command.

Single-ended mode refers to a mode, or circuit set-up, in which a voltage is measured between 1 signal line and common ground voltage (V_{cm}). The measured voltage may be shared with other channels. The advantage of a single-ended *non-differential* mode [over differential mode] is that it provides for a higher channel count (16 vs 8 channels).

Differential-mode refers to a mode, or circuit set-up, in which a voltage is measured between 2 signal lines. The resulting measured differential voltage is used for a single channel. Differential inputs reduce signal errors and the induction of noise from ground current. The following illustration is an example of how noise is reduced, or canceled-out, when using the differential mode.

In the schematic, voltage signal S_2 is subtracted from signal S_1 , resulting in the output signal shown. Noise spikes with *the same polarity, phase, and magnitude in each input signal* cancel out—resulting in a clean differential signal ($S_1 - S_2$).

In the schematic, signals S_1 and S_2 are shown in-phase; however, even if these signals were out of phase, the noise in each (indicated by jagged lines) would still have the same magnitude, phase, and polarity. For that reason, they would still cancel out.



Noise Reduction in Differential Mode

Input Isolation

Three benefits of input isolation are circuit protection, noise reduction, and the rejection of high common mode voltage.

- **Circuit protection.** Input isolation separates the signal source from circuits that may be damaged by the signal. (Voltages higher than about 10 V can distort data or damage chips used in data acquisition.) High-voltage signals or signals with high-voltage spikes should therefore be isolated. The protection can also work the other way—to safeguard a sensitive signal conditioner from a failing device elsewhere in the system.
- **Noise reduction.** Isolation eliminates ground loops for high-gain systems and multi-unit systems that are grounded together. The chassis for each device can rest at a ground potential slightly different from the other devices. These irrelevant currents and the spikes they may have picked up by induction can thus be kept out of the measurement circuit.
- **Rejection of high common-mode voltage.** There is a limit to the voltage applied to a differential amplifier between ground and the amplifier inputs. Fortunately, the differential amplifier rejects high common-mode voltage signals. High common-mode voltage and noise spikes are rejected (canceled out) in *in-phase* signals (same amplitude and frequency) that are present in both the high and low inputs at the same time.

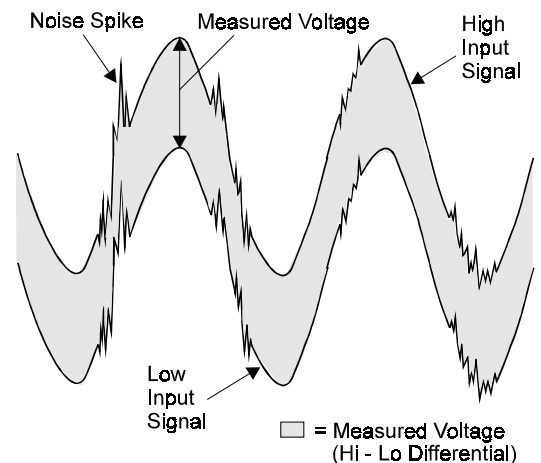
References for Differential Modes

There are three basic types of measurement configuration related to differential mode; these are ground-referenced, shunt-referenced, and floating.

Differential Mode, Ground-Referenced

In ground-referenced configurations, the signal voltage is referenced to a local common ground. In most cases, the local ground will be at a different voltage potential from the PC's ground.

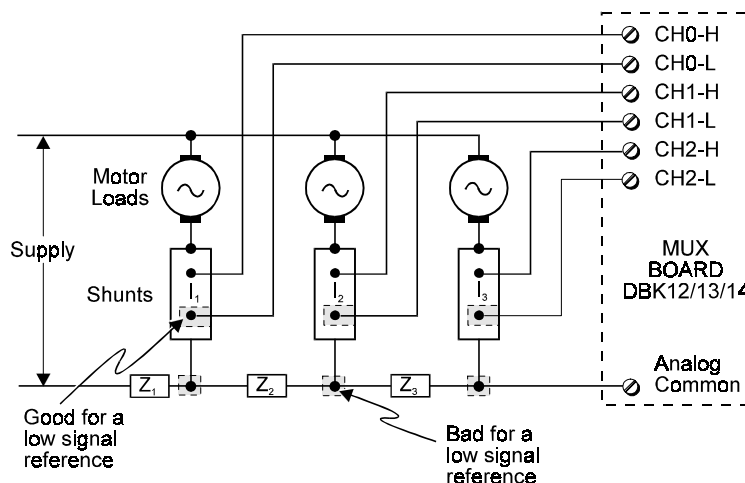
Differential inputs provide attenuation of the common-mode noise. When in this mode, the amplifier sees the voltage differential between the high and low inputs (see figure). Common-mode noise reduction occurs because noise in the high input signal is typically the same as the noise in the low input signal. Because of this phenomena, the voltage difference between the 2 signals remains essentially unaffected by noise spikes, since these spikes appear at the same instant and at the same magnitude in both the high and low input signals. In other words, the noise spikes cancel each other out. As noted earlier, even if these signals were out-of-phase, the noise would still cancel out since the spikes in both signals would be of the same magnitude and polarity.



Note: In the simple example (shown in the figure), the differential between the high and low signals would result in a straight line because the signals are equal in frequency, phase, and magnitude.

Differential Mode, Shunt-Referenced

There are situations in which small voltages need to be measured and the currents flowing in the power supply common will cause measurement errors. As shown in the figure, using the analog common as the reference point will result in errors. These errors are the result of variations in current flow along the common line $[(I_3 * Z_3) + (I_3 \& I_2) * Z_2]$.

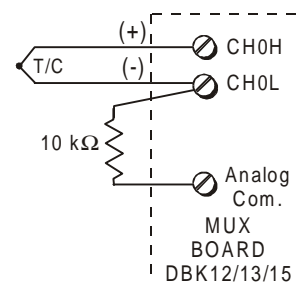


Differential Circuit with Shunt-reference

A way around this problem is to use a differential measurement for each shunt, with the instrument common connected to the supply common. Each input channel will measure the shunt voltage and will reject any voltage in the common wire (common-mode rejection).

Differential Mode, Floating (Isolated from Ground)

Floating-differential measurements are made when low-level signals must be measured in the presence of high levels of common-mode noise (e.g., a non-grounded thermocouple). When the signal source has no direct connection to the system analog common, one must be provided. This can be done by connecting a resistor between one of the two signal lines; usually the lower in potential and common. A resistor of 10 to 100 k Ω is satisfactory (less noise with the lower values).



Floating Differential Circuit

CAUTION

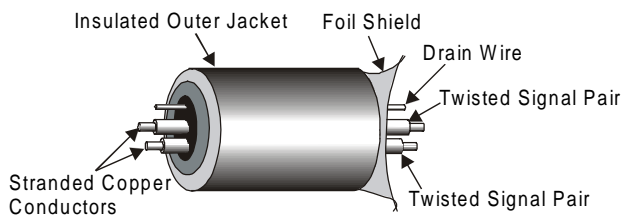


Do not use differential signal hookups with the intent of achieving isolation or circuit protection. Differential signal hookups do not provide isolation, or any other kind of circuit protection.

Connecting Differential Amplifiers

Wire connections must be solid. Loose wires will add noise to the circuit. Low grade unshielded cables will act as antennas, inducing more noise into the system. For this reason, all applications using a differential amplifier require the use of quality signal cables and connectors. The signal cable used should be constructed with:

- Insulated outer jacket
- Twisted signal pairs
- Foil shield
- Drain wire (copper stranded)

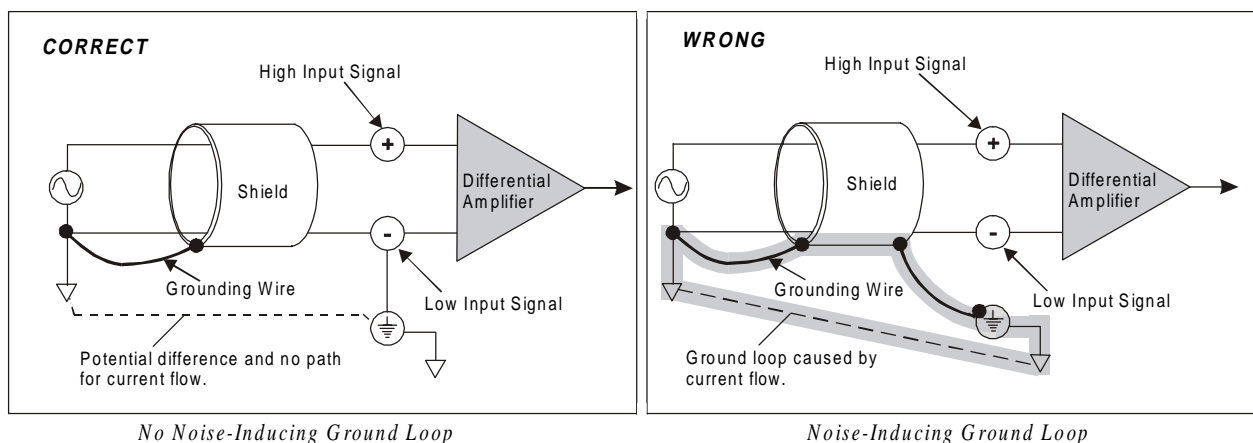


Shielded Signal Cable

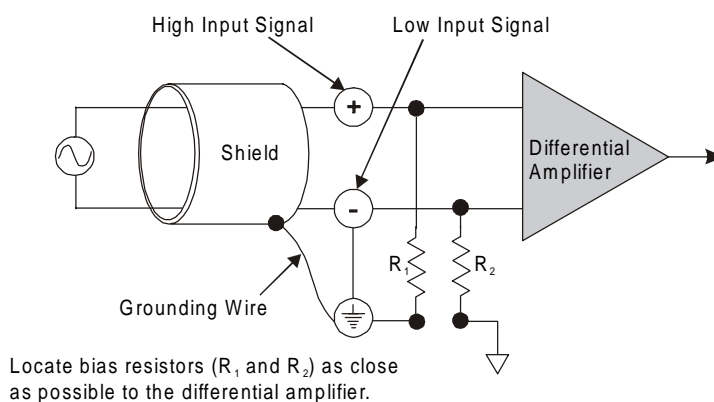
The twisted signal pairs should make use of low impedance, stranded copper conductors; and the foil shield should be of the type using multiple folds.

The copper-stranded drain wire should be considered as part of the shield, and should be connected as described later in this section. Proper use of a quality signal cable will result in a dramatic reduction of noise.

The signal circuit must be connected with only one ground from the shield, as indicated in the left side of the figure below. A mistake, which is often made, is having two grounds (one at each end of the signal shield). Having two grounds, as shown in the right side of the figure, creates a “ground loop.” The ground loop provides a path for current to circulate, causing the induction of noise that can affect the signal.



Aside from eliminating noise-inducing ground loops, the use of bias resistors should also be considered with isolated signal sources. Bias resistors can be used to provide bias current for the positive and negative (high and low) input signals to the differential amplifier. The impedance value of the bias resistors depends on the output impedance of the signal source.



A basic rule of thumb is: *The value of the bias resistor should be at least 10 times the output impedance of the signal source, but less than 1 M Ω .* Bias resistors should be located as close as possible to the differential amplifier. Ground only one end of the signal shield.

Unipolar and Bipolar Measurement

Unipolar signals are always zero or positive. Bipolar signals can be negative or positive and typically range from -5 V to +5 V (-10 to +10 V for the DaqBoard/2000). Using one or the other depends on the signal from the transducer and its signal conditioning. If the DBK (or other signal conditioner) outputs a bipolar signal, then the LogBook or Daq device should be set to bipolar. If the LogBook or Daq device sequencer is using the wrong mode for a channel, that channel's reading may be clipped or in error. Reading a bipolar signal in unipolar mode misses half the signal, and the half received is not converted with optimal resolution.

Note: The different DBKs can use either or both signal modes. Refer to the DBK documentation, and verify that the DBK and the LogBook or Daq device are set to the proper mode for each channel.

12-Bit vs 16-Bit Resolution

An analog-to-digital converter (ADC) converts an analog voltage to a digital number. The digital number represents the input voltage in discrete steps with finite resolution. The number of bits that represent the digital number determines ADC resolution. An n -bit ADC has a resolution of 1 part in 2^n .

- 12-bit resolution is 1 part in 4096 (in binary powers, 2^{12}) and corresponds to 2.44 mV for a 10 V range.
- 16-bit resolution is 1 part in 65,536 (in binary powers, 2^{16}) and corresponds to 0.153 mV in a 10 V range.

System Noise

Electrical noise can present problems even with good equipment; thus, controlling noise is imperative. Some techniques avoid or prevent noise sources from entering the system; other techniques remove noise from the signal.

Laboratory and industrial environments often have multiple sources of electrical noise. An AC power line is a source of 50/60 Hz noise. Heavy equipment (air conditioners, elevators, pumps, etc.) can be a source of noise, particularly when turned on and off. Local radio stations are a source of high-frequency noise, and computers and other electronic equipment can create noise in a multitude of frequency ranges. Thus, an absolute noise-free environment for data acquisition is not realistic. Fortunately, noise-reduction techniques such as averaging, filtering, differential voltage measurement, and shielding are available to reduce noise to an acceptable level.

Note: Additional noise-reduction information is contained in the section, “Signal Modes,” especially in the paragraphs pertaining to connections, signal cables, and ground loops.

Averaging

Averaging is done in software after several samples have been collected. Depending on the nature of the noise, averaging can reduce noise by the square root of the number of averaged samples. Although averaging can be effective, it suffers from several drawbacks. Noise in measurements only decreases as the square root of the number of measurements—reducing RMS noise significantly may require many samples. Thus, averaging is suited to low-speed applications that can provide many samples.

Note: Only random noise is reduced or eliminated by averaging. Averaging will not reduce or eliminate any signal that is periodic.

Analog Filtering

A filter is an analog circuit element that attenuates an incoming signal according to its frequency. A low-pass filter attenuates frequencies above the cutoff frequency. Conversely, a high-pass filter attenuates frequencies below the cutoff. As frequency increases beyond the cutoff point, the attenuation of a single-pole, low-pass filter increases slowly. Multi-pole filters provide greater attenuation beyond the cutoff frequency but may introduce phase (time delay) problems that could affect some applications.

Filter circuits can be active or passive:

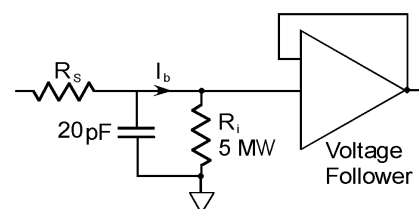
- **Active.** The DBK18 Low-Pass Filter Card has an instrumentation amplifier with variable gain and filter configurations. The DBK18 uses an active 3-pole filter (mostly contained within the UAFF42 ICs) that can be configured as a Butterworth, Bessel, or Chebyshev filter with corner frequencies up to 50 kHz. Filter properties depend on the values of resistors and capacitors. These components can be changed by the user.
- **Passive.** The DBK11 has a prototype area on the PC board for attaching non-powered components such as resistors and capacitors. The user chooses component values to produce the desired properties.

Input and Source Impedance

As shown in the following figure, The input impedance (R_i) combines with the transducer's source impedance (R_s) forming a voltage divider. This divider distorts the voltage being read at the analog-to-digital converter. The actual voltage read is represented by the equation:

$$V_{\text{read}} = V_T \times [R_i / (R_i + R_s)] [V_t - I_b R_s]$$

The low source impedance (R_s) of most signals usually presents no problem. Some transducers, such as piezoelectric types, have high source impedance. These transducer types should be used with a charge-sensitive amplifier of low output impedance.



Crosstalk

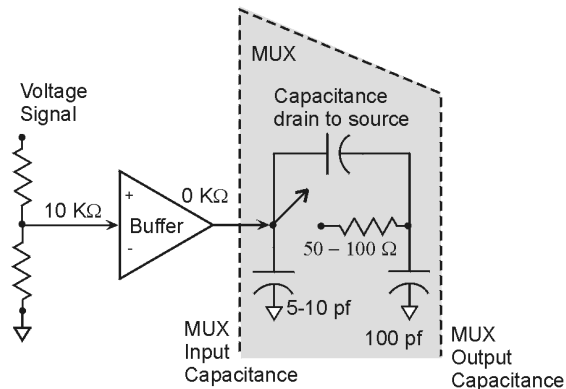
Crosstalk is a type of noise related to source impedance and capacitance, in which signals from one channel leak into an adjacent channel, resulting in interference or signal distortion. The impact of source impedance and stray capacitance can be estimated by using the following equation.

$$T = RC$$

Where **T** is the time constant, **R** is the source impedance, and **C** is the stray capacitance.

High source (transducer) impedance can be a problem in multiplexed A/D systems like the DBK12, DBK13, DBK15. When using more than 1 channel, the channel input signals are multiplexed into the circuit card. The multiplexer samples each signal for only 10 μ s and then switches to the next input signal. A high-impedance input interacts with the multiplexer's stray capacitance and causes crosstalk and inaccuracies in the A/D sample. In such cases, the source impedance should be less than 1 k Ω . If the source impedance exceeds this value, sampling problems can be expected.

A solution to high source impedance in relation to multiplexers involves the use of buffers. The term buffer has several meanings; but in this case, *buffer* refers to an operational amplifier having high input impedance but very low output impedance. In the example illustrated, a buffer has reduced the source impedance from 10 k Ω to effectively 0 k Ω . Placing such a buffer on each channel (between the transducer and the multiplexer) prevents the multiplexer's stray capacitance from combining with the high input impedance (10 k Ω in the example). This use of a buffer also stops transient signals from propagating backwards from the multiplexer to the transducer.



Using DBK Cards and Modules for Signal Conditioning

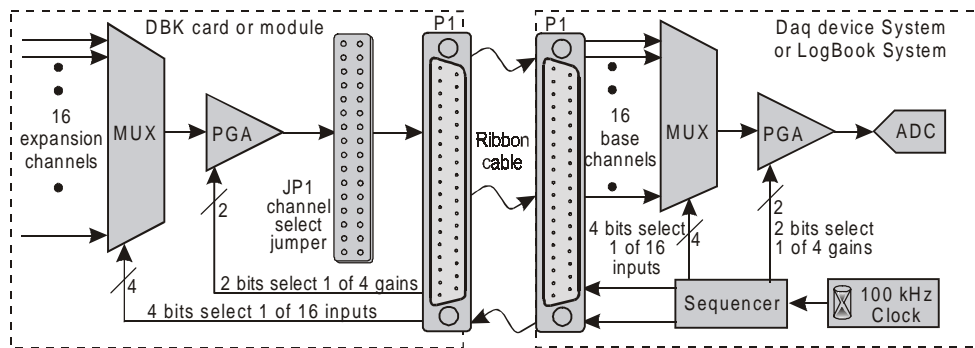
The DBK signal-conditioning units are designed for use with Daq devices and LogBooks. Although the DBK options can be used with ISA or PCI bus-based data acquisition boards from other vendors; they perform best when used with an acquisition device that can dynamically select channel, gain, and range. Dynamic channel and gain/range make it possible to have 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 DaqBooks and LogBooks. This dimensional aspect provides for convenient stacking of modules with each other and with most notebook PCs. Note that most DBK modules have their own power supply.

Channel Control and Expansion

In a Daq device or LogBook system, DBK expansion cards and modules can increase the number of analog input channels from 16 base channels to 256 input channels (16×16). The configuration will vary depending on the DBK's channel capacity; for example, four 4-channel DBKs or two 8-channel DBKs can share the same base channel. As part of the multiplexing scheme, each DBK card provides a single output that must be directed to one of the 16 base channels via the DBK's JP1 jumper setting.



Channel Control and Expansion Block Diagram

The above figure shows the functional parts related to channel control and expansion. An explanation of the diagram follows.

- The **sequencer** selects the channel and gain by controlling multiplexers (MUX) and programmable gain amplifiers (PGA) in either the LogBook or the Daq device and the DBK. The sequencer uses 4 expansion address lines to provide 16 unique channel addresses for each base channel. A 100 kHz clock and user programming of the scan sequence control the sequencer.

Note: DaqBoard/2000 Series [and cPCI Daqboard/2000c] Boards allow for selection of 100 kHz, or 200 kHz internal clock speed via software.

- The **DBK multiplexer** selects 1 of 16 (max) channels as directed by the sequencer. The selected signal travels to the PGA, to the channel-selection jumper, then to the Daq device, or LogBook via P1.
- The **Daq device or LogBook multiplexer** selects 1 of 16 base channels from P1 input lines as directed by the sequencer. The selected signal goes to the PGA and then to the A/D converter (A/D).
- The **PGAs** can vary the gain on a per channel basis as directed by the sequencer. For DBKs with a PGA, the sequencer can combine the gains of the DBK PGA and the LogBook or Daq device PGA for a variety of gain settings.
- The **P1 interface** has a signal line for each of the 16 base channels and control lines for gain setting (pins 5, 6) and sub-channel selection (pins 3, 4, 22, 23).
- The **JP1 channel select jumper** in the DBK can be placed on pins for channel 0 through channel 15. Until the base channel capacity is filled (16 max), multiple cards can use the same JP1 channel setting if their DIP switches are set to identify unique sub-channel card numbers.

Note: The channel select header on DBK17 and DBK18 is labeled J1 instead of JP1.

The following table details how expansion channels are numbered in DaqView and LogView. API Channels are used in Daq devices by third party programs. **Note that API Channels are not used in LogBook systems.**

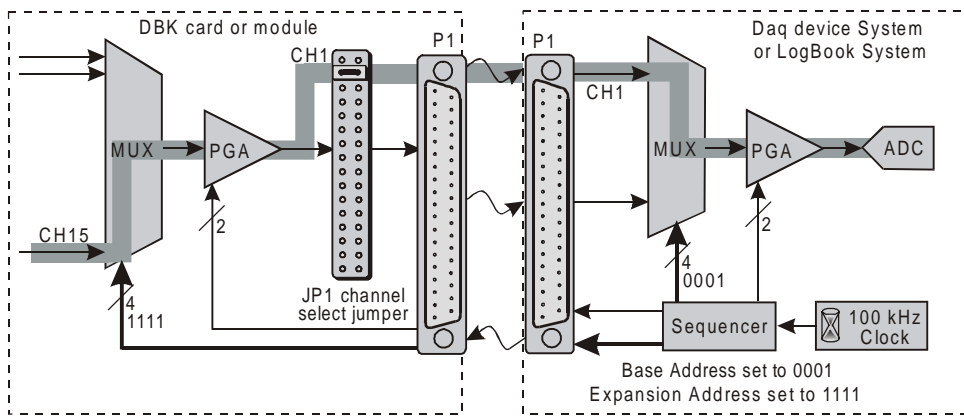
| Channel Numbering | | |
|--|---|-------------|
| DaqView or LogView Channel ¹ | Signal Source | API Channel |
| 0 to 15 | Local channels 0 to 15 ² | 0 to 15 |
| 0-0 to 0-15 | 0 to 15 of A/D exp. card 0 | 16 to 31 |
| 1-0 to 1-15 | 0 to 15 of A/D exp. card 1 | 32 to 47 |
| 2-0 to 2-15 | 0 to 15 of A/D exp. card 2 | 48 to 63 |
| 3-0 to 3-15 | 0 to 15 of A/D exp. card 3 | 64 to 79 |
| 4-0 to 4-15 | 0 to 15 of A/D exp. card 4 | 80 to 95 |
| 5-0 to 5-15 | 0 to 15 of A/D exp. card 5 | 96 to 111 |
| 6-0 to 6-15 | 0 to 15 of A/D exp. card 6 | 112 to 127 |
| 7-0 to 7-15 | 0 to 15 of A/D exp. card 7 | 128 to 143 |
| 8-0 to 8-15 | 0 to 15 of A/D exp. card 8 | 144 to 159 |
| 9-0 to 9-15 | 0 to 15 of A/D exp. card 9 | 160 to 175 |
| 10-0 to 10-15 | 0 to 15 of A/D exp. card 10 | 176 to 191 |
| 11-0 to 11-15 | 0 to 15 of A/D exp. card 11 | 192 to 207 |
| 12-0 to 12-15 | 0 to 15 of A/D exp. card 12 | 208 to 223 |
| 13-0 to 13-15 | 0 to 15 of A/D exp. card 13 | 224 to 239 |
| 14-0 to 14-15 | 0 to 15 of A/D exp. card 14 | 240 to 255 |
| 15-0 to 15-15 | 0 to 15 of A/D exp. card 15 | 256 to 271 |
| | High-speed digital I/O (DaqBook/100/200 and DaqBoard/100A/200A) | 272 |
| ¹ Note: DaqView identifies channels for some DBKs (e.g., DBK4) with a 3-part number for local channel, card, and sub-address. | | |
| ² Note: In differential mode, only channels 0 to 7 are valid. | | |

In addition to the base channel selection on JP1, many DBKs must be set to the sub-channel (or card) number by a DIP-switch labeled SW1 or S1. Since DBKs vary in their channel capacity and identification, refer to the respective DBK document modules.

Example. Refer to the above table (the 1-0 to 1-15 row) and to the following figure. To select **channel 15** on a DBK card that is connected to **base channel 1**:

- set the sequencer expansion address to **1111**
- set the base address to **0001**
- set JP1 to **channel 1**
- Depending on the DBK, set the DIP-switch to identify one of the multiple cards on a single channel.

The corresponding API channel number would be 47; i.e., *DaqView* Channel 1-15 (see table). **Note that API Channels are not used in LogBook systems.**



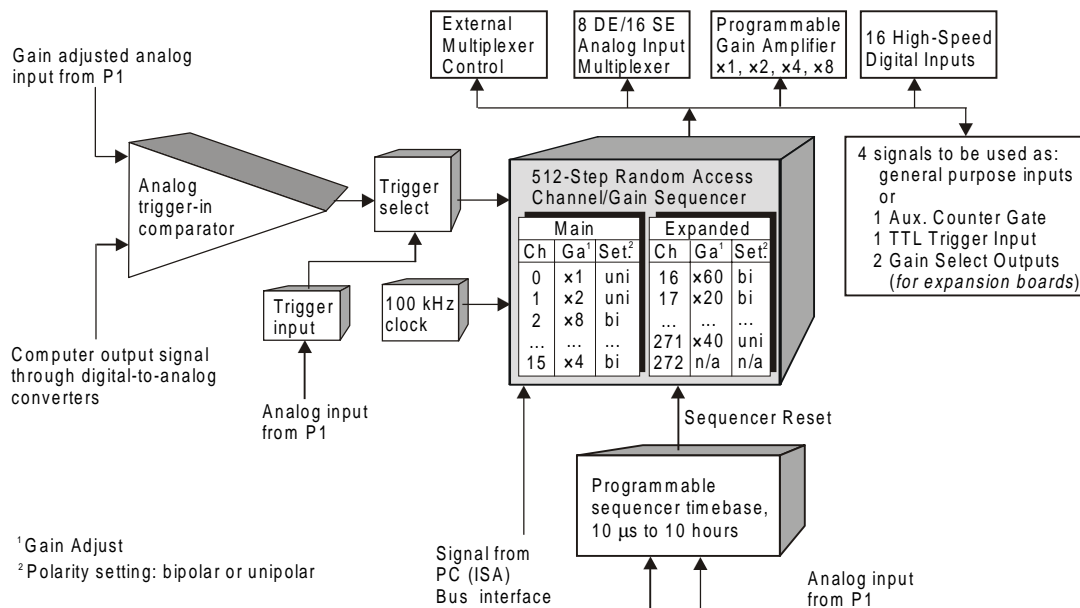
Example Channel Selection

Signal Acquisition

Sequencer

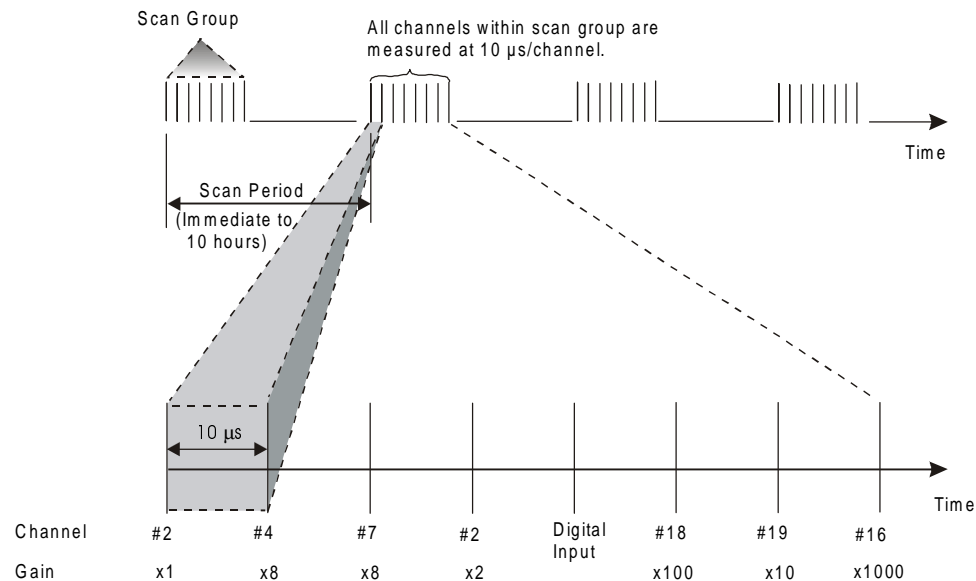
The hardware sequencer performs several functions:

- Allows each channel to have an independent gain.
- Ensures that channels are scanned at exactly $10\ \mu\text{s}$ intervals.
- Allows channels to be accessed randomly in the scan rather than “start channel to end channel”.
- Provides high-speed access to expansion modules.



The LogBook or Daq device holds the scan information in its internal sequencer. On every timebase “tick”, the sequencer steps through all the programmed channels and sets the gain for each channel (also the unipolar/bipolar setting for the Daq device 200 series and DaqBoard/2000 Series [2000c Series board]). Thus, each sample in a scan is read optimally. In addition to controlling the LogBook or the Daq device, the sequencer controls the programmable features on expansion cards via the P1 connector.

This architecture ensures that the same $10\ \mu\text{s}$ sampling ($5\ \mu\text{s}$ or $10\ \mu\text{s}$ for DaqBoard/2000 Series, and cPCI DaqBoard/2000c Series boards) exists for external channels as well as internal channels.



Scan Rate

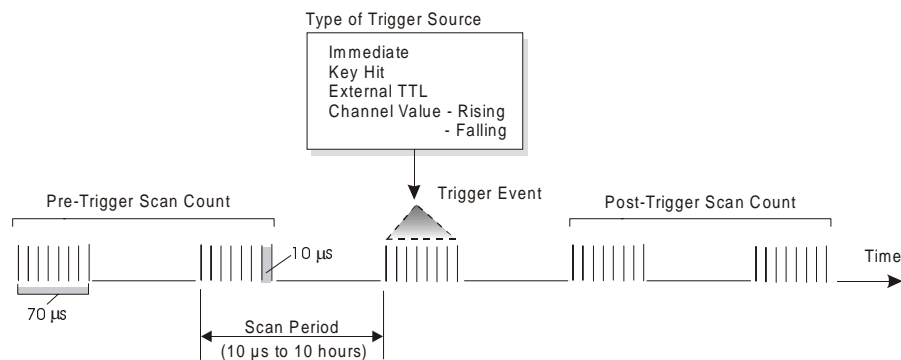
Most sampling of analog signals occurs on the timebase of the LogBook or the Daq device clock. The **scan period** is the time duration between successive scans. Inversely, the **scan rate**, or **scan frequency** is the number of scans per time interval, usually expressed in *scans per second*. The channels within the scan are always sampled at a fixed period of 10 μ s (100 kHz rate), or 5 μ s (200 kHz rate); or 10 μ s for the DaqBoard/2000 Series[/2000c Series]. Generally, the sampling frequency must be greater than twice the highest signal frequency of interest to prevent aliasing error.

Note 1: With DaqBoard/2000 Series and /2000c Series boards, either 100 kHz or 200 kHz can be selected to be used as the internal clock speed. To ensure signal accuracy the 100 kHz speed must be selected when using a DBK12, DBK13, DBK15, DBK19, DBK53 or DBK54 in conjunction with DaqBoard/2000 Series, or cPCI DaqBoard2000c Series boards.

Note 2: Except in the case of a single-channel scan, the sampling rate per channel can be much slower than the scan rate.

Triggering

Triggering controls an acquisition cycle. Once the system is armed, a trigger is required to collect the data. Typically, three data collection parameters are specified: the pre-trigger count, the post-trigger scan count, and the trigger source. The user must determine the triggering requirement based on the nature of the measurement and the amount of data needed to satisfy the system's purpose.



- The **pre-trigger scan count** specifies the number of scans that are to be collected before the trigger point. If the pre-trigger scan count is greater than zero, the system will continuously collect data until the trigger is satisfied. If no pre-trigger scans are required, the system sits idle until the trigger; then, it collects the post-trigger scans before it disarms.

- The **post-trigger scan count** specifies the number of scans to be collected after the trigger point. After the trigger, the post-trigger scans will be collected as programmed and then the system will disarm itself.
- The **trigger source** can be a software command, an external TTL input, etc. An analog input channel on reaching a specified voltage level can be used to trigger the system. (In this mode, an analog output channel is used to internally set the analog threshold—making it unavailable for other use.)

Counter/Timer Functions

Counter/timer circuits are used for counting digital events, timing digital pulses, and generating square waves and pulses. Counter/timer functions are available from the P3 interface.

| Counter/Timer Pins on P3 | | |
|--------------------------|-------------|-----------------|
| Pin | Signal Name | Description |
| 15 | TMR 0 OUT | Timer 0 output |
| 16 | TMR 1 OUT | Timer 1 output |
| 17 | CTR 2 IN | Counter 2 input |
| 18 | CTR 0 IN | Counter 0 input |
| 35 | CTR 3 IN | Counter 3 input |
| 36 | CTR 1 IN | Counter 1 input |

The table shows the P3 pinout for the 4 counter and 2 timer channels.

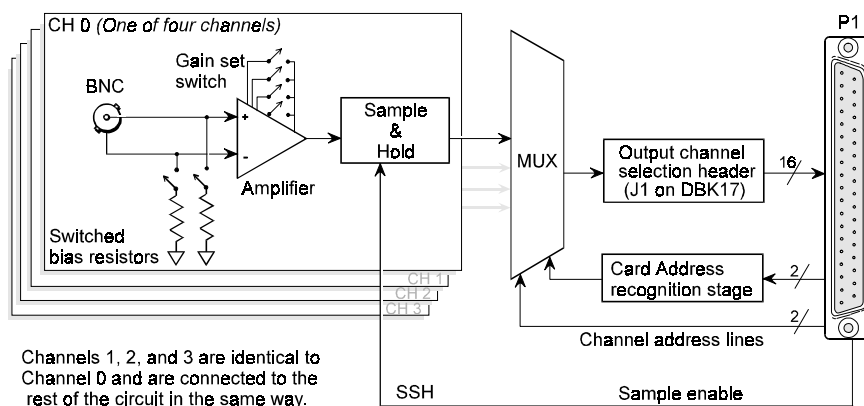
- **IN** - a digital input that increments the counter and provides a timebase for counter operation.
- **OUT** - an output of digital square waves and pulses.

The counter channels can act as 4 independent 16-bit up-counters.

The timer channels are driven by an internal timebase of 1 MHz which can be divided by 1 to 65535 to obtain output frequencies from 15 Hz to 1 MHz.

Simultaneous Sample and Hold (SSH)

Some applications require every channel in a scan group to be read *at the same instant*, as opposed to being read with 10 μ s between channels. Acquiring multiple readings at the same instant is accomplished with **Simultaneous Sample and Hold (SSH)**.



Simultaneous Sample and Hold Circuit, DBK17 Example

An example of an SSH application is as follows. In the example, a performance analysis of an engine needs to indicate cylinder pressure and temperature, piston strain and position, valve position, and engine rpm and vibration—all at the same instant. Simultaneous Sample and Hold (SSH) is a means of obtaining such instantaneous data on multiple channels while avoiding time-skew problems.

The previous figure can be used to understand how SSH is used in the DBK17 SSH Card. The process is as follows:

- Input signals pass through an instrumentation amplifier and into a sample-and-hold stage.
- When the sample enable line goes high, each channel's sample-and-hold stage will "freeze" the current analog value. The values for all channels are separately "latched" within 50 ns of each other.
- The signals are held in a stable condition, while the multiplexer switches through all channels.
- The multiplexer sends the signals [one-by-one] to be digitized by the analog-digital converter (ADC) in the primary data acquisition device.
- The resulting data is a snapshot of conditions at an instant, but the multiplexing and analog-to-digital conversion are spread over a longer time interval.
- The simultaneous sample and hold circuit allows you to gather up to 256 simultaneous samples using sixty-four DBK17s.

Two-Point Calibration of a Temperature Measurement System

Note: In the following text a temperature measurement system consisting of a DaqBook, a DBK19 thermocouple card, and DaqView is referred to. However, it is important to note that the two-point calibration method can be applied to measurement systems that consist of other acquisition devices and software.

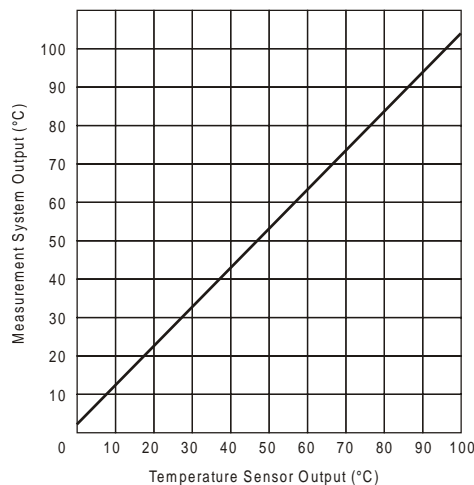
Overview

Two-point calibration makes use of correction constants to eliminate offset and gain errors in a temperature measurement system.

The graph shows an example for a temperature measuring system, with temperature expressed in degrees Celsius.

The sensor output is on the horizontal axis and system response is on the vertical.

The graph illustrates the following bulleted points:



- The system has a linear response. Most thermocouple measurement devices have a software driver, which corrects for the nonlinear output voltage of each thermocouple type. Normally, there is no provision for linearity adjustment by the user.
- The system has an offset at 0°C, which can be eliminated by introducing an offset correction. This is the first point of a two-point correction.
- The system has a gain error at 100°C, which can be eliminated by introducing a gain (slope) correction. This is the second point of a two-point correction.

Suppose you have a temperature measurement system consisting of a DaqBook, a DBK19 thermocouple card, and DaqView data acquisition software. The DBK19 was shipped with a diskette of calibration constants. These calibration constants are specific to the DBK19.

Download instructions for loading the constants into DaqView were included with the DBK19. The constants will improve the accuracy of each DBK19 channel when amplifying the thermocouple's millivolt output, which is read by the DaqBook.

The temperature measurement system, as well as the thermocouple itself, can still have the following types of errors:

- Thermocouple error (departure from performance of an ideal T/C of that type)
- CJC sensor error ($\pm 1^{\circ}\text{C}$ maximum for the DBK19)
- The DaqBook may have small calibration errors

In some applications, it is possible to ignore these sources of errors and still obtain useful results from the temperature measurement system. However, the only way to optimize the performance of the system is to perform an end-to-end calibration. This is done by applying two different temperatures to the thermocouple connection: one temperature is close to 0°C and the other is at approximately full scale.

Then observe the two corresponding temperature readings in DaqView, and use this information to derive the values of “m” and “b” in the line slope equation “mx + b.” In this equation, the value of “m” is usually called the scale, and the value of “b” is usually called the offset. When both the offset and gain correction values are applied, the system errors are reduced to their lowest level.

An Example of Two-Point Calibration

For illustration, suppose the temperature measurement system consists of a DaqBook/100, DBK19 thermocouple card, and DaqView software. (The following calibration procedure also applies to temperature measurement systems made up of similar products, but the discussion is simplified with a specific example.) After setting up the DBK19 card in DaqView as described previously, consider one of the channels on the DBK19, for example, channel 2. Suppose a type T thermocouple connected to this channel. In DaqView, select a sampling frequency of 1 Hz and an averaging factor of 200 so that the readings you get are steady and not fluctuating rapidly.

When you look at this channel in DaqView, the default units are in degrees Celsius. With the acquisition “off”, click on the cell in DaqView in the Units column for channel 2. You will see an engineering units pull-down menu in a dialog box above the spreadsheet area. Click on the down arrow in this dialog box, and then select the “mx + b” option. You will note that the default values of scale and offset are $m=1$ and $b=0$ for engineering units of degrees C. These values need to be changed to ones that will give more accurate temperature readings.

To do this, first place the thermocouple for channel 2 in an environment with a known temperature, for example an ice bath. Click on the Start All Indicators button in DaqView, and observe the Readings column for channel 2. Wait until the reading stabilizes, then write down the number in degrees C. Call this reading the “first actual reading” or RA1, and suppose it is:

$$\text{RA1} = 2.1^{\circ}\text{C}$$

Since this reading was supposed to be 0°C , call the first correct reading RC1:

$$\text{RC1} = 0^{\circ}\text{C}$$

Place the thermocouple for channel 2 in a second known environment. This might be a thermocouple block calibrator or a fluidized sand bath. In this example, assume that the calibrator has been set to 100°C . Observe the reading in DaqView for channel 2, wait until it stabilizes, then write down this number in degrees Celsius. Call this reading the “second actual reading” or RA2, and suppose it is:

$$\text{RA2} = 104^{\circ}\text{C}$$

Since the correct second reading was supposed to be 100°C , write down the correct value as:

$$\text{RC2} = 100^{\circ}\text{C}$$

Stop the monitoring process in DaqView by clicking on the Stop All Indicators button.

Calculation of Scale and Offset

Using the above information, calculate the values of scale (m) and offset (b) that will compensate for the measurement errors (RA1 and RA2). This is possible because the correct and actual readings are related by the (mx + b) equations:

$$\begin{aligned} \text{RC1} &= \text{m(RA1)} + \text{b} \\ \text{and} \\ \text{RC2} &= \text{m(RA2)} + \text{b} \end{aligned}$$

Substituting in the values noted in the above calibration process:

$$\begin{aligned} \text{RC1} &= \text{m(RA1)} + \text{b} \\ 0 &= \text{m(2.1)} + \text{b} \\ \text{RC2} &= \text{m(RA2)} + \text{b} \\ 100 &= \text{m(104)} + \text{b} \end{aligned}$$

Solving for “m” results in:

$$\begin{aligned} 100 &= \text{m(104 - 2.1)} \\ \text{m} &= 100/(104 - 2.1) = 0.9814. \end{aligned}$$

Substituting this value of “m” to solve for the value of “b”:

$$\begin{aligned} 0 &= 0.9814 (2.1) + \text{b} \\ \text{b} &= -2.0608. \end{aligned}$$

Implementing the Scale and Offset Constants in DaqView

To implement the scale and offset constants in DaqView, first make sure that the acquisition process is turned off. Then, click on the cell in the Units column for channel 2. The engineering units pull-down menu above the grid becomes active; click on the down arrow and select the “mx + b” option.

After doing that, you have the ability to enter new numbers for m and b. Perform those entries and click on OK to save them. You can then place the thermocouple back in the ice and fluidized sand baths, observe the new readings, and note the improvement in their accuracy.

If you want optimum accuracy of all channels in the temperature measurement system, you should perform the two-point calibration process for each channel.

Converting Degrees from Celsius to Fahrenheit

Once you have performed the two-point calibration process and determined the scale and offset values for units of degrees Celsius, you can use this information to find the corresponding scale and offset values for other temperature units. In the previous example, the calibration process produced the following equation for “mx + b”, using units of degrees Celsius:

$$\text{RC } (^{\circ}\text{C}) = 0.9814 * \text{RA } (^{\circ}\text{C}) - 2.0608$$

To convert to degrees Fahrenheit, use the relationship:

$$\text{RC } (^{\circ}\text{F}) = 1.8 * \text{RC } (^{\circ}\text{C}) + 32$$

Substituting the latter equation into the former yields:

$$\begin{aligned} \text{RC } (^{\circ}\text{F}) &= 1.8 * [0.9814 * \text{RA } (^{\circ}\text{C}) - 2.0608] + 32 \\ \text{RC } (^{\circ}\text{F}) &= 1.7665 * \text{RA } (^{\circ}\text{C}) + 28.29 \end{aligned}$$

So the new values of m and b are:

$$\begin{aligned} \text{m}' &= 1.7665 \\ \text{b}' &= 28.29 \end{aligned}$$

These are the scale and offset values that you should enter. Note that RA is still in degrees Celsius since the raw reading produced by the data acquisition software is in degrees Celsius.

One Known Temperature Environment

Suppose that you only have one known temperature environment, such as an ice bath. In this case only one parameter in the “mx + b” equation can be determined for system calibration. This is called single-point calibration. Since this is normally the largest source of error, single-point calibration is used to correct the offset.

Using the same information as in the first example, and supposing that the only actual reading available is called RA:

$$RA = 2.1^{\circ}\text{C}$$

Since this reading was supposed to be 0°C , call the correct reading RC:

$$RC = 0^{\circ}\text{C}$$

Substituting these values into the mx + b equation results in:

$$RC = 0 = m(2.1) + b$$

In a single-point calibration, it is assumed that the value of the scale parameter is completely accurate; that is, $m = 1$. Using this information in the above equation results in:

$$\begin{aligned} 0 &= 1(2.1) + b, \\ b &= -2.1 \end{aligned}$$

These are the scale ($m = 1$) and offset ($b = -2.1$) values that should be entered into DaqView.

Use of a Temperature Calibrator

Occasionally, it is impractical or difficult to get physical temperature references for system calibration. The temperature region of interest may be far removed from the example temperatures of 0°C and 100°C . Accurate temperature baths may not be available.

In these cases, you should use a temperature simulation instrument that lets you dial in your thermocouple type. The simulator should also let you set the two calibration temperatures that are correct for your application. The calibrator then generates milli-volt signals into the DBK19 card (or other temperature measurement product). These signals correspond to those that would be generated, by the chosen thermocouple types, at the selected temperatures. A disadvantage of this approach is that thermocouple errors are not corrected or compensated.

For many applications, where the thermocouple is used at lower temperatures, a single-point calibration is sufficient. In general, thermocouples have little error at 0°C . The thermocouple error tends to increase linearly as the temperature increases.

CE Compliance

The European Union (EU) first developed CE standards in 1985. The standards include specifications for safety and for EMI emissions and immunity. Now, all relevant products sold in Europe must meet these standards.

Although CE compliance is not required in the United States, the standards are often adopted by U.S. companies since they improve product safety, reduce noise, and minimize ESD problems.

In contracted and in-house testing, most LogBook and Daq device products met the required specifications. Others were redesigned to meet compliance. In some cases, alternate product versions, shield plates, edge guards, special connectors, and add-on kits were developed. The section, [CE Enhancements for Existing Products](#), located at the end of this chapter, includes examples.



CE-compliant products bear the “CE” mark and include a *Declaration of Conformity* stating the particular specifications and conditions that apply. Test Records and supporting documentation that validate compliance are kept on file at the factory.

CE Standards and Directives

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

- The device must not interfere with radio or telecommunications.
- 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 LogBook or Daq device equipment are listed on the product's Declaration of Conformity and include: CISPR22:1985; EN55022:1988 (Information Technology Equipment, Class A for commercial/industrial use); and EN50082-1:1992 for various categories of EMI immunity.

The safety standard that applies to LogBook and Daq device 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 $\pm 10\%$ 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. A **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 over-voltage, 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 listed in the Declarations of Conformity and in the user documentation. This manual, LogBook, and Daq device hardware use the following Warning and Caution symbols:

(If you see 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.

LogBook and Daq device 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 Existing Products

This section of describes three CE enhancements.

- DBK41/CE
- Edge Guards for the DBK5, DBK8, and DBK44
- BNC Connectors for CE compliance

Edge Guards for DBK5, DBK8, and DBK44

A plastic barrier attached to the end of a DBK card helps prevent access to leads, and to live circuits. The edge guards attach to DBKs (see figure below) that are mounted in a DBK41/CE, with EMI shield plates. The access slot allows insulated wires to pass through the barrier.

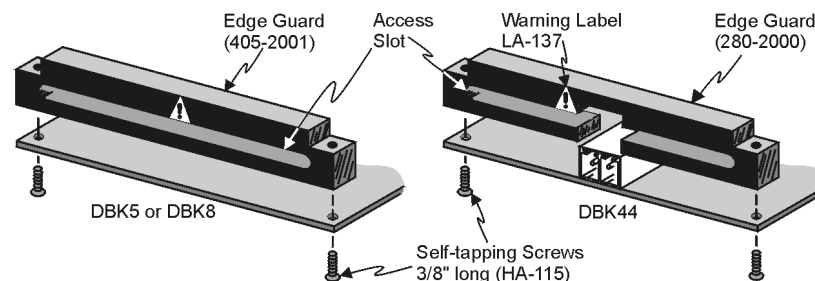


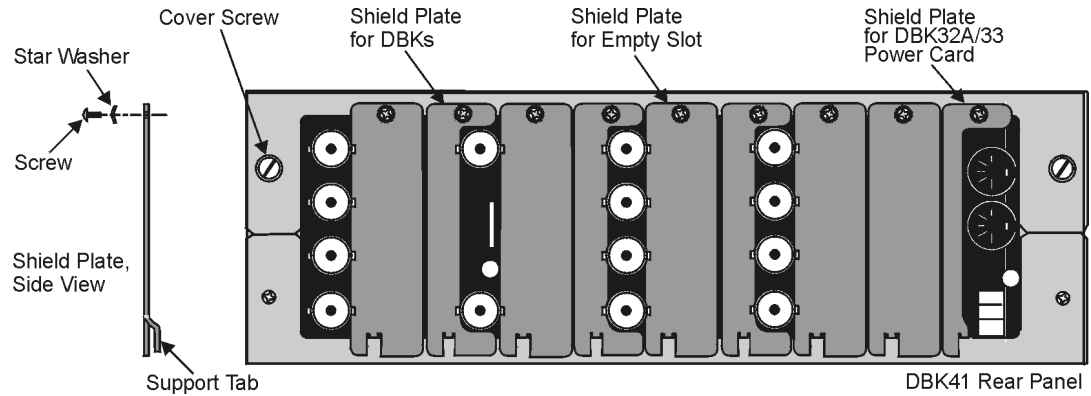
Fig 1. Edge Guard Kit for DBK5 and DBK8
(p/n 232-0806)

Fig 2. Edge Guard Kit for DBK44
(p/n 232-0805)

DBK41/CE

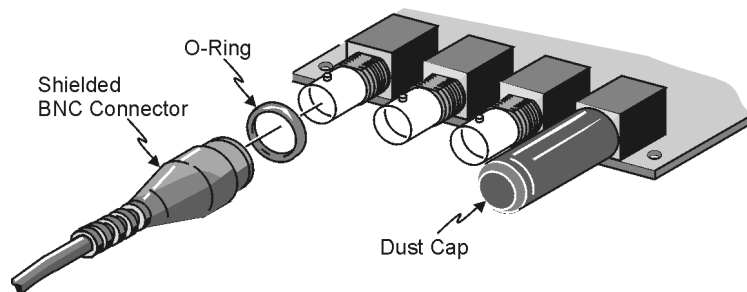
The DBK41/CE includes 3 variations of EMI shield plates that attach to the DBK41 enclosure. Besides acting as an electrical safety barrier, these shields reduce electromagnetic interference (EMI).

Note: The CE kit is included with the DBK41/CE. It can be purchased as an optional accessory for use with DBK41.



BNC Connectors for CE Compliance

Exposed BNC connectors can receive static charges, which can enter the board's circuitry, resulting in ESD damage. To comply with CE standards, BNC connectors must be shielded from high-voltage sources such as static charges.



Some points:

- Cable and connector requirements are stated in the product's *Declaration of Conformity*. These are typically special coaxial cables with insulated end-connectors and rubber O-rings, for example, cable kit p/n 418-0800.
- PVC dust caps (p/n CN-96) must cover all unused BNC connectors.
- Properly installed connectors and dust caps will cover the entire surface of the BNC, i.e., no BNC metal will be exposed.



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Power Supplies and Connectors 2-7



Depending on your system's use of power, you may need to add auxiliary power supplies. The misuse of power can cause equipment damage; so, it is important to read this chapter and related sections of the manual carefully.



Reference Note:

Refer to specific document modules for complete information on the DBKs discussed in this chapter.

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.

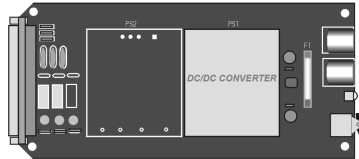
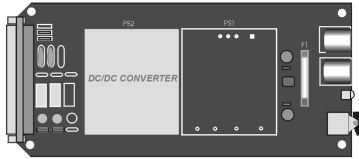
A brief synopsis of the DBK power options follows. Refer to the respective document modules for complete information.



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.

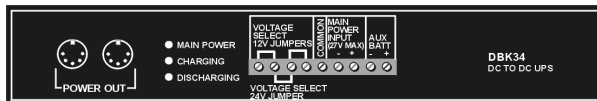
When installed in a DBK10 three-slot expansion chassis, the DBK32A or DBK33 supplies power to the analog DBK [that is to receive power] via a CA-37-x cable.

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 DBK41 slot (other than the leftmost, when viewed from the rear) will power the other cards that are connected to the DBK41's backplane.

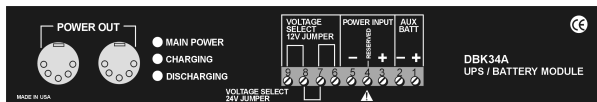
CAUTION



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 / DaqBoard [ISA] / Daq PC-Card User's Manual [p/n 457-0901] 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.

Power Requirements

Foreword

The improper use of power can cause system damage. The following terms are important in regard to understanding your system's power needs.

- **Supply** power for signal conditioning type DBKs comes from either a LogBook or Daq device, a power card, or a module. If needed, the DBK32A or DBK33 can provide additional power to meet DBK power demands. The DBK power supplies work off of low-voltage DC that can come from an AC adapter or from a DC source, such as a car battery.
- **Demand** for power comes from DBK cards and modules [and in some systems, from transducers]. You should use the [*DBK Power Requirement Worktable*](#) (page 2-6) to calculate your system's power needs. After completing the table, compare the total power demand to the supply power.
- **Distribution** of power to most DBKs is via the P1 interface. The DBK41 expansion chassis has a jumper to isolate +5 VDC power from P1. The P1 Pin designations are as follows:

Pin 1: +5 VDC
Pin 2: -15 VDC
Pin 21: +15 VDC
Pin 7: digital ground
Pin 28: analog ground
Pin 29: analog ground

Note: Certain DBK modules have their own internal power supplies and require only 10 to 20 VDC.

LogBook

The LogBook [with no DBKs attached] uses approximately 12 Watts of power. If using battery-power, you can compute operational endurance from your battery's wattxhr rating and the following calculation tables.

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards use 3.5 watts of power (700 mA @ 5 VDC) from their host computer. Power consumption can be up to 10 W with external accessories.

Avoid power cycling the host PC. Wait 10 seconds after powering down the host PC before powering it back on. This will allow any residual voltages to decay enabling the DaqBoard/2000 Series or /2000c Series board to start up in a known good state.

DaqBook, DaqBoard [ISA], and Daq PC-Card

If using power from AC mains (through adapter), you need not worry about Daq device power use. If using battery-power, you can compute operational endurance from the battery's wattxhr rating and power tables. Daq PC-Card and DaqBoard use power from their host PC.

DaqBook uses no power from the PC, but requires DC voltage from an AC-to-DC adapter, or another suitable source. Voltage needs are as follows:

- +7 to +20 VDC for DaqBook/100, DaqBook/112, and DaqBook/120
- +10 to +24 VDC for DaqBook/216
- 9 to +18 VDC for DaqBook/200 and DaqBook/260.

Various AC adapter models support power grids of USA, Europe, Japan, and Asia.

| Daq device Model | Power Required (Watts) |
|-------------------------------------|---|
| DaqBook/100 | 510 mA @ 12 VDC = 6.12 W |
| DaqBook/112 | 360 mA @ 12 VDC = 4.32 W |
| DaqBook/120 | 510 mA @ 12 VDC = 6.12 W |
| DaqBook/200 | 620 mA @ 12 VDC = 7.44 W |
| DaqBook/216 | 600 mA @ 12 VDC = 7.2 W |
| DaqBook/260 | 620 mA @ 12 VDC = 7.44 W |
| DaqBoard/100A | 1330 mA @ 5 VDC = 6.65 W |
| DaqBoard/112A | 970 mA @ 5 VDC = 4.85 W |
| DaqBoard/200A | 1700 mA @ 5 VDC = 8.5 W |
| DaqBoard/216A | 1340 mA @ 5 VDC = 6.7 W |
| DaqBoard/2000 Series board | 700 mA @ 5 VDC = 3.5 W (Note 1) |
| cPCI DaqBoard/2000c Series board | 700 mA @ 5 VDC = 3.5 W (Note 1) |
| Daq PC-Card /112B/216B | Normal Operation: 160 mA @ 5 VDC = 0.8W Power Down Mode: 40 mA @ 5 VDC = 0.2 W |

Note 1: For DaqBoard/2000 Series and /2000c Series boards, consumption can be up to 10 W with external accessories.

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 |
| DaqBoard/2000 Series & /2000c Series | 5000 mW; 5 V at 1 A; ± 15 V at 75 mA each (with exception of DaqBoard/2002 and /2002c) |
| Daq PC-Card/112B | 0 mW |
| Daq PC-Card/216B | 0 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.



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 Options | Voltage Reference | | | Calculation | | |
| | +15 VDC | -15 VDC | +5 VDC | Quantity | x 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 | |
| DBK70*** | <1 mA | <1 mA | <1 mA | | 35 | |
| 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 | | | | | | |
| <p>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.</p> <p>Note 2: DBK2 and DBK5 are not used with LogBook.</p> <p>*** Three asterisks indicate that the DBK is a module with internal power supply; powered separately.</p> | | | | | | |

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.

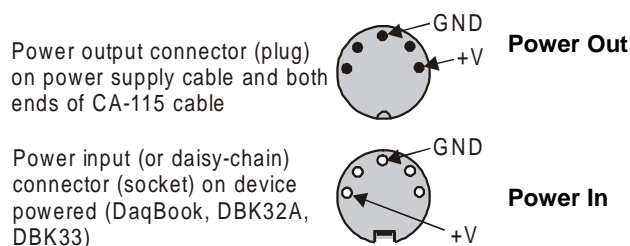
LogBooks - The switching-mode power supply commonly used with LogBook systems uses an input range of 100 VAC to 240 VAC at 50 Hz to 60 Hz. The power supply's output [to the LogBook] is 15 VDC @ 2.7 amps via a DIN5 connector.

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 <i>Switching-Mode Type Power Supply</i> | | 15 VDC @ 900 mA <i>Transformer/Rectifier Type, Unregulated Power Supply</i> | |
|---|--|---|--|
| The DBKs in this column use up to 15 VDC @ 2700 mA. This <i>switching-mode</i> power supply receives power from a 100 to 240 VAC source, at 50 to 60 Hz, and converts it to the required value. | | The DBKs in this column use up to 15 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 |
| DBK70 | Vehicle Network Interface | DBK50 | Isolated High-Voltage Input Module |
| | | DBK51 | Isolated Low-Voltage Input Module |

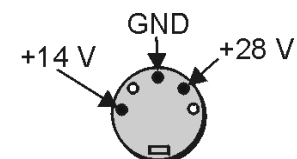
The DIN5 is the system's basic power connector (see the following figure). The CA-115 is a 6-in. cable with a plug (male) DIN5 connector on both ends. The CA-115 is used to connect DBK32As [or DBK33s] in parallel when they are to be powered by the same power supply.



DIN5 Power Connectors

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

Note: The figure at the right 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



| | |
|---|-------------|
| <i>Overview</i> | <i>3-1</i> |
| <i>DaqBook</i> | <i>3-2</i> |
| <i>DaqBoard [ISA-Type]</i> | <i>3-7</i> |
| <i>Daq PC-Card</i> | <i>3-13</i> |
| <i>LogBook</i> | <i>3-15</i> |
| <i>DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards</i> | <i>3-21</i> |

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.

Overview

Primary data acquisition devices such as DaqBooks and DaqBoards are designed to accommodate a wide variety of applications and the number of possible system configurations, when considering all the additive DBK options, is staggering.

Another data acquisition product line, LogBook, can also be enhanced and expanded with the use of optional DBK cards and modules. In addition, LogBook systems can incorporate various options that do not fall within the DBK product line. These LBK options are detailed in the LogBook User's Manual, p/n 461-0901.

This chapter describes the typical connections of DBKs to the primary Daq device, or to a LogBook. Chapter sections begin with the name of the primary device, for example, DaqBook, DaqBoard, or LogBook. Each device section concludes with port connector pinouts.



Reference Note: If you plan to use an expansion chassis for your data acquisition system, refer to the respective document modules for detailed information, e.g., the [DBK10](#), [DBK41](#), and [DBK60](#) document modules.



Reference Notes: For additional information regarding the primary data acquisition devices, and their associated software programs, refer to the following, as applicable:

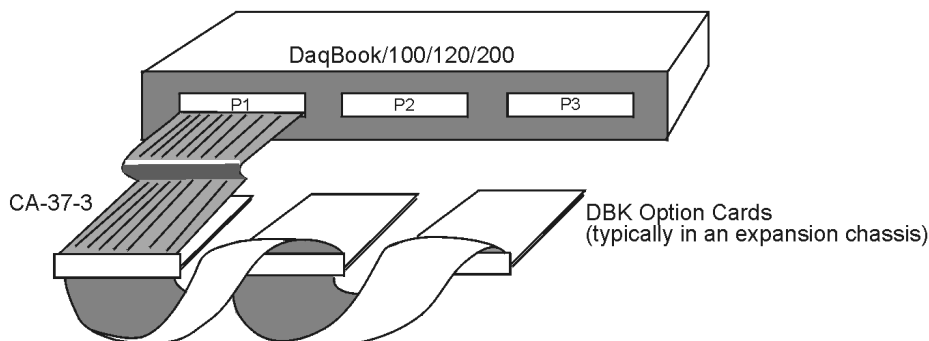
- *DaqBook, DaqBoard [ISA-Type], Daq PC-Card User's Manual – p/n 457-0901*
- *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual – p/n 1033-0901*
- *LogBook User's Manual – p/n 461-0901*



Reference Note: This section pertains to connections and pinouts for DaqBook applications. Additional information can be found in the *DaqBook* section of the *DaqBook*, *DaqBoard [ISA-Type]*, *Daq PC-Card User's Manual* – p/n 457-0901.

DBK option cards connect to a DaqBook, or to a DBK expansion module via a 37-pin (DB37) I/O connector. You can slide a DBK card into the expansion slot of a DaqBook/112, DaqBook/216, or into one of the multiple slots of 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.

Note: If DBK cards are adequately secured and protected, they can be used without an enclosure.



DaqBook Multi-Card Cabling

The P1 connector on the DaqBook, and on each DBK, is a DB37 male connector. Connecting DBKs to a DaqBook is accomplished with a CA-37-x cable, where the x is the number of option cards to be connected; for example, to attach three DBK cards to a DaqBook, a CA-37-3 cable would be used. Such a set up is often referred to as a “daisy-chain.” Note that the CA-37-x cables make use of female DB37 connectors.

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.

The P1 connector can support up to 256 analog input channels.

The DaqBook/100, DaqBook/120, DaqBook/200, and DaqBook/260 have two additional DB37 connectors, P2 and P3.

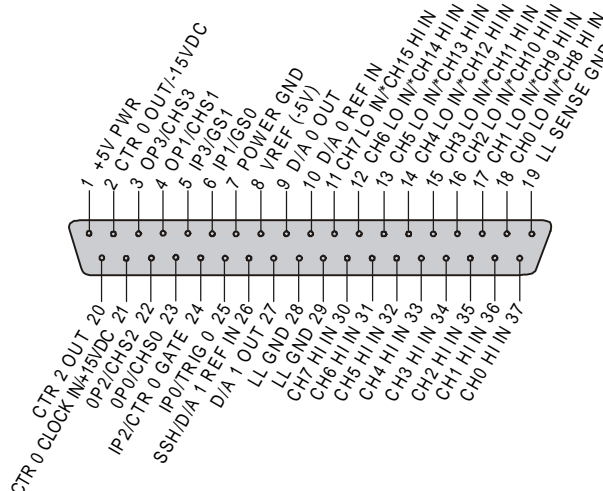
- P2 can support up to 192 digital expansion channels
- P3 can support 1 terminal block card with no expansion.



Reference Note: 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 the following documents as needed.

- [Chapter 4 of this manual, *DBK Set Up in DaqView*.](#)
- The DBK document modules, for hardware configuration aspects that require setup in software.
- *DaqBook*, *DaqBoard[ISA]*, *Daq PC-Card User's Manual*, p/n 457-0901, with emphasis on the *DaqView* document module.

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



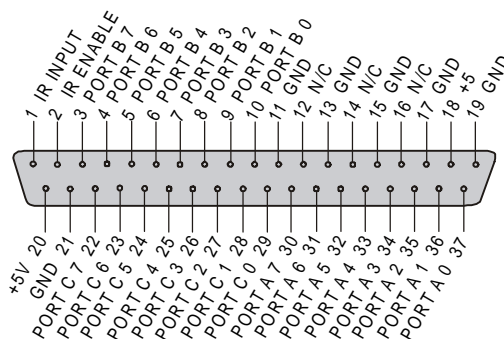
| Pin | Signal Name | Description for P1 Pin Use |
|-----|------------------------|---|
| 1 | +5 PWR | +5 V supply (Refer to Power Management , chapter 2) |
| 2 | CTR 0 OUT/-15 VDC | Counter 0 output (8254 chip)/ -15 V supply (Refer to Power Management , chapter 2) |
| 3 | OP 3/CHS 3 | Digital out bit 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 , chapter 2) |
| 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. "I" indicates the pin can be used for either function but not both at the same time.
- (4) DaqBook P1 is compatible with Metrabyte DAS-16.

This DaqBook P2 interface is available on:

DaqBook/100
DaqBook/120
DaqBook/200
DaqBook/260



| 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 , chapter 2) |
| 19 | GND | Digital ground |
| 20 | +5 V | +5 V supply (Refer to Power Management , chapter 2) |
| 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 |

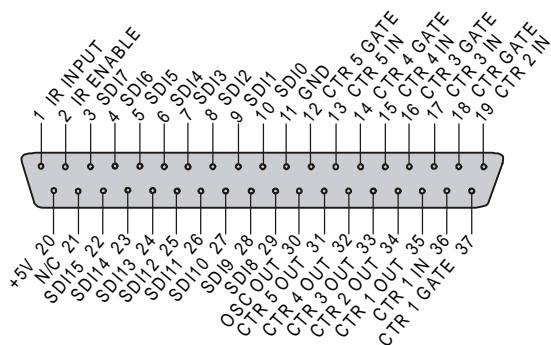
Note: No local lines are available if digital expansion cards are in use.



P2 expansion cables must be kept short for proper operation. Do not exceed 14" per attached DBK card.

This DaqBook P3 interface is available on:

DaqBook/100
DaqBook/120
DaqBook/200
DaqBook/260



| 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 , chapter 2) |
| 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) |

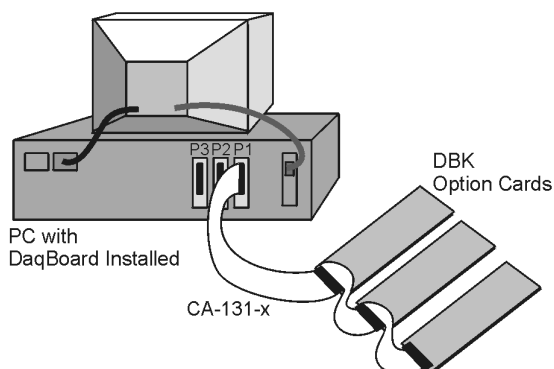


DaqBoard [ISA Type]



Reference Note: This section pertains to connections and pinouts for ISA-type DaqBoard applications. Additional information can be found in the *DaqBook*, *DaqBoard [ISA-Type]*, *Daq PC-Card User's Manual* – p/n 457-0901.

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 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.



DaqBoard [ISA type] Multi-Card Cabling

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



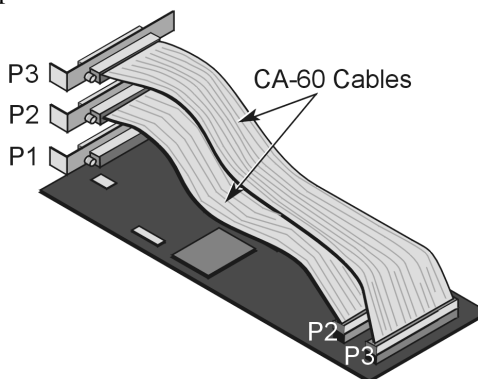
Before connecting DBKs to the DaqBoard, power-down all connected units. Failure to do so could result in damage to the DBK or DaqBoard.

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 16 analog input channels, 2 analog output channels, a 16-bit counter/timer, 4 TTL inputs and outputs, and various signals for driving expansion cards.
- P2 Digital I/O. Provides (3) 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 (5) 16-bit counters and 16 high-speed digital inputs and external interrupt input.

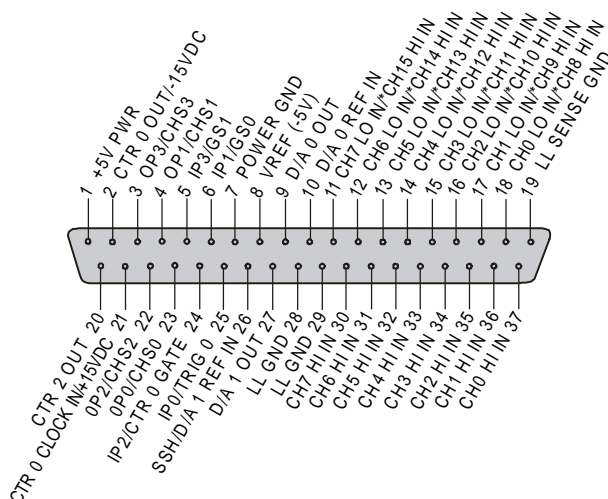
To gain access to the DaqBoard port connectors, signals can be connected via CA-131-x cable through a D-shell 37-pin female connector or a DBK11 screw-terminal option card with component sockets.



Reference Note: 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 the following documents as needed.

- [Chapter 4 of this manual, *DBK Set Up in DaqView*.](#)
- The DBK document modules, for hardware configuration aspects that require setup in software.
- *DaqBook*, *DaqBoard[ISA]*, *Daq PC-Card User's Manual*, p/n 457-0901, with emphasis on the *DaqView* document module.

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



| Pin | Signal Name | Description for P1 Pin Use |
|-----|------------------------|---|
| 1 | +5 PWR | +5 V supply (Refer to Power Management , chapter 2) |
| 2 | CTR 0 OUT/-15 VDC | Counter 0 output (8254 chip)/ -15 V supply (Refer to Power Management , chapter 2) |
| 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 , chapter 2) |
| 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:

- Software configuration commands determine P1 digital I/O pin functions.
- Actual shunt-jumper placement is required to provide ± 15 VDC to expansion cards or disconnect internal DAC references to allow externally selected DAC references.
- Digital I/O is not available with DBKs due to line use for addressing. "I" indicates the pin can be used for either function but not both at the same time.
- DaqBoard [ISA-Type] P1 is compatible with Metrabyte DAS-16.
- This pinout is for ISA-type DaqBoard. For PCI and cPCI type DaqBoards refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000 Series* section.

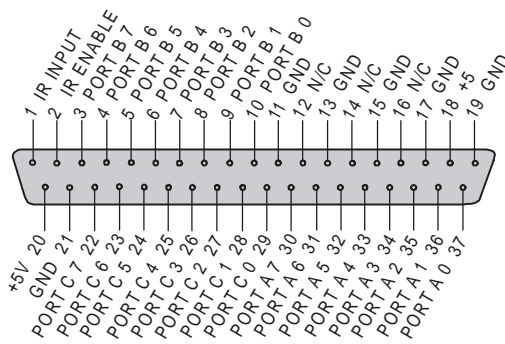
DaqBoard [ISA-Type] P2

Digital I/O

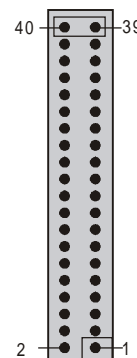


The DaqBoard [ISA-Type] P2 interface is available on:

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 , chapter 2) |
| 19 | GND | Digital ground |
| 20 | +5 V | +5 V supply (Refer to Power Management , chapter 2) |
| 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.

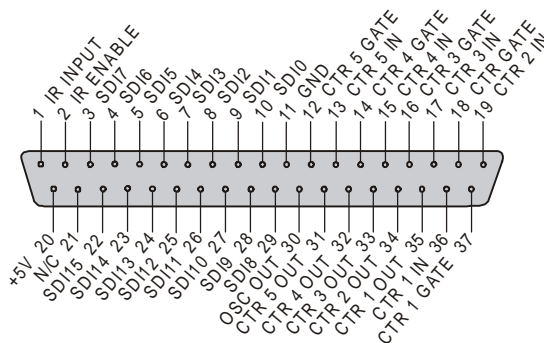


**P2 expansion cables must be kept relatively short to ensure reliable operation.
Do not exceed 14 inches per attached DBK card.**

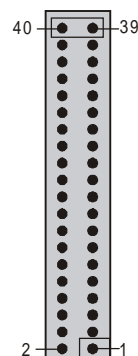


The DaqBoard P3 interface is available on:

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 , chapter 2) |
| 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 - f _{out} (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: This pinout is for ISA-type DaqBoard. For PCI and cPCI type DaqBoards refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000 Series* section of this chapter.



Daq PC-Card



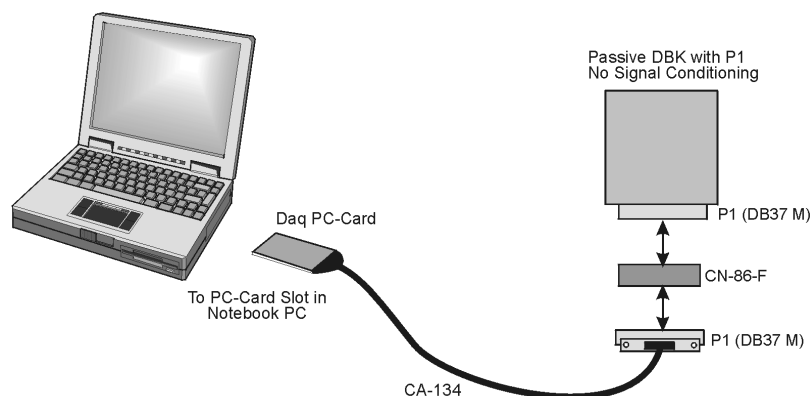
Reference Note: This section pertains to connections and pinouts for Daq PC-Card applications. Additional information can be found in the *DaqBook*, *DaqBoard [ISA-Type]*, *Daq PC-Card User's Manual* – p/n 457-0901.

A CA-134 Interface Cable provides a DB37 P1 connection for the Daq PC-Card. The CA-134 can connect the Daq PC-Card to a single passive card or module. These are:

- DBK1 – 16 Connector BNC Module
- DBK11A – Screw Terminal Option Card
- DBK40 – BNC Analog Interface

A pin-out for the Daq PC-Card's P1 connector is located on the following page.

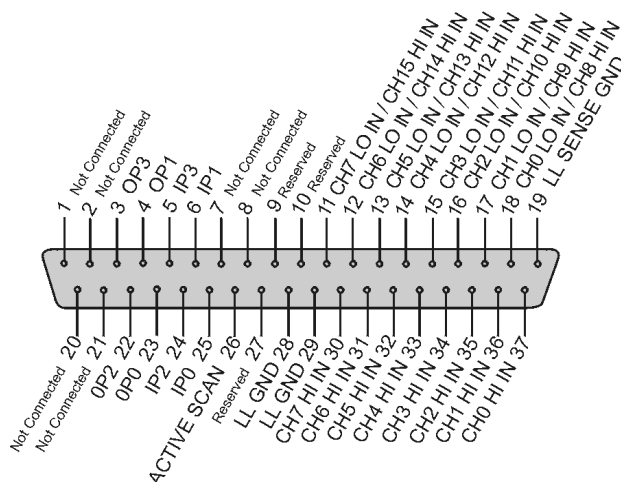
Note: A CN-86-F (dual-socket type, DB37 connector) is used as an interface to connect CA-134's P1 connector to the DBK's P1 connector, as indicated in the following figure. CN-86-F is included with orders for CA-134.



Daq PC-Card Cabling



Do not use the Daq PC-Card in conjunction with signal-conditioning type DBK cards. The Daq PC-Card is only intended for connections to a P1 connector of a single “passive” DBK card or module. A passive DBK card or module is one that provides a desired connectivity (such as BNCs or screw terminals), but performs no signal conditioning.



| Pin | Signal Name | Description for P1 Pin Use in the Daq PC-Card |
|-----|--------------------------|--|
| 1 | Not Connected | -- |
| 2 | Not Connected | -- |
| 3 | OP 3 | Digital out bit 3 |
| 4 | OP 1 | Digital out bit 1 |
| 5 | IP 3 | Digital in bit 3 |
| 6 | IP 1 | Digital in bit 1 |
| 7 | Not Connected | -- |
| 8 | Not Connected | -- |
| 9 | Reserved | -- |
| 10 | Reserved | -- |
| 11 | CH 7 LO IN / CH 15 HI IN | Ch 7 LO IN (differential mode), or Ch 15 HI IN (single ended mode) |
| 12 | CH 6 LO IN / CH 14 HI IN | Ch 6 LO IN (differential mode), or Ch 14 HI IN (single ended mode) |
| 13 | CH 5 LO IN / CH 13 HI IN | Ch 5 LO IN (differential mode), or Ch 13 HI IN (single ended mode) |
| 14 | CH 4 LO IN / CH 12 HI IN | Ch 4 LO IN (differential mode), or Ch 12 HI IN (single ended mode) |
| 15 | CH 3 LO IN / CH 11 HI IN | Ch 3 LO IN (differential mode), or Ch 11 HI IN (single ended mode) |
| 16 | CH 2 LO IN / CH 10 HI IN | Ch 2 LO IN (differential mode), or Ch 10 HI IN (single ended mode) |
| 17 | CH 1 LO IN / CH 9 HI IN | Ch 1 LO IN (differential mode), or Ch 9 HI IN (single ended mode) |
| 18 | CH 0 LO IN / CH 8 HI IN | Ch 0 LO IN (differential mode), or Ch 8 HI IN (single ended mode) |
| 19 | L.L. GND | Low level ground (analog ground; for use with analog inputs) |
| 20 | Not Connected | -- |
| 21 | Not Connected | -- |
| 22 | OP 2 | Digital output bit 2 |
| 23 | OP 0 | Digital output bit 0 |
| 24 | IP 2 | Digital input bit 2 |
| 25 | IP 0 | Digital input bit 0 |
| 26 | Active Scan | Active Scan |
| 27 | Reserved | -- |
| 28 | L.L. GND | Low level ground (analog ground; for use with analog inputs) |
| 29 | L.L. GND | Low level ground (analog ground; for use with analog inputs) |
| 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) |



- (1) Only use Daq PC-Card with passive DBK cards or modules, e.g., DBK1, DBK11A, DBK40.
- (2) No power or analog output is available from P1.



Reference Note: This section pertains to connections and pinouts for LogBook applications. Additional information can be found in the *LogBook User's Manual – p/n 461-0901*.

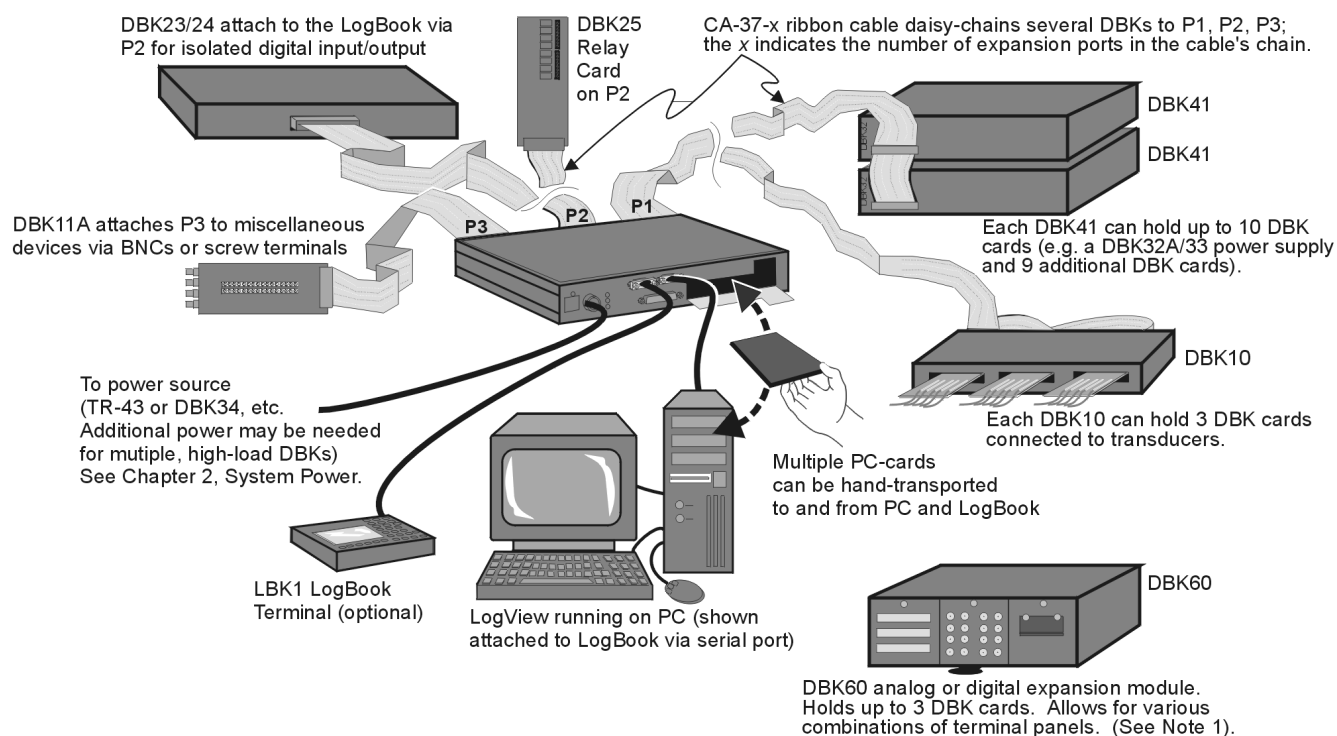
LogBooks have three port connectors: P1, P2, and P3. For **LogBook/300**, these connectors are located on the rear panel. For **LogBook/360**, they are on the front panel as discussed in the following note. Connector pinouts for LogBook begin on [page 3-17](#).

Note: LogBook/360 actually has two sets of P1, P2, and P3 connectors, one internal set located on the motherboard, and one external set located on the unit's front panel. LogBook/360's front panel P1, P2, and P3 connectors connect to the motherboard's P1, P2, and P3 via ribbon cables.

Most system expansions stem from the 37-pin Signal I/O ports P1, P2, and P3. Note that LogBook/360 combines the features and capabilities of LogBook/300 with those of a DBK60 expansion chassis.

- **P1.** Each of 16 main (base) channels can support up to 16 sub-channels and thereby provide expansion up to 256 analog input channels. LogBook's channel sequencer scans expansion channels at the same high speed as the base channels. DBKs can be daisy-chained off the P1 connector of LogBook or an expansion module. Some DBKs add another level of multiplexing and programmable gain to each channel, and setting channel parameters properly sometimes requires both hardware and software setup.
- **P2.** The Digital I/O port can accommodate the DBK20/21 (digital I/O cards), DBK23/24 (isolated digital input/output chassis), DBK25 (8-channel relay card), and other compatible devices; up to 208 digital I/O lines.
- **P3.** The Pulse Frequency port can be used for analog output and other uses. A DBK11A provides for easy signal connection via screw terminals or optional BNC connectors.

The following figure, taken from the LogBook User's Manual (p/n 461-0901) illustrates various expansion possibilities. Note that additional options exist. DBK expansion options are detailed in document modules.



A Few Possible Expansion Configurations

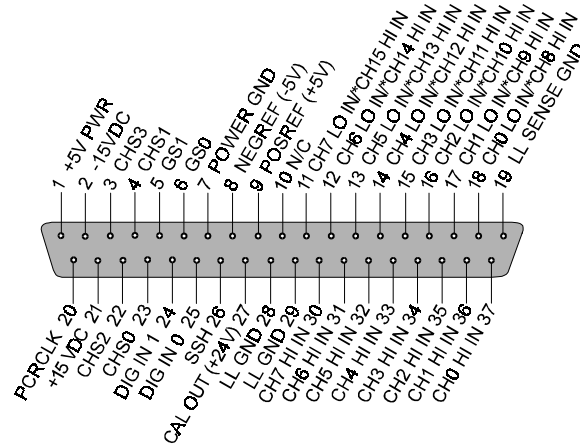
Note 1: LogBook/360 (not shown) combines the features and capabilities of LogBook/300 with those of a DBK60.



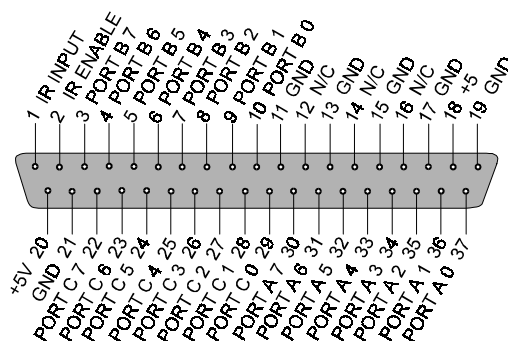
Reference Note: You must set up LogView for the particular DBKs in your system. If you are unfamiliar with the method of setting up DBKs in LogView, or if you need a refresher, refer to the following documents as needed.

- [Chapter 5 of this manual, *DBK Set Up in LogView*.](#)
- The DBK document modules, for hardware configuration aspects that require setup in software.
- *LogBook User's Manual*, p/n 461-0901, with emphasis on the LogView document module.

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

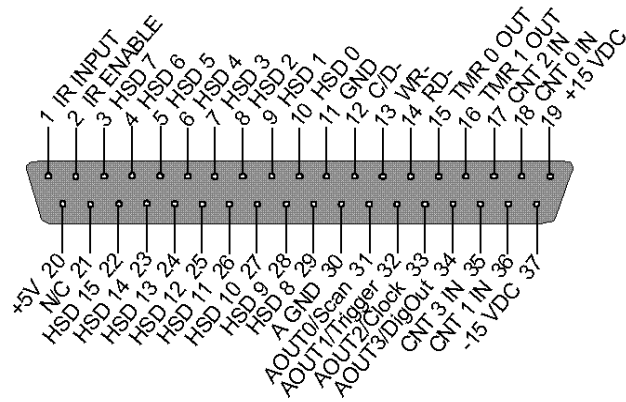


| Pin | Signal Name | Description for P1 Pin Use |
|-----|------------------------|--|
| 1 | +5 PWR | +5 V supply @ 0.100 A |
| 2 | -15 VDC with diode | -15 V supply @ 0.150 A |
| 3 | CHS 3 | Channel select line for expansion cards |
| 4 | CHS 1 | Channel select line for expansion cards |
| 5 | GS 1 | Gain select line for expansion cards |
| 6 | GS 0 | Gain select line for expansion cards |
| 7 | POWER GND | Digital ground |
| 8 | NEGREF (-5 V) | -5.0000 VDC @ 0.005 A reference used for various DBKs |
| 9 | POSREF (+5 V) | +5.0000 VDC @ 0.005 A reference used for calibration with optional 4-channel D/A board |
| 10 | N/C | No Connection |
| 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 | PCRCLK | Pacer clock output/input |
| 21 | +15 VDC with diode | +15 V supply @ 0.150 A |
| 22 | CHS 2 | Channel select line for expansion cards |
| 23 | CHS 0 | Channel select line for expansion cards |
| 24 | DIG IN 1 | Digital input bit 1 |
| 25 | DIG IN 0 | External TTL trigger input |
| 26 | SSH | Simultaneous Sample and Hold Output |
| 27 | CAL24 | Calibration output (+24 V @ 0.010 A) |
| 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) |



| 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 @ 0.100 A |
| 19 | GND | Digital ground |
| 20 | +5 V | +5 V supply @ 0.100 A |
| 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.



| Pin | Signal Name | Description for P3 Pin Use |
|-----|-----------------|---|
| 1 | IR INPUT | Interrupt line input |
| 2 | IR ENABLE | Interrupt line enable |
| 3 | HSD 7 | High-speed digital I/O bit 7 (low byte) |
| 4 | HSD 6 | High-speed digital I/O bit 6 (low byte) |
| 5 | HSD 5 | High-speed digital I/O bit 5 (low byte) |
| 6 | HSD 4 | High-speed digital I/O bit 4 (low byte) |
| 7 | HSD 3 | High-speed digital I/O bit 3 (low byte) |
| 8 | HSD 2 | High-speed digital I/O bit 2 (low byte) |
| 9 | HSD 1 | High-speed digital I/O bit 1 (low byte) |
| 10 | HSD 0 | High-speed digital I/O bit 0 (low byte) |
| 11 | GND | Digital ground |
| 12 | C/D- | |
| 13 | WR- | |
| 14 | RD- | |
| 15 | TMR 0 OUT | Timer 0 output |
| 16 | TMR 1 OUT | Timer 1 output |
| 17 | CNT 2 IN | Counter 2 input |
| 18 | CNT 0 IN | Counter 0 input |
| 19 | +15 VDC | +15 V supply @ 0.050 A |
| 20 | +5 V | +5 V supply @ 0.100 A |
| 21 | N/C | Pin not connected/not used |
| 22 | HSD 15 | High-speed digital I/O bit 15 (high byte) |
| 23 | HSD 14 | High-speed digital I/O bit 14 (high byte) |
| 24 | HSD 13 | High-speed digital I/O bit 13 (high byte) |
| 25 | HSD 12 | High-speed digital I/O bit 12 (high byte) |
| 26 | HSD 11 | High-speed digital I/O bit 11 (high byte) |
| 27 | HSD 10 | High-speed digital I/O bit 10 (high byte) |
| 28 | HSD 9 | High-speed digital I/O bit 9 (high byte) |
| 29 | HSD 8 | High-speed digital I/O bit 8 (high byte) |
| 30 | AGND | Analog ground |
| 31 | AOUT0 / Scan | Analog output 0, optional LBK2: 16-bit, 100 kHz, ± 10 VDC DAC |
| 32 | AOUT1 / Trigger | Analog output 1, optional LBK2: 16-bit, 100 kHz, ± 10 VDC DAC |
| 33 | AOUT2 / Clock | Analog output 2, optional LBK2: 16-bit, 100 kHz, ± 10 VDC DAC |
| 34 | AOUT3 / DigOut | Analog output 3, optional LBK2: 16-bit, 100 kHz, ± 10 VDC DAC |
| 35 | CNT 3 IN | Counter 3 input |
| 36 | CNT 1 IN | Counter 1 input |
| 37 | -15 VDC | -15 V supply @ 0.050 A |

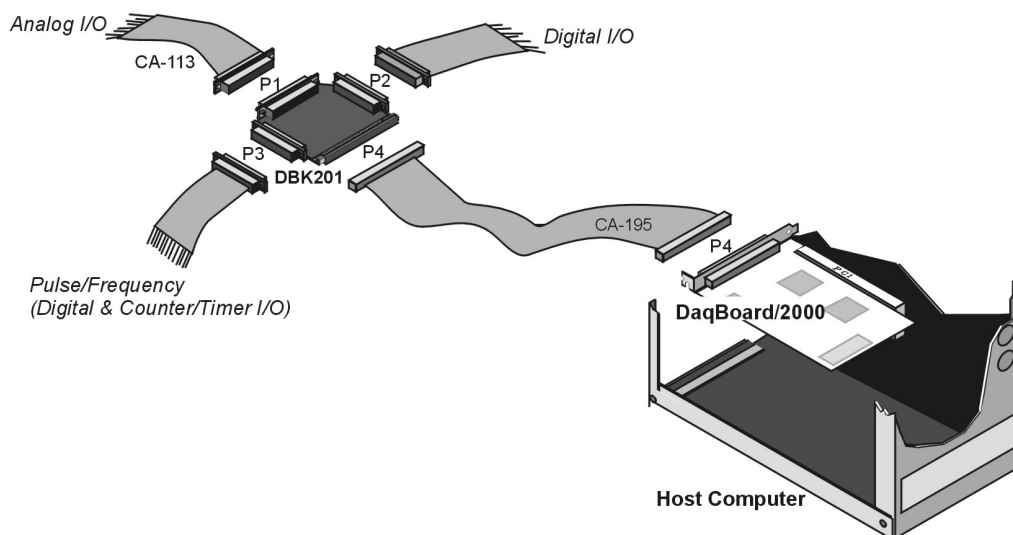


DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards



Reference Note: This section pertains to connections and pinouts for DaqBoard/2000 Series and /2000c Series Boards. Additional information can be found in the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual*, p/n 1033-0901.

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards communicate [external from the host PC] through the board's 100-pin P4 connector. Typically a DBK200 Series P4-adapter is used to provide one or more DB37 connectors (P1, P2, P3).



Using a DBK201 P4-to-P1/P2/P3 Adapter

The following matrix provides a quick comparison of the DBK200 Series adapter boards. Details for each board are provided in the DBK200 Series document modules.

| DBK200 Series, Adapter Board Matrix | | | | | | | |
|-------------------------------------|-----------------|-----------------|-----------------------------------|-----|-------------------------|-----------------------------|---|
| DBK | P1 Analog | P2 Digital | P3 Pulse, Freq., Digital | P4 | Screw Term- inals | Special Features | Comments |
| 200 | Yes | No | No | Yes | No | No | Analog I/O use only. |
| 201 | Yes | Yes | Yes | Yes | No | No | Like DBK209, except for form-factor. |
| 202 203 204 | Yes | Yes | 40-pin header for P3 | Yes | Yes | Custom RC Filter Setup. | DBK202 is a bare board. DBK203 consists of a DBK202 mounted in a chassis. DBK204 consists of a DBK203 and a CA-209 CE cable kit. |
| 205 | No | No | 12 screw- term. | Yes | Yes | No | Only used with DaqBoard/2003 or /2003c. Can plug directly into P4. Screw terminals are related to P3. |
| 206 | Yes | Yes | Yes | Yes | Yes | No | Similar to DBK202, but has a different form-factor and has no RC filter setup. |
| 207 207/CJC | Yes (Qty. 2) | No | No | Yes | Yes | Can carry 5B modules. | Supports 5B-compatible Analog I/O modules. DBK207/CJC includes Cold Junction Compensation. Includes two P1 connectors. Screw terminals are for 5B module connections. |
| 208 | No | Yes (Qty. 2) | No | Yes | Yes | Can carry relay modules. | Supports Opto-22 compatible Solid-State-Relay (SSR) digital modules. Includes two P2 connectors. |
| 209 | Yes | Yes | Yes | Yes | No | No | Like DBK201, except for form-factor. |



Reference Note: DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards typically connect to data acquisition I/O cards via P4 100-pin adapters. Refer to the *DBK200 Series* and other DBK document modules, as applicable, prior to connecting a DBK to a DaqBoard/2000 Series or /2000c Series board.



Reference Note: 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 the following documents as needed.

- [Chapter 4 of this manual, *DBK Set Up in DaqView*.](#)
- The DBK document modules, for hardware configuration aspects that require setup in software.
- *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual*, p/n 1033-0901, with emphasis on the *DaqView* document module.

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

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.

DBK200 Series Pinouts

The P1, P2, and P3 connectors discussed in association with the DBK200 Series are subset connectors of the 100-pin P4 connector found on the DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards.

Note that DBK205, used with DaqBoard/2003, makes use of a Terminal Block (TB1). DBK205 terminals are called out in the DBK205-dedicated section of the *DBK200 thru DBK206, Adapter DBKs with P4* document module.

CAUTION

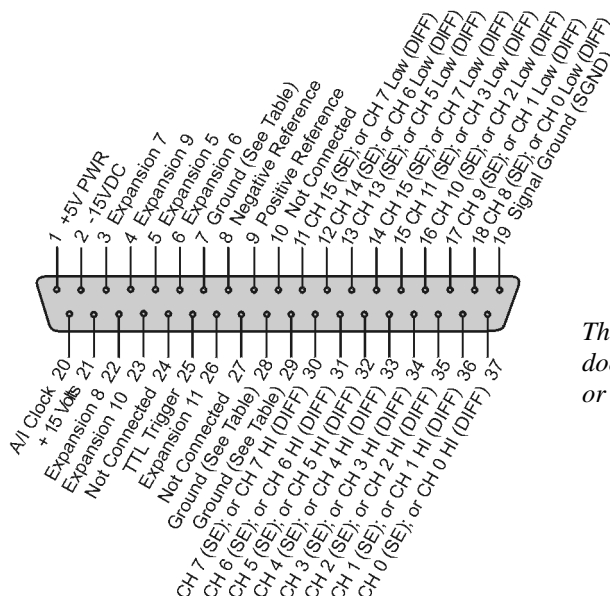


Do not confuse connectors. Ensure that you only connect P1 I/Os to P1, P2 I/Os to P2, and P3 I/Os to P3. Improper connection may result in equipment damage.

P1

The P1 DB37 connector is obtained with the use of one of the following:

DBK200
DBK201
DBK202
DBK203
DBK204
DBK206
DBK207
DBK207/CJC
DBK209



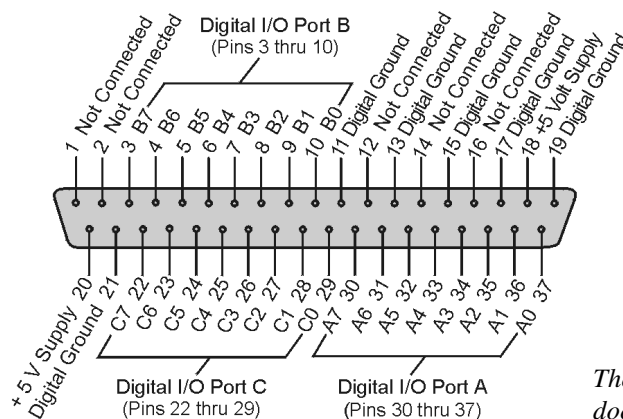
The P1 DB37 connector does not apply to DBK205 or to DBK208.

| Pin | Signal Name | Description for P1 Pin Use | P4 Correlation |
|-----|-----------------------------|---|----------------|
| 1 | +5 Volts | Expansion +5 V power (Refer to Power Management , chapter 2) | A1 |
| 2 | -15 Volts | Expansion -15 VDC power (Refer to Power Management , chapter 2) | A48 |
| 3 | Expansion 7 | Digital OUT, external ADDRESS select bit 3 | B32 |
| 4 | Expansion 9 | Digital OUT, external ADDRESS select bit 1 | B33 |
| 5 | Expansion 5 | Digital OUT, external GAIN select bit 1 | B31 |
| 6 | Expansion 6 | Digital OUT, external GAIN select bit 0 | A32 |
| 7 | Ground | Common See Ground Correlation Tables, page 3-30. | ← |
| 8 | Negative Reference | Analog, -5 V reference | A36 |
| 9 | Positive Reference | Analog +5V reference | B35 |
| 10 | Not Connected | N/A | N/A |
| 11 | CH 15 (SE), or CH 7 LO DIFF | Ch 15 HI IN (single-ended mode) / Ch 7 LO IN (differential mode) | B36 |
| 12 | CH 14 (SE), or CH 6 LO DIFF | Ch 14 HI IN (single-ended mode) / Ch 6 LO IN (differential mode) | A38 |
| 13 | CH 13 (SE), or CH 5 LO DIFF | Ch 13 HI IN (single-ended mode) / Ch 5 LO IN (differential mode) | B39 |
| 14 | CH 12 (SE), or CH 4 LO DIFF | Ch 12 HI IN (single-ended mode) / Ch 4 LO IN (differential mode) | A41 |
| 15 | CH 11 (SE), or CH 3 LO DIFF | Ch 11 HI IN (single-ended mode) / Ch 3 LO IN (differential mode) | B42 |
| 16 | CH 10 (SE), or CH 2 LO DIFF | Ch 10 HI IN (single-ended mode) / Ch 2 LO IN (differential mode) | A44 |
| 17 | CH 9 (SE), or CH 1 LO DIFF | Ch 9 HI IN (single-ended mode) / Ch 1 LO IN (differential mode) | B45 |
| 18 | CH 8 (SE), or CH 0 LO DIFF | Ch 8 HI IN (single-ended mode) / Ch 0 LO IN (differential mode) | A47 |
| 19 | Signal Ground (SGND) | Sense Common (SGND) | A45 |
| 20 | A/I Clock | External ADC Pacer Clock Input / Internal ADC Pacer Clock Output | B26 |
| 21 | +15 Volts | Expansion +15 V power (Refer to Power Management , chapter 2) | B48 |
| 22 | Expansion 8 | Digital OUT, external ADDRESS select bit 2 | A33 |
| 23 | Expansion 10 | Digital OUT, external ADDRESS select bit 0 | A34 |
| 24 | Not Connected | N/A | N/A |
| 25 | TTL Trigger | Digital IN, External TTL Trigger Input | A27 |
| 26 | Expansion 11 | Digital OUT, Simultaneous sample and hold (SSH) | B34 |
| 27 | Not Connected | N/A | N/A |
| 28 | Ground | Common See Ground Correlation Tables, page 3-30. | ← |
| 29 | Ground | Common See Ground Correlation Tables, page 3-30. | ← |
| 30 | CH 7 (SE), or CH 7 HI DIFF | Ch 7 IN (single-ended mode) / Ch 7 HI IN (differential mode) | A37 |
| 31 | CH 6 (SE), or CH 6 HI DIFF | Ch 6 IN (single-ended mode) / Ch 6 HI IN (differential mode) | B38 |
| 32 | CH 5 (SE), or CH 5 HI DIFF | Ch 5 IN (single-ended mode) / Ch 5 HI IN (differential mode) | A40 |
| 33 | CH 4 (SE), or CH 4 HI DIFF | Ch 4 IN (single-ended mode) / Ch 4 HI IN (differential mode) | A33, B41 |
| 34 | CH 3 (SE), or CH 3 HI DIFF | Ch 3 IN (single-ended mode) / Ch 3 HI IN (differential mode) | A43 |
| 35 | CH 2 (SE), or CH 2 HI DIFF | Ch 2 IN (single-ended mode) / Ch 2 HI IN (differential mode) | B44 |
| 36 | CH 1 (SE), or CH 1 HI DIFF | Ch 1 IN (single-ended mode) / Ch 1 HI IN (differential mode) | A46 |
| 37 | CH 0 (SE), or CH 0 HI DIFF | Ch 0 IN (single-ended mode) / Ch 0 HI IN (differential mode) | B47 |

P2

The P2 DB37 connector is obtained with the use of one of the following:

DBK201
DBK202
DBK203
DBK204
DBK206
DBK208
DBK209



The P2 DB37 connector does not apply to DBK200, DBK205, DBK207, or DBK207/CJC.

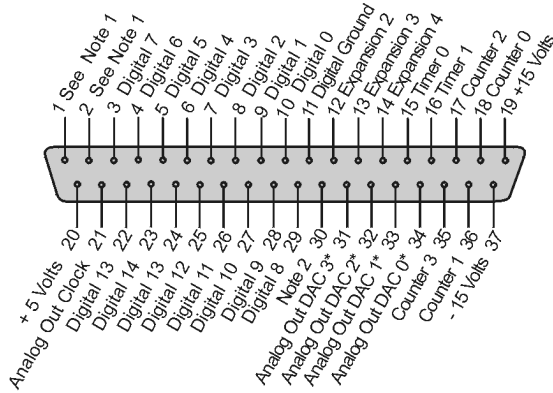
| Pin | Signal Name | Description for P2 Pin Use | P4 Correlation |
|-----|-----------------|---|----------------|
| 1 | Not Connected | N/A | N/A |
| 2 | Not Connected | N/A | N/A |
| 3 | Port B - B7 | Digital I/O: P2 Digital Port B, Bit 7; or, P2 Expansion Address Bit 0 Out | B10 |
| 4 | Port B - B6 | Digital I/O: P2 Digital Port B, Bit 6; or, P2 Expansion Address Bit 1 Out | A11 |
| 5 | Port B - B5 | Digital I/O: P2 Digital Port B, Bit 5; or, P2 Expansion Address Bit 2 Out | B11 |
| 6 | Port B - B4 | Digital I/O: P2 Digital Port B, Bit 4; or, P2 Expansion Address Bit 3 Out | A12 |
| 7 | Port B - B3 | Digital I/O: P2 Digital Port B, Bit 3; or, P2 Expansion Address Bit 4 Out | B12 |
| 8 | Port B - B2 | Digital I/O: P2 Digital Port B, Bit 2; or, P2 Expansion RESET Output | A13 |
| 9 | Port B - B1 | Digital I/O: P2 Digital Port B, Bit 1; or, P2 Expansion WRITE Output | B13 |
| 10 | Port B - B0 | Digital I/O: P2 Digital Port B, Bit 0; or, P2 Expansion READ Output | A14 |
| 11 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 12 | Not Connected | N/A | N/A |
| 13 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 14 | Not Connected | N/A | N/A |
| 15 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 16 | Not Connected | N/A | N/A |
| 17 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 18 | + 5 Volt Supply | Expansion +5 Volt Power (Refer to Power Management , chapter 2) | A1, B1 |
| 19 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 20 | + 5 Volt Supply | Expansion +5 Volt Power (Refer to Power Management , chapter 2) | A1, B1 |
| 21 | Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 22 | Port C - C7 | Digital I/O: P2 Digital Port C, Bit 7; or, P2 Expansion Data Bit 7 | A6 |
| 23 | Port C - C6 | Digital I/O: P2 Digital Port C, Bit 6; or, P2 Expansion Data Bit 6 | B6 |
| 24 | Port C - C5 | Digital I/O: P2 Digital Port C, Bit 5; or, P2 Expansion Data Bit 5 | A7 |
| 25 | Port C - C4 | Digital I/O: P2 Digital Port C, Bit 4; or, P2 Expansion Data Bit 4 | B7 |
| 26 | Port C - C3 | Digital I/O: P2 Digital Port C, Bit 3; or, P2 Expansion Data Bit 3 | A8 |
| 27 | Port C - C2 | Digital I/O: P2 Digital Port C, Bit 2; or, P2 Expansion Data Bit 2 | B8 |
| 28 | Port C - C1 | Digital I/O: P2 Digital Port C, Bit 1; or, P2 Expansion Data Bit 1 | A9 |
| 29 | Port C - C0 | Digital I/O: P2 Digital Port C, Bit 0; or, P2 Expansion Data Bit 0 | B9 |
| 30 | Port A - A7 | Digital I/O: P2 Digital Port A, Bit 7; or, P2 Expansion Data Bit 15 | A2 |
| 31 | Port A - A6 | Digital I/O: P2 Digital Port A, Bit 6; or, P2 Expansion Data Bit 14 | B2 |
| 32 | Port A - A5 | Digital I/O: P2 Digital Port A, Bit 5; or, P2 Expansion Data Bit 13 | A3 |
| 33 | Port A - A4 | Digital I/O: P2 Digital Port A, Bit 4; or, P2 Expansion Data Bit 12 | B3 |
| 34 | Port A - A3 | Digital I/O: P2 Digital Port A, Bit 3; or, P2 Expansion Data Bit 11 | A4 |
| 35 | Port A - A2 | Digital I/O: P2 Digital Port A, Bit 2; or, P2 Expansion Data Bit 10 | B4 |
| 36 | Port A - A1 | Digital I/O: P2 Digital Port A, Bit 1; or, P2 Expansion Data Bit 9 | A5 |
| 37 | Port A - A0 | Digital I/O: P2 Digital Port A, Bit 0; or, P2 Expansion Data Bit 8 | B5 |

P3 for DaqBoard/2000 Series and /2000c Series Boards Pulse/Frequency/Digital I/O

P3

The P3 DB37 connector is obtained with the use of one of the following:

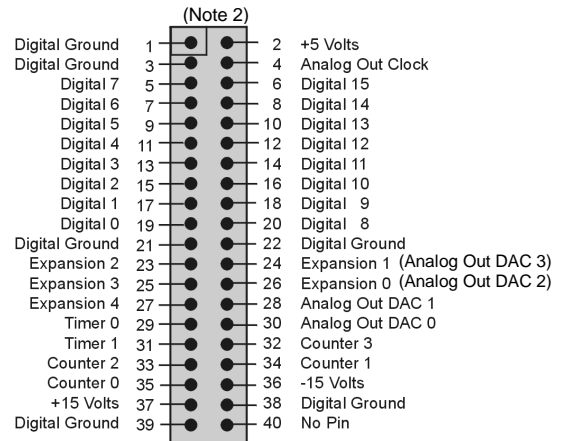
DBK201
DBK202 (Note 1)
DBK203 (Note 1)
DBK204 (Note 1)
DBK206
DBK209



DB37 P3 Connector

Note: There is no direct pin number correlation between the 40-pin header and the DB37 P3 connector.

*In regard to pins 31 through 34, see Note 3.



DBK202, DBK203, DBK204 "On-Board" 40-Pin Header

The P3 DB37 connector does not apply to DBK200, DBK205, DBK207, DBK207/CJC, or DBK208.

| Pin | Signal Name | Description for P3 Pin Use | P4 Correlation |
|-----|---------------------------|---|----------------|
| 1 | Digital Ground (Note 1) | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 2 | Digital Ground (Note 1) | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 3 | Digital 7 | P3 Digital Port Bit 7 | B19 |
| 4 | Digital 6 | P3 Digital Port Bit 6 | A19 |
| 5 | Digital 5 | P3 Digital Port Bit 5 | B20 |
| 6 | Digital 4 | P3 Digital Port Bit 4 | A20 |
| 7 | Digital 3 | P3 Digital Port Bit 3 | B21 |
| 8 | Digital 2 | P3 Digital Port Bit 2 | A21 |
| 9 | Digital 1 | P3 Digital Port Bit 1 | B22 |
| 10 | Digital 0 | P3 Digital Port Bit 0 | A22 |
| 11 | Digital Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 12 | Expansion 2 | Reserved | --- |
| 13 | Expansion 3 | Reserved | --- |
| 14 | Expansion 4 | Reserved | --- |
| 15 | Timer 0 | P3 Timer 0 Output | B24 |
| 16 | Timer 1 | P3 Timer 1 Output | A25 |
| 17 | Counter 2 | P3 Counter 2 Input | B28 |
| 18 | Counter 0 | P3 Counter 0 Input | B29 |
| 19 | + 15 Volts | Expansion, +15 VDC | B48 |
| 20 | + 5 Volt Supply | Expansion, +5 Volt Power (Refer to Power Management , chapter 2) | A1, B1 |
| 21 | Analog Out Clock | External DAC Pacer Clock Input/Internal DAC Pacer Clock Output | A26 |
| 22 | Digital 15 | Digital I/O; P3 Digital Port Bit 15 | B15 |
| 23 | Digital 14 | Digital I/O; P3 Digital Port Bit 14 | A15 |
| 24 | Digital 13 | P3 Digital Port Bit 13 | B16 |
| 25 | Digital 12 | P3 Digital Port Bit 12 | A16 |
| 26 | Digital 11 | P3 Digital Port Bit 11 | B17 |
| 27 | Digital 10 | P3 Digital Port Bit 10 | A17 |
| 28 | Digital 9 | P3 Digital Port Bit 9 | B18 |
| 29 | Digital 8 | P3 Digital Port Bit 8 | A18 |
| 30 | Digital Ground | Digital Common See Ground Correlation Tables, page 3-30. | ← |
| 31 | Analog Out DAC 3 (Note 3) | Analog DAC 3 Output | B50 |
| 32 | Analog Out DAC 2 (Note 3) | Analog DAC 2 Output | B49 |
| 33 | Analog Out DAC 1 (Note 3) | Analog DAC 1 Output | A50 |
| 34 | Analog Out DAC 0 (Note 3) | Analog DAC 0 Output | A49 |
| 35 | Counter 3 | P3 Counter 3 Input | A28 |
| 36 | Counter 1 | P3 Counter 1 Input | A29 |
| 37 | - 15 Volts | Expansion, - 15 VDC Power (Refer to Power Management , chapter 2) | A48 |

Note 1: P3 pins 1 and 2 are not connected on DBK201.

Note 2: For DBK202, DBK203, and DBK204, the 37-pin P3 connector is obtained by connecting a CA-60 cable to an "On-Board" 40-pin header.

Note 3: Pins 31, 32, 33, and 34 on the P3 DB37 connector are used for Analog Out DACs. DaqBoard/2001, /2003 & /2004 can utilize all four pins. DaqBoard/2000 does not make use of pins 31 or 32. DaqBoard/2002 and DaqBoard/2005 boards do not make use of pins 31 through 34 as these series two boards have no Analog Out DAC.

P4 to P1, P2 and P3 Correlation

The following table lists the correlation between the P4 I/O lines and their respective P1, P2 and P3 pin locations on the DBK200 Series boards. Ground correlation is provided in a subsequent table.

| P4 Pin | Signal | Type | Description | P1, P2, P3 Correlation |
|--------|--------------|---------|---|--|
| A1 | +5VDC | Power | Expansion +5 Volts | P1 pin 1 P2 pin 18, 20 P3 pin 20 |
| B1 | +5VDC | Power | Expansion +5 Volts | P1 pin 1 P2 pin 18, 20 P3 pin 20 |
| A2 | Port A bit 7 | Dig I/O | P2 Digital Port A, bit 7 -or- P2 expansion Data bit 15 | P2 pin 30 |
| B2 | Port A bit 6 | Dig I/O | P2 Digital Port A, bit 6 -or- P2 expansion Data bit 14 | P2 pin 31 |
| A3 | Port A bit 5 | Dig I/O | P2 Digital Port A, bit 5 -or- P2 expansion Data bit 13 | P2 pin 32 |
| B3 | Port A bit 4 | Dig I/O | P2 Digital Port A, bit 4 -or- P2 expansion Data bit 12 | P2 pin 33 |
| A4 | Port A bit 3 | Dig I/O | P2 Digital Port A, bit 3 -or- P2 expansion Data bit 11 | P2 pin 34 |
| B4 | Port A bit 2 | Dig I/O | P2 Digital Port A, bit 2 -or- P2 expansion Data bit 10 | P2 pin 35 |
| A5 | Port A bit 1 | Dig I/O | P2 Digital Port A, bit 1 -or- P2 expansion Data bit 9 | P2 pin 36 |
| B5 | Port A bit 0 | Dig I/O | P2 Digital Port A, bit 0 -or- P2 expansion Data bit 8 | P2 pin 37 |
| A6 | Port C bit 7 | Dig I/O | P2 Digital Port C, bit 7 -or- P2 expansion Data bit 7 | P2 pin 22 |
| B6 | Port C bit 6 | Dig I/O | P2 Digital Port C, bit 6 -or- P2 expansion Data bit 6 | P2 pin 23 |
| A7 | Port C bit 5 | Dig I/O | P2 Digital Port C, bit 5 -or- P2 expansion Data bit 5 | P2 pin 24 |
| B7 | Port C bit 4 | Dig I/O | P2 Digital Port C, bit 4 -or- P2 expansion Data bit 4 | P2 pin 25 |
| A8 | Port C bit 3 | Dig I/O | P2 Digital Port C, bit 3 -or- P2 expansion Data bit 3 | P2 pin 26 |
| B8 | Port C bit 2 | Dig I/O | P2 Digital Port C, bit 2 -or- P2 expansion Data bit 2 | P2 pin 27 |
| A9 | Port C bit 1 | Dig I/O | P2 Digital Port C, bit 1 -or- P2 expansion Data bit 1 | P2 pin 28 |
| B9 | Port C bit 0 | Dig I/O | P2 Digital Port C, bit 0 -or- P2 expansion Data bit 0 | P2 pin 29 |
| A10 | Ground | Dig I/O | Digital Common | See Ground Tables |
| B10 | Port B bit 7 | Dig I/O | P2 Digital Port B, bit 7 -or- P2 expansion address bit 0 | P2 pin 3 |
| A11 | Port B bit 6 | Dig I/O | P2 Digital Port B, bit 6 -or- P2 expansion address bit 1 | P2 pin 4 |
| B11 | Port B bit 5 | Dig I/O | P2 Digital Port B, bit 5 -or- P2 expansion address bit 2 | P2 pin 5 |
| A12 | Port B bit 4 | Dig I/O | P2 Digital Port B, bit 4 -or- P2 expansion address bit 2 | P2 pin 6 |
| B12 | Port B bit 3 | Dig I/O | P2 Digital Port B, bit 3 -or- P2 expansion address bit 3 | P2 pin 7 |
| A13 | Port B bit 2 | Dig I/O | P2 Digital Port B, bit 2 -or- P2 expansion RESET | P2 pin 8 |
| B13 | Port B bit 1 | Dig I/O | P2 Digital Port B, bit 1 -or- P2 expansion WRITE | P2 pin 9 |
| A14 | Port B bit 0 | Dig I/O | P2 Digital Port B, bit 0 -or- P2 expansion READ | P2 pin 10 |
| B14 | Ground | Dig I/O | Digital Common | See Ground Tables |

This table is continued.

| P4 Pin | Signal | Type | Description | P1, P2, P3 Correlation |
|--------|----------------|---------|--|------------------------|
| A15 | P3 Dig bit 14 | Dig I/O | P3 Digital Port bit 14 | P3 pin 23 |
| B15 | P3 Dig bit 15 | Dig I/O | P3 Digital Port bit 15 | P3 pin 22 |
| A16 | P3 Dig bit 12 | Dig I/O | P3 Digital Port bit 12 | P3 pin 25 |
| B16 | P3 Dig bit 13 | Dig I/O | P3 Digital Port bit 13 | P3 pin 24 |
| A17 | P3 Dig bit 10 | Dig I/O | P3 Digital Port bit 10 | P3 pin 27 |
| B17 | P3 Dig bit 11 | Dig I/O | P3 Digital Port bit 11 | P3 pin 26 |
| A18 | P3 Dig bit 8 | Dig I/O | P3 Digital Port bit 8 | P3 pin 29 |
| B18 | P3 Dig bit 9 | Dig I/O | P3 Digital Port bit 9 | P3 pin 28 |
| A19 | P3 Dig bit 6 | Dig I/O | P3 Digital Port bit 6 | P3 pin 4 |
| B19 | P3 Dig bit 7 | Dig I/O | P3 Digital Port bit 7 | P3 pin 3 |
| A20 | P3 Dig bit 4 | Dig I/O | P3 Digital Port bit 4 | P3 pin 6 |
| B20 | P3 Dig bit 5 | Dig I/O | P3 Digital Port bit 5 | P3 pin 5 |
| A21 | P3 Dig bit 2 | Dig I/O | P3 Digital Port bit 2 | P3 pin 8 |
| B21 | P3 Dig bit 3 | Dig I/O | P3 Digital Port bit 3 | P3 pin 7 |
| A22 | P3 Dig bit 0 | Dig I/O | P3 Digital Port bit 0 | P3 pin 10 |
| B22 | P3 Dig bit 1 | Dig I/O | P3 Digital Port bit 1 | P3 pin 9 |
| A23 | Ground | Dig I/O | Digital Common | See Ground Tables |
| B23 | XCK | Dig I/O | Reserved | No Connection |
| A24 | Ground | Dig I/O | Digital Common | See Ground Tables |
| B24 | Timer 0 | Dig OUT | P3 Timer 0 Output | P3 pin 15 |
| A25 | Timer 1 | Dig OUT | P3 Timer 1 Output | P3 pin 16 |
| B25 | Ground | Dig I/O | Digital Common | See Ground Tables |
| A26 | DAC Pacer | Dig I/O | External DAC Pacer Clock Input / Internal DAC Pacer Output | P3 pin 21 |
| B26 | ADC Pacer | Dig I/O | External ADC Pacer Clock Input / Internal ADC Pacer Output | P1 pin 20 |
| A27 | TTL Trigger | Dig IN | External TTL Trigger Input | P1 pin 25 |
| B27 | Ground | Dig I/O | Digital Common | See Ground Tables |
| A28 | Counter 3 | Dig IN | P3 Counter 3 Input | P3 pin 35 |
| B28 | Counter 2 | Dig IN | P3 Counter 2 Input | P3 pin 17 |
| A29 | Counter 1 | Dig IN | P3 Counter 1 Input | P3 pin 36 |
| B29 | Counter 0 | Dig IN | P3 Counter 0 Input | P3 pin 18 |
| A30 | CD ACK- | Dig IN | Reserved | No Connection |
| B30 | SDI | Dig IN | Reserved | No Connection |
| A31 | Ground | Analog | Analog Signal Common | See Ground Tables |
| B31 | XI/O Gain 1 | Dig OUT | Analog Expansion Gain Select bit 1 | P1 pin 5 |
| A32 | XI/O Gain 0 | Dig OUT | Analog Expansion Gain Select bit 0 | P1 pin 6 |
| B32 | XI/O Address 3 | Dig OUT | Analog Exp. Address Select bit 3 | P1 pin 3 |
| A33 | XI/O Address 2 | Dig OUT | Analog Exp. Address Select bit 2 | P1 pin 22 |
| B33 | XI/O Address 1 | Dig OUT | Analog Exp. Address Select bit 1 | P1 pin 4 |
| A34 | XI/O Address 0 | Dig OUT | Analog Exp. Address Select bit 0 | P1 pin 23 |
| B34 | External SSH | Dig OUT | Analog Expansion Simultaneous Sample/Hold Signal | P1 pin 26 |
| A35 | Ground | Analog | Analog Signal Common | See Ground Tables |
| B35 | Positive Ref | Analog | Analog +5 Volt Reference | P1 pin 9 |
| A36 | Negative Ref | Analog | Analog -5 Volt Reference | P1 pin 8 |
| B36 | Analog In Ch15 | Analog | Analog Input Chan 15 (SE) Analog Input Chan 7L (DIF) | P1 pin 11 |
| A37 | Analog In Ch7 | Analog | Analog Input Chan 7 (SE) Analog Input Chan 7H (DIF) | P1 pin 30 |
| B37 | Ground | Analog | Analog Signal Common | See Ground Tables |
| A38 | Analog In Ch14 | Analog | Analog Input Chan 14 (SE) Analog Input Chan 6L (DIF) | P1 pin 12 |
| B38 | Analog In Ch6 | Analog | Analog Input Chan 6 (SE) Analog Input Chan 6H (DIF) | P1 pin 31 |
| A39 | Ground | Analog | Analog Signal Common | See Ground Tables |

This table is continued.

| P4 Pin | Signal | Type | Description | P1, P2, P3 Correlation |
|--------|----------------|--------|---|------------------------|
| B39 | Analog In Ch13 | Analog | Analog Input Chan 13 (SE) Analog Input Chan 5L (DIF) | P1 pin 13 |
| A40 | Analog In Ch5 | Analog | Analog Input Chan 5 (SE) Analog Input Chan 5H (DIF) | P1 pin 32 |
| B40 | Ground | Analog | Analog Signal Common | See Ground Tables |
| A41 | Analog In Ch12 | Analog | Analog Input Chan 12 (SE) Analog Input Chan 4L (DIF) | P1 pin 14 |
| B41 | Analog In Ch | Analog | Analog Input Chan 4 (SE) Analog Input Chan 4H (DIF) | P1 pin 33 |
| A42 | Ground | Analog | Analog Signal Common | See Ground Tables |
| B42 | Analog In Ch11 | Analog | Analog Input Chan 11 (SE) Analog Input Chan 3L (DIF) | P1 pin 15 |
| A43 | Analog In Ch3 | Analog | Analog Input Chan 3 (SE) Analog Input Chan 3H (DIF) | P1 pin 34 |
| B43 | Ground | Analog | Analog Signal Common | See Ground Tables |
| A44 | Analog In Ch10 | Analog | Analog Input Chan 10 (SE) Analog Input Chan 2L (DIF) | P1 pin 16 |
| B44 | Analog In Ch2 | Analog | Analog Input Chan 2 (SE) Analog Input Chan 2H (DIF) | P1 pin 35 |
| A45 | Signal Ground | Analog | Sense Common (SGND) | P1-19 |
| B45 | Analog In Ch9 | Analog | Analog Input Chan 9 (SE) Analog Input Chan 1L (DIF) | P1 pin 17 |
| A46 | Analog In Ch1 | Analog | Analog Input Chan 1 (SE) Analog Input Chan 1H (DIF) | P1 pin 36 |
| B46 | Ground | Analog | Analog Signal Common | See Ground Tables |
| A47 | Analog In Ch8 | Analog | Analog Input Chan 8 (SE) Analog Input Chan 0L (DIF) | P1 pin 18 |
| B47 | Analog In Ch0 | Analog | Analog Input Chan 0 (SE) Analog Input Chan 0H (DIF) | P1 pin 37 |
| A48 | -15VDC | Power | Expansion -15 Volts | P1 pin 2 P3 pin 37 |
| B48 | +15VDC | Power | Expansion +15 Volts | P1 pin 21 P3 pin 19 |
| A49 | DAC 0 | Analog | DAC 0 Output | P3 pin 34 |
| B49 * | DAC 2 | Analog | DAC 2 Output | P3 pin 32 |
| A50 | DAC 1 | Analog | DAC 1 Output | P3 pin 33 |
| B50 * | DAC 3 | Analog | DAC 3 Output | P3 pin 31 |

* DAC 2 and DAC 3 (from P4 pins B49 and B50, respectively) only apply to DaqBoard/2001, /2003 /2004 and the equivalent cPCI DaqBoard/2000c Series Boards.

Ground Tables – P4 Pin to P1, P2, and P3 Ground Correlation

| Digital Common (DGND) | | | | | | | | |
|-----------------------|--------|--------|----------------------------|--------|--------|--------|--------|-----------|
| P4 Pin | DBK200 | DBK201 | DBK202 DBK203 DBK204 | DBK206 | DBK207 | DBK208 | DBK209 | |
| A10 | ----- | ----- | ----- | P1-7 | ----- | ----- | P1-7 | P1 |
| B14 | ----- | P2-11 | P2-11 | P2-11 | ----- | P2-11 | P2-11 | P2 |
| A23 | | P2-13 | P2-13 | P2-13 | | P2-13 | P2-13 | |
| A24 | | P2-15 | P2-15 | P2-15 | | P2-15 | P2-15 | |
| B25 | | P2-17 | P2-17 | P2-17 | | P2-17 | P2-17 | |
| B27 | | P2-19 | P2-19 | P2-19 | | P2-19 | P2-19 | |
| | | P2-21 | P2-21 | P2-21 | | P2-21 | P2-21 | |
| | ----- | ----- | P3-1 | P3-1 | ----- | ----- | P3-1 | P3 |
| | | ----- | P3-2 | P3-2 | | | P3-2 | |
| | | P3-11 | P3-11 | P3-11 | | | P3-11 | |
| | | ----- | P3-30 | P3-30 | | | P3-30 | |

| Analog Common (AGND) | | | | | | | | |
|----------------------|--------|--------|----------------------------|--------|--------|--------|--------|-----------|
| P4 Pin | DBK200 | DBK201 | DBK202 DBK203 DBK204 | DBK206 | DBK207 | DBK208 | DBK209 | |
| A31 | P1-7 | P1-7 | P1-7 | ----- | P1-7 | ----- | ----- | P1 |
| A35 | P1-28 | P1-28 | P1-28 | P1-28 | P1-28 | | P1-28 | |
| B37 | P1-29 | P1-29 | P1-29 | P1-29 | P1-29 | | P1-29 | |
| A39 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | P2 |
| B40 | ----- | P3-30 | ----- | ----- | ----- | ----- | ----- | P3 |
| A42 | | | | | | | | |
| B43 | | | | | | | | |
| B46 | | | | | | | | |

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[Setting up Analog DBKs 4-3](#)

[Setting up Digital DBKs 4-5](#)

[Setting Internal Clock Speed to 100 kHz 4-7](#)

Overview

Most DBK card and module options provide for channel expansion and signal conditioning; however, some serve as power supplies, and others are no more than interfaces that allow the user to meet desired connection needs, for example, the use of BNC connectors.

For proper operation with DaqBook or DaqBoard systems, most of the DBK options must be configured, both physically on the DBK, and in the data acquisition application.

All DBK configuration-related parameters can be found in the *DaqView's Configure System Hardware* screen. "Analog Input" type DBKs will be under the P1 section of the screen, "Digital Input" DBKs will be under the P2 section, and analog and digital outputs [if applicable] will be under P3.

The following table, in addition to providing a brief description of DBK options, can be used to quickly identify whether the DBK option is of the P1-Analog or of the P2-Digital type. Table rows for DBKs that require no software setup in *DaqView* have been *grayed-over*.

| DBK Reference for <i>DaqView</i> Users | | | |
|--|---|------------|---|
| DBK | Description | Type | Comment |
| DBK1 | 16-Connector BNC Adapter Module | Adapter | No configuration in <i>DaqView</i> . |
| DBK2 | 4-Channel Voltage Output Card | P1-ANALOG | Must enter S1 setting in H/W Config. |
| DBK4 | 2-Channel Dynamic Signal Input Card | P1-ANALOG | Must enter S1 setting in H/W Config. |
| DBK5 | 4-Channel Current Output Card | P1-ANALOG | Must enter S1 setting in H/W Config. |
| DBK7 | 4-Channel, Frequency-to-Voltage Input Card | P1-ANALOG | Must enter S1 setting in H/W Config. |
| DBK8 | 8-Channel High-Voltage Input Card | P1-ANALOG | Must enter JP16 setting in H/W Conf. |
| DBK9 | 8-Channel RTD Card | P1-ANALOG | Must enter JP4 setting in H/W Conf. |
| DBK10 | 3-Slot Expansion Chassis | Expansion | No configuration in <i>DaqView</i> . |
| DBK11A | Screw-Terminal Option & BNC Option Card | Adapter | Must select "Direct Signal Conn." |
| DBK12 | Low Gain A/I Multiplexer Card | P1-ANALOG | For these three DBKs: In <i>DaqView's Acquisition Setup</i> tab select 100 kHz as the Internal Clock speed. |
| DBK13 | High Gain A/I Multiplexer Card | P1-ANALOG | |
| DBK15 | Universal Current, Voltage Input Card | P1-ANALOG | |
| DBK16 | 2-Channel Strain-Gage Card | P1-ANALOG | Must enter S1 setting in H/W Config. |
| DBK17 | 4-Channel Simultaneous Sample & Hold Card | P1-ANALOG | Must enter SW6 setting in H/W Conf. |
| DBK18 | 4-Channel Low-Pass Filter Card | P1-ANALOG | Must enter SW6 setting in H/W Conf. |
| DBK19 | 14-Channel Thermocouple Card | P1-ANALOG | Must select T/C Type in <i>DaqView's Channel Setup Window</i> . Also, see Note 1. |
| DBK20 | Digital I/O Card, with screw terminals | P2-DIGITAL | Digital I/O (Note 2) |
| DBK21 | Digital I/O Card, with DB37 male connectors | P2-DIGITAL | Digital I/O (Note 2) |
| DBK23 | Isolated Digital Input Chassis | P2-DIGITAL | Digital I/O (Note 2) |
| DBK24 | Isolated Digital Output Chassis | P2-DIGITAL | Digital I/O (Note 2) |
| DBK25 | 8-Channel Relay Output Card | P2-DIGITAL | Digital I/O (Note 2) |
| DBK30A | Rechargeable Battery Module | Power | No configuration in <i>DaqView</i> . |
| DBK32A | Auxiliary Power Supply Card | Power | No configuration in <i>DaqView</i> . |

Note 1: If using a DBK19 with a DaqBoard/2000 Series or a cPCI DaqBoard/2000c Series Board, you should select 100 kHz as the Internal Clock speed in *DaqView's Acquisition Setup* tab.

Note 2: After the DBK option is selected in Hardware Configuration, the Digital I/O settings are made in *DaqView's Digital I/O Window*.

| DBK Reference for <i>DaqView</i> Users | | | |
|--|---|------------------|---|
| DBK | Description | Type | Comment |
| DBK33 | Triple-Output Power Supply Card | Power | No configuration in <i>DaqView</i> . |
| DBK34 | Vehicle UPS Module | Power | No configuration in <i>DaqView</i> . |
| DBK34A | UPS / Battery Module | Power | No configuration in <i>DaqView</i> . |
| DBK40 | 18-Connector BNC Analog Interface | Adapter | No configuration in <i>DaqView</i> . |
| DBK41 | 10-Slot Expansion Module | Expansion | No configuration in <i>DaqView</i> . |
| DBK42 | 16-Slot 5B Signal Conditioning Module | P1-ANALOG | 5B Module selection, see Note 3. |
| DBK43A | 8-Channel Strain-Gage Module | P1-ANALOG | Must enter J2 setting in H/W Config. |
| DBK44 | 2-Channel 5B Signal-Conditioning Card | P1-ANALOG | 5B Module selection, see Note 3. |
| DBK45 | 4-Channel SSH and Low-Pass Filter Card | P1-ANALOG | Must enter SW6 setting in H/W Config. |
| DBK50 | 8-Channel High-Voltage Input Module | P1-ANALOG | Must enter JP1C setting in H/W Config. |
| DBK51 | 8-Channel Low-Voltage Input Module | P1-ANALOG | Must enter JP1C setting in H/W Config. |
| DBK52 | 14-Channel Thermocouple Input Module | P1-ANALOG | For these three DBKs: In <i>DaqView's Acquisition Setup</i> tab select 100 kHz as the Internal Clock speed. |
| DBK53 | 16-Ch. Low-Gain Multiplexing Module | P1-ANALOG | |
| DBK54 | 16-Ch. High-Gain Multiplexing Module | P1-ANALOG | |
| DBK60 | 3-Slot Expansion Chassis | Expansion | No configuration in <i>DaqView</i> . |
| DBK70 | Vehicle Network Interface Mux. Module | P1-ANALOG | (see second reference note) |
| DBK80 | 16-Ch. Differential Voltage Input Card with Excitation Output | P1-ANALOG | No configuration in <i>DaqView</i> . |
| DBK81 | 7-Channel T/C Card, High-Accuracy | P1-ANALOG | Must select the Thermocouple Type in <i>DaqView's Channel Setup Window</i> . |
| DBK82 | 14-Channel T/C Card, High-Accuracy | P1-ANALOG | |
| DBK83 | 14-Ch. T/C Card, High-Accuracy; uses Connection Pod | P1-ANALOG | |
| DBK84 | 14-Ch. T/C Module, High-Accuracy | P1-ANALOG | |
| DBK200 | P4-to-P1 Adapter Card | Adapter | No configuration in <i>DaqView</i> . |
| DBK201 | P4-to-P1/P2/P3 Adapter Board | Adapter | No configuration in <i>DaqView</i> . |
| DBK202 | P4-to-P1/P2/P3 Adapter Board, with Screw Terminals & Locators for RC Filter | Adapter | No configuration in <i>DaqView</i> . |
| DBK203 | P4-to-P1/P2/P3 Adapter Chassis, with Screw Terminals & Locators for RC Filter | Adapter | No configuration in <i>DaqView</i> . |
| DBK204 | DBK203 with a CA-209 CE Cable Kit | Adapter | No configuration in <i>DaqView</i> . |
| DBK204c | DBK203 with a CA-209c CE Cable Kit | Adapter | No configuration in <i>DaqView</i> . |
| DBK205 | P4 to 12-Slot Screw Terminal Adapter | Adapter | No configuration in <i>DaqView</i> . |
| DBK206 | P4-to-P1/P2/P3 Adapter Board, with Screw Terminals | Adapter | No configuration in <i>DaqView</i> . |
| DBK207 | 16-Channel, 5B Carrier Board | P1-ANALOG | 5B Module selection, see Note 3. |
| DBK207/CJC | DBK207 with Cold Junction Compensation | P1-ANALOG | 5B Module selection, see Note 3. |
| DBK208 | Relay Carrier Board, Opto-22 Compatible | P2-DIGITAL | Must enter S1, JP-0, and JP-1 settings in the H/W Configuration window. |
| DBK209 | P4-to-P1/P2/P3 Mini-Adapter Board | Adapter | No configuration in <i>DaqView</i> . |
| DBK601 thru DBK609 | Rear Panels for use with DaqBoard/260, DBK60, and LogBook/360. | Connector Panels | No configuration in <i>DaqView</i> . |

Note 3: After selecting the DBK option in the Hardware Configuration window, 5B Module selection is made in the *DaqView* main window, on the Channel Setup tab (for Analog and Scanned Digital Inputs). Clicking on the Units column brings up the 5B Module selection function.



Reference Notes:

- The *DBK Document Modules* contain parameter definitions and information as to which DBK parameters are physically set on the hardware.
- The DBK70 is discussed in a separate document, The *DBK70 User's Manual*, p/n 1056-0901.

Setting Up Analog DBKs

If you have not already done so, review the applicable *DBK Document Module* to ensure that the DBK option is physically set as desired. Note that certain DBKs do not require hardware or software configuration.



Understand your DBK's physical configuration before attempting to set the device in DaqView's Hardware Configuration window. For example, if you were configuring a DBK45 in DaqView, you would need to know the physical setup of rotary switch SW6 to properly set the address. To expedite the configuration, it is a good idea to have the identity and setting information ready for each DIP-switch, rotary switch, and jumper, as applicable.



Reference Note:

The *DaqView Document Module*, located in your Daq device user's manual, contains a detailed description of *DaqView* and should be referred to if you need to go beyond the basic setup information that follows.

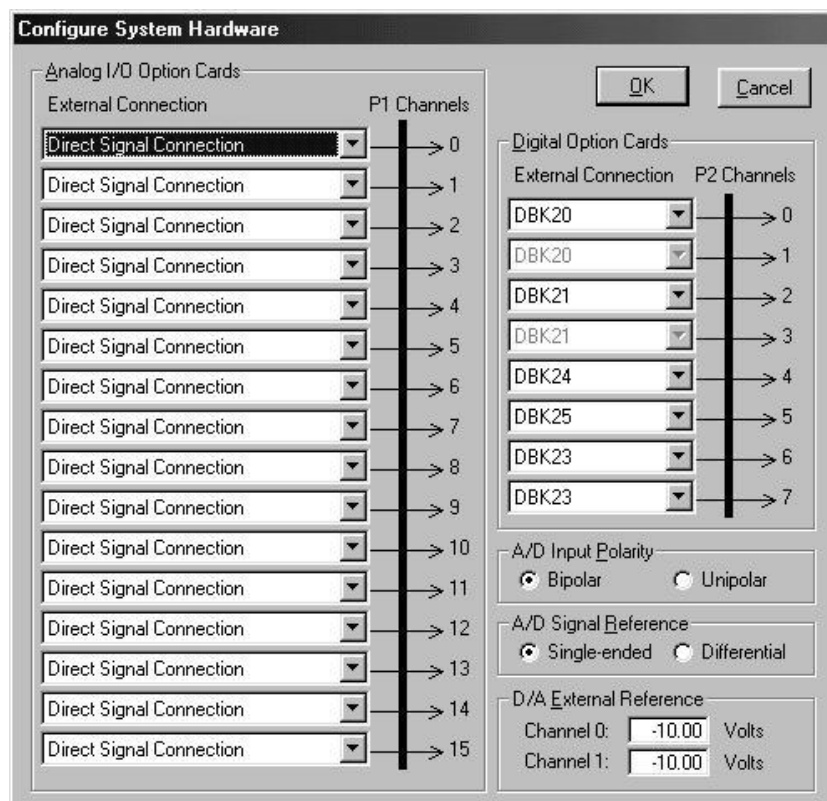
Complete the following steps to set up analog DBKs in *DaqView*.

1. From *DaqView*'s main screen, pull down the **Device** menu, and select “**Configure Hardware Settings**.”



Selecting Configure Hardware Settings from the Device Pull-down Menu

The *Configure System Hardware* screen appears, showing the channel assignments.



Configure System Hardware Screen

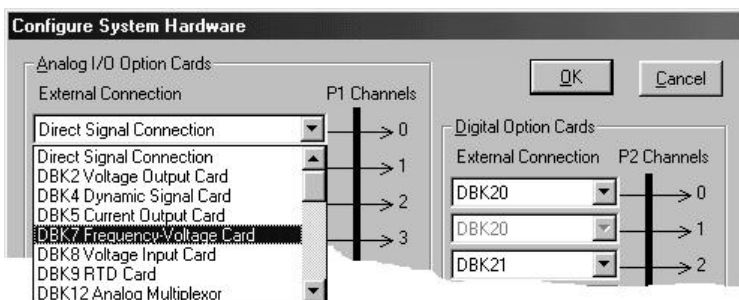


The DBKs typically have a channel address set physically on the device, by either a switch or a header. The channel designated in software must agree with the hardware setting. Thus, in step 2 below, Channel 0 will only be used to select a specific DBK when that DBK is physically set for Channel 0. Refer to the DBK Document module for more information, if needed.

- Under **Analog I/O Option Cards External Connection**, select the *expansion* down-arrow for the chosen Daq Device channel, for example, **P1 Channel 0**. A “drop-down” will list the available analog DBK options.



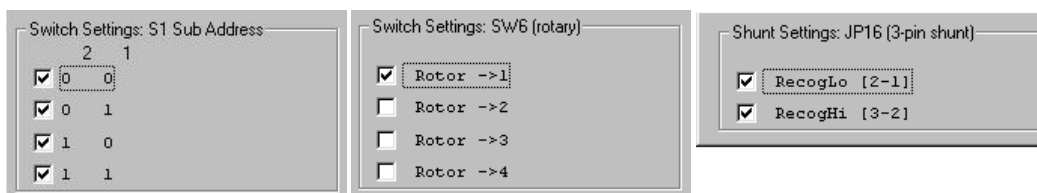
An alternative to using the *expansion* down-arrow to access the external connection drop-down list, is to click within the text box. For example, in the following figure, after clicking on P1 Channel 0’s “Direct Signal Connection” text, the drop-down list appeared.



Configure System Hardware Screen Showing Analog I/O Option Cards, External Connection, P1 Channel Pull-down List for Channel 0

- Select the applicable DBK card from the drop-down list.

If the card has jumper or switch setups that need to be set in DaqView, a related window will appear. Three extracted examples follow: (a) Switch Settings: S1 Sub Address, (b) Switch Settings: SW6 (rotary), and (c) Shunt Settings: JP16 (3-pin shunt).



Examples from Setup Windows

- Set the software DIP-switch settings, shunt-settings, and so forth to match the hardware settings on the actual DBK(s).
- When all the channels and sub-addresses are set correctly, select **OK** to return to the *DaqView* main screen.
- From *DaqView*, complete the channel setup, acquisition setup, and data destination setup for each of the new DBKs.



Reference Note:

If needed, refer to the *DaqView Document Module*, located in your Daq device user’s manual, for more information.

This completes the software setup for analog DBK options.

Setting Up Digital DBKs

If you have not already done so, review the applicable *DBK Document Module* to ensure that the DBK option is physically set as desired. Note that certain DBKs do not require hardware or software configuration.

If you have not already done so, review the applicable *DBK Document Module* to ensure that the DBK option is physically set as desired. Note that certain DBKs do not require hardware or software configuration.

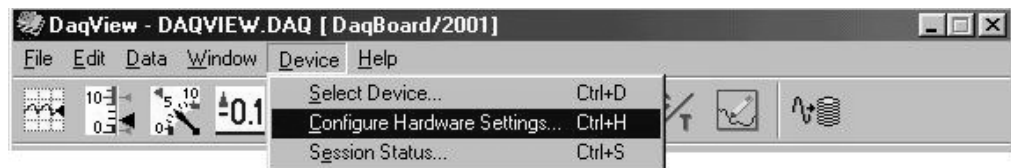


Reference Note:

The *DaqView Document Module*, located in your Daq device user's manual, contains a detailed description of *DaqView* and should be referred to if you need to go beyond the basic setup information that follows.

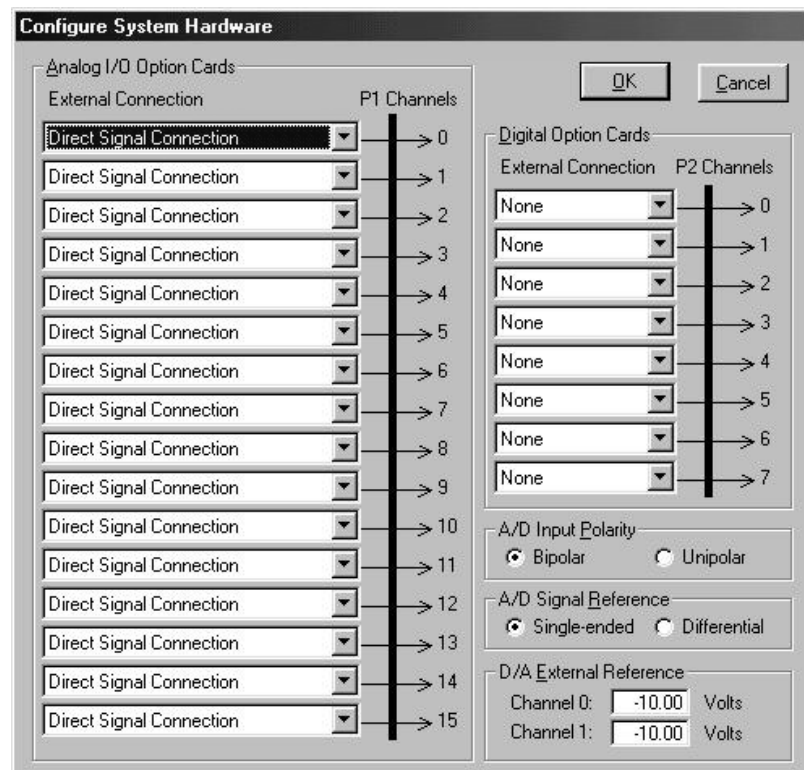
Complete the following steps to set up digital DBKs in *DaqView*.

1. From *DaqView*'s main screen, pull down the **Device** menu, and select “**Configure Hardware Settings.**”



Selecting Configure Hardware Settings from the Device Pull-down Menu

The *Configure System Hardware* screen appears, showing the channel assignments.



Configure System Hardware Screen

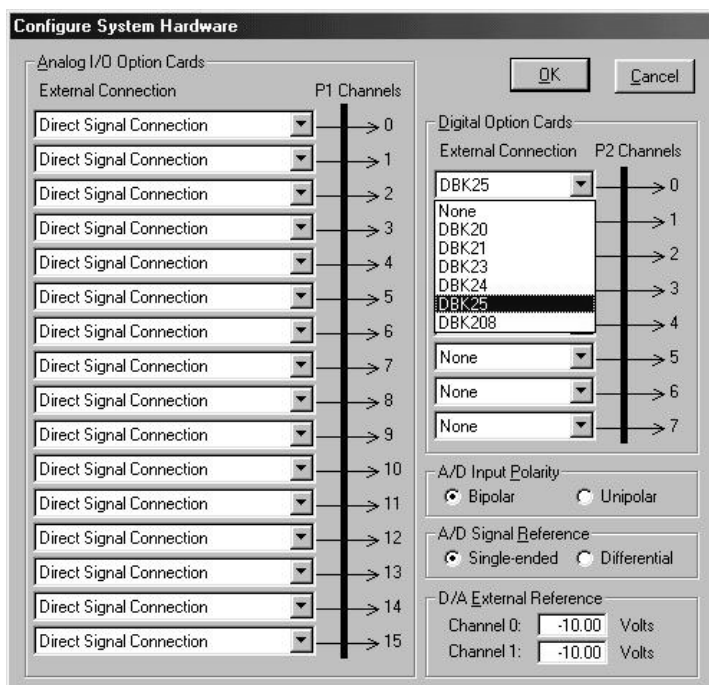


DBKs typically have a channel address set on the device, by either a switch or a header. The channel designated in software must agree with the hardware setting. Thus, in step 2 below, Channel 0 will only be used to select a specific DBK when that DBK is physically set for Channel 0. Refer to the DBK Document module for more information, if needed.

- Under **Digital Option Cards**, select the *expansion* down-arrow for the chosen Daq Device channel, for example, **P2 Channel 0**. A “drop-down” will list the available digital DBK options.



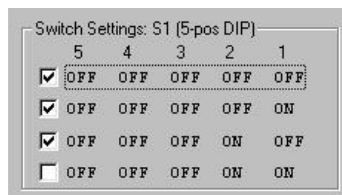
An alternative to using the *expansion* down-arrow to access the external connection drop-down list, is to click within the text box. For example, in the following figure, after clicking on P2 Channel 5's “None,” a drop-down list will appear, like the one shown for Channel 0.



Configure System Hardware Screen Showing Digital Option Cards, External Connection, P2 Channel Pull-down List for Channel 0

- Select the applicable digital DBK card.

If the card has jumpers or switches, a related window will appear. Two examples follow. The first is for DIP-switch and jumper settings for a DBK208. The other is for a DBK25 DIP-switch.



Examples from Setup Windows (These vary according to the DBK)

- If applicable, set the software DIP-switch and other settings (such as jumpers) to match the hardware settings on the actual DBK(s).
- After all the settings are confirmed correct, select **OK** to return to the *DaqView* main screen.
- From *DaqView*, complete the channel setup, acquisition setup, and data destination setup for each of the new DBKs.



Reference Note:

If needed, refer to the *DaqView Document Module*, located in your Daq device user's manual, for more information.

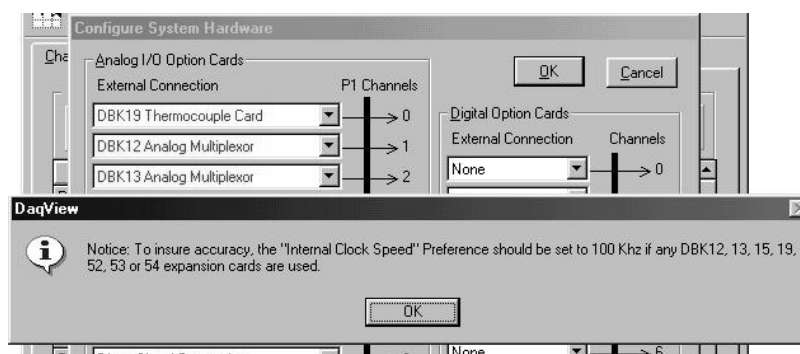
This completes the software setup for digital DBK options.

Setting Internal Clock Speed to 100 kHz

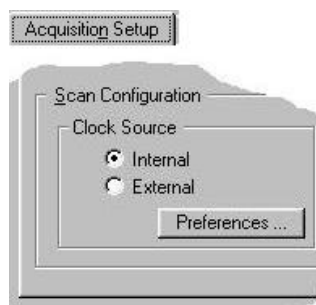
This section applies to DaqView users who are using one or more of the following DBK options in conjunction with a DaqBoard/2000, DaqBoard/2001, DaqBoard/2005 or a compact PCI counterpart of these boards; i.e., cPCI DaqBoard/2000c, cPCI DaqBoard/2001c, and cPCI DaqBoard/2005c.

DBKs impacted at the time of this writing are: DBK12, DBK13, DBK15, DBK19, DBK52, DBK53, and DBK54.

Note: In DaqView's *Configure Systems Hardware* window, after selecting DBK12, DBK13, DBK15, DBK19, DBK52, DBK53, or DBK54 a message box should prompt you to select an internal clock speed of 100 kHz.



A Message Box Regarding Specific DBKs and the 100 kHz Internal Clock Speed Setting



To select an “Internal Clock Speed” of 100 kHz:

1. Select the *Acquisition Setup* tab on DaqView's main window.
2. On the lower left corner of the window, under *Scan Configuration*, click the **Preferences** button.

The *Advanced Options* window will appear (following figure).

Note: The *Advanced Options* box can also be accessed from the Windows pull-down menu.



3. Under “Internal Clock Speed,” select **100 kHz**.
4. Click the OK button to return to DaqView's main window.

The internal clock is now set for 100 kHz.



[Overview..... 5-1](#)

[Setting up Analog DBKs 5-3](#)

[Setting up Digital DBKs 5-6](#)

Overview

Most DBK card and module options provide for channel expansion and signal conditioning; however, some serve as power supplies, and others are no more than interfaces that allow the user to meet desired connection needs, for example, the use of BNC connectors.

For proper operation with LogBook systems, most of the DBK options must be configured, both physically on the DBK, and in the *LogView* program. All DBK configuration-related parameters can be found in the program's *LogBook Hardware Configuration Window*, sometimes referred to as a hardware tree. "Analog Input" type DBKs will be under the P1 branch of the tree, "Digital Input" DBKs will be under the P2 branch, and analog and digital outputs [if applicable] will be under P3.

The following table, in addition to providing a brief description of DBK options, can be used to quickly identify whether the DBK option is of the P1-Analog or of the P2-Digital type. Table rows for DBKs that require no software setup in LogView, or do not apply to LogBook systems, have been *grayed-over*.

| DBK Reference for <i>LogView</i> Users | | | |
|--|---|------------|---|
| DBK | Description | Type | Comment |
| DBK1 | 16-Connector BNC Adapter Module | Adapter | No configuration in <i>LogView</i> . |
| DBK2 | 4-Channel Voltage Output Card | P1-ANALOG | Not used with LogBook. |
| DBK4 | 2-Channel Dynamic Signal Input Card | P1-ANALOG | Set the Filter Mode to "On" or "Bypass." |
| DBK5 | 4-Channel Current Output Card | P1-ANALOG | Not used with LogBook. |
| DBK7 | 4-Channel, Frequency-to-Voltage Input Card | P1-ANALOG | (Note 1) |
| DBK8 | 8-Channel High-Voltage Input Card | P1-ANALOG | Select Input Voltage Range. |
| DBK9 | 8-Channel RTD Card | P1-ANALOG | Select the RTD Type (resistance). |
| DBK10 | 3-Slot Expansion Chassis | Expansion | No configuration in <i>LogView</i> . |
| DBK11A | Screw-Terminal Option & BNC Option Card | Adapter | No configuration in <i>LogView</i> . |
| DBK12 | Low Gain A/I Multiplexer Card | P1-ANALOG | (Note 1) |
| DBK13 | High Gain A/I Multiplexer Card | P1-ANALOG | (Note 1) |
| DBK15 | Universal Current, Voltage Input Card | P1-ANALOG | Set RA and RB resistor settings. |
| DBK16 | 2-Channel Strain-Gage Card | P1-ANALOG | (Note 1) |
| DBK17 | 4-Channel Simultaneous Sample & Hold Card | P1-ANALOG | Enter Gain Resistor (RG) information. |
| DBK18 | 4-Channel Low-Pass Filter Card | P1-ANALOG | Enter Gain Resistor (RG) information. |
| DBK19 | 14-Channel Thermocouple Card | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK20 | Digital I/O Card, with screw terminals | P2-DIGITAL | Select Mode & Control Resolution (Note 2). |
| DBK21 | Digital I/O Card, with DB37 male connectors | P2-DIGITAL | Select Mode & Control Resolution (Note 2). |
| DBK23 | Isolated Digital Input Chassis | P2-DIGITAL | Select Control Resolution (Note 2). |
| DBK24 | Isolated Digital Output Chassis | P2-DIGITAL | Select Control Resolution (Note 2) |
| DBK25 | 8-Channel Relay Output Card | P2-DIGITAL | Select Control Resolution (Note 2) |
| DBK30A | Rechargeable Battery Module | Power | No configuration in <i>LogView</i> . |
| DBK32A | Auxiliary Power Supply Card | Power | No configuration in <i>LogView</i> . |

Note 1: The "note 1" comment indicates that LogView's Hardware/Configuration window is used to select the DBK; but does not provide any other configuration options for that specific DBK.

Note 2: For the P2-DIGITAL type DBKs, **Mode** permits selection of "Input" or "Output." The modes for DBK23, DBK24, and DBK25 are pre-set. **Control Resolution** permits selection of "Individual Bits" or "Single Port of Bits."

| DBK Reference for <i>LogView</i> Users | | | |
|--|---|------------------|---|
| DBK | Description | Type | Comment |
| DBK33 | Triple-Output Power Supply Card | Power | No configuration in <i>LogView</i> . |
| DBK34 | Vehicle UPS Module | Power | No configuration in <i>LogView</i> . |
| DBK34A | UPS / Battery Module | Power | No configuration in <i>LogView</i> . |
| DBK40 | 18-Connector BNC Analog Interface | Adapter | No configuration in <i>LogView</i> . |
| DBK41 | 10-Slot Expansion Module | Expansion | No configuration in <i>LogView</i> . |
| DBK42 | 16-Slot 5B Signal Conditioning Module | P1-ANALOG | Select 5B Modules. |
| DBK43A | 8-Channel Strain-Gage Module | P1-ANALOG | Can set CAL/NORM switch. |
| DBK44 | 2-Channel 5B Signal-Conditioning Card | P1-ANALOG | Select 5B Modules. |
| DBK45 | 4-Ch. SSH and Low-Pass Filter Card | P1-ANALOG | Enter Gain Resistor (RG) information. |
| DBK50 | 8-Channel High-Voltage Input Module | P1-ANALOG | (Note 1) |
| DBK51 | 8-Channel Low-Voltage Input Module | P1-ANALOG | (Note 1) |
| DBK52 | 14-Channel Thermocouple Input Module | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK53 | 16-Ch. Low-Gain Multiplexing Module | P1-ANALOG | (Note 1) |
| DBK54 | 16-Ch. High-Gain Multiplexing Module | P1-ANALOG | (Note 1) |
| DBK60 | 3-Slot Expansion Chassis | Expansion | No configuration in <i>LogView</i> . |
| DBK70 | Vehicle Network Interface Mux. Module | P1-ANALOG | See second reference. |
| DBK80 | 16-Ch. Differential Voltage Input Card with Excitation Output | P1-ANALOG | No configuration in <i>LogView</i> . |
| DBK81 | 7-Channel T/C Card, High-Accuracy | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK82 | 14-Channel T/C Card, High-Accuracy | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK83 | 14-Ch. T/C Card, High-Accuracy; uses Connection Pod | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK84 | 14-Ch. T/C Module, High-Accuracy | P1-ANALOG | Select Thermocouple Type (J, K, T, E, etc.) |
| DBK200 | P4-to-P1 Adapter Card | Adapter | Not used with LogBook. |
| DBK201 | P4-to-P1/P2/P3 Adapter Board | Adapter | Not used with LogBook. |
| DBK202 | P4-to-P1/P2/P3 Adapter Board, with Terminals & Locators for RC Filter | Adapter | Not used with LogBook. |
| DBK203 | P4-to-P1/P2/P3 Adapter Chassis, with Terminals & Locators for RC Filter | Adapter | Not used with LogBook. |
| DBK204 | DBK203 with a CA-209 CE Cable Kit | Adapter | Not used with LogBook. |
| DBK204c | DBK203 with a CA-209c CE Cable Kit | Adapter | Not used with LogBook. |
| DBK205 | P4 to 12-Slot Screw Terminal Adapter | Adapter | Not used with LogBook. |
| DBK206 | P4-to-P1/P2/P3 Adapter Board, with Screw Terminals | Adapter | Not used with LogBook. |
| DBK207 | 16-Channel, 5B Carrier Board | P1-ANALOG | Not used with LogBook. |
| DBK207/CJC | DBK207 with Cold Junction Compensation | P1-ANALOG | Not used with LogBook. |
| DBK208 | Relay Carrier Board, Opto-22 Compatible | P2-DIGITAL | Not used with LogBook. |
| DBK209 | P4-to-P1/P2/P3 Mini-Adapter Board | Adapter | Not used with LogBook. |
| DBK601 thru DBK609 | Rear Panels for use with DaqBoard/260, DBK60, and LogBook/360. | Connector Panels | No configuration in <i>LogView</i> . |

Note 1: The “note 1” comment indicates that *LogView*’s Hardware/Configuration window is used to select the DBK; but does not provide any other configuration options for that specific DBK.



Reference Notes:

- The *DBK Document Modules* contain parameter definitions and information as to which DBK parameters are physically set on the hardware.
- The DBK70 is discussed in a separate document, *The DBK70 User’s Manual*, p/n 1056-0901.

Setting Up Analog DBKs

If you have not already done so, review the applicable *DBK Document Module* to ensure that the DBK option is physically set as desired. Note that certain DBKs do not require hardware or software configuration.



Understand your DBK's physical configuration before attempting to set the device in LogView's Hardware Configuration window. For example, if you were configuring a DBK4 in LogView, you would need to know the physical setup of jumpers JP7 and JP8 in order to properly set the Filter Mode for each channel.

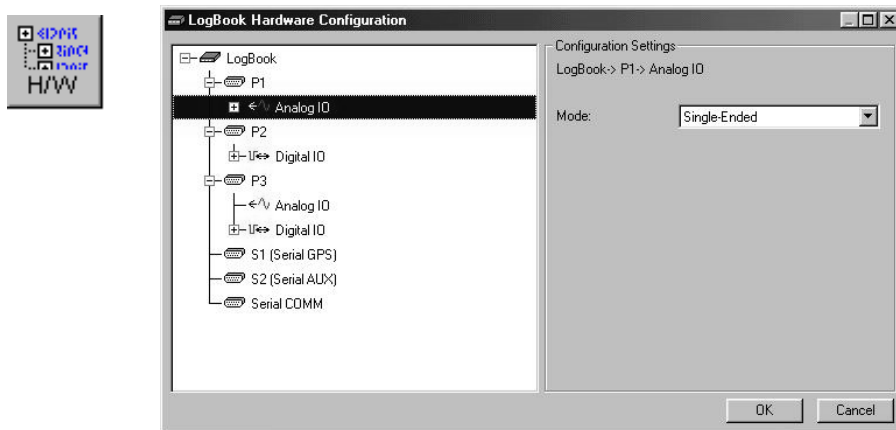


Reference Note:

The *LogView Document Module*, located in the LogBook User's Manual (p/n 461-0901), contains a detailed description of *LogView*, and should be referred to if you need to go beyond the basic setup information that follows.

Complete the following steps to set up analog DBKs in *LogView*.

1. Open the *LogBook Hardware Configuration Window* by clicking the Hardware Configuration button in LogView's toolbar. A window similar to the following should appear.



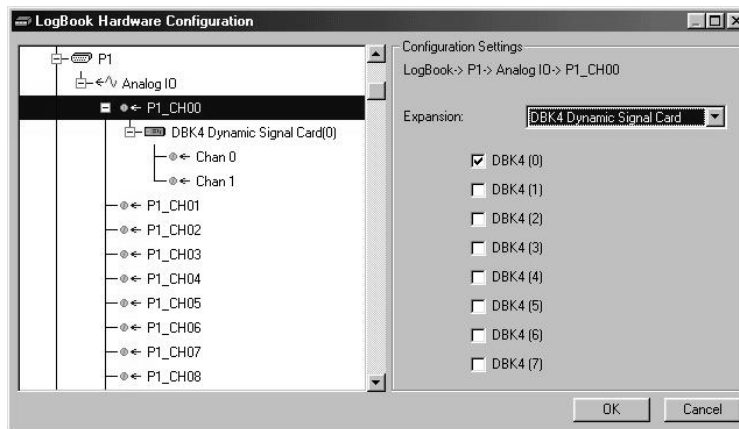
Selecting P1, Analog IO, and a Mode of Single-Ended

2. Select **P1, Analog IO** and verify that its mode is set to *Single-Ended*. See preceding figure.



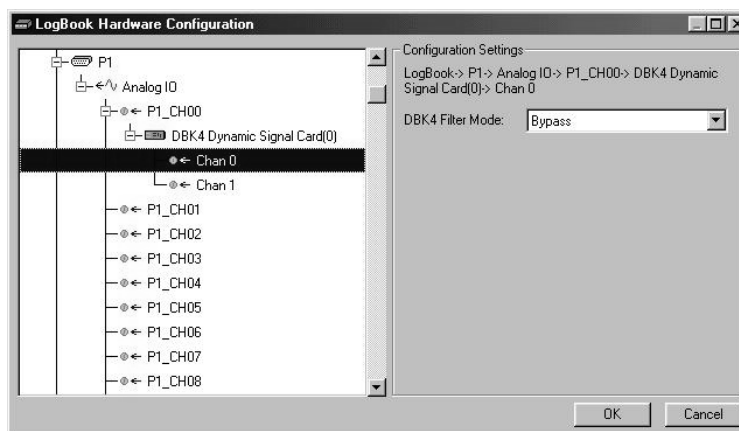
The DBKs typically have a channel address set physically on the device, by either a switch or a header. The channel designated in software must agree with the hardware setting. Thus, in step 3 below, Channel 0 will only be used to select a specific DBK when that DBK is physically set for Channel 0. Refer to the DBK Document module for more information, if needed.

3. Select an available channel, such as P1_CH00, and assign it to the specific DBK option. As in the above note, the DBK option's physical channel must agree with the channel selected in *LogView*. In the ongoing example we have selected one DBK4. Up to 8 DBK4s could be selected for P1_CH00.



Expanding P1_CH00 with a DBK4

4. Configure the DBK option(s) as applicable for your situation. For example, when configuring DBK4s, ensure the filter mode (“On” or “Bypass”) agrees with the setup on the actual card(s).



Setting the DBK4 Filter Mode for Channel 0 to Bypass

Note: Setups in software must agree with the physical settings on the DBKs. Refer to the applicable *DBK Document Modules* for detailed information.

5. Click the **OK** button to accept the settings.
6. Click the **Analog Input** button to view the new setup in the *Analog Input Channel Configuration Window*. Verify all channel numbers. Assign user labels as desired.



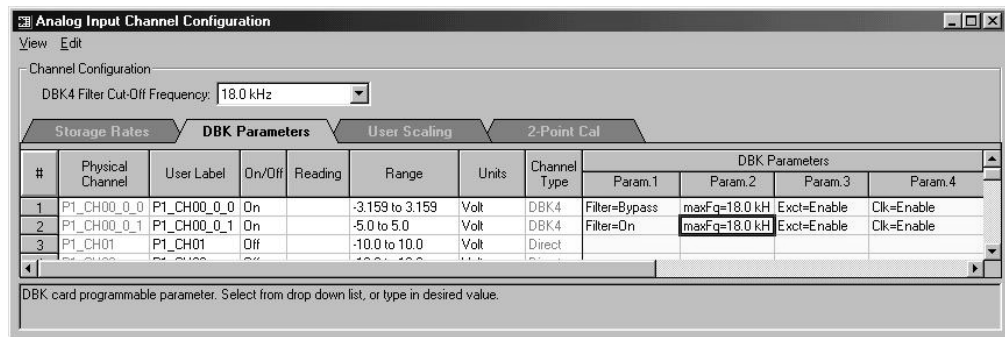
The **analog input** spreadsheet (see following figure) uses four tabs to group analog input parameters. Always visible are the Physical Channel, User Label, On/Off, real-time Reading, Range, Units, and Channel Type columns.

Clicking a tab exposes one of the four sub-windows of parameters:

- **Storage**
- **DBK Parameters**
- **User Scaling**
- **2-Point Calibration.**



If beneficial, adjust column width by placing the cursor on the line between columns (in the column header) and drag the line left or right as needed; for example -- to make room for a longer, more descriptive user label.



Analog Input Channel Configuration Window

7. From the *Analog Input Channel Configuration* window, select the **DBK Parameters** tab to view the specific settings for each DBK channel.



Some DBKs have settings that are physically set on the hardware via jumpers or switches. In these cases, the designated parameter settings in *LogView* must agree with those on the hardware. Setting one does not automatically set the other; in other words, you must make configuration settings in both software and hardware, when applicable. For information regarding specific DBK hardware configuration, refer to the applicable *DBK Document Modules*.

8. Ensure that the DBK parameters are correctly set at this time. If necessary, refer to the applicable *DBK Document Module(s)* for an explanation of the parameters; for example, DBK4 programmable filter values.



You can resize the *Analog Input Channel Configuration* window by dragging its right edge further to the right. This allows you to see up to four parameters for each channel.



When possible, use User Label names that closely resemble the Physical Channel names. This practice makes channel identification easier to remember and helps avoid confusion.

Example: If Physical Channel P1_CH01 was being used for an alarm, then Alarm-P101 would be a logical User Label.

A note regarding the Range column:

All LogBook channels and many DBK channels have a programmable gain amplifier (PGA) that provides multiple ranges. Adjusting the range allows you to zoom in or out on your signal for maximum signal resolution for the range needed. If the **Units** and/or **Scale** (from the User Scaling tab) are changed, the available ranges are presented in terms of the new units. For example, if a user scaling of $\times 20$ is applied to a channel to convert volts to PSI (pounds per square inch), the available range choices for that LogBook channel would be ± 200 PSI, ± 100 PSI, ± 50 PSI, 0-400 PSI, 0-200 PSI, etc.



Some DBKs have hardware switches and jumpers for configuration. When using such DBKs, corresponding parameters may need to be set in the *LogBook Hardware Configuration* window.

Setting Up Digital DBKs

If you have not already done so, review the applicable *DBK Document Module* to ensure that the DBK option is physically set as desired. Note that certain DBKs do not require hardware or software configuration.



Understand your DBK's physical configuration before attempting to set the device in LogView's Hardware Configuration window. For example, if you were configuring a DBK23, you would need to know the physical setup of switch S1 in order to select the correct channel in LogView.

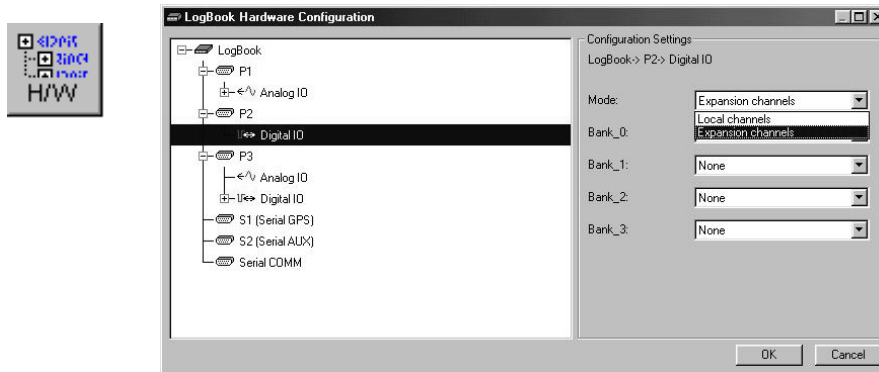


Reference Note:

The *LogView Document Module*, located in the LogBook User's Manual (p/n 461-0901), contains a detailed description of *LogView*, and should be referred to if you need to go beyond the basic setup information that follows.

Complete the following steps to set up digital DBKs in *LogView*.

1. Open the *LogBook Hardware Configuration Window* by clicking the Hardware Configuration button in LogView's toolbar. A window similar to the following should appear.



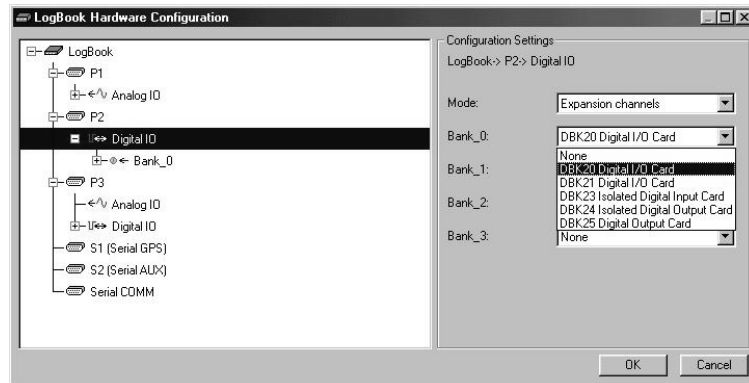
Selecting P1, Analog IO, and a Mode of Single-Ended

2. Select **P2, Digital IO** and verify that its mode is set to *Expansion Channels*. See preceding figure.



The DBKs typically have a channel address set physically on the device, by either a switch or a header. The channel designated in software must agree with the hardware setting. Thus, in step 3 below, Channel 0 will only be used to select a specific DBK when that DBK is physically set for Channel 0. Refer to the DBK Document module for more information, if needed.

3. Select an available channel, such as P1_CH00, and assign it to the specific DBK option. As in the above note, the DBK option's physical channel must agree with the channel selected in *LogView*. In the ongoing example we have selected one DBK4. Up to 8 DBK4s could be selected for P1_CH00.

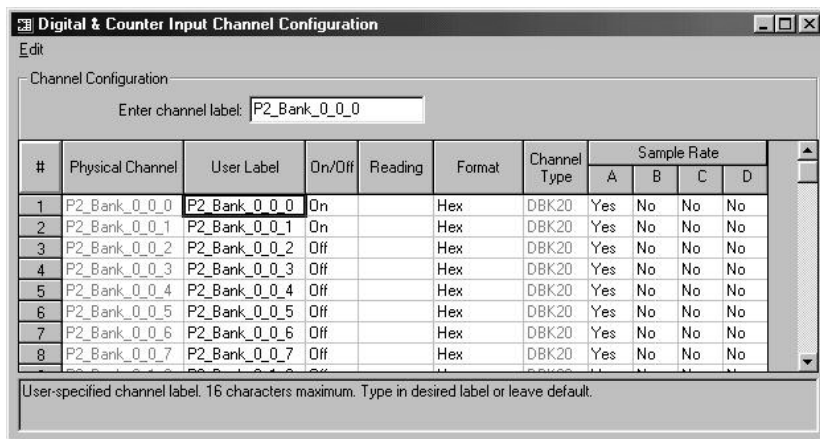


Expanding P2, Digital IO_Bank 0 with a DBK20

4. Configure the DBK option(s) as applicable for your situation. For digital DBKs this typically consists of selecting the correct location under P2, Digital IO.

Note: Setups in software must agree with the physical settings on the DBKs. Refer to the applicable *DBK Document Modules* for detailed information.

5. Click the **OK** button to accept the settings.
6. Click the **Digital Input** button to view the new setup in the *Digital Input Channel Configuration Window*. Verify all channel numbers. Assign user labels as desired.



Digital & Counter Input Channel Configuration Window

This completes the software setup for digital DBK options.



Reference Notes:

- The *DBK Document Modules* contain parameter definitions and information as to which DBK parameters are physically set on the hardware.
- The *LogView Document Module*, located in the LogBook User's Manual (p/n 461-0901), contains a detailed description of *LogView*, and should be referred to if you need additional information.



Electrostatic Discharge (ESD), Handling Notice 6-1

Troubleshooting Checklist 6-1

Frequently Asked Questions 6-3

Customer Assistance 6-6

Many customers have solved problems without factory assistance. Read through this chapter before calling for help. You may want to check our web site to see if additional FAQs have been posted since the publication of this document, or if older FAQs have been updated.



Reference Note:

A list of API error codes appears in the Programmer's Manual included on your CD-ROM. Note that API does not apply to LogBook.

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.

Troubleshooting Checklist

For most problems, proceed through the following checklist. When applicable, be sure to follow ESD prevention guidelines to avoid damaging components.

1. Power. Check power and fuses to all affected units.
2. If the System Parameters Need Reset. Cycle the power "off" then back "on." This will often reset system parameters to the correct values.
3. Signal. Check signal lines and connectors. Connectors must be free of corrosion. All lines should be undamaged and free of sharp bends and twists. Signal paths should avoid potential sources of noise such as high voltage and electromagnetic interference.
4. Self-Test. Run system diagnostic tests to confirm the LogBook or Daq device is properly connected to the PC.
5. Software. Try to acquire data with the DaqView windows application if you are using a Daq device or LogView windows application if you are using a LogBook. If you are unable to acquire data in either DaqView or LogView and another program, a hardware problem is likely. If you can obtain readings by enabling the input reading column, but cannot log data to disk, an interrupt problem is indicated.
6. Interrupt. Make sure the interrupt selected matches the interrupt used by the parallel port [for LogBooks and DaqBooks] or the interrupt selected by the hardware switches [on the DaqBoard]. The program MSD.EXE (comes with DOS 6.0 and later) reports the interrupt usage of the computer. In some cases, an interrupt conflict may arise due to a Windows printer driver stealing the interrupt. For such a problem, you must edit the SYSTEM.INI file and remove lines loading the printer drivers. In other cases, the hardware is incapable of accepting interrupts through the parallel port.
7. Parallel port. Make sure the parallel port selected is the same as the port to which the LogBook or DaqBook is connected. Also, make sure the correct protocol is selected. For Daq device users, Daq device configuration or DaqTest.exe will verify this. Also see *Parallel Port Troubleshooting Tips*.

8. Software setup. Make sure the device selected in software matches the hardware being used. Verify that setup parameters are correct for your application and attached DBK cards and modules.
9. Power management. The POWER.EXE power management program that is used by some notebook computers is known to affect proper operation of the parallel and PCMCIA ports. If you are having such trouble, remove the line loading this program from your AUTOEXEC.BAT file.
10. Device drivers. Some computers are pre-configured for numerous device drivers in their AUTOEXEC.BAT and CONFIG.SYS files. These drivers often conflict and can be a source of trouble. It is helpful for diagnostic purposes to boot the machine and test the system with the minimum number of device drivers loaded.

Parallel Port Troubleshooting Tips

Note: Does not apply to LogBook

After completing the Test Hardware function within the Daq device Configuration control panel applet, if a connection is not made, try the following troubleshooting tips:

Windows 95/98/Me/2000

1. Check the power supply to make sure power is applied.
2. Check the parallel port cable for tight connections.
3. Try all of the protocols listed in the Daq device Configuration control panel. The parallel port might have a communication protocol other than standard or normal mode.
4. If you still have not established communications, go to Control Panel, System, Device Manager, Ports, LPT1 and verify the following:
 - (a) Under the General and Driver sections, make sure the parallel port is a standard parallel port with a driver installed and that no resource conflicts are present. If no driver is installed or resource conflicts are present, you need to resolve these issues with your computer manufacturer or information services department.
 - (b) Under the Resource section, make sure the parallel port has an interrupt level assigned. If not, add one by unchecking the "Use automatic settings" button, selecting "Basic configuration 0001" so the same base address is maintained but an interrupt level is added, and double-clicking on the interrupt level so you can add the interrupt level. Generally, 7 is reserved for parallel ports but pick one to avoid conflicts. Reboot the computer.
 - (c) If the parallel port is configured as an ECP parallel port and there are connection problems, you need to access the BIOS and change the parallel port to a standard or normal mode. You can generally access the BIOS by pressing F2 or Esc during booting of the computer. You should see a message "Press F2 to enter setup." Change the parallel port mode from ECP to standard or normal. Reboot the computer.
 - (d) **Windows/2000 users:**
 - (1) In the Device Manager's list, expand "Ports (COM & LPT)"
 - (2) Highlight "ECP Printer Port (LPT1)" and 'right-click.'
 - (3) On the Properties box that appears, select the "Port Settings" Tab.
 - (4) Select the radio-button option that reads, "Use any interrupt assigned to the port."

Windows NT

1. Check the power supply to make sure power is applied.
2. Check the parallel port cable for tight connections. Try all of the protocols listed in the Daq device Configuration control panel. The parallel port might have a communication protocol other than standard or normal mode.
3. If you still have not established communications, go to Control Panel, Devices, Hardware Profiles, Parallel Port and verify the parallel port drivers are installed. If the drivers are not installed, you need to resolve this with your computer manufacturer. Also, check that the parallel port has an interrupt level assigned to it by looking at the parallel port resources in the Daq device Configuration control panel.
4. If it is necessary to add an interrupt level or to change the parallel port communication port, you need to access the BIOS during computer booting. You should see a message that reads similar to "Press F2 to enter setup." If the parallel port is configured for ECP or EPP, change it to standard or normal; then reboot the computer.

Frequently Asked Questions

Q: What are the input and output signal levels on P2 and P3?

A: P2 and P3 are TTL compatible with high levels no greater than 5 volts and low signals at 0 volts or ground.

Q: Does DASYPac 5.0 support the Daq devices in Windows 95, Windows 98 and Windows NT?

A: Yes, DASYPac 5.0 supports the DaqBoard, DaqBook, Personal Daq, and Daq PC-Cards, and the associated DBK expansion cards.

Q: What DBK options require the SSH jumper on JP2 to operate?

A: The SSH jumper must be installed on DaqBooks and DaqBoards [ISA-Type] to operate the following DBK options: DBK2, DBK4, DBK5, DBK7, DBK17, DBK45, DBK50 and DBK51. Daq PC Cards do not have a JP2, but will operate these cards as long as power for these cards is available.

Q: How do I set the Daq device to measure single-ended vs differential analog input signals?

A: DaqBook/100, DaqBook/112, and DaqBook/120 models are set by JP4's position. DaqBook/200, DaqBook/216, and all DaqBoard models and Daq PC Cards are set by software commands. All Daq devices must be set to single ended mode in order for DBK options to operate.

Q: How do I set the Daq device to measure bipolar (+5v to -5v) instead of unipolar (0 to 10v) analog input signals?

A: DaqBook/100, DaqBook /112, and DaqBook /120 models are set by JP3's position and are unable to mix bipolar and unipolar input signals (unless using a DBK15 option). DaqBook/200, DaqBook /216, all DaqBoard models and Daq PC Cards are set by software commands and are able to mix bipolar and unipolar inputs by channel.

Q: I am trying to measure differential signals, but my Daq device is not reading the signal correctly. What could be wrong?

A: The Daq device must be configured to measure differential signals. Differential signals are measured by reading the signal at the high input with respect to common and then subtract the signal at the low input with respect to common. In addition, common must be connected at the Daq device in order to measure the differential signal accurately. If the signal being measured only has 2 wires, connect a 100 Kohm resistor between low and common to provide a reference.

Q: I can read analog inputs at the primary Daq device, but my DBK option cards do not work. What could be wrong?

A: The analog DBK cards require power to operate. This power can be provided by the DaqBook or ISA-type DaqBoard (via JP1), DBK32A, or a DBK33. The following voltages [with respect to P1's pin 7] must be present to power up analog DBK option cards:

- +15 volts on P1, pin 21
- -15 volts on P1, pin 2
- +5 volts on P1, pin 1

Note: Daq PC Cards do not have power available. If all power is present, there could be a failure in the DBK option or the Daq device. If the first channel of the DBK option can be read, but other channels cannot, then the failure is in the primary Daq device .

Q: How does the Daq P1 expansion bus work?

A: All Daq products have 16 single-ended analog inputs. Each of these analog inputs can be expanded to 16 additional inputs with DBK options, providing up to 256 analog inputs. The primary Daq device uses 4 digital output lines on P1 to multiplex the DBK option channels through each analog input of the Daq device.

Channel numbers on the Daq device are numbered 0 through 15; and expansion channels are numbered 16 through 271. Since each Daq channel can have up to 16 option channels, multiple DBK options that have 2, 4, or 8 channels can be multiplexed through one primary Daq device channel.

Q: How do I get analog outputs, other than the 0 to 5 volt analog outputs, from my DaqBook or my ISA-type Daq device?

A: DaqBook and ISA-type DaqBoard analog outputs (12 bit D/A converters) are 0 to 5 volts using the internal -5 volt reference. For different or higher analog output ranges (-10 to +10 volts max), you must provide an external reference voltage equal to the maximum analog output value desired times -1 (-10 volts for 0 - 10 volt range).

This reference voltage must be applied to pin 10 for D/A channel 0 and pin 26 for D/A channel 1 with respect to pin 28 or 29 on P1. JP2 on the Daq device must be set to DAC EXT for each channel used. You cannot use the SSH line for smart DBK options (DBK2, DBK4, DBK5, DBK7, DBK17, DBK45, DBK50 and DBK51) when using an external reference on D/A channel 1.

Failure to remove the SSH jumper on JP2 when applying an external reference voltage to D/A channel 1 (pin 26) will result in damage to the Daq device.

Note: Daq PC-Cards do not have analog outputs.

Q: My computer uses ECP is that the same as EPP?

A: No. ECP (Enhanced Computer Port) is a different protocol than EPP (Enhanced Parallel Port).

- ECP will function with DaqBooks.
- ECP will function with LogBooks.
- ECP will work with WaveBooks *only if*,
 - (a) the WaveBook has a 262-0301 rev b or later chip. Note that chip upgrades are available.
 - (b) the version of WaveView being used is higher than version 7.8.

Q: I cannot find where the software settings for the DBK7 and the DBK4 cards are located in DaqView. Where do I find these?

A: After selecting a DBK4 or DBK7 card in "Configure Hardware Settings," a dialog box appears that allows you to select the number of cards and the sub address settings. There is a <Config> button in the lower right hand corner. After clicking on the <Config> button the software settings for these cards can be set.

Q: The DBK4 seems to kill my system. When the DBK4 is removed, the system functions properly. Does this imply that the DBK4 is defective?

A: Some might assume this symptom indicates that the DBK4 card is defective; but more often than not it indicates a lack of available power. The most common symptom of low power is a "dead" unit. **Failure to provide adequate power can damage one or more components in your system**, but more frequently, the system simply won't work.

It is important that you calculate your system's power demand **before** connecting the DBK4, as you may need an auxiliary power supply. Each DBK4 draws 2750 mW, which is high in comparison to the power drawn by other DBK cards. As can be seen in the following table, when using a DaqBook/100 Series product you will *always* need additional power, while other systems can typically power at least one DBK4 card.



Reference Note:

Refer to [Power Management](#), chapter 2, for more information on calculating the system power demand for all your DBK cards.

| Product | Available Power (mW) | Product | Available Power (mW) |
|-------------|----------------------|---------------|----------------------|
| LogBook/300 | 5000 | DaqBook/260 | 4000 |
| DaqBook/100 | 2100 | DaqBoard/100A | 3300 |
| DaqBook/112 | 2400 | DaqBoard/112A | 3300 |
| DaqBook/120 | 2100 | DaqBoard/200A | 3000 |
| DaqBook/200 | 4000 | DaqBoard/216A | 3000 |
| DaqBook/216 | 4000 | Daq PC-Cards | 0 |

Q: How do I calculate the total amount of power needed for all my DBK options?

A: You can calculate your power needs with the tables available in chapter 2, [Power Management](#).

Q: The CA-134 cable does not work with my Daq PC-Card. Why not?

A: Daq PC-Cards Daq/112B and Daq/216B that have a serial number equal to or greater than S/N 151044 use cable CA-134. This cable's latching connector does not work with the older PC-cards.

Daq PC-Cards Daq/112B and Daq/216B that have a serial number preceding 151044 require cable CA-134Q.

Q: I cannot read signals with the DBK12 or DBK13. What could be wrong?

A: To measure single-ended signals with the DBK12 and DBK13:

- 1) the JP3 jumper on those boards must be set to **SE** (Single Ended)
- 2) the signal must be connected to the analog input **High** terminal and **Common**.

When measuring SE signals, the Low input is ignored.

To measure differential signals with the DBK12 and DBK13:

- 1) the JP3 jumper on those boards must be set to **DIFF** (Differential)
- 2) the signals must be connected to the **High**, **Low**, and **Common** input terminals.

If only 2 wires exist for your signal, connect them to the High and Low inputs and install a 1K ohm resistor between the Low and Common [in the area between the terminal strips and the electronics] on the DBK12 or DBK13. The place to install the resistor is labeled by channel number and is designated by the letter "L." The letter "H" designates where to install a resistor between the high and common terminals if balanced inputs are desired.

Note: Cards are presently manufactured with 100K ohm resistors installed in the "L" locations.

Customer Assistance

To report problems and receive support, call the manufacturer's Applications department. Contact information is provided at the beginning of the manual. When you call, please have the following information available:

- Hardware model numbers
- Hardware serial numbers
- Contents of your CONFIG.SYS, AUTOEXEC.BAT, and SYSTEM.INI files
- Software version numbers (including DOS and Windows)
- Type of computer and features
- Results of performance tests

All equipment returned to the factory must be accompanied by an RMA# (Return Merchandise Authorization number). Use original shipping containers or equivalent to prevent shipping damage. Include the information above plus:

- The name of a contact person who can discuss the problems encountered
- The contact's phone number
- The return shipping instructions
- All troubleshooting notes and comments on tests performed and all problem-related conditions

Note: Before calling for assistance, please take a few minutes to review documentation segments that appear relevant to the problem conditions. Also, if you have not already done so, please look over the FAQs and the *Troubleshooting Checklist* that are presented in this chapter.

DBK Document Modules

DBK1, 16-Connector BNC Adapter Module

DBK2, 4-Channel Voltage Output Card

DBK4, 2-Channel Dynamic Signal Input Card

DBK5, 4-Channel Current Output Card

DBK7, 4-Channel Frequency-To-Voltage Input Card

DBK8, 8-Channel High-Voltage Input Card

DBK9, 8-Channel RTD Card

DBK10, 3-Slot Expansion Chassis

DBK11A, Screw-Terminal and BNC Option Card

DBK12 and **DBK13**, A/I Multiplexer Cards

DBK15, Universal Current, Voltage Input Card

DBK16, 2-Channel Strain-Gage Card

DBK17, 4-Channel Simultaneous Sample and Hold Card

DBK18, 4-Ch. Low-Pass Filter Card

DBK19, 14-Ch. Thermocouple Card

DBK20 and **DBK21**, Digital I/O Cards

DBK23, Isolated Digital Input Chassis

DBK24, Isolated Digital Output Chassis

DBK25, 8-Channel Relay Output Card

DBK30A, Rechargeable Battery Module

DBK32A, Auxiliary Power Supply Card

DBK33, Triple-Output Power Supply Card

DBK34, Vehicle UPS Module

DBK34A, UPS / Battery Module

DBK40, 18-Connector BNC Interface

DBK41, 10-Slot Analog Expansion Module

DBK42, 16-Slot 5B Signal Conditioning Module

DBK43A, 8-Channel Strain Gage Module

DBK44, 2-Channel, 5B Signal-Conditioning Card

DBK45, 4-Channel, SSH and Low-Pass Filter Card

DBK50 and **DBK51**, 8-Channel, Isolated Voltage Input Modules

DBK52, 14-Channel, Thermocouple Input Module

DBK53 and **DBK54**, 16-Channel, Analog Input Multiplexing Modules

DBK60, 3-Slot Expansion Chassis with Termination Panels

DBK80, Diff. Voltage Input Card with Excitation Output

DBK81, 7-Channel Thermocouple Card, High Accuracy

DBK82, 14-Channel Thermocouple Card, High Accuracy

DBK83, 14-Channel Thermocouple Card, High Accuracy; uses connection pod

DBK84, 14-Channel Thermocouple Module, High Accuracy

DBK601 through **DBK609**, Rear Panels for DaqBoard/260, DBK60, & LogBook/360

Overview 1

Hardware Setup 2

DBK1 Configuration 2

JP4 Configuration in DaqBook 2

Software Configuration 2

DBK1 – Specifications 2

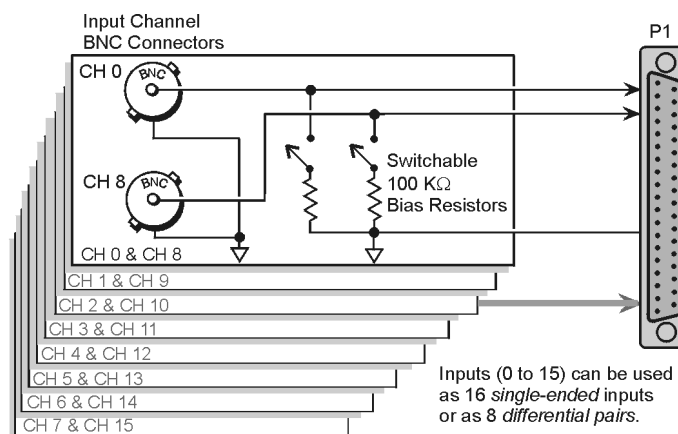


Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK1 provides a convenient means of attaching analog input signals from BNC cables to a LogBook or Daq Device via the P1 interface. Each of the 16 inputs has a switchable 100 K Ω bias resistor to accommodate floating signal sources. The 16 inputs can be used as 16 single-ended inputs (channel 0 to 15) or as 8 differential pairs (channel 0 to 7). The BNC inputs are grouped to reflect use in the differential mode (ch 0, ch 8, ch 1, ch 9, ch 2, ch 10 ...) where channel 8 serves as the low-signal line of channel 0 and so forth.



Connections are shown for channels 0 and 8. As differential pairs, channel 0 serves as the high signal line; and channel 8, the low signal line. Connections for remaining channels are similar.

DBK1 Block Diagram

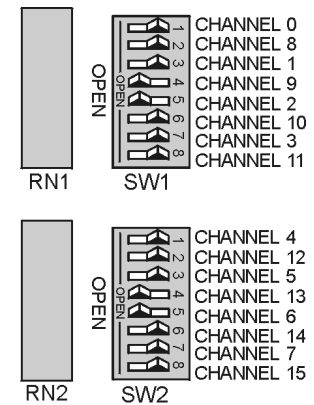
Hardware Setup

DBK1 Configuration

Factory Default: 100K Ω Bias resistors are Enabled

The only configuration option is to enable or disable the 100 K Ω bias resistors, 1 per channel. Two resistor networks (RN1 and RN2) contain the resistor elements that are switched by SW1 and SW2 DIP switches. The rocker-arm switches must be depressed in the desired orientation: OPEN for disabled (shunted). Default is enabled. Enable bias resistors to make differential measurements of signal sources with floating voltages. As shown in the figure and silk-screened on the board,

- SW1 controls channels 0, 8, 1, 9, 2, 10, 3, 11
- SW2 controls channels 4, 12, 5, 13, 6, 14, 7, 15



DBK1 Resistor Configuration

JP4 Configuration in DaqBook

For DaqBook/100, DaqBook/112, and DaqBook/120 devices you must set the DaqBook's JP4 jumper for single-ended, or for differential input as needed. Refer to your DaqBook Hardware chapter in the *DaqBook, DaqBoard, Daq PC-Card User's Manual* (p/n 457-0901) for additional information.

Software Configuration

None Required. Treat as a direct signal connection in both DaqView and LogView.

DBK1 - Specifications

Name/Function: 16-Connector BNC Adapter Module

Connectors:

DB37 male, mates with P1

BNC connectors for signal input

Analog Input Connection: 1 BNC connector for each of 16 analog input channels

Dimensions: 221 mm wide x 285 mm long x 25 mm high (8.5" x 11" x 1.375")

Weight: 1.3 kg (3 lb)

| | |
|---|----------|
| Overview | 1 |
| Hardware Setup | 2 |
| Card Configuration | 2 |
| Card Connection | 2 |
| Software Setup | 3 |
| Use of CA-115 Cables and DIN5 Power Connectors | 3 |
| DBK2 – Specifications | 4 |



This product is not used for LogBook applications.



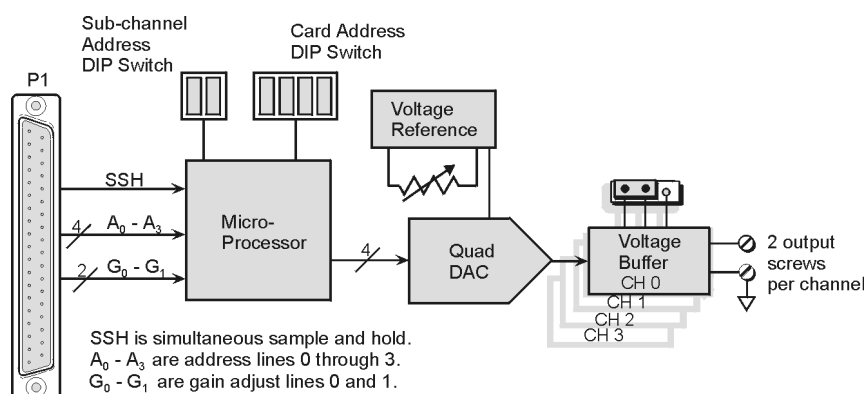
Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK2 provides the ability to generate precise, bipolar output voltages. The DBK2 connects to the Daq device P1 port. Like other P1-compatible DBK cards, the DBK2 is addressed using one of 16 base channels. Up to 4 DBK2s can share a single base channel for a maximum of 256 channels. The DBK2 can control an array of external devices including programmable power supplies, proportional actuators, analog indicators, and process controllers.

The DBK2 generates output voltages using a 4-channel 14-bit digital-to-analog converter (DAC). A precision bipolar reference is used onboard to provide accurate and stable output voltages. Each output channel is independently jumper configurable for either ± 5 V or ± 10 V operation. A 14-bit DAC can have values from 0 to 16,383 (a value of 8192 should produce a voltage of 0). Thus in the ± 5 V mode, the voltage out $V_{OUT} = [10 \text{ V} \times (\text{DAC}/16383)] - 5 \text{ V}$.



DBK2 Block Diagram

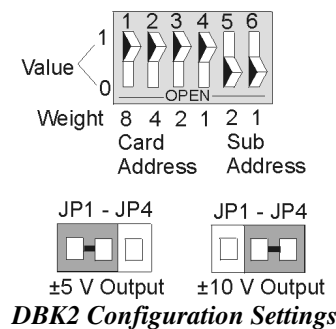
Hardware Setup

Card Configuration

Factory Default: Voltage Range $\pm 5\text{V}$

The Daq Device channel and the output level must be configured.

A 6-position DIP switch provides for address selection. The card address refers to the Daq device base channel. Any card address in the range of 0 to 15 is valid. The sub-address allows up to 4 DBK2s to share a single base channel. Any sub-address in the range of 0 to 3 is valid. (With 4 local channels on a card and 4 cards on each of 16 base channels, a maximum of 256 channels are possible.)



The DIP switch uses binary weighted values. To select the desired address, set the corresponding switch values to one. For example, if the desired card address is 11, switches 1, 3, & 4 should be set to one. To set a switch to a value, depress the corresponding side of the rocker-arm switch.

Each local channel can be set for either $\pm 5\text{ V}$ or $\pm 10\text{ V}$ output. Four 3-pin headers (JP1 through JP4) correspond to output channels 0 through 3. To configure a channel for $\pm 5\text{ V}$ output, place the shunt jumper across positions 1 & 2 (default setting) of the corresponding header (see figure). To configure a channel for $\pm 10\text{ V}$ output, place the shunt jumper across positions 2 & 3 of the channel header.

Card Connection

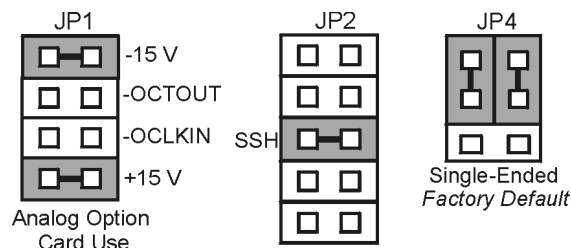
Output voltage connections are provided via convenient screw terminals or J1. Each terminal has an adjacent analog common terminal for convenience. After all connections are in place, secure the wires to the card for strain relief. Small nylon tie wraps (not included) work well for this purpose. For convenience, there are also footprints on the board to accommodate BNC connectors.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK2 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, place the DaqBook or DaqBoard JP1 jumper in the expanded analog mode, as indicated for JP1 in the following figure.



Note: JP1, in the previous figure, is indicated in its default position. The default position is necessary to power the interface circuitry of the DBK2 via the internal ± 15 VDC power supply.

CAUTION



If using auxiliary power cards, DBK32A or DBK33, you must remove both JP1 jumpers entirely from JP1.



Reference Notes:

- > Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- > Refer to the [DBK32A](#) or [DBK33](#) Document Modules if applicable to your application.

CAUTION



When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

2. Place the JP2 jumper in the SSH position.
3. **For DaqBook/100, DaqBook/112 and DaqBook/120 only**, place the JP4 jumper in *single-ended mode*.

Software Setup

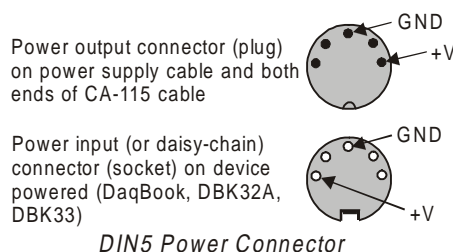


Reference Notes:

- > **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- > **LogView users** - Not Applicable.

Use of CA-115 Cables and DIN5 Power Connectors

CA-115 is a 6-inch cable with a male DIN5 connector on both ends. CA-115 is used to connect DBK32As or DBK33s in parallel (when powered by a common power supply).



DBK2 – Specifications

Name/Function: 4-Channel Voltage Output Card

Connectors: DB37 male, mates with P1. Screw terminals for signal output

Resolution: 14-bits (monotonic)

Output Ranges: ± 5 V or ± 10 V (jumper selectable per channel)

Accuracy: 0.05% of FS

Linearity: 0.02% of FS

Hysteresis: 0.01% of FS

| | |
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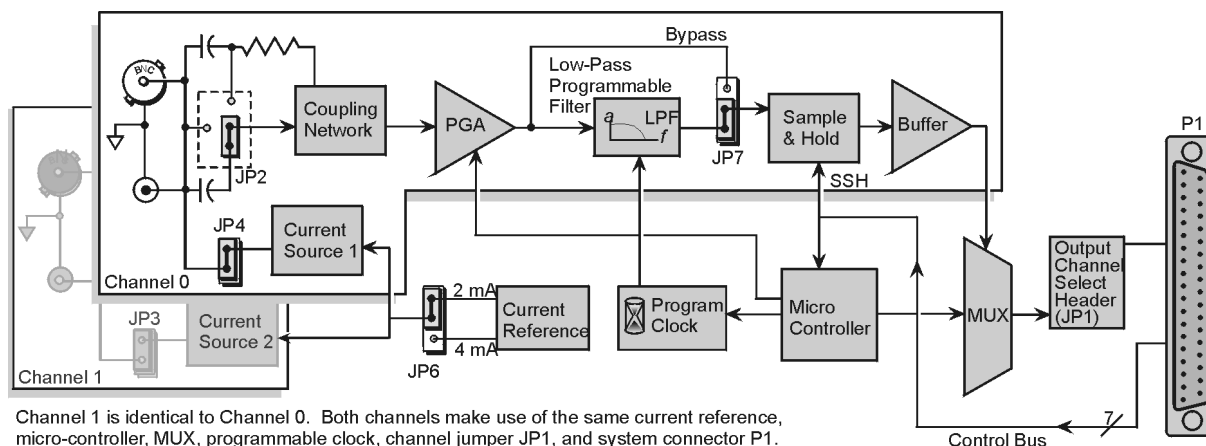


Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

DBK4 is a 2-channel signal conditioner for dynamic signals. The unit provides a means of interfacing the data acquisition device with piezoelectric transducers that include, but are not limited to: accelerometers, microphones, and force/pressure transducers. The DBK4 interfaces with the LogBook's or Daq Device P1 connector.



DBK4 Block Diagram

DBK4 Power Notice



DaqBook/100 cannot provide adequate power for a DBK4. See chapter 2, [Power Management](#) for information regarding the use of power cards and power modules.

CAUTION



Excessive power consumption can cause equipment damage. Calculate system power requirements before adding a DBK4 to the system.

Note: It is important to carefully read this DBK4 power notice and other sections of the manual that apply to your LogBook or Daq device system.

In comparison to other DBK cards, the DBK4 demands significant power. It is important that you calculate your system's power demand, as you may need to add auxiliary power supplies. This document provides a worktable for calculating system power demand.

To use the worktable: list the quantities of the applicable DBK options, and multiply these by the mW value. Place the results in the *Power* column and add them. The result is the *total power required*.

If the *power required* exceeds, or is close to the *available power*, you must add a power module or card (such as a DBK30A or DBK32A). Refer to chapter 2, [Power Management](#) for more information.

The following two charts provide information regarding available power.

| A/D Available Power Chart | |
|---------------------------|--------------|
| Product | Available mW |
| LogBook/300 | 5000 |
| LogBook/360 | 5000 |
| DaqBook/100 | 2100 |
| DaqBook/112 | 2400 |
| DaqBook/120 | 2100 |
| DaqBook/200 | 4000 |
| DaqBook/216 | 4000 |
| DaqBook/260 | 4000 |
| DaqBoard/100A | 3300 |
| DaqBoard/112A | 3300 |
| DaqBoard/200A | 3000 |
| DaqBoard/216A | 3000 |
| Daq PC-Cards | 0 |
| | |
| | |
| | |

| Auxiliary Power Supplies | |
|---|----------------|
| Product | Available mW |
| DBK32A | 15000 (Note 1) |
| DBK33 | 7500 |
| <p>For information regarding Battery and UPS Modules, refer to the following document modules:</p> <p>DBK30A DBK34 DBK34A</p> | |

| Power-Requirement Worktable | | | | |
|---|-----|---|------|---------|
| Quantity x milli-Watts = power required | | | | |
| Option | Qty | x | mW | = power |
| DBK1 | | x | 0 | = 0 |
| DBK2 | | x | 565 | = |
| DBK4 | | x | 2750 | = |
| DBK5 | | x | 135 | = |
| DBK7 | | x | 420 | = |
| DBK8 | | x | 455 | = |
| DBK9 | | x | 560 | = |
| DBK11A | | x | 0 | = 0 |
| DBK12 | | x | 455 | = |
| DBK13 | | x | 455 | = |
| DBK15 | | x | 485 | = |
| DBK16 | | x | 1040 | = |
| DBK17 | | x | 905 | = |
| DBK18 | | x | 1085 | = |
| DBK19 | | x | 200 | = |
| DBK20 | | x | 50 | = |
| DBK21 | | x | 50 | = |
| DBK23*** | | x | 10 | = |
| DBK24*** | | x | 10 | = |
| DBK25 | | x | 10 | = |
| DBK35 | | x | 0 | = 0 |
| DBK40 | | x | 0 | = 0 |
| DBK41 | | x | 0 | = 0 |
| DBK42 | | x | 35 | = |
| DBK43A*** | | x | 35 | = |
| DBK44 | | x | 330 | = |
| DBK45 | | x | 1565 | = |
| DBK50*** | | x | 35 | = |
| DBK51*** | | x | 35 | = |
| DBK52 | | x | 200 | = |
| DBK53 | | x | 455 | = |
| DBK54 | | x | 455 | = |
| DBK70*** | | x | 35 | = |
| DBK80 | | x | 755 | = |
| DBK81 | | x | 1060 | = |
| DBK82 | | x | 1810 | = |
| DBK83 | | x | 1810 | = |
| DBK84 | | x | 1810 | = |
| Total Power Required => | | | | |

Note 1: DBK32A only provides ± 15 VDC output.

*** Three asterisks indicate that the module has an internal power supply that is powered separately.

Hardware Setup



If using a DaqBook/200, DaqBook/216, DaqBoard/200A, or DaqBoard/216A that has a serial number of 103350 or earlier, you must contact the factory for a hardware upgrade (EO-1911) before using the DBK4.



Software calibration for each DBK4 requires a set of unique constants supplied on a diskette identified by a serial number matching the DBK4 card. To install these constants, follow instructions on the “readme” file included on the calibration disk.

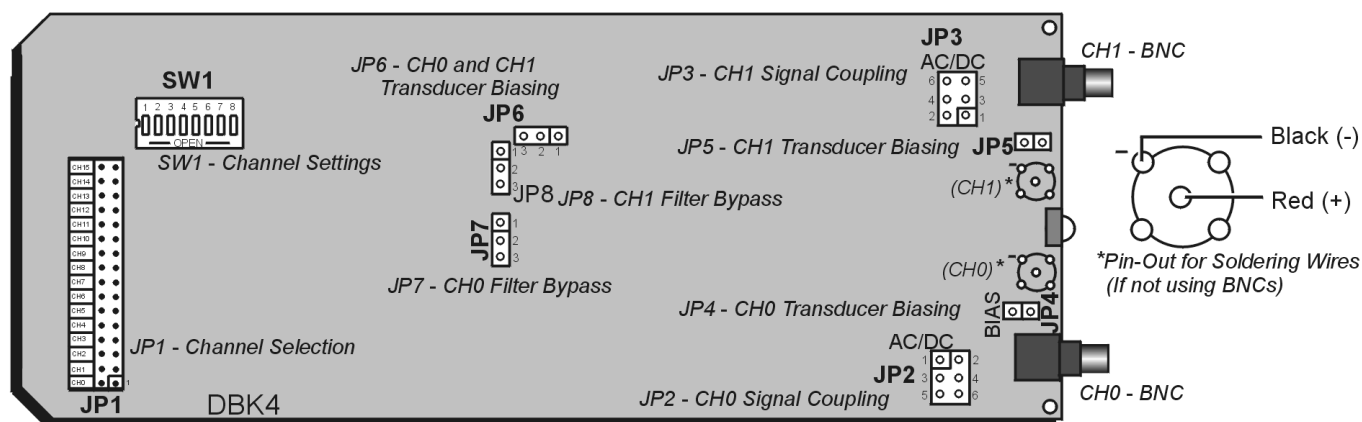
Card Configuration

Factory Defaults

- Current Level – 4ma
- Coupling – 10 Hz
- Current Source – On
- 40Khz Filter – In-Line

Both hardware and software are used in configuration. This section focuses on the hardware. Jumpers and switches are used to set: **current source (current level and source enable/disable)**, **filter bypass**, **signal coupling**, and **channel addressing**. It is best to remove power from the card to perform these selections. The figure reveals the jumper and switch locations.

Note: The hardware jumper settings referenced in the following subsections are per-channel selections unless otherwise specified.

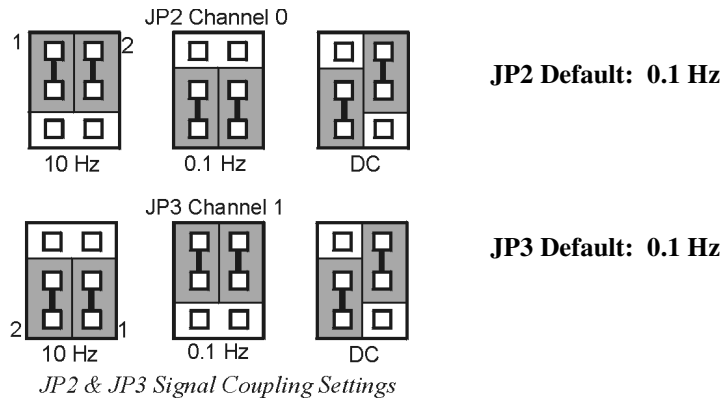


DBK4, Board Layout (not to scale)

Signal Coupling (JP2 & JP3)


The figure shows jumper settings for selecting AC coupling, 10 Hz or 0.1 Hz High Pass Filter (HPF), or DC coupling.

Signal coupling is application specific. 10 Hz HPF suits most applications for acceleration measurements on “light” structures. When performing seismic measurements (or measurements on “massive” structures) the 0.1 Hz HPF rejects the DC bias component while preserving the low-frequency signals.



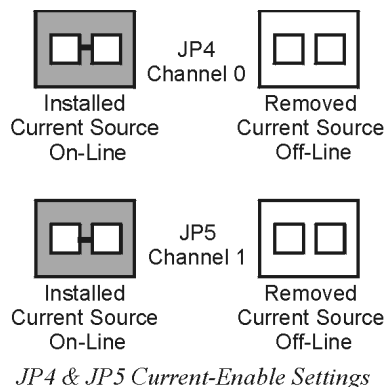
DC coupling may be used when making a voltage mode measurement.

CAUTION


**When the input signal is DC-coupled, the current source must be deselected (Jumper JP4 and/or JP5 removed). Failure to do so could result in damage to the transducer.**

Current Source for Transducer Biasing (JP4 & JP5)

The DBK4 provides a current source for transducer biasing. Bias current is selected (enabled or disabled) via jumpers JP4 (channel 0) and JP5 (channel 1) as shown in the figure.

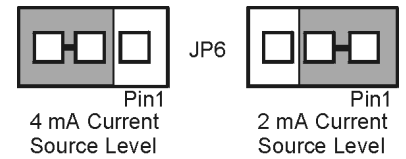


CAUTION

**When the input signal is DC coupled, the current source must be “off-line” (jumper removed) to protect the transducer. While DC coupled, the output voltage of the current source can approach 30 V depending on the output impedance of the transducer.**

Current Level (Transducer Biasing) (JP6)

Current level is not channel-specific. The level selected applies to both channels. The figure shows the JP6 jumper settings for current level. Most transducers operate with either 2 or 4 mA of bias current. However, biasing at 4 mA allows the transducer to drive longer cables.



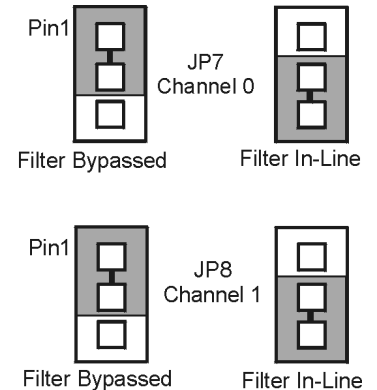
JP6 Current-Level Setting



Reference Note: For more information, refer to the [Cable Driving](#) section of the *Accelerometer Tutorial* that is included in this DBK4 document module.

Filter Bypass (JP7 & JP8)

Jumpers JP7 and JP8 are used to enable or disable programmable filtering for channel 0 and 1 respectively. This selection determines the bandwidth of the signal to be processed. When disabled (bypassed), the DBK4 can process a signal with a bandwidth up to 40 kHz. The gain in bypass mode is greater than in the filter mode by a factor of 1.583. For example, When the PGA gain is set to 10, the filter-mode gain is $\times 10$ and the bypass-mode gain is $\times 15.83$.

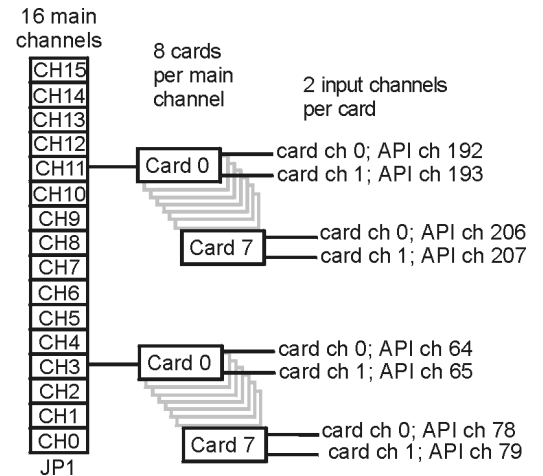


JP7 & JP8 Filter-Bypass Settings

Main Channel and Sub Channel Selection

Up to 8 DBK4 cards can use 1 of 16 main channels. Each DBK4 has 2 inputs; thus the input capacity is 256 channels (2 inputs \times 8 cards \times 16 main channels).

The DBK4 uses JP1 and SW1 for channel and sub-channel selection. (Position s8 on SW1 is not used.) The DBK4 card or a group of DBK4 cards (0-7) must have a dedicated main channel. Do not intermix DBK4 cards with other types of DBK cards in a channel. LogBook or Daq device will not function properly if channel settings are in conflict.



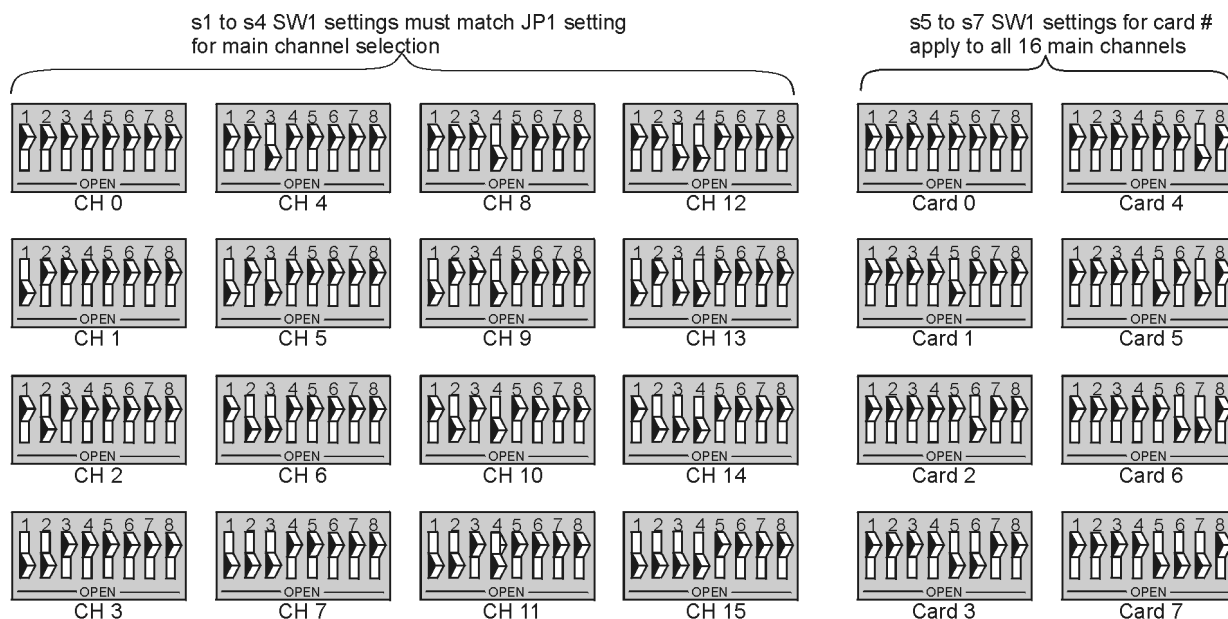
DBK4 Channel Hierarchy



Record all channel settings and label the transducers for future reference.

JP1 on the DBK4 is a 2 \times 16 header located on the far left side of the card. A shunt jumper setting on JP1 allows a card to reside in 1 of 16 possible main channels. Any main channel in the range 0-15 is valid. The figure below shows that sub-switches s1 to s4 of SW1 can be set by binary values to equal the main channel selection. This setting must match the jumper on JP1 so the onboard microcontroller knows the JP1 selection. The card then interprets and responds to only the correct card-related commands via P1.

The DBK4's sub-channel address is selected using switches s5 - s7 of DIP switch SW1 (located above and to the right of JP1). As a 2-channel card, 3 switches are used to select 8 sub-channel addresses. Therefore, it is possible for each main channel to use up to 8 DBK4s. The figure below shows 16 switch settings for the main channel and 8 settings for the sub-channel (card) selection.



DBK4 SW1 Channel Settings

Card Connections

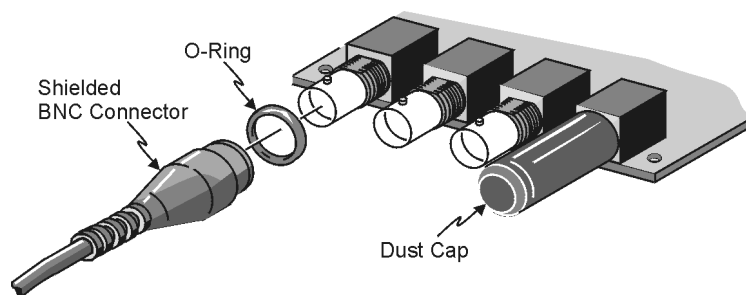
The DBK4 connects to the LogBook's or Daq device's P1 port or a P1 port on a DBK Expansion Module.

For signal inputs, a BNC connector interface is provided for each channel. The DBK4 PC Board has a microdot connector footprint that is wired in parallel with each BNC connector. The user is can customize the input connector as needed. As a factory default, the DBK4 is not populated with microdot connectors.

CE Compliance

Special Cables and Connectors for CE Compliance

To insulate BNC connectors from high-voltage sources such as static charges that can enter the circuitry via an exposed connector and cause ESD damage. Specific cables and connectors that must be used (as stated in the Declaration of Conformity), PVC dust caps (p/n CN-96) must cover all unused BNC connectors. With dust caps removed, special coaxial cables with insulated end-connectors and rubber O-rings (p/n 418-0800) must be used (see figure). Properly installed connectors and dust caps ensure that no metallic surfaces are exposed.



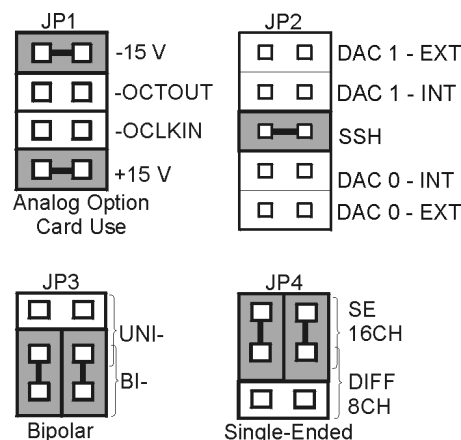


DaqBook and DaqBoard [ISA type] Configuration

Several setup steps of DaqBooks and DaqBoards [ISA type] are required to use DBK4 cards in a system. Note that the Daq PC-Card is configured in software; it cannot supply power to DBKs.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode (Analog Option Card Use). In this mode jumpers are at JP1's -15 V and +15 V positions.

Note: This default position is necessary to power the interface circuitry of the DBK4 via the internal ± 15 VDC power supply. If using auxiliary power DBK32A or DBK33, you must remove both JP1 jumpers.



DaqBook/Board Settings for the DBK4

The DBK4 is **power intensive**; refer to [chapter 2, Power Management](#) to calculate system power requirements.

2. Place the JP2 jumper in the SSH position.

| CAUTION | |
|---------|---|
| | When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26. |

3. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP3 jumpers in *bipolar* mode.
4. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP4 jumpers in *single-ended* mode.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

Hardware Description

Current Source (Transducer Biasing)

Each channel has a constant-current source that can be jumper-set to 2 mA or 4 mA. The bias current is sourced through the center conductor of a coaxial lead and returns to the DBK4 from the transducer's case via the outer conductor. The current source provides a dynamic load of more than 1.4 M Ω and has a negligible loading effect on the transducer's output. If bias is not required, removing a jumper and coupling the signals directly to the input preamplifier can disable the current source.

Note: Use the 4 mA for long cables, high peak voltages, and high signal frequencies.

Signal Coupling

The input can be configured via jumpers to maximize the usable signal spectrum. The DBK4 provides two, 1-pole High-Pass Filters (HPF) and one DC path. The HPF can be set to 0.1 Hz, 3 dB cut-off frequency. In this case, the system frequency response is limited by the source characteristics. The HPF can also be set to 10 Hz, 3-dB cut off frequency, for high-frequency measurements. The 10 Hz setting is useful in attenuating setup-induced low-frequency signals that can reduce the dynamic range (e.g., when using tape recorders as signal sources).

Note: When using 0.1 Hz coupling, you should set the baseline (via software) to one-shot mode.

The DC path allows the DBK4 to be used in voltage-mode measurements that convey DC as well as AC information. For example, when motion is measured with a DC LVDT, the transducer is biased with an independent power supply and its output is referenced to ground.

CAUTION



JP4 or JP5, as applicable, must be removed to disable the current source whenever the input is *DC-coupled*. Failure to remove JP4 or JP5, when the input is *DC-coupled*, can result in transducer damage.

Amplifier

The DBK 4 includes a Programmable Gain Amplifier (PGA) with three gain settings ($\times 1$, $\times 10$, and $\times 100$). The gain settings are set for each channel via software. These gain settings are performed at configuration and remain unchanged during a measurement sequence. The PGA has a flat response up to 100 kHz for in-band and out-of-band frequencies.

Low-Pass Filter

To protect the in-band components from distortion caused by aliases of the out-of-band spectrum, the DBK4 features a 12-pole programmable Butterworth Low-Pass Filter (BLPF). There are eight 3 dB cut-off frequency (F_c) settings per channel, the lowest frequency is 141.6 Hz and the highest is 18 kHz. In general, high order BLPF introduce amplitude and phase distortion near the 3 dB cut off frequency. Limiting the measurement range can reduce this error. A typical measurement range is 70% to 80% of the 3-dB cut-off frequency.

For narrowband measurements, the anti-alias filter can be bypassed providing an extended bandwidth of 40 kHz. In this configuration, the channel has lower distortion and a gain factor of 1.583. This setup may be useful when calibrating accelerometers with sinusoidal motion. However, in this case, special attention should be given to external noise since high-frequency noise will be aliased into the signal band.



The switched capacitor clock must be turned on in software for the filter to work.

Sample and Hold

The card's sample and hold amplifier samples all channels within a system (up to 256) within 50 ns of one another and preserves their phase information. Measurement of transmissibility can be made between any two of the 256 possible channels.

The Simultaneous Sample and Hold (SSH) is triggered on the first channel of a scan sequence; after which, the A/D converter sequentially measures the output of each of the SSH amplifiers. In a scan sequence, the first channel should be a non-SSH channel. However, if the scan sequence contains only SSH channels the first channel will contain data taken in the sample mode. This data is inaccurate and therefore should be discarded; however, the second sample (valid) can be a repeat of the first.

Power Management

The DBK4 has circuits for a variety of measurement environments. When not needed, the filters and/or current source can be powered down via software. This feature can be useful in field units to reduce overall power consumption.

Software Controls

Power management, the PGA, and the low-pass filter's cut-off frequency are all software controllable. These parameters are sent via the external address bus in the P1 connector to the DBK4. The micro-controller decodes the configuration message, sets the PGA and filter controls, and illuminates the on-board LED. However, if transmission errors are detected, the micro-controller flashes the LED and ignores the message. The error is cleared when an error-free message is received. At power up, the current source and filters are powered off and the LED is off. The LED will remain off until the DBK4 is successfully addressed for the first time.

DBK4 – Specifications

Name/Function: 2-Channel Dynamic Signal Input Card

Physical Specifications

Channels: 2

Signal Connection: 1 BNC connector per channel

Dimensions: 8.28" W × 3.25" H

Operating Specifications

Power Consumption (typical): 20 mA @ +5 V, 95 mA @ +15 V, 80 mA @ -15 V

Current Source:

Output Impedance: >1.4 MΩ

Compliance: 27 VDC

Current Levels: 2 & 4 mA

Broadband Noise: 0.3 μA RMS (Bw = 100 kHz)

Input Impedance: 150 kΩ

Gain:

Bypass Mode: ×1.583 ×15.83 ×158.3

Filter Mode: ×1 ×10 ×100

Input Ranges: ±5 V ±500 mV ±50 mV FS

Coupling:

 AC, DC

AC: 1-pole, 10 Hz HPF

1-pole, 0.1 Hz HPF

Input Signal/Noise: >96 dB (Bw = 100 kHz)

Filter(Typical):

Distortion

Bypass Mode: @ 1 kHz: -83 dB; @ 10 kHz: -80 dB

Filter Mode: @ 1 kHz: -75 dB; @ 10 kHz: -72 dB

Cut-off(Fc):

18 kHz 9 kHz 4.5 kHz 2.25 kHz

1125 Hz 562.5 Hz 281.2 Hz 141.6 Hz

Flatness DC - 80% Fc: ±0.2 dB

Channel Matching DC - 80% Fc: Phase: ±6°

Accuracy Passband Center: ± 0.5 dB



Accelerometer Tutorial

This accelerometer tutorial covers the following topics. Page numbers refer to DBK4 document module pages.

What is a Piezoelectric Accelerometer?.....11

Accelerometer Specification Parameters.....11

Physical Setup.....13

Electrical Grounding.....14

Practical Limitations..... 15

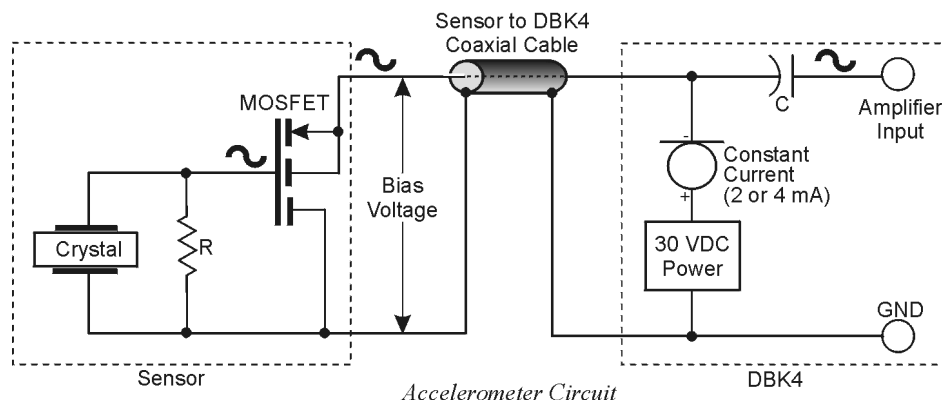
Cable-Connector Handling Precautions.....15

Cable Driving.....16

What is a Piezoelectric Accelerometer?

A low-impedance piezoelectric accelerometer consists of a piezoelectric crystal and an electronic amplifier. When stretched or compressed, the two crystal surfaces develop a charge variation that is related to the amount of stress, shock, or vibration affecting the crystal. The amplifier outputs a corresponding signal and transforms the sensor's high impedance to a lower output impedance of a few hundred ohms. Besides acceleration, such sensors can measure pressure and force.

The circuit requires only 2 wires (coaxial or twisted pair) to transmit both power and signal. At low impedance, the system is insensitive to external or "triboelectric" cable noise. Cable length does not affect sensitivity.



The figure shows a simple sensor-DBK4 connection. The MOSFET is powered from a constant-current source of 2 or 4 mA at 27 volts. In the quiet state, the MOSFET circuit will bias off at about 12 V. As the system is excited, a voltage develops across R and the crystal and is applied to the gate of the MOSFET. This voltage will cause linear variation in the impedance of the MOSFET and a proportional change in bias voltage. This voltage change will be coupled to the DBK4 input amplifier through the capacitor C. The value of R and the internal capacitance of the crystal control the low-frequency corner. Units weighing only a few grams can provide high-level outputs up to 1 V/g with response to frequencies below 1 Hz.

Accelerometer Specification Parameters

Noise in Accelerometers

The noise floor or resolution specifies the lowest discernible amplitude (minimum "g") that can be measured. There are two main sources of noise:

- Noise from the crystal and circuit inside the accelerometer. Some types of crystals, such as quartz, are inherently more noisy than others. A good noise floor is 10 to 20 μV .
- Noise from electrical activity on the mounting surface. Since the signal is a voltage, 60 Hz or other voltages (induced or ground loop, etc) may interfere. The best protection is to electrically isolate the accelerometer.

Sensitivity

The sensitivity of an accelerometer is defined as its output voltage per unit input of motion. The unit of motion used is the “g”. One “g” is equal to the gravitational acceleration at the Earth’s surface, which is 32.2 ft/(sec)(sec) or 981 cm/(sec)(sec). The output is usually specified in millivolts per “g” (mV/g). Sensitivity is usually specified under defined conditions (frequency, testing levels, and temperature), for example: 100 mV/g at a frequency of 100 Hz, level +1 g, at 72°F.

While a given sensor model may have a “typical” sensitivity of 100 mV/g, its actual sensitivities may range from 95 to 105 mV/g when checked under stated conditions. The manufacturer typically provides sensor calibration values.

Transverse Sensitivity

An accelerometer is designed to have one major axis of sensitivity, usually perpendicular to the base and co-linear with its major cylindrical axis. The output caused by the motion perpendicular to the sensing axis is called the transverse sensitivity. This value varies with angle and frequency and typically is less than 5% of the basic sensitivity.

Base-Strain Sensitivity

An accelerometer’s strain sensitivity is the output caused by deformation of the base due to bending in the mounting structure. In measurements on large structures with low natural frequencies, significant bending may occur. Units with low base-strain sensitivity should be selected.

Inserting a washer smaller than the accelerometer base under the base to reduce the contact surface area can substantially reduce base-strain effects. This technique lowers the usable upper frequency range.

Acoustic Sensitivity

High-level acoustic noise can induce outputs unrelated to vibration input. In general, the effect diminishes as the accelerometer mass increases. Using a light, foam-rubber boot may reduce this effect.

Frequency Response

An accelerometer’s frequency response is the ratio of the sensitivity measured at frequency f to the basic sensitivity measured at 100 Hz. This response is usually obtained at a constant acceleration level, typically 1 g or 10 g. Convention defines the usable range of an accelerometer as the frequency band in which the sensitivity remains within 5% of the basic sensitivity. Measurements can be made outside these limits if corrections are applied. Care should be taken at higher frequencies because mounting conditions greatly affect the frequency range (see *Mounting Effects* below).

Dynamic Range

The dynamic measurement range is the ratio of the maximum signal (for a given distortion level) to the minimum detectable signal (for a given signal-to-noise ratio). The dynamic range is determined by several factors such as sensitivity, bias voltage level, power supply voltage, and noise floor.

Bias Level

Under normal operation, a bias voltage appears from the output signal lead to ground. There are two basic MOSFET configurations commonly used. One exhibits a 7-8 V bias and the second a 9-12 V bias. Operation of the two circuits is identical except for the available signal swing. The low-voltage version typically exhibits 5-10 μ Vrms versus 10-20 μ Vrms for the high voltage.

Thermal Shock - Temperature Transients

Piezoelectric accelerometers exhibit a transient output that is a function of a temperature’s “rate-of-change”. This “thermal shock” is usually expressed in $g/^{\circ}\text{C}$ and is related to:

- Non-uniform mechanical stresses set up in the accelerometer structure
- A pyroelectric effect in piezoelectric materials—an electrical charge is produced by the temperature gradient across the crystal.

This quasi-static effect produces a low-frequency voltage input to the MOSFET amplifier. This voltage is usually well below the low-frequency corner, but the effect can reduce the peak clipping level and cause loss of data. This effect does not affect the accelerometer's basic sensitivity or the data unless the thermal shift in the operation bias level results in clipping. Where drastic thermal shifts are expected, use 12 V bias models. The effect's severity is related to the mass of the accelerometer. In 100 mV/g industrial units, the effect is usually negligible. Using rubber thermal boots can reduce the effect significantly.

Overload Recovery

Recovery time from clipping due to over-ranging is typically less than 1 ms. Recoveries from quasi-static overloads that generate high DC bias shifts are controlled by the accelerometer input RC time constant that is fixed during manufacture.

Power Supply Effects

The nominal power supply voltage recommended by most manufacturers is 15 to 24 V. Units may be used with voltages up to 28 volts. Sensitivity variations caused by voltage change is typically 0.05%/volt. Power supply ripple should be less than 1 mVrms.

Connector

This parameter specifies the connector type and size (4-48, 6-40, 10-32 coaxial etc) and the location on the sensor, i.e., top or side (usually on the hex base). Where there is no connector on the sensor, an integral cable is specified with the length and the connector, i.e., integral 6-ft to 10-32.

Physical Setup

Mounting Effects

Adding an accelerometer to a test object may influence the object's mechanical resonance and/or reduce the resultant vibration level. The mass of the structure and accelerometer as well as the position on the structure can affect the measurement. For example, an accelerometer with a small mass relative to a car's mass will affect measurements on the hood when placed directly in the hood's center. The same accelerometer placed on the more massive frame will have little effect.

The resonance change in a simple spring-mass system caused by adding an accelerometer may be approximated by:

$$\Delta f = f_n \{1 - [m/(m - m_a)]^{1/2}\}$$

Where:

Δf = Change in Resonant Frequency

f_n = Original Resonance Frequency without Accelerometer

m = Spring Mass

m_a = Mass of Accelerometer

Threaded Stud Mount

The preferred method for attaching an accelerometer to the test surface is by the threaded stud mount. This method fuses the accelerometer and test surface. When the stud mount is impractical, an adhesive installation is usually a good alternative.

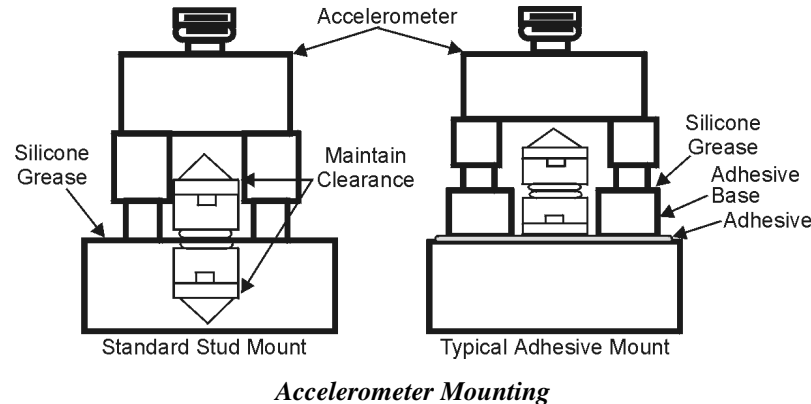
Adhesive Mounts

Some accelerometers can be glued directly to the test surface. Others must use mounting adapters (bases). These adapters are normally glued to the test surface and the accelerometers are stud-mounted to them. When applying a layer of adhesive, keep in mind that the adhesive creates a new spring-mass system with lower high-frequency response. To avoid a thick glue line, Cyanocrylate adhesives work well because:

- They cure quickly, within seconds.
- Glue lines can be kept ultra-thin by using glue sparingly and pressing the accelerometer to the surface with adequate force.
- Cleanup is easy since these adhesives will dissolve with acetone.

Removal of Adhesive Accelerometers

Many accelerometers and adhesive adapters have been damaged by improper removal. A safe removal method is to torque the accelerometer or its adapter with a wrench using the flats provided. Adhesives are generally weakest in the shear mode and will yield under steady torque.



CAUTION



Never strike an accelerometer to remove it. The trauma will likely damage the accelerometer and affect calibration.

Magnetic Mounting Adapters

Magnetic mounting adapters can attach accelerometers to ferromagnetic surfaces such as machinery and structures where the sensor is to be moved quickly from place to place. The accelerometer is attached to the magnet (usually by stud mount) and the assembly is then applied to the surface.

In general, use magnetic adapters with caution and never beyond 1 kHz. Expect response degradation in proportion to accelerometer mass. To ensure the best accuracy from the magnetic mount:

1. If possible, attach the magnet to bare metal. Paint will lessen the holding force of the magnet and can affect response.
2. Clean mounting area to remove oil, grease and foreign matter, which could reduce the contact for a strong magnetic bond.
3. Select a flat area to achieve maximum surface contact.
4. Attach the magnet to the test surface **CAREFULLY**. Remember that the pull of the magnet rises sharply just before contact with the ferromagnetic surface. This force could pull the assembly from your hand resulting in a severe metal-to-metal shock. This could over-range the accelerometer beyond its maximum shock limit and damage it.
5. If possible, calibrate the magnetic/accelerometer assembly.

Electrical Grounding

Case-Grounded Design

In case-grounded designs, the common lead on the impedance-matching circuit is tied to the accelerometer case. The accelerometer base/stud assembly forms the signal common and electrically connects to the shell of the output connector. Case-grounded accelerometers are connected electrically to any conductive surface on which they are mounted. When using these units, take care to avoid errors due to ground noise.

Isolated-Base Design

To prevent ground-noise error, many accelerometers have a base-isolated design. The outer case/base of the accelerometer is isolated electrically off ground by means of an isolation stud insert. The proprietary material used to form the isolation provides strength and stiffness to preserve high-frequency performance.

Practical Limitations

Mass Loading

The accelerometer mass should be less than 10% of the rigidly-coupled mass of the test object. The test object should be rigid at the mounting point, such as a bearing housing rather than a sheet metal cover.

Upper Frequency Response

Piezoelectric accelerometers will attenuate below the low-frequency 3-dB point, but they will amplify at or near their resonant frequency. The mounted resonant frequency of the accelerometer should be about five times the highest frequency of interest (for ± 0.5 dB accuracy). Refer to the frequency response data supplied with each accelerometer to establish the usable range. For general surveys or broader tolerances, smaller multiples may be used. For example, for frequencies up to 1/2 the mounted resonance, sensitivity would typically be 12% higher than nominal.

Cable-Connector Handling Precautions

Connectors

Clean the connector ends periodically with a stiff-bristle brush (such as a glue brush or small paintbrush with clipped bristles) dipped in a solvent. This will remove metal slivers (which can peel off connector threads and short across contacts), oil and other contaminants.

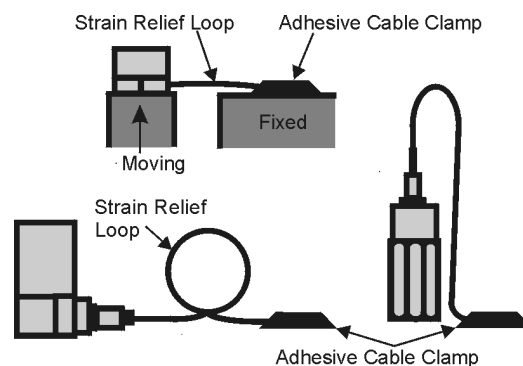
When connecting 10-32 or 5-44, thread the cables to sensor jacks. Do not use pliers to torque knurled coupling nuts in place. Hand tightening is sufficient for most applications. If the nut tends to loosen under severe shock or vibration, you may use a mild thread-locking compound. Use it very sparingly and apply only to the male thread to avoid contamination of the electrical contact.

Because of their size, 10-32 (and smaller) connectors are relatively fragile. Always hold the transducer steady and twist off the knurled coupling-nut. *Never hold the coupling-nut and twist the transducer.* Use 10-32 (and smaller) connectors only when necessary.

Cables

The weakest point on the cable assembly is at the intersection of the wire and connector; so, avoid stress at this point. Sharp bends can overstress the conductors and insulation causing shorting or breakage.

The figure shows the preferred methods of cable routing to the connector. The flexure occurs away from the intersection point. Relative cable motion at the sensor body or connector can cause erroneous output signals at frequencies where cable motion is amplified (cable “whip”). Miniature accelerometers are especially susceptible due to their small size and low mass. This problem is remedied by proper tie down as shown. A “strain relief loop” will ensure that cable flexure does not occur at the connector when the cable is fastened to a stationary surface.



Accelerometer Connections

Triboelectric Noise

Triboelectric noise is caused by the potential developed in a flexing cable. The cable shield may rub against the cable's insulator, and the interior friction generates a charge that produces noise. The triboelectric noise voltage or charge is coupled to the signal leads by inner conductor capacitance and may be represented by a voltage source in series with a capacitance. In general, triboelectric noise is associated with bending of signal cables when low-frequency vibrations (below 10Hz) are being measured. If moving or securing the cable alters the output compared to an external reference, triboelectric noise is a likely suspect.

Cable Driving

Operation over long cables is a concern with all types of sensors. Concerns involve cost, frequency response, noise, ground loops, and distortion caused by insufficient current available to drive the cable capacitance.

Coupling a short (e.g., 1m) adapter cable from the accelerometer to a long, low-cost cable like RG-58U or RG-62U with BNC connectors can reduce the cost of long cables. Since most cable failures occur at the accelerometer connection where vibration is the greatest, only the short adapter cable would need replacement.

Capacitive loading in long cables acts like a low-pass, second-order filter and can attenuate or amplify high-frequency signals depending on the output impedance of the accelerometer electronics. Generally this is not a problem with low-frequency vibration (10 Hz to 2000 Hz). For measurements above 2000 Hz and cables longer than 100 ft, the possibility of high-frequency amplification or attenuation should be considered.

The DBK4 constant-current source provides 2 or 4 mA to integral electronics. Use the higher current setting (4 mA) for long cables, high peak voltages, and high signal frequencies.

The maximum frequency that can be transmitted over a given length of cable is a function of both the cable capacitance and the ratio of the maximum peak signal voltage to the current available from the constant current source:

$$f = \frac{K}{2\pi C \left(\frac{V}{I_{cc} - I_b} \right)}$$

Where:

f = Maximum frequency in Hz

K = 3.45×10^9 (K is the scale factor to convert Farads to picoFarads and Amperes to milliAmperes and a factor to allow cable capacitance to charge to 95% of the final charge.)

C = Cable capacitance in picoFarads

V = Maximum peak measured voltage from sensor in volts

I_{cc} = Constant current from current source in mA

I_b = Current required to bias the internal electronics, typically 1 mA

| Drive Current (mA) | Cable Length @30 pF/ft (Ft) | Frequency Response to 5% of Maximum Output Signal Amplitude | |
|-----------------------|--------------------------------|--|---------|
| | | ± 1 V | ± 5 V |
| 2 | 10 | 185 kHz | 37 kHz |
| 2 | 100 | 18.5 kHz | 3.7 kHz |
| 2 | 1000 | 1.85 kHz | 370 Hz |
| 4 | 10 | 550 kHz | 110 kHz |
| 4 | 100 | 55 kHz | 11 kHz |
| 4 | 1000 | 5.5 kHz | 1.1 kHz |

| | |
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This product is not used for LogBook applications.



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

DBK5 can control four 4 to 20 mA current loops. DBK5 connects to the Daq Device's P1 port and uses one of the Daq Device's 16 base channels. Up to 4 DBK5s can share a single base channel for a maximum of 256 channels. DBK5 neither sources nor sinks current; instead, it modulates current in an externally powered loop. In this way, DBK5 acts as a current-loop transmitter. DBK5 is compatible with both regulated and unregulated loop supplies, providing these supplies are within the range of 12 to 45 V and have a loop resistance that does not exceed 1.95 k Ω , according to the following relationship:

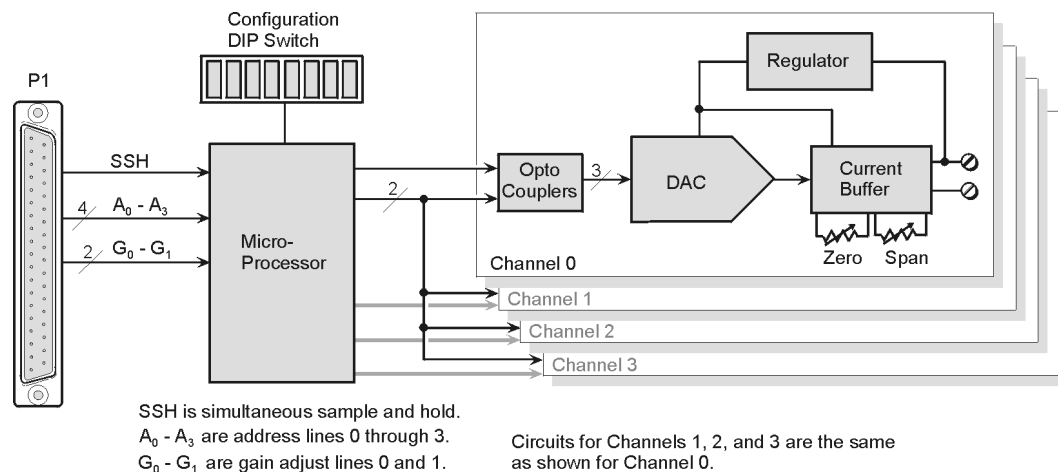
$$V_{\text{SUPPLY}} = V_{\text{TRANSMITTER}} + (I_{\text{LOOP}} * R_{\text{LOOP}})$$

where: $V_{\text{TRANSMITTER}} = 6 \text{ V}$, and $I_{\text{LOOP}} = 20 \text{ mA max}$

The DBK5 provides loop-current control through 12-bit digital-to-analog converters (DACs). The 12-bit range of 0 to 4095 corresponds with 0 to 100% of full-span and an output of 4 to 20 mA. As shown in the table, the current output $I_{\text{OUT}} = 4 \text{ mA} + (\text{DAC}/4095 \times 16 \text{ mA})$. Thus, the DAC values for currents between 4 and 20 mA is equal to $255.94 \times (I_{\text{OUT}} - 4 \text{ mA})$.

| DAC | mA |
|------|-----|
| 0 | 4 |
| ... | ... |
| 1000 | 7.9 |
| ... | ... |
| 4095 | 20 |

The 4 channels are optically isolated from the Daq Device and from each other. Isolation allows the loop voltages to float beyond the Daq Device's common mode range. An externally powered loop allows the DBK5 to continue to modulate the loop current in the event of a fault or power loss in the Daq Device. If the loop is powered-up before the Daq Device, the DBK5 will maintain the loop current at 4 mA. After a fault, the DBK5 will maintain the loop current at the last level set.

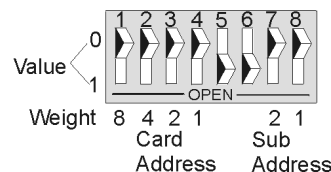


DBK5 Block Diagram

Hardware Setup

Card Configuration

Up to four DBK5s can use a single Daq Device channel. With 4 inputs on a card and 16 main channels, a maximum of 256 inputs are possible. Note that each card must appear unique to the Daq Device. An onboard DIP switch is used to set the card and sub address. Micro-switches 1 through 4 set 1 of 16 main Daq Device channels (any card address in the range of 0 to 15 is valid.). Micro-switches 7 and 8 set the sub address.



DBK5 Configuration Settings

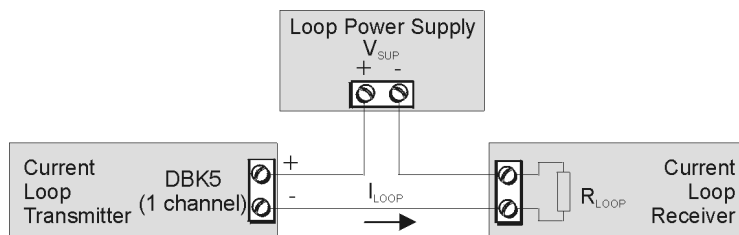
The sub address distinguishes each of four DBK5s on a single channel (any sub address in the range of 0 to 3 is valid). The card and sub address selection DIP switches form a set of binary-weighted values. To select the desired address, set the corresponding switches to the proper binary settings. For example, if the desired card address is 11 then switches 1, 3, & 4 should be set to 1. To set a switch to a value, depress the corresponding side of the rocker-arm switch. (Switch positions 5 and 6 are not used.)

Card Connection

Current-loop connections are provided via dual screw terminal connections. The + and - loop connections are shown in the figure. Once all connections are in place, secure wires to the board at captive areas at the end of the board. Nylon tie wraps (not included) work well for this purpose.



- (1) An external *loop-voltage supply* must be provided.
- (2) To meet CE safety specifications, an edge guard (kit p/n 232-0806) must be attached to the DBK5 card before insertion into a DBK41 expansion chassis. This guard helps prevent accidental access to high-voltage circuits.



DBK5 Current Loop Configuration

CE Compliance



Reference Notes:

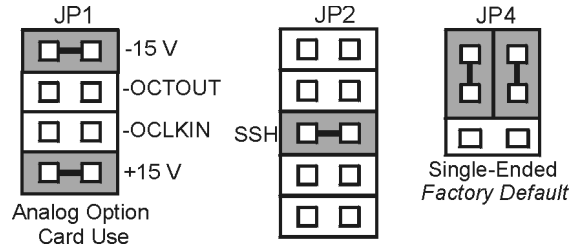
Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK5 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. **If not using auxiliary power**, place the **JP1** jumper in the expanded analog (Analog Option Card Use) mode. In this mode JP1 jumpers are positioned in the –15 V and +15 V positions.



Jumper Configurations in DaqBooks and DaqBoards

Note: The JP1 default position, indicated above, is necessary to power the interface circuitry of the DBK5 via the internal ± 15 VDC power supply. If using auxiliary power cards DBK32A or DBK33 you must remove both JP1 jumpers. Refer to Chapter 2, [Power Management](#) and to the DBK32A and DBK33 document modules.

CAUTION



When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

2. Place the **JP2** jumper in the *SSH* position (see above CAUTION).
3. **For DaqBook/100, DaqBook/112 and DaqBook/120 only**, place the **JP4** jumper in *single-ended mode*.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Not Applicable.

DBK5 – Specifications

Name/Function: 4-Channel 4-20 mA Current Output Card

Connectors: DB37 male, mates with P1. Screw terminals for signal output.

Accuracy/Linearity: 0.1% FS

Resolution: 4 • A / LSB, monotonic

Hysteresis: 0.02% FS

Regulation: 0.05% FS

Compliance: $R_{LOOP} = (V_{SUPPLY} - 6) / 0.020$ max

Isolation: 500 V



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Specifications - DBK7..... 13**Reference Notes:**

- Refer to [Chapter 2, *Power Management*](#), in regard to calculating system power requirements.
- [Chapter 3, *System Connections and Pinouts*](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK7 can be used for diverse frequency-monitoring applications. Typical uses include measuring the flow of liquids with a flowmeter and measuring rotation (rpm) with a shaft encoder. The monitored process must generate a series of electrical pulses whose frequency is related to the desired variable.

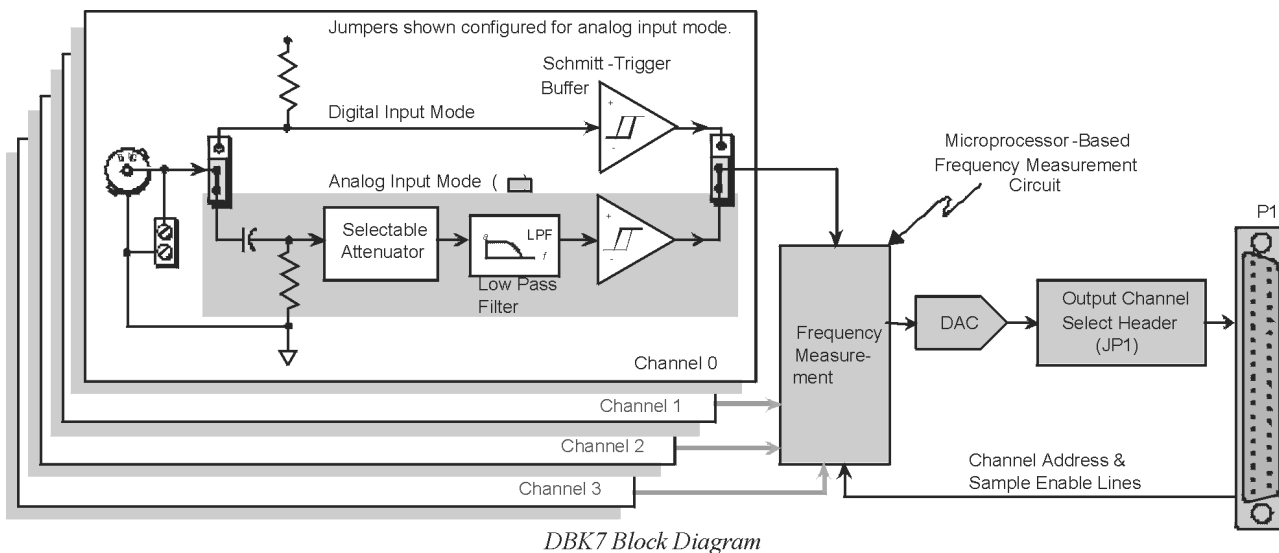
Features of the DBK7 include:

- Inputs can be analog (high or low level) or digital.
- Each channel has a programmable frequency range.
- Noise effects can be minimized by debounce, attenuation, and low-pass filtering.
- Up to 64 DBK7s can be used with a single LogBook or Daq device for a maximum of 256 channels.

The card's basic function can be realized from the following block diagram. Each channel:

- Conditions an input signal
- Selects the signal's rising or falling edge
- Debounces the edge
- Measures the signal's frequency.

The D/A converter outputs a voltage from -5 V to +5 V to correspond with the selected frequency range. The LogBook directs the card's D/A converter to convert the data from the proper input channel.



Hardware Setup

CAUTION



DBK7 must be configured before connecting the card to inputs and outputs. Failure to do so could result in card damage.

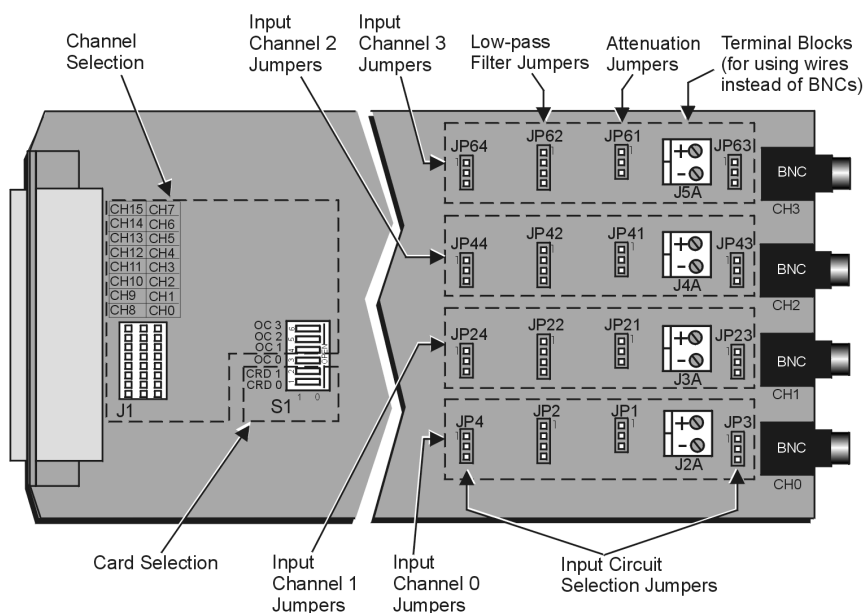
Hardware-related steps for setting up DBK7 include:

- Configuring the DBK7 onboard jumpers and switches for the application (see previous CAUTION).
- [Configuring the Daq device \(see page 8\)](#)
- Connecting the input cables to sensors and the output cable to a Daq device or LogBook.

Card Configuration

Several jumpers and one switch must be set on the DBK7 card to match both the system setup and the signal-conditioning requirements. This section describes a typical configuration. The following table indicates the factory default settings of each jumper. The below figure shows the location of the jumpers and DIP-switch (S1).

| Factory Defaults for DBK7 On-board Jumpers | | |
|---|---------------|----------------|
| Configuration | Jumpers | Applies to ... |
| Channel Selection , pg. 4 <ul style="list-style-type: none"> The default is channel 0 Up to 4 cards can share the same J1 channel. See switch S1 information in regard to card selection. | J1 | 16 Channels |
| Input Circuit Selection , pg. 6 <ul style="list-style-type: none"> The default is Analog Input Each jumper connects pins 1 and 2 | JP3 and JP4 | CH 0 |
| | JP23 and JP24 | CH 1 |
| | JP43 and JP44 | CH 2 |
| | JP63 and JP64 | CH 3 |
| Attenuation Selection , pg. 6 <ul style="list-style-type: none"> The default is Attenuation Enabled (reduced sensitivity) Each jumper connects pins 1 and 2 | JP1 | CH 0 |
| | JP21 | CH 1 |
| | JP41 | CH 2 |
| | JP61 | CH 3 |
| Low Pass Filter Selection , pg. 7 <ul style="list-style-type: none"> The default is 100 kHz Each jumper connects pins 1 and 2 | JP2 | CH 0 |
| | JP22 | CH 1 |
| | JP42 | CH 2 |
| | JP62 | CH 3 |



DBK7 Board Layout

Channel and Card Selection Configuration (J1 and S1)

Up to 4 DBK7 cards can connect to a single main channel. Thus, a 16-channel LogBook or Daq device can connect to 64 DBK7 cards. Since each card has 4 input channels, a fully populated system can use 256 input sensors. To keep these inputs organized, the card is configured by physically setting a jumper (J1) and a DIP switch (S1).

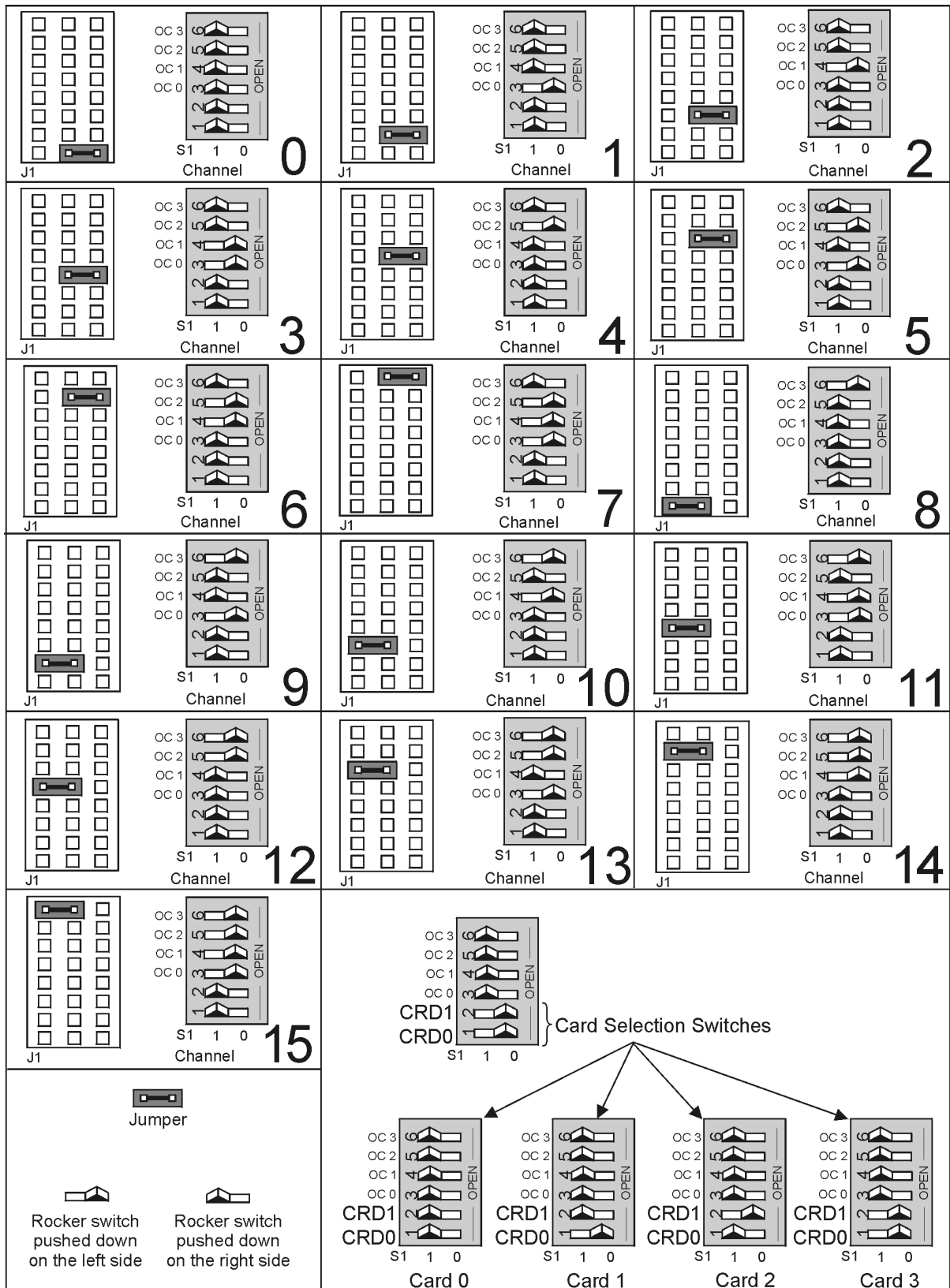
- **J1** is a 24-pin (3×8) header requiring two pins in a row to be connected. Up to 4 cards can share the same channel.
- **S1** is a 6-position DIP switch (positions 3-6 set the main channel). Each card sharing a main channel can have one of four sub-addresses (card number) as set by S1 (positions 1 & 2).



J1, S1, and the software must all be set to the same channel.

Set the main channel and sub-address as follows:

1. Determine the main channel and card number for each DBK7 used. It may be necessary to check the software setup and other cards in the system to avoid a conflict. Note that a DBK7 may share a channel with 3 other DBK7s. Each card sharing a LogBook or Daq device base channel must use a unique card number sub-address.
2. Set the J1 jumper across the 1st and 2nd or the 2nd and 3rd pin of a row to the desired channel. Refer to the silk screening just above the jumper for proper positioning (see previous figure).
3. Set S1 DIP switches 3-6 (OC0 to OC3) to match the channel selected on J1, and verify both settings (S1 and J1) are correct (see previous figure).
4. Set S1 DIP switches 1 & 2 (CRD0 and CRD1) to give the card a unique sub-address with the chosen main channel. Any unused sub-address in the range 0-3 is valid (see following figure).



DBK7 Channel Configuration

Note: Each of the 16 main Daq* channels can support 4 DBK7 cards; and each DBK7 card can support 4 analog channels. Both J1 and S1 (3-6) select the main channel (they must match). S1 (1-2) selects the card. **Every card must have a unique address of channel and card.**

Input Signal Conditioning Configuration

Hardware settings affect 3 aspects of signal conditioning:

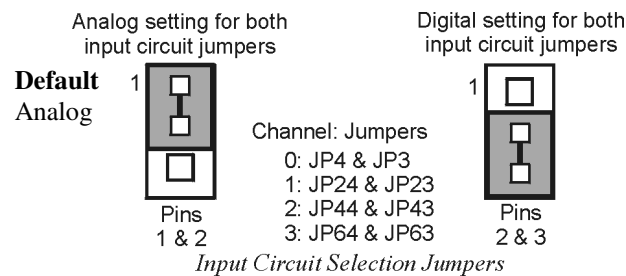
- Input circuit selection: analog or digital
- Attenuation selection
- Low-pass filter selection.

Input Circuit Selection

Each input channel can be set for the analog or digital circuit. Two jumpers must be set for each channel.

Select the input circuit for each input channel as follows:

1. Determine the best circuit type for each channel.
 - The digital input circuit works best for DC-coupled signals where the low level is less than 0.5 V and the high level is above 2.5 V and the voltage does not exceed ± 15 V. By using a pull-up resistor, switches and relays can create the signal. Frequencies can be as high as 960 kHz. The digital input circuit does not attenuate or filter the input signal.
 - The analog input circuit is AC-coupled and is sensitive to signals from 100 mV to 84 V p-p. It also provides attenuation and low-pass filtering to reduce the effects of noise.
2. Position the input circuit jumpers for analog or digital (see figure). Verify that both jumpers for a channel are set the same (JP3 and JP4 for channel 0; JP23 and JP24 for channel 1; JP43 and JP44 for channel 2; and JP63 and JP64 for channel 3).

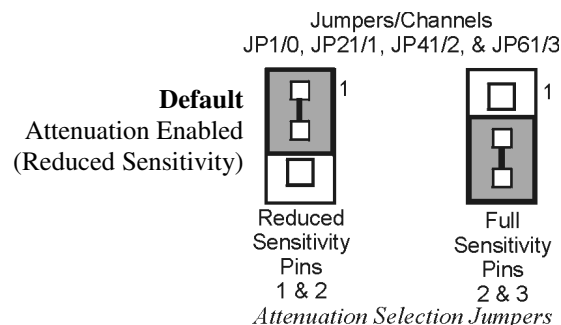


Attenuation Selection (Analog Input Circuit Only)

When measuring strong analog signals, the attenuator can reduce the input sensitivity and the effects of noise. If enabled, the attenuator reduces the input sensitivity by a factor of about 20.

Set the attenuation for each channel as follows:

1. Determine the best attenuation for each channel.
 - Use attenuation and reduced sensitivity if the input signal's peak level exceeds 1 V.
 - Disable attenuation for full sensitivity if the input signal's peak level is less than 1 V.
2. For attenuation, position the jumper across pins 1 and 2. Attenuation is enabled (the default setting). (See figure.)



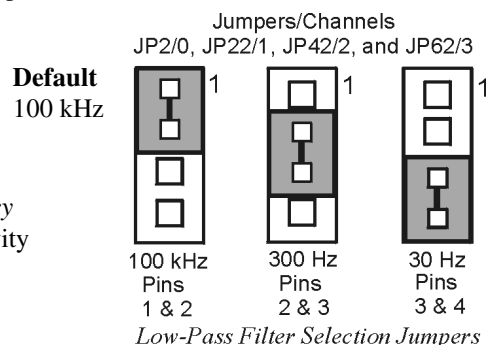
3. To disable attenuation, position the jumper across pins 2 and 3. The full-strength signal is used.

4. Verify the jumper position for each input channel.
 - **JP1 for channel 0**
 - **JP21 for channel 1**
 - **JP41 for channel 2**
 - **JP61 for channel 3**

Low-Pass Filter Selection (Analog Input Circuit Only)


The low-pass filter removes high-frequency noise that could otherwise fool the DBK7 into detecting a higher frequency. To set the low-pass filter:

1. Determine the highest frequency you expect to measure on each input channel.
2. Select the next higher cutoff frequency (30 Hz, 300 Hz, or 100 kHz) for each corresponding channel (see figure *Typical Sine-Wave Sensitivity vs Frequency* later in this section). Verify that the DBK7's sensitivity will accommodate the expected input signal strength.
3. Set jumpers for low-pass filter selection.
 - **JP2 for channel 0**
 - **JP22 for channel 1**
 - **JP42 for channel 2**
 - **JP62 for channel 3**



Card Connection

After the DBK7 hardware is configured, the card can be safely connected to the signal inputs and to the primary acquisition device. You can connect up to four sensors to the DBK7's input BNC connectors. A CA-37-x (or CA-131-x) cable is used to connect the card to a LogBook or Daq device [possibly through an expansion module] via the card's DB37 connector. Connection steps follow.

| WARNING | |
|---|--|
|  | <p>Electric shock hazard! Do not exceed a sensor input of 30 Vrms (42 Vpeak, 84 Vp-p) for analog or ±15 Volts for digital. Exceeding these values may present an electric shock hazard that could possibly result in injury or death, in addition to DBK7 damage.</p> |

Connect the DBK7 card as follows:

1. Connect each sensor's BNC connector to a mating connector on the card. Channel labels (CH0 to CH3) are printed just below the corresponding connector. Label each sensor with its corresponding channel, card sub-address, and DBK7 input channel.
2. For a single DBK7 card, connect one end of the P1 cable to the card's male DB37 output connector.
 - For DaqBook applications - use a CA-37-1 cable
 - For DaqBoard/2000 Series or /2000c Series boards - use a CA-37-1 with a DBK200 Series adapter
 - For DaqBoard [ISA type] boards - use a CA-131-1 cable
 - For Daq PC-Card, use a CDK10 (expansion, power module) with CA37-1 and CA-134 cables.

3. Connect the other end of the cable to the P1 port of the LogBook or Daq device. For multiple DBK7 cards, use a CA-37-x (or CA-131-x) cable to daisy-chain several cards or an expansion module. For example, three DBK7s (or 2 DBK7s and an expansion module) can be connected to a LogBook or a Daq device with a CA-37-3.
4. For multiple cards from a Daq PC-Card, cable CA-134 must first connect to an expansion module (a CDK10 or a DBK41 with a DBK33 power card) then through a CA-37-x to the DBK7s.

Note: For longer cable runs, use a CA-113 to add 6 ft of cable length where needed.

CE Compliance

If your data acquisition system needs to comply with CE standards, the DBK7 must be placed in a DBK41/CE 10-slot analog expansion module that is connected to the LogBook or Daq device by a CA-143-x cable.

Note that in the presence of 3 V/m RF fields, the following conditions must exist in order to meet CE requirements:

- 500 mVpp signals are required to maintain 0.1% accuracy.
- Metal shells of the BNC connectors must be directly connected to the chassis ground in order to maintain 100 mV sensitivity and 0.1% accuracy.
- The host computer must be properly grounded.
- The host computer and peripheral equipment must be CE compliant.



Reference Notes: If your data acquisition system needs to comply with CE standards, refer to the following:

- The [CE Compliance](#) section of Chapter 1.
- The [DBK41](#) document module.

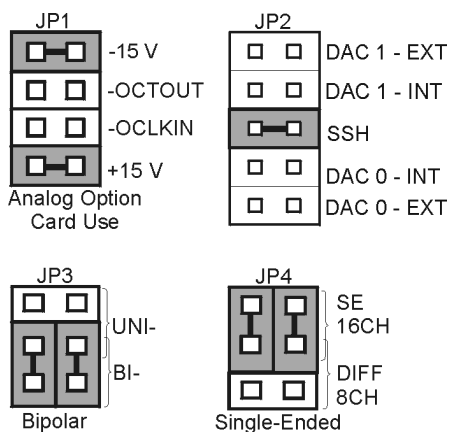


DaqBook and DaqBoard [ISA type] Configuration

Several setup steps of DaqBooks and DaqBoards [ISA type] are required to use DBK7 cards in a system.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.

Note: This default position is necessary to power the interface circuitry of the DBK42 via the internal ± 15 VDC power supply. If using auxiliary power (DBK32A/33), you must remove both JP1 jumpers (refer to chapter 2, [Power Management](#) and the DBK32A/33 modules).



DaqBook/DaqBoard Settings for DBK7



CAUTION

When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

2. Place the JP2 jumper in the SSH position (See previous CAUTION).
3. **For DaqBook/100, /112 and /120 only**, place JP3 jumpers in *bipolar mode*.
4. **For DaqBook/100, /112 and /120 only**, place JP4 jumpers in *single-ended mode*.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

Hardware Function

This section explains DBK7 functions that affect user settings to ensure the best performance. For setup questions or noise problems, refer to the related section. The figure provides an overview of signal conditioning function blocks and can be referred to for the following discussions.



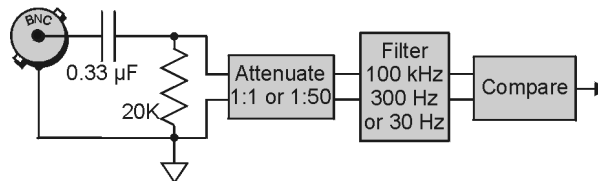
DBK7 Function Diagram

Input Signal Conditioning

The DBK7 conditions the input signal in several ways to provide the best output accuracy. Reducing noise and limiting the bandwidth are the first steps in the conditioning process and are done in hardware. Software can further clean up the signal by selecting the cleanest edge to read and by setting a debounce delay to ignore spurious signals.

Analog Input Signal Conditioning

The equivalent analog input circuit is shown in the figure. Input voltages should be at least 50 mV peak-to-peak. The maximum analog input signal is 30 Vrms (42 Vpeak, 84 Vp-p). Stronger signals may damage the DBK7 or present an electrical shock hazard.

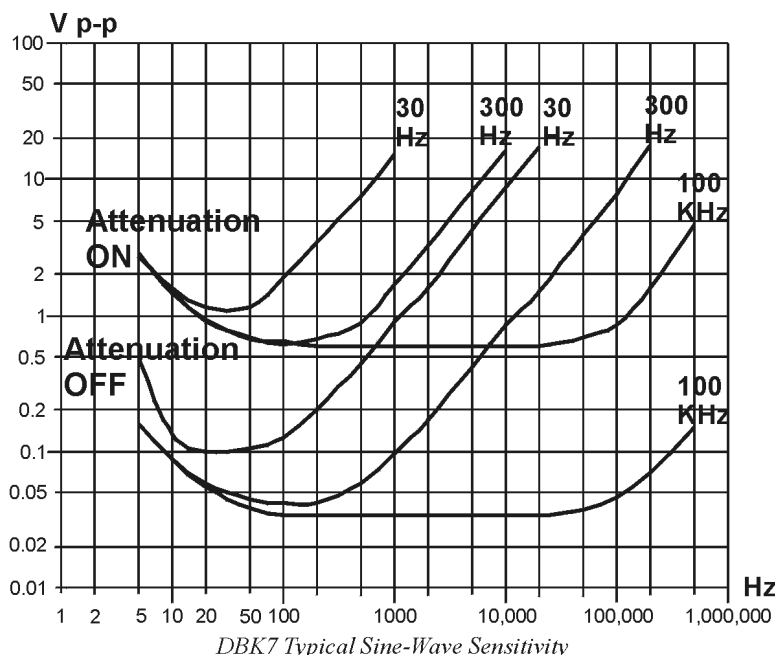


DBK7 Analog Equivalent Input Circuit

When the input circuit jumpers are set for analog, the center conductor of the BNC connector is AC-coupled through a 0.33 μF capacitor to the attenuator. The outside conductor connects directly to ground. With the attenuator disabled for full sensitivity, input-protection diodes limit the signal to about 1.5 Vp-p. Larger signals will see an impedance of 6.7 $\text{K}\Omega$ (rather than 20 $\text{K}\Omega$) in series with 0.33 μF . With the attenuator enabled, the input impedance remains 20 $\text{K}\Omega$ regardless of the input level.

After AC-coupling, attenuation and filtering, a comparator converts the input signal into a clean digital signal. The comparator output is high when the center-pin signal is higher than the outside-conductor signal (and low when the center-pin is lower). The comparator has hysteresis to reduce the effects of noise by ignoring small signals.

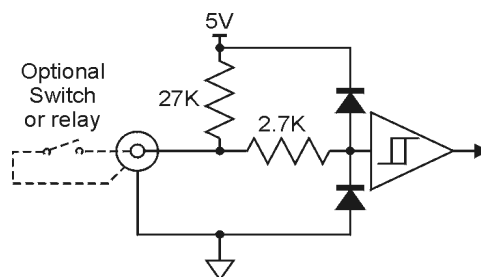
The following graph shows typical sine-wave sensitivity in peak-to-peak voltage vs frequency. Six combinations of attenuation (on/off) and low-pass filtering (30 Hz, 300 Hz, and 100 kHz) are graphed.



Digital Input Signal Conditioning

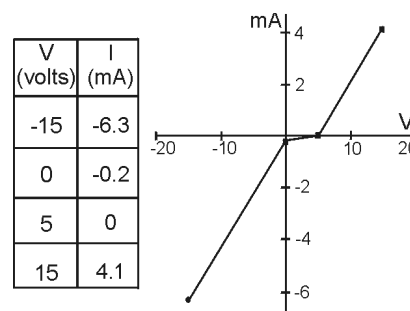
The equivalent digital input circuit is shown in the figure. The input signal may range from -15 to +15 V. Higher voltages may damage the DBK7.

When the input circuit jumpers are set for digital, the outside (shield) conductor of the BNC connector connects directly to ground. The center conductor is pulled up with 27 K Ω to +5 V and then passes through a 2.7 K Ω protection resistor before being detected by a Schmitt-trigger buffer with input-protection diodes.



DBK7 Digital Equivalent Input Circuit

The input thresholds are fixed TTL levels. Below 0.5 V (0.8 V typical), the Schmitt-trigger buffer output is low. Above 2.1 V (1.6 V typical), the buffer output is high. The 27 K Ω pull-up resistor allows the digital inputs to sense switches or relays connected directly to the DBK7 as shown in the figure. The debounce circuit can remove noise effects of switching.



DBK7 Digital I/V Relationship

The input impedance for digital signals depends on the signal level. For signals between 0 and 5 V, the input-protection diodes do not conduct, and the digital input impedance is just the 27 K Ω pull-up resistance. For signals less than 0 V or greater than 5 V, the input-protection diodes conduct and the impedance drops to about 2.4 K Ω . The figure shows the approximate digital-input current/voltage relationship.

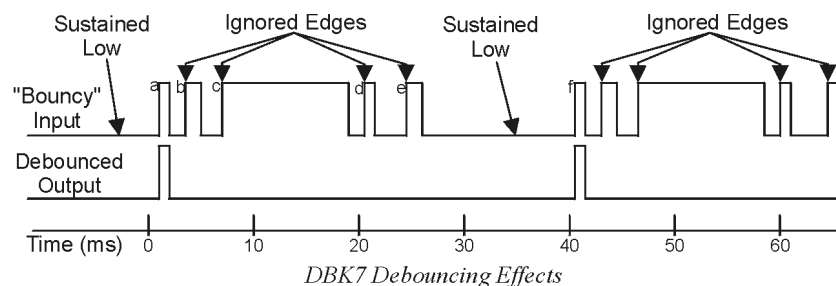
Edge Selection

The DBK7 determines the frequency by measuring the time between successive rising or falling edges of the input signal. Which edge is electrically cleaner depends on the application and related components. If rising edges are used, the edge-selection circuit does not modify the signal. If falling edges are used, the circuit inverts the signal so falling edges appear as rising edges to the subsequent circuits. Through software, each channel can be independently set for rising- or falling-edge.

Debouncing

Debouncing is a process of ignoring signals too short to be real events. When a relay or switch closes, the electrical contacts may not initially make good contact. Mechanical vibrations can occur, and contact is made and broken several times stabilizing. Counting all these signals would yield too high a frequency. The debounce circuit solves this problem by ignoring rising edges not preceded by a sustained low signal. The sustain interval can be set in software to 0, 0.6, 2.5, or 10 ms for each channel. Debouncing may be disabled (0 ms) for clean, high-frequency signals. Long debounce times will limit high-frequency response (e.g., a 10 ms debounce will limit the frequency to about 100 Hz). In general, use “0” (debounce disabled) for clean, high-frequency signals; increase the debounce as needed for noisy, low-frequency signals from switches and relays.

The figure shows the effect of 10 ms debouncing on a noisy signal. To be counted, a rising edge must be preceded by a low sustained for at least 10 ms without any other edges. Rising edges **a** and **f** are counted because they are preceded by low signal levels sustained for at least 10 ms (the debounce time). All other rising edges (**b**, **c**, **d**, and **e**) are ignored. Any falling edge makes (or keeps) the debounced output low, regardless of preceding edges. Thus, the DBK7 can detect short pulses even with debouncing.



Frequency Measurement

After debouncing, the signal's frequency is ready to be measured. Frequencies are measured to 12-bit accuracy between a minimum frequency (F_{\min}) and maximum frequency (F_{\max}). This frequency range can be programmed individually for each channel. The limitations on F_{\min} and F_{\max} are:

- The frequency range must be within 0 to 1 MHz.
- $F_{\max} - F_{\min}$ must be at least 1 Hz.
- F_{\max} / F_{\min} must be at least 100/99 (1.010101).

Based on F_{\min} and F_{\max} , the DBK7 measures the frequency by counting input cycles during a variable time interval. The length of the interval depends on the difference between F_{\min} and F_{\max} .

- For a wide range (when F_{\min} and F_{\max} are far apart), each bit of the 12-bit result represents a large frequency change and can be measured quickly.
- For a narrow range (when F_{\min} and F_{\max} are close together), each bit of the 12-bit result represents a small frequency change and takes longer to measure.

The following equation determines the time interval needed to measure a frequency:

$$\text{Minimum Measurement Period (sec)} = (4096 \times 0.5 \mu\text{s}) [F_{\text{max}} / (F_{\text{max}} - F_{\text{min}})]$$

In this equation: 4096 derives from 12-bit precision; 0.5 μs is the resolution of the DBK7's timing circuits; and $F_{\text{max}} / (F_{\text{max}} - F_{\text{min}})$ is the ratio the measurement time must be increased to achieve 12-bit accuracy over the selected range.

To see how the measurement period varies, consider two examples:

- To measure frequencies from 59 to 61 Hz, the measurement period is at least $4096 \times 0.5 \mu\text{s} \times 61/2 = 62.5 \text{ ms}$, or about 16 measurements per second.
- To measure frequencies from 1 to 61 Hz, the measurement period is at least $4096 \times 0.5 \mu\text{s} \times 61/60 = 2.1 \text{ ms}$. Note that as the DBK7 only measures frequency once per cycle, it would take from 1 to 61 measurements per second.

Thus, measuring frequencies over a narrow range takes longer than over a wide range as the ratio of $F_{\text{max}} / (F_{\text{max}} - F_{\text{min}})$. The actual measurement time is the sum of several items: the minimum measurement period (from the equation above), the actual input period, and a variable processing time of 0 to 4 ms.

Note: If the Sequence Rep Rate is set faster than the measurement rate, multiple readings of the same measurement will occur.

After the frequency (F) is measured to the required accuracy, it is scaled to a 12-bit number (D) for use by the Digital to Analog Converter (DAC). This 12-bit number is determined by the formula:

$$D = 4096 [(F - F_{\text{min}}) / (F_{\text{max}} - F_{\text{min}})]; \text{ where: } 0 < \text{DAC} < 4096$$

If the measured frequency is F_{min} , then the scaled result is 0. If the measured frequency were F_{max} , then the scaled result would be 4096 but is limited to 4095. Measured frequencies below F_{min} are scaled as 0; frequencies above F_{max} are scaled as 4095. The highest frequency that produces an accurate result is the one that converts to a DAC value of 4095; that is, $F_{\text{min}} + 4095/4096 (F_{\text{max}} - F_{\text{min}})$ which is the same as $F_{\text{max}} - 1/4096 (F_{\text{max}} - F_{\text{min}})$.

D/A Conversion

The 12-bit scaled result is stored in the DAC to be read by the data acquisition system. Instead of having four DACs with their associated circuits, the DBK7 shares a single DAC among the four channels. Using the DAC this way makes the DBK7 more reliable, cost-efficient, and easier to calibrate. Each time the LogBook or Daq device addresses a different DBK7 channel, the DAC supplies the corresponding voltage (V_{out}) according to the formula:

$$V_{\text{out}} = 10.0 (D/4096) - 5.0 \text{ V}$$

Since DAC values (D) range from 0 to 4095, DBK7 output voltages range from -5.0000 to +4.9976 V.

Calibration for the DBK7 is automatic. When the DBK7 is initialized through software, its gain and offset errors are measured. The output circuits are then adjusted so the LogBook or Daq device measurements correspond to the DAC setting. The DBK7's software-adjustable gain and offset can correct for small errors in the DBK7 or the LogBook/Daq device. This automatic calibration eliminates the periodic need for manual calibration.

Specifications - DBK7

Name/Function: 4-Channel Frequency-to-Voltage Input Card

Input Channels per Card: 4

Maximum Cards per System: 64

Maximum Channels per System: 256

Input Connector: 1 BNC connector per channel

Connector: DB37 male, mates with P1

Frequency Ranges: (programmable) 0 Hz to 960 kHz

Output Voltage Range: -5 V to +5 V

Debounce Delays: (software selectable) 0, 0.6, 2.5, 10 ms

Measurement Rate: up to 500 per second per channel, 1000 per second total

Accuracy: 0.1%

Analog Input

Low-level:

50 mV typical (100 mV max) p-p sine wave @ 10 Hz to 100 kHz

Any edge of 50 (100 max) mV amplitude and 5 V/s rate.

Input impedance: AC-coupled (0.33 μ F), in series w/ 20 K Ω to ground.

15 mV hysteresis.

High-level:

0.75 V typical (1.25 V max) p-p sine wave @ 10 Hz to 100 kHz

Any edge of 0.75 V (1.25 V max) amplitude and 50 V/s rate.

Input impedance: AC-coupled (0.33 μ F), in series w/ 20 K Ω to ground.

250 mV hysteresis.

Maximum Input Voltage: 30 Vrms (84 Vp-p)

Low-Pass Filters: (hardware selectable) 30 Hz, 300 Hz, 100 kHz

Digital Input

TTL-Level: 0.001 to 960 kHz.

Input Impedance: 27 K Ω pull-up to +5 V || 50 pF

V Low ("0"): 0.8 V typ, 0.5 V min

V High ("1"): 1.6 V typ, 2.1 V max

Hysteresis: 400 mV min

Pulse Width (high or low): 520 nsec min.

Maximum Input Voltage: -15 V to +15 V



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Card Configuration 2

Card Connection 2

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DaqBook and DaqBoard [ISA type] Configuration 3

Daq Device Connection 3

Safe Mounting 3

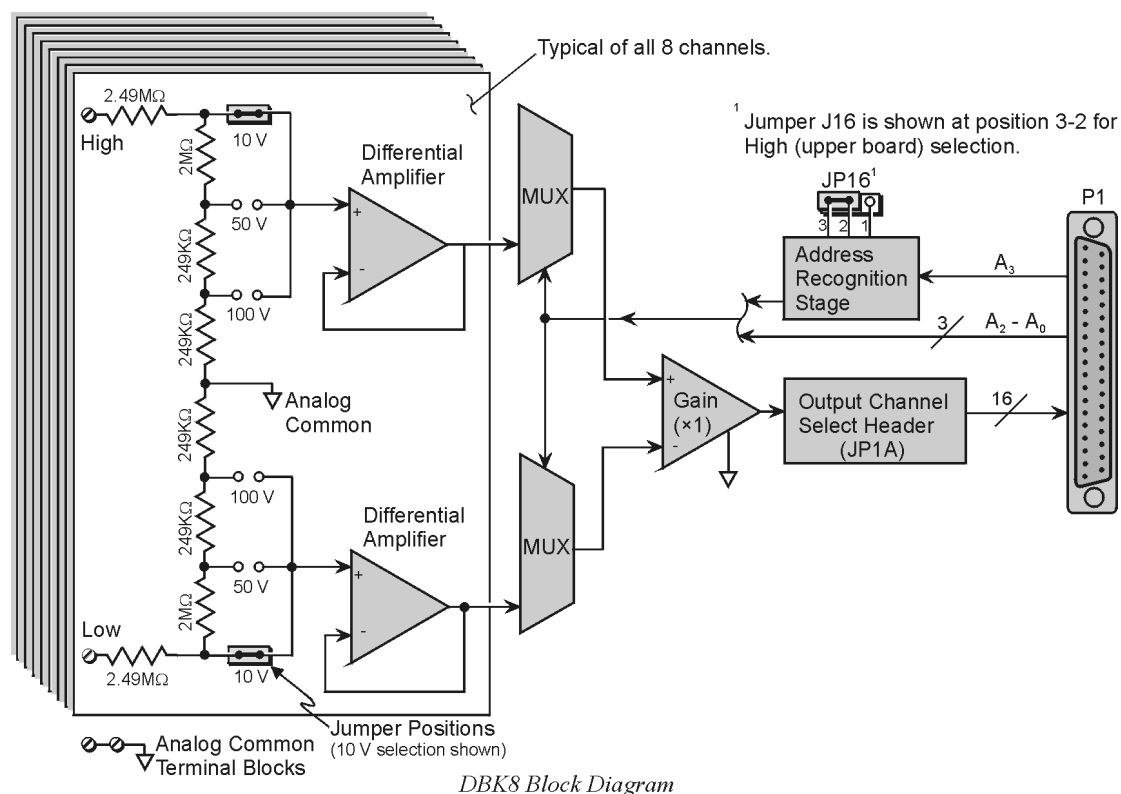
Software Setup 3**DBK8 – Specifications 4****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Note: DBK8 has a footprint for installing a second DB37 connector, to accommodate input signals. Pins 30 to 37 correspond to channels 7 to 0; pins 11 to 18 correspond to channels 15 to 8 (or low 7 to 0 in *differential mode*). This pinout [for the footprint] is the same as P1 for the 16 main channels, with exception that the non-channel pins are not wired. Chapter 3 includes P1 pinouts.

Overview

The DBK8 reads voltages up to ± 100 V from DC to 10 kHz. The inputs are balanced differential and referenced to the LogBook or the Daq Device analog common. No external biasing resistors are used. The input impedance of each DBK8 channel is 10 M Ω to minimize loading of the circuit being measured. Two DBK8s can share the same base channel to allow a maximum of 32 DBK8s and 256 high-voltage inputs.



Each DBK8 channel has 3 user-set voltage ranges: 10, 50, and 100 V. The ranges are selected by the placement of shunt jumpers on pin headers for each channel. While the channel-to-channel resistance is 10 M Ω , there is no other inherent isolation between the channels. The common of the host computer has a direct connection to the LogBook or the Daq Device analog common. Either side of any input channel is 5 M Ω from analog common.

The DBK8 has 3 attenuation factors.

- The ± 100 V range attenuates the input by a factor of 20.
- The ± 50 V range attenuates the input by a factor of 10.
- The ± 10 V range attenuates the input by a factor of 2.

Note: The signal coming from the DBK8 into the LogBook or Daq Device does not exceed ± 5 V.

Hardware Setup

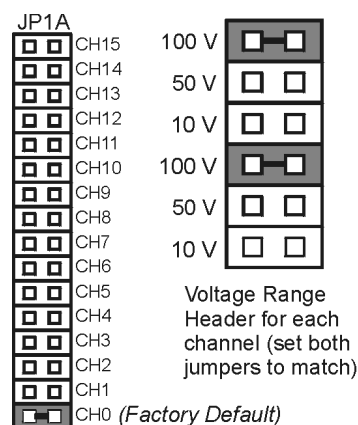
Card Configuration

Factory Defaults: Voltage Range (each channel) - ± 10 V

Inputs from 1 or 2 DBK8s are multiplexed into 1 of the base channels. Channel selection is made on 2 \times 16-pin header JP1A by placing the shunt jumper on the pair of pins next to the chosen base channel.

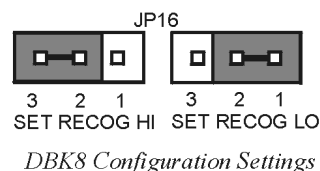
The addressing scheme allows for 16 inputs on each analog channel. The DBK8 is an 8-input card; and 2 DBK8's can use the same channel if one is configure for low channels and the other for high channels. Placing the shunt jumper on JP16 in the 2-1 position sets the card address for the lower 8 channels (0-7) in an address group. Placing the shunt jumper on JP16 in the 2-3 position sets the card address for the upper 8 channels (8-15).

Each of the 8 input channels has 3 voltage ranges that are manually selected by the placement of a pair of shunt jumpers on a channel range select header. It is important that both jumpers are placed on the same range value or incorrect voltage readings will be received by the system.



Card Connection

The DBK8 is equipped with screw terminal connectors for easy access to all of the analog inputs. Connections are provided for 8 pairs of inputs and 2 analog-commons. There is a high and a low terminal in each channel pair to maintain consistent polarity signs with voltage readings. For AC signals, the polarity is arbitrary unless multiple signals are being connected with an interest in channel-to-channel phase relationships. After all connections are in place, captive areas are provided at the end of the DBK8 for securing the wires to the board. Nylon tie wraps (not included) work well for this purpose.



CE Compliance



Reference Notes:

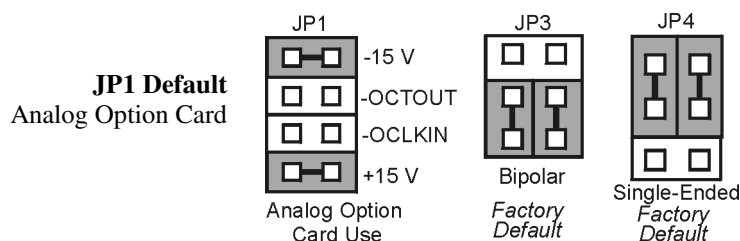
Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK8 expansion card with DaqBooks and DaqBoards [ISA type] requires 3 jumper settings.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog (Analog Option Card Use) mode. This is indicated for JP1, in the following figure.



DaqBook and DaqBoard [ISA-Type] Jumper Settings for the DBK8

Note: JP1's default position is necessary to power the interface circuitry of the DBK42 via the internal +15 VDC power supply. If using auxiliary power cards DBK32A or DBK33, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the [DBK32A](#) and [DBK33](#) document modules.

2. For DaqBook/100, DaqBook/112, and DaqBook/120 *only*, place the JP3 jumper in *Bipolar Mode*.
3. For DaqBook/100, DaqBook/112, and DaqBook/120 *only*, place the JP4 jumper in *Single-Ended Mode*.

Daq Device Connection

Several options exist for placement of the DBK8 card in a system. Because the inputs can be high-voltage, the card should be physically secure and out of harm's way. DBK8 will install in the 3-position DBK10 chassis, 10-position DBK41 card cage, a CDK10, the card slot in either the DaqBook/112 or /216, or in a section of a *snap-in* mounting track (mounted to a secure surface), or used as an insulated holder for a loose DBK8.

Safe Mounting

Several options exist for placement of the DBK8 card in a system. Because the inputs can be high-voltage, the card should be physically secure and out of harm's way. The DBK8 will install readily in the 3-position DBK10 chassis, the 10-position DBK41 card cage, or in a section of a snap-in mounting track mounted to a secure surface or used as an insulated holder for a loose DBK8.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK8 - Specifications

Name/Function: 8-Channel High-Voltage Input Card

Connectors:

DB37 male, mates with P1

screw terminals

DB37 footprint, for signal inputs

Voltage Input Ranges: ± 10 VDC, ± 50 VDC, ± 100 VDC; selection by jumper for each channel.

Input Impedance: 10 M Ω

Attenuation:

@ 10 V, $V_{out} = V_{in}/2$

@ 50 V, $V_{out} = V_{in}/10$

@ 100 V, $V_{out} = V_{in}/50$

Output Voltage Range: ± 5 VDC

Bandwidth: 15 kHz

Attenuation Accuracy: 0.5%

Offset Voltage: Typical: 0.5 mV; Maximum: 2.0 mV

Offset Drift : Typical: 4 $\mu\text{V}/^\circ\text{C}$; Maximum: 10 $\mu\text{V}/^\circ\text{C}$

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DaqBook and DaqBoard [ISA type] Configuration 3

Software Setup 3**DBK9 – Specifications 3****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

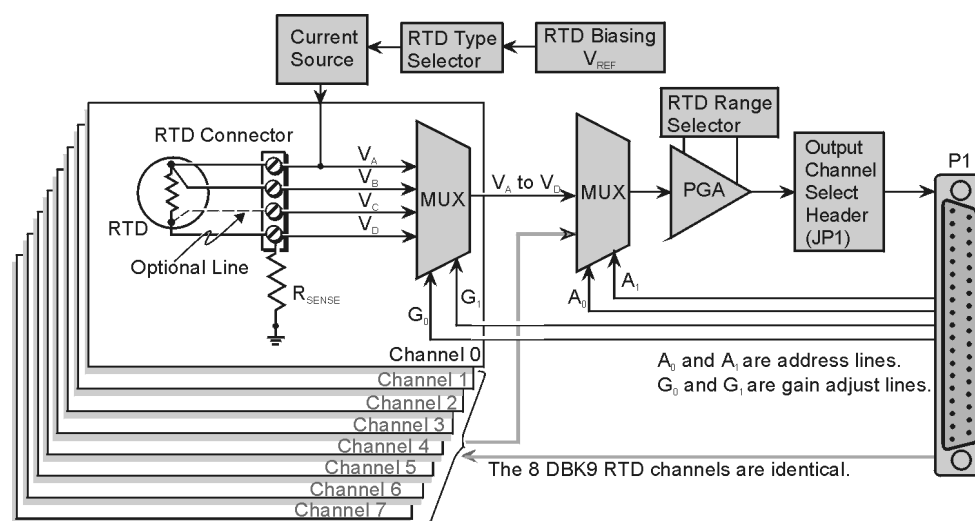
Temperatures sensed by RTDs are attached to the LogBook or the Daq Device through the DBK9 RTD expansion card.

Up to eight RTDs can attach to each DBK9 and up to 8 DBK9s can attach to the LogBook or the Daq Device for measuring a maximum of 256 temperatures. The DBK9 card supports 3- or 4-wire RTDs and operates by reading 3 voltages and using them in the following equation:

$$\text{RTD} = [V_a - V_d - 2(V_a - V_b) R_{\text{sense}}] / V_d \quad (\text{Result in Ohms})$$

Where: $R_{\text{sense}} = 100 \, \Omega$ (a constant derived from the actual hardware)

The result of this equation is converted into a temperature via software (using a complex formula and lookup tables). The DBK9 features an on-board Programmable Gain Amplifier for measuring 100 Ω , 500 Ω , or 1000 Ω type RTDs. For each RTD, the DBK9 can measure temperatures in a range of -200 to +850°C.

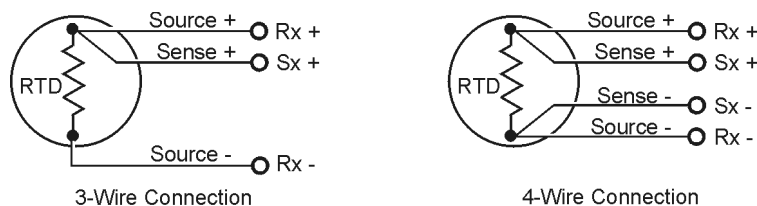


DBK9 Block Diagram

Hardware Setup

Card Connection

The DBK9 is equipped with screw terminals for the connection of 3-wire or 4-wire RTDs as shown in the figure.



RTD Connections for the DBK9

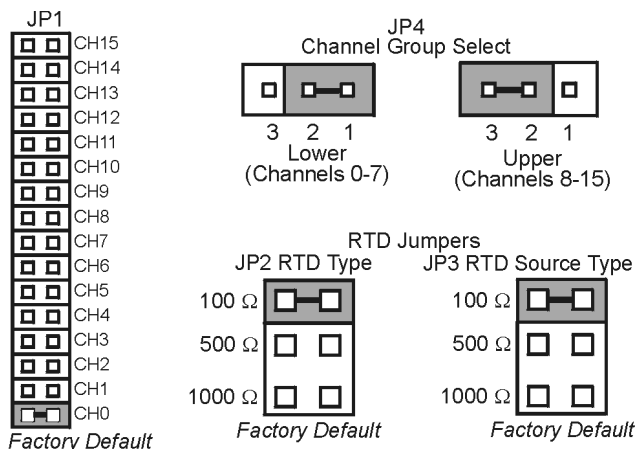
Card Configuration

Factory Defaults: JP2 RTD Type: 100ohm

JP3 RTD Source Type: 100 ohm

Two aspects of card configuration are the channel address and the RTD type.

Channel Address Jumpers



DBK9 Configuration

Channel Group Select (JP4)

One or two DBK9s may be connected to each channel (2x8 signals x 16 channels for a maximum of 256 inputs). Since this is a daisy-chain type of interface, each card must appear unique to the LogBook or the Daq Device. This is accomplished by setting the Channel Select jumper (JP1) and the Channel Group Select jumper (JP4) of each DBK9. JP4 selects either Upper (8-15) or Lower (0-7) channels.



No two cards in a system should be set with the same channel settings.

RTD Type Selection Jumpers (JP2 and JP3)

The DBK9 was designed to measure 100 Ohm, 500 Ohm, and 1000 Ohm RTDs (all 8 RTDs must be the same type for each DBK9). The different RTD types can be selected by changing the RTD Type jumper (JP2) and the RTD Voltage Source jumper (JP3). The default settings are shown in the figure.



JP2 and JP3 must use the same setting.

DBK9 Calibration

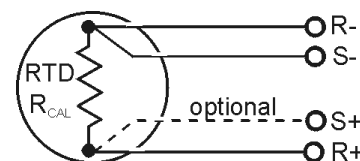
The DBK9 is default-calibrated for a 100 Ω RTD. To use the DBK9 with a 500 Ω or a 1000 Ω RTD, the user must calibrate the card as follows:

1. Purchase the resistors above for the given RTD type.
2. Measure the resistor with a reliable meter, and record the exact value.
3. Refer to the charts, and match up the proper temperature with the measured Resistance.
4. Connect the resistor to Channel 0 on the DBK9.
5. Run DaqCal from the Windows support for DBK9.
6. Adjust RP1 for the temperature that was found in the charts.
7. After the temperature is matched, the DBK9 is calibrated.
8. Repeat this procedure to use a different RTD type.

| RTD Type | Required Resistor* |
|---------------|----------------------|
| 100 Ω | 374 Ω , 1.0% |
| 500 Ω | 1870 Ω , 1.0% |
| 1000 Ω | 3740 Ω , 1.0% |

* These resistors are theoretical values that correspond to 795°C.

Note: Be sure JP2 & JP3 settings are correct for the RTD type that is being calibrated.



DBK9 Calibration Setup

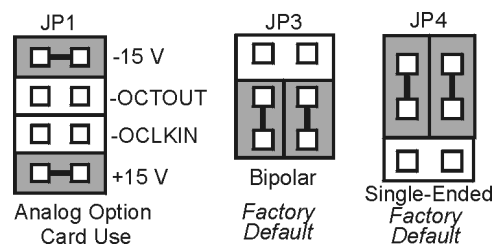


DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK9 expansion card with DaqBooks and DaqBoards [ISA type] requires three jumper settings.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.

Note: This default position is necessary to power the interface circuitry of the DBK9 via the internal ± 15 VDC power supply. If using auxiliary power cards DBK32A or DBK33, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 document modules.



DaqBook/DaqBoard Jumpers for the DBK9

2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP3 jumper in *Bipolar* mode.
3. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in *Single-Ended* Mode.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK9 – Specifications

Name/Function: 8-Channel RTD Measurement Card

Connector: DB37 male, mates with P1 pinout; screw terminals for signal connections

Configurations: 3-wire or 4-wire

Alpha: 0.00385

Inputs: 8 channels

Temperature Ranges: -200 to +850°C

RTD Excitation Current:

100 Ω 500 μA

500 Ω 227 μA

1000 Ω 160 μA

Accuracy: $\pm 1.5^\circ\text{C}$ (wide band)

Resolution: 0.3°C

Range and RTD Type Adjustments: Jumpers on circuit board

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[DBK10 - Specifications..... 2](#)



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

DBK10 is a metal enclosure that holds up to 3 expansion cards. Cards can slide into their slots without removing the signal connections. Two DBK10s are ideal for applications that require 6 or fewer DBK cards. Multiple enclosures can be stacked to accommodate many cards. For applications that require more than six cards, the DBK41 is recommended.

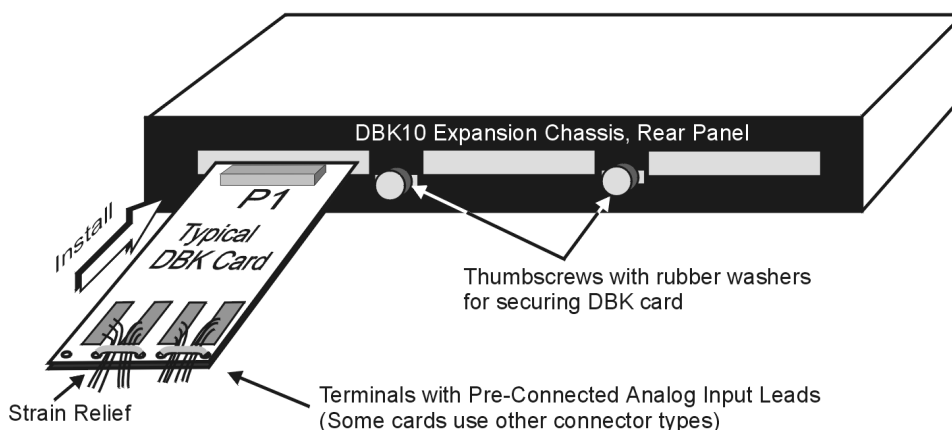
Note: Cards can be used alone without an enclosure if they are secured and protected as needed.

Note: DBK10 requires no software configuration; however, the installed analog DBK cards do.

Hardware Setup

The DBK10 has 3 card slots for easy access to the analog expansion cards. Set up hardware as follows:

1. Complete all DBK card configuration to fit your application and channel assignments.
2. Attach signal input wires (with strain relief as needed) or BNC connectors before inserting card into DBK10 slot.
3. Secure card in slot by tightening screw and washer to hold card securely in place.
4. Attach the card's DB37 connector to the P1 connector with the appropriate cable (CA-37-x or CA-131-x) to daisy-chain all cards installed in the DBK10(s).



Installing a Card in a DBK10 Expansion Chassis

DBK10 - Specifications

Name/Function: 3-Slot Expansion Chassis

Size: 11" long x 8½" wide x 1 3/8" high

Weight: 3 lb (empty); add 8 to 12 oz for each card

Capacity: Accommodates 3 DBK expansion cards

Material: Aluminum

Finish: Black, powder-coated

- Overview 1**
- Hardware Setup 2**
 - DBK11A Connections 2
 - DaqBook and DaqBoard Configuration 3
 - CE Compliance 3
- Software Setup 3**
- DBK11A - Specifications 4**



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

DBK11A is a passive card that provides screw-terminal connections and optional BNC connections in place of a 37-pin (DB37) connector; i.e., P1, P2, or P3. In addition to providing access to all 37 pins on a DB37 connector, the card includes sockets for optional passive-filtering components.

In regard to the optional filtering aspect, the card provides connectivity between DB37 pins and screw terminals while passing through the card's prototyping area, as can be seen in the following figure. This region of the DBK11A can accommodate resistors, capacitors, and custom wiring. The user can choose component values to meet application requirements.

Note: DBK11A is compatible with DB37 connectors, for example the P1, P2, and P3 connectors on LogBook, DaqBook, and DaqBoard devices. The DBK11A card has footprints for 4 BNC connectors that can be soldered onto the card.

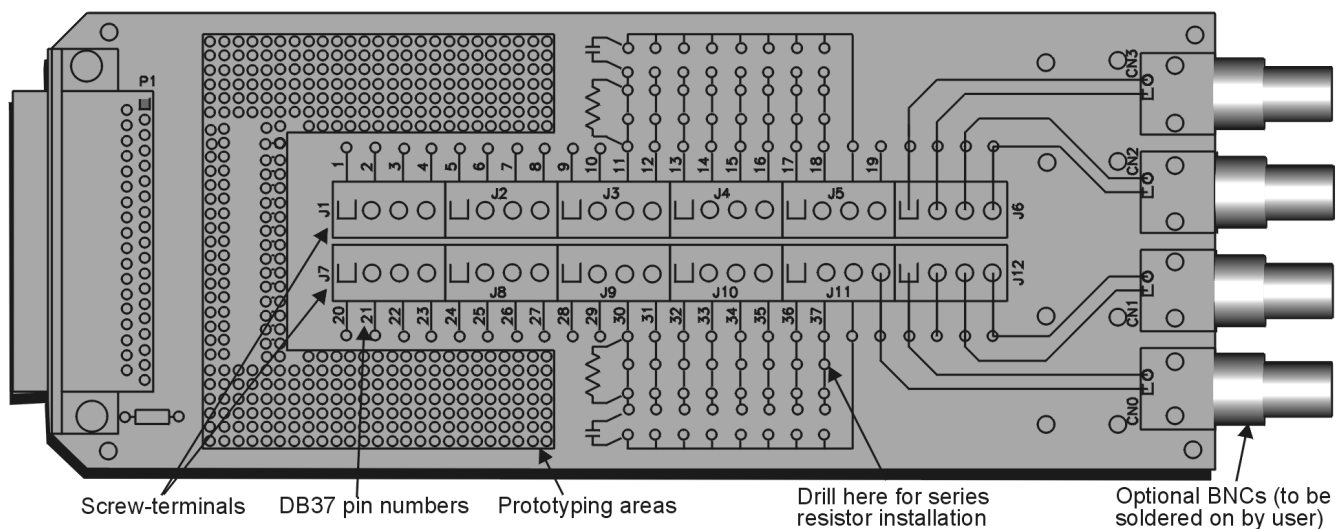
Hardware Setup

DBK11A Connections

The DBK11A connects to a P1, P2, or P3 DB37 connector via a CA-37-x cable. The card has screw-terminal blocks for easy access to analog inputs and outputs. Each screw-terminal has a number that corresponds to a pin number on the DB37 connector.

The DBK11A prototyping area, see figure, contains standard 0.1" hole spacing for the optional installation of user-customized circuitry.

BNC connectors can be soldered to the board at footprints labeled: CN0, CN1, CN2, and CN3. These will have connectivity to J6 and J12, as indicated in the figure. The J6 and J12 terminals can be wired to the other screw terminals to provide BNC connection for designated P1 pins.



DBK11A Board Layout



Reference Notes:

Refer to [Chapter 3, System Connections and Pinouts](#), to verify the pin designations for P1, P2, or P3, as applicable. The DBK11A screw-terminals are labeled 1 through 37. These numbers correspond one-to-one with specific DB37 pins for P1, P2, and P3.

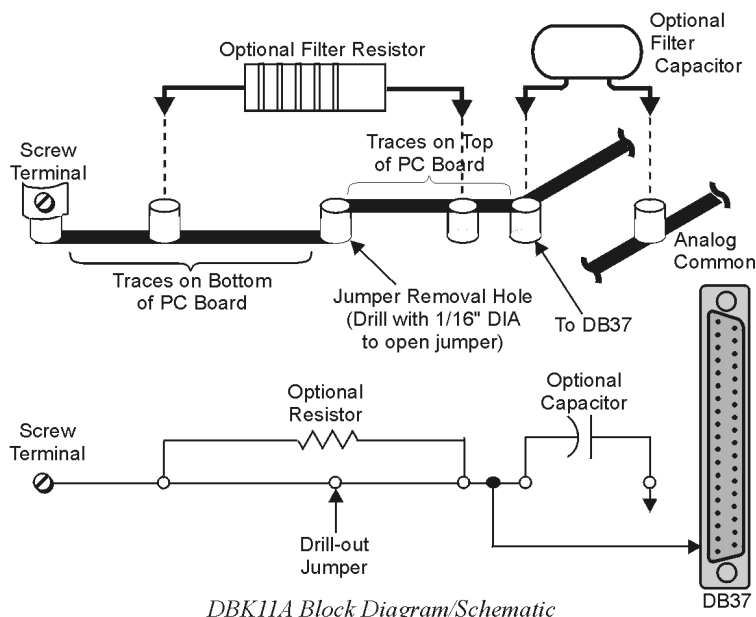
To make wire connections to the card's terminal blocks:

1. Refer to the applicable pinout (P1, P2, or P3) in Chapter 3.
2. Using 14 to 26 gage signal wire, make the appropriate connections to the DBK11A terminal blocks. The screw-terminal numbers 1 through 37 correspond directly with the P1, P2, or P3 pins, depending on which DB37 connector applies.
3. Once all connections have been made, secure all wires at the end of the DBK11A board. Nylon tie wraps (not included) work well for this purpose.

If you want to add your own custom circuit to the DBK11A:

The DBK11A includes spare terminals for optional circuitry, such as RC networks. The card includes several hundred *unconnected* solder pads and signal paths to the analog input terminals [pins 11-18 and 30-37]. Note that the default circuit path is just a straight connection, with no options.

Optional RC filters can be located on the card to correspond with the DB37 pins for the 16 analog input channels. Before adding components, drill out the 1/16" diameter *jumper-removal holes*.



DaqBook and DaqBoard Configuration

Due to the DBK11A's simplicity and flexibility, no configurations are required other than those that may depend on the nature of the signal source.

CE Compliance



Reference Note:

Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - No Setup in LogView.

Note: DaqView Users – The DBK11A is not listed in *DaqView's Hardware Configuration window*; however, to use the card you must configure the applicable DBK11A channel(s) for **Direct Signal Connect**. When you select **Direct Signal Connect**, the applicable channels are made available on the DBK11A, from within *DaqView*. Note that aside from the ability to read Analog accessed through **P1**, the digital I/O window of *DaqView* can access a DBK11A connected to **P2**; and the counter/timer window can access a DBK11A connected to **P3**.

DBK11A - Specifications

Name/Function: Screw-Terminal Card

Connector: DB37 male, attaches to P1, P2 or P3 connector

Wire Size Range: 14 to 26 gage

BNC Option: DBK11A includes 4 BNCs for optional user-soldered connections

DBK12 – Low Gain Programmable Card

DBK13 – High Gain Programmable Card

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Hardware Setup 2

Card Connection 3

Card Configuration 3

DaqBook and DaqBoard [ISA type] Configuration 4

Software Setup 4

DBK12 – Specifications 5

DBK13 – Specifications 5



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

Both the DBK12 and DBK13 provide 16 single-ended, or 16 differential, analog inputs.

DBK12

The DBK12's amplifier offers $\times 1$, 2, 4, or 8 gain (programmable per channel). These gains can be combined with:

LogBook: the standard LogBook gains of 1, 2, 4, 8, 16, 32, and 64 to yield gains of 1, 2, 4, 8, 16, 32, 64, 128, 256, and 512.

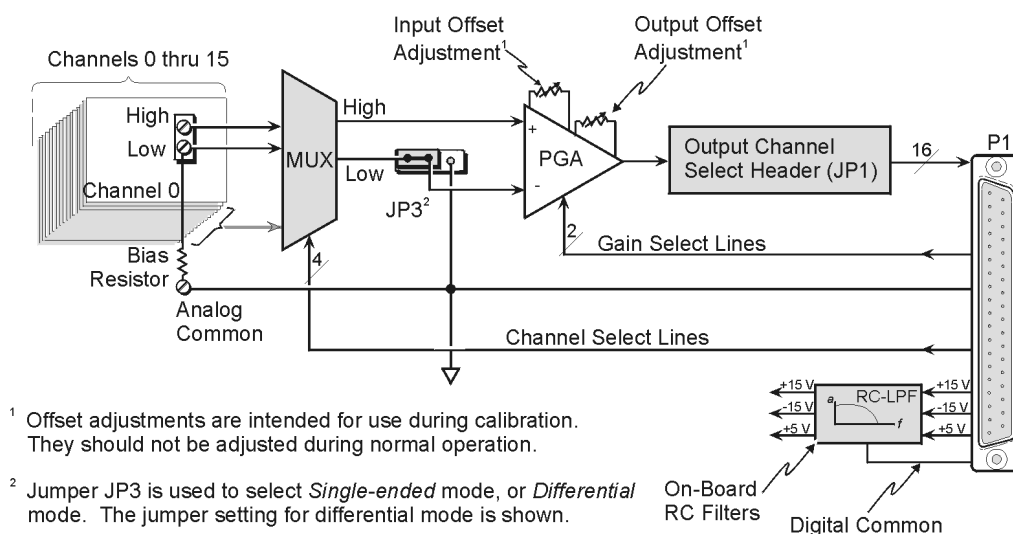
Daq devices: the standard Daq device gains of 1, 2, 4, or 8 to yield gains of 1, 2, 4, 8, 16, 32, and 64.

DBK13

The DBK13 amplifier offers $\times 1$, 10, 100, or 1000 gain (programmable per channel). These gains can be combined with:

LogBook: the standard LogBook gains of 1, 2, 4, 8, 16, 32, and 64 to yield gains of 1, 2, 4, 8, 10, 16, 20, 32, 40, 64, 80, 100, 160, 200, 320, 400, 640, 800, and 1000.

Daq devices: the standard Daq device gains of 1, 2, 4, or 8 for net gains of 1, 2, 4, 8, 10, 20, 40, 80, 100, 200, 400, 800, 1000.



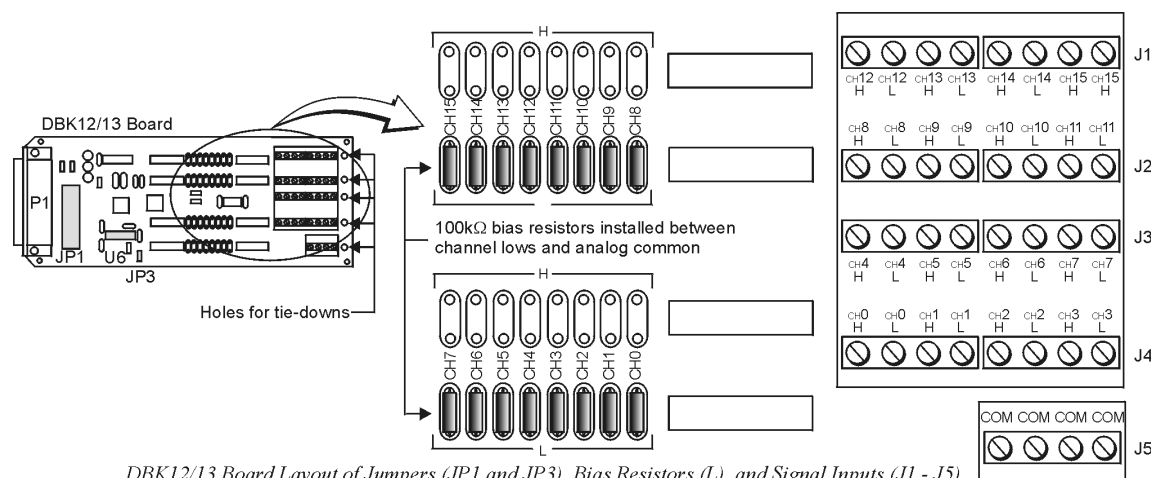
DBK12 and DBK13 Block Diagram

Up to 16 such cards can be attached to one of the 16 base channels for 256 single-ended or differential inputs. The scan sequencer can directly program the expansion cards to scan external signals at the same 10 μ s/channel rate as on-board channels.

Note: DBK12 and DBK13 use the same printed circuit board and look quite similar. If the label becomes unreadable, you can distinguish them as follows: the U6 integrated circuit is a PGA203 in DBK12; but a PGA202 in DBK13.

Hardware Setup

To set up the card, you may need to refer to the following board layout. The layout can be used for both DBK12 and DBK13.



Card Connection

DBK12 and DBK13 are equipped with screw terminal connectors for easy access to all of the analog inputs, as well as several analog ground access points. Connections are provided for 16 single-ended or 16 differential inputs. On board, there are factory-installed, 100 K Ω bias resistors in the L locations for each channel; these resistors can be removed if desired. (The H locations have no factory-installed resistors).

1. For **single-ended operation**, connect the signal's high end to the high input of the desired channel and the low end to analog common (J5).
2. For **differential operation**, connect the signal's high end to the high input and the low end to the low input of the desired channel. When using differential input, ground referencing to analog common is important for accuracy. If necessary, use bias resistors. The two differential measurement configurations (floating and referenced) are discussed in the [Signal Management](#) section of Chapter 1.
3. After all connections are in place, secure wires to the card at the captive areas at the end of the card. Nylon tie wraps work well for this purpose.



A path to analog common must exist, either by direct connection or through bias resistors.

Card Configuration

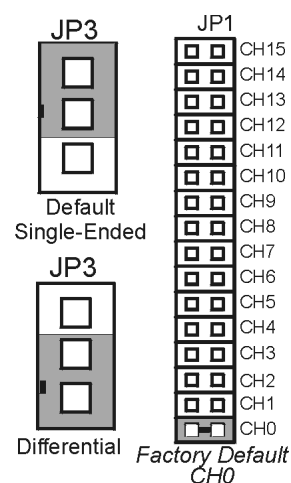
Factory Default: Input mode – Single-ended

The two variables of card configuration are input mode to the card and channel output to the LogBook or the Daq device.

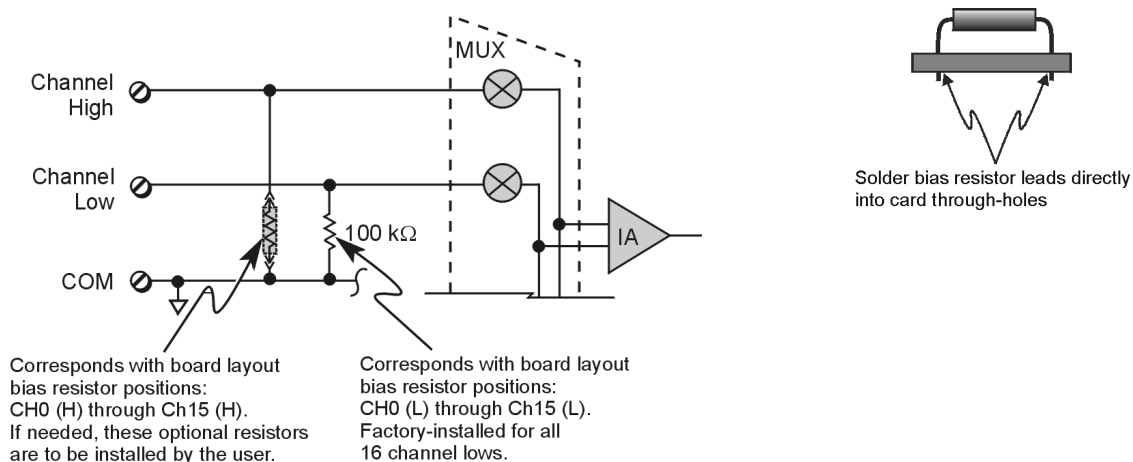
1. Using the onboard jumper, JP3, set the signal input mode (see figure). The jumper and its SE (Single-Ended) and DIFF (Differential) positions are clearly identified on the board overlay.
 - For **single-ended** inputs, place the jumper in the **SE** position.
 - For **differential** inputs, place the jumper in the **DIFF** position.
2. To configure the channel, locate the 16 \times 2-pin header (JP1) located near the front of the board. JP1's 16 jumper locations (CH0 through CH15) match corresponding base channels. Place the jumper on the channel you wish to use.

Only one channel can be selected on a single card; and all cards in a daisy-chain must have unique jumper settings. Up to sixteen DBK12s (or DBK13s) may be connected to your LogBook or to your Daq device. An optional DBK10 enclosure may be used.

Bias resistors are now factory-installed between the channel lows and analog common. If you have an early version board, you can still install the bias resistors. The use of bias resistors is discussed in the [Signal Management](#) section of chapter 1.



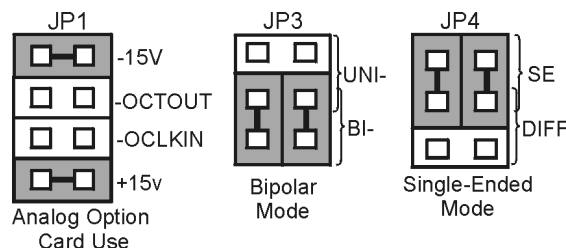
**DBK12, DBK13
Configurations**



DaqBook and DaqBoard [ISA type] Configuration

Use of DBK12 or DBK13 requires the following setup steps for DaqBook and DaqBoard [ISA type] applications.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.



Default Configuration Settings for DBK12 and DBK13

Note: These jumpers are located in the DaqBook and DaqBoard [ISA-Type] units.

The JP1 default position, indicated in the above figure, is necessary to power the interface circuitry of the DBK12 or DBK13 via the internal ± 15 VDC power supply. If using auxiliary power (e.g. a DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 document modules as applicable.

2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP3 jumper in either the *unipolar* or *bipolar* mode as needed (bipolar shown).
3. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in the DaqBook/DaqBoard in *single-ended* mode.

Note: Analog expansion cards convert all input signals to *single-ended* voltages referenced to analog common.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK12 – Specifications

Name/Function: Analog Multiplexing Card (Low Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 2$, $\times 4$, $\times 8$

Inputs: 16 differential or single-ended
(switch selectable as a group)

Voltage Range: 0 to ± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: $\pm 0.05\%$ typ, $\pm 0.25\%$ max

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20 V/ μ s typ, 10 V/ μ s min

Settling Time: 2 μ s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typ, 0.015% max

Bias Current: 150 pA, 0.2 μ A max

Offset Voltage: $\pm(0.5 + 5/G)$ mV typ; $\pm(2.0 + 24/G)$ mV max

Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typ; $\pm(2.0 + 24/G)$ μ V/ $^{\circ}$ C max

DBK13 – Specifications

Name/Function: Analog Multiplexing Card (High Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 10$, $\times 100$, $\times 1000$

Inputs: 16 differential or single-ended (switch selectable as a group)

Voltage Range: 0 to ± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: $\pm 0.05\%$ typ @ $G < 1000$
 $\pm 0.25\%$ max @ $G < 1000$
 $\pm 0.10\%$ typ @ $G = 1000$
 $\pm 100\%$ max @ $G = 1000$

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20V/ μ s typ, 10V/ μ s min

Settling Time: 2 μ s to 0.01% @ $G < 1000$
10 μ s to 0.01% @ $G = 1000$

CMRR: 80 dB @ $G=1$ min
86 dB @ $G=10$ min
92 dB @ $G=100$ min
94 dB @ $G=1000$ min

Non-Linearity: 0.002% typ @ $G < 1000$
0.015% max @ $G < 1000$
0.02% typ @ $G = 1000$
0.06% max @ $G = 1000$

Bias Current: 150 pA typ; 0.2 μ A @ 25 $^{\circ}$ C max

Offset Voltage: $\pm(0.5 + 5/G)$ mV @ 25 $^{\circ}$ C typ;
 $\pm(2.0 + 24/G)$ mV @ 25 $^{\circ}$ C max

Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typ; $\pm(12 + 240/G)$ μ V/ $^{\circ}$ C max



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DaqBook and DaqBoard [ISA-Type] Configuration 4

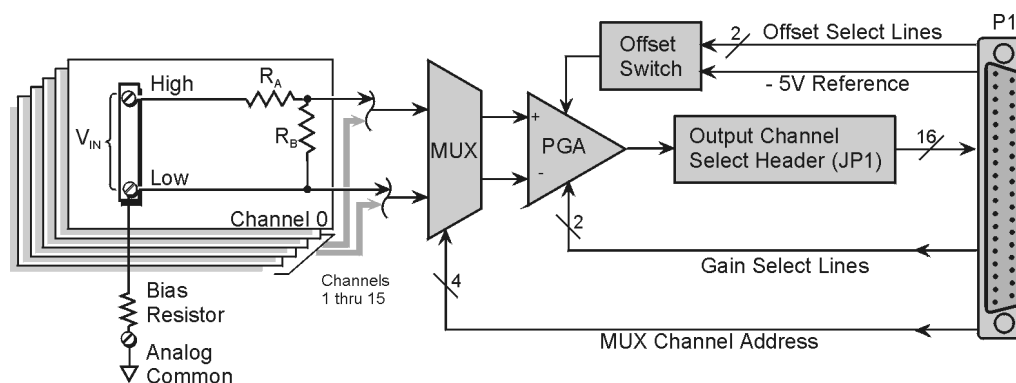
Software Setup 5**DBK15 – Specifications5****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

DBK15 uses a 16-channel multiplexer and a programmable gain input amplifier (PGA). Component sockets accept resistors that configure each channel for current-to-voltage conversion or for voltage attenuation. The differential signal input from the transducer must use 3 leads: high, low, and common.

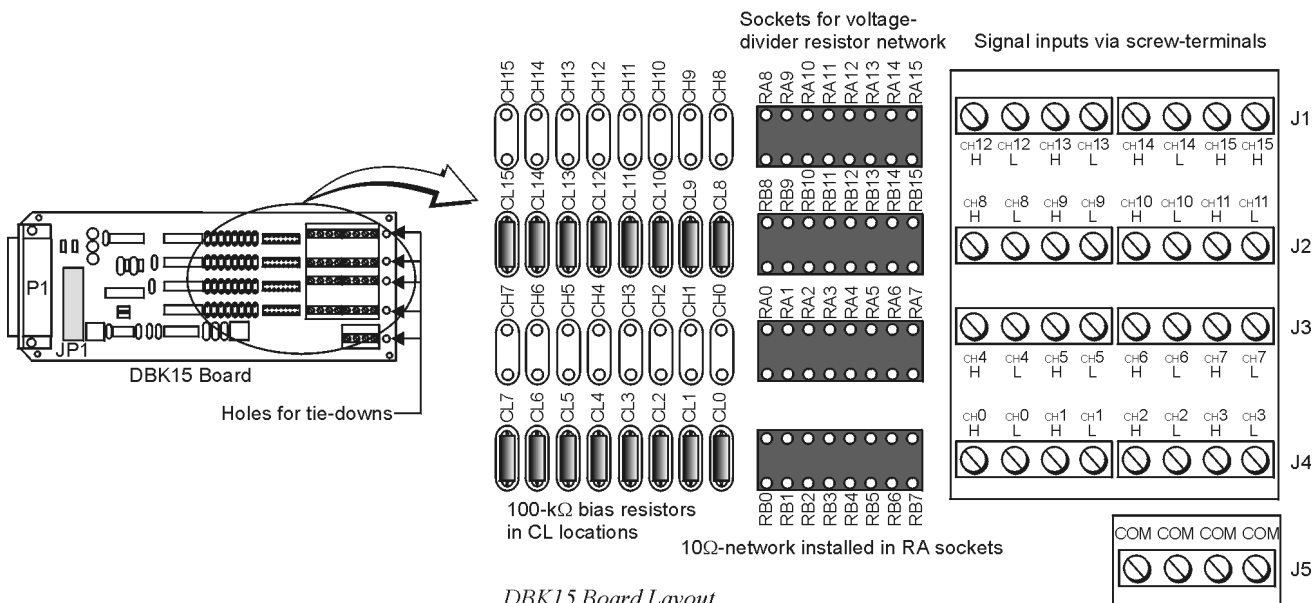
When configured by appropriate resistors, the DBK15 can measure voltages up to 30 VDC or currents up to 20 mA. Each of 16 input channels has a resistor “A” and “B” location. Installing various resistors in these locations yields channel-to-channel flexibility. The DBK15’s input amplifier is software programmable for ×1 or ×2 gain per channel, providing unipolar 0 to +10 V or bipolar -5 to +5 V ranges per channel.



$$V_{OUT} = V_{IN} \left(\frac{R_B}{R_A + R_B} \right) (GAIN) + OFFSET$$

DBK15 Block Diagram

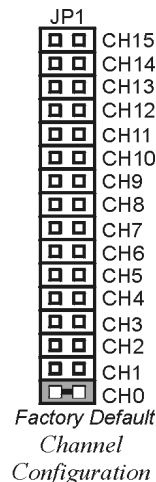
Hardware Setup



Card Configuration

Factory Default: Input range of $\pm 5V$

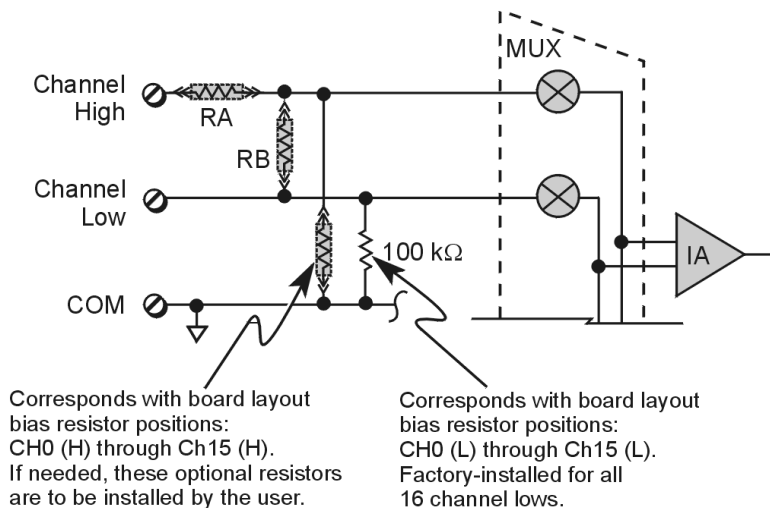
- Determine the LogBook's or Daq device's Analog Input Channel for each DBK15 in your system. As few as one or as many as 16 DBK15's may be connected to your device. Since this is a daisy-chain type interface, each card must appear unique. This is accomplished by assigning each card to a different Analog Input on the LogBook or the Daq device.
- Locate the 16 \times 2 pin header labeled JP1 near the front of the board. Note the 16 jumper locations on this header labeled CH0 through CH15 corresponding to the LogBook's or Daq device's Analog Input Channels.
- Set JP1 jumper on the pins for your intended output channel (CH0-CH15, see figure). Only one jumper is used on a single card. No two cards in the same system can have the same jumper setting.
- On enhanced versions of this board, bias resistors have been installed between the channel lows and analog common. If you have an early version of the board, you can still install bias resistors. The use of bias resistors is discussed in the [Signal Management](#) section of Chapter 1.
- Determine values for R_A and R_B for each input signal channel. Standard RN55D ($\frac{1}{4}$ watt, 1%, metal film) resistors or 22 gage bare wire (short) plug in pin sockets. See the following table.



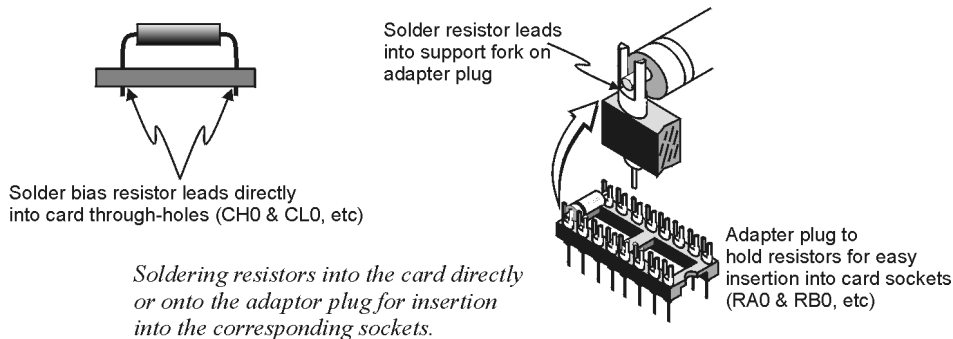
Note that a multiplexed input in sampled data systems must have low impedance to allow for accurate measurements. For 12-bit accuracy at 100 kHz, equivalent attenuator impedances should be less than 1 k Ω and signal sources must have impedances less than 1/4000 of the attenuator input impedance. For example, a 2:1 attenuator using 2 K Ω resistors will have 1 K Ω of equivalent impedance; but the source impedance must be less than 1/2 Ω (1/4000 of 2000) for 12-bit measurement accuracy to be attained.

| Input Range | RA | RB | Gain | Polarity |
|-------------|----------------------|---------------|------|----------|
| ±5 VDC | 10 Ω Short | Open | ×1 | Bipolar |
| ±10 VDC | 2 K Ω | 2 K Ω | ×1 | Bipolar |
| ±30 VDC | 10 K Ω | 2 K Ω | ×1 | Bipolar |
| ±20 mA | Short | 249 Ω | ×1 | Bipolar |
| ±20 mA | Short | 124 Ω | ×2 | Bipolar |
| ±2 mA | Short | 1240 Ω | ×2 | Bipolar |

6. Install resistors in R_A and R_B sockets for each channel as desired (see figures).



In voltage mode, R_A and R_B (installed by the user) form a resistor divider network. In current mode, R_A is always shorted, R_B is shunted with a resistor. 8 channels can be configured alike with 16-pin, 8-resistor DIP-8 resistor networks. With no resistors, DBK15 provides 16 differential voltage inputs for +5 V full-scale inputs. CL positions are used for bias resistors if necessary. Two differential measurement configurations can be used: floating or referenced differential. Refer to the [Signal Management](#) of chapter 1 for more information.



Card Connection

1. Connect the signal input wires to the appropriate screw terminals. The DBK15 is equipped with screw terminal connectors for easy access to inputs and ground access points. Connectors are provided for 16 differential inputs and are labeled by channel number and H and L for high and low analog inputs. On board, there are 100K Ω bias resistors in the CL locations per channel (the CH locations are not used). These resistors can be removed if desired.



The DBK15 card only supports differential inputs (not single-ended). Connect the high end of the signal to the High input and the low end to the Low input of the desired channel. Ground referencing to Analog Common is important for optimum accuracy.

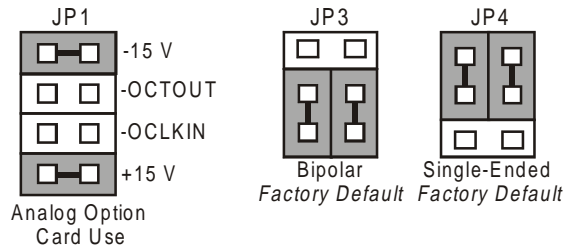
2. Use tie wraps (not included) and the board's edge-holes to secure all wires in a way that will not allow mechanical stress to affect the signal connection. In other words, be sure to provide a degree of slack, or "strain-relief."



DaqBook and DaqBoard [ISA-Type] Configuration

Use of the DBK15 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.



DaqBook/DaqBoard Jumpers for the DBK15

Note: The JP1 default position is necessary to power the interface circuitry of the DBK5 via the internal ± 15 VDC power supply. If using auxiliary power (e.g., DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 modules as applicable.

2. For DaqBook/100, DaqBook /112 and DaqBook /120 *only*, place the JP3 jumper in *Bipolar mode*.
3. For DaqBook/100, DaqBook /112 and DaqBook /120 *only*, place the JP4 jumper in *single-ended mode*.

Note: Analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).



DaqView Users: When DBK15 is used with DaqBoard/2000 Series or /2000c Series Boards, the Internal Clock Speed must be set to 100 kHz as described in the *DaqView* section of your device user's manual.

DBK15 – Specifications

Name/Function: Universal Current/Voltage Input Card

Input Connectors: Screw terminals for signal connections

Output Connector: DB37 male, mates with P1 using CA-37-x cable

Attenuation/Shunt Resistor Connector: Machine sockets accommodate standard ¼-watt resistors

Gain Ranges: x1, x2

Inputs: 16 differential

Voltage Input Ranges: ±5 VDC max

Current Input Range: ±20 mA max

Attenuator Resistors:

Accuracy: +1%

Temperature Coefficient: 100 ppm/°C

Gain Accuracy: ±0.05% typ, ±0.25% max

Maximum Input Voltage: ±35 VDC

Slew Rate: 10 V/μs

Settling Time: 2μs to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typ, 0.015% max

Unattenuated Bias Current: 150 pA typ, 0.2 μA max @ 25°C

Offset Voltage:

±(0.5 + 5/G) mV @ 25°C typ

±(2.0 + 24/G) mV @ 25°C max

Offset Drift:

±(3 + 50/G) μV/°C typ

±(12 + 240/G) μV/°C max



| | |
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Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK16 will condition signals from most types of bridge circuit configuration transducers that have a signal output of less than 50 mV. Strain gages and load cells are common types of these transducers. For half- and quarter-bridge strain gages, the DBK16 can accommodate user-supplied bridge completion resistors that complete the bridge circuit.

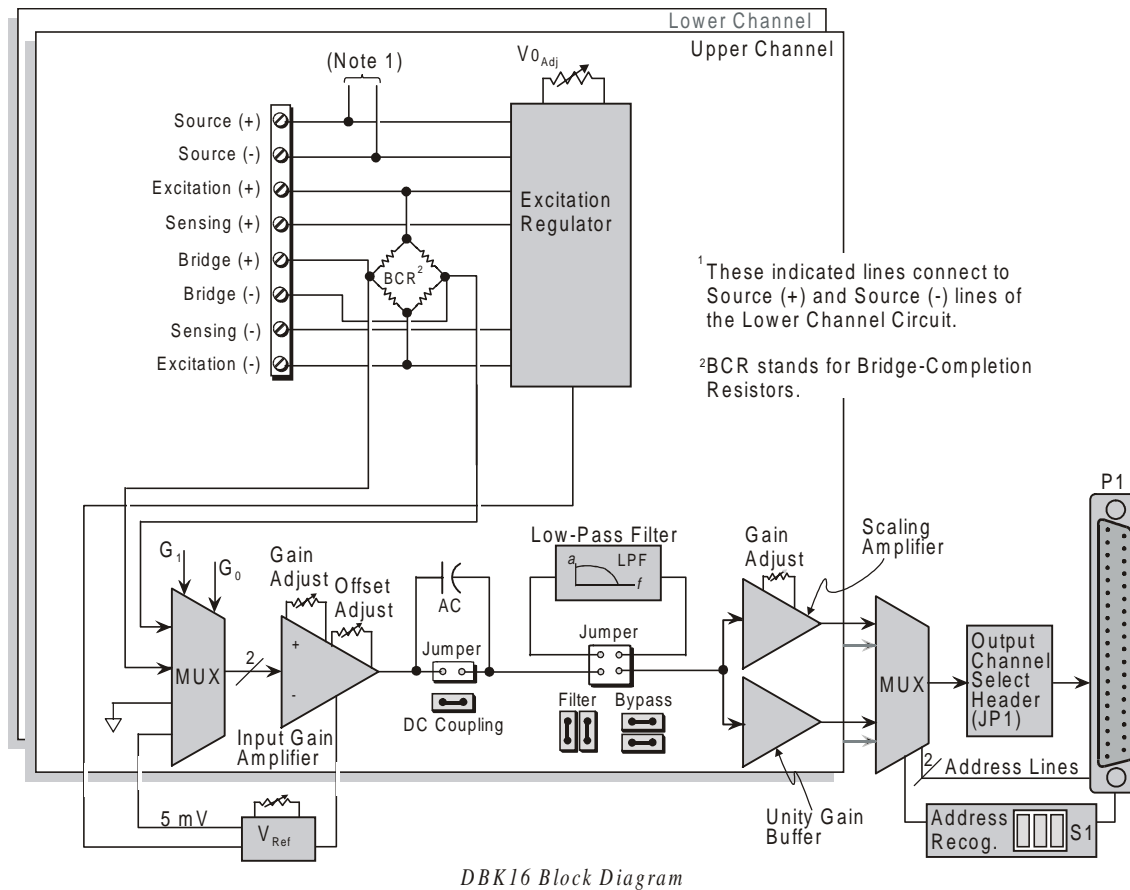


The bridge circuit must be complete for the DBK16 to operate correctly.

Each channel of the DBK16 offers a selectable 3-pole, low-pass filter with a user-set cut-off frequency. Up to 8 DBK16 boards can be connected to each of 16 analog LogBook or Daq device base channels for a maximum of 256 input signals. Remote-sense terminals are used with 6-wire Kelvin connections.

The DBK16 provides an amplifier gain range of $\times 100$ to $\times 12,500$ for use with strain gages having 0.4 to 10 mV/V sensitivities. Most strain gages are specified for a full-scale value of weight, force, tension, pressure, or deflection with an output of mV/V of excitation. For example, a strain gage with a full-scale rating of 1000 lb of tension might output 2 mV/V of excitation at full load. With an excitation of 10 VDC, 1000 pounds of load would produce an output of 20 mV.

The card's 0 to 5 VDC offset and output-scaling permit nulling of large quiescent (inactive or motionless) loads and expansion of the dynamic range for maximum resolution. Typically, the quiescent output is non-zero. Prior to a force being applied, a mounted strain gage can be in a state of partial deflection resulting in an output. In the case of a tension gage, this output may be due to the weight of a hook or empty container.



A wide-range excitation regulator is adjustable from 1.5 to 10.5 VDC with a current limit of 50 mA. The DBK16 requires a 12 to 15 VDC external excitation voltage that can be supplied from the DBK30A battery module or other user-supplied source.

Hardware Setup

CAUTION



Each regulator has a maximum current of 50 mA. The maximum amount of excitation that can be provided by the DBK16 excitation regulator is represented by the following equation:

$$V_{EXC[Max]} = 0.05 \times R_{GAGE}$$

Where R_{GAGE} = the resistance of 1 element in the bridge circuit.

Exceeding the maximum allowed excitation can cause the DBK16 to fail.

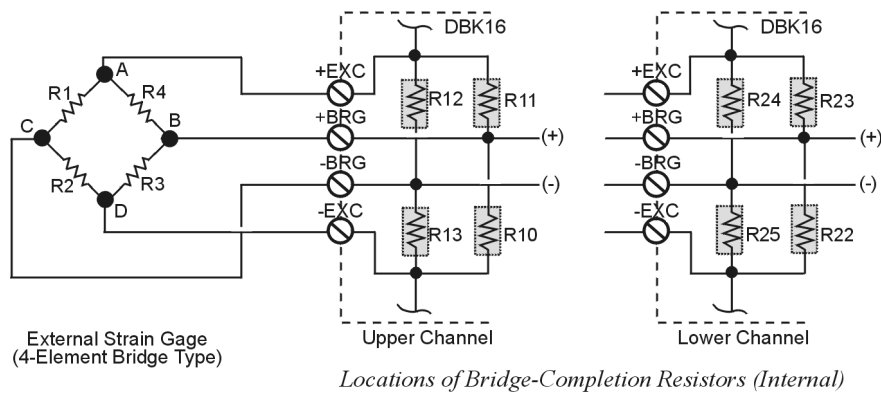
Card Connection

For DBK16s, the strain gage is configured as a 4-element bridge. There are 4 legs in a bridge circuit; the *quarter*, *half* or *full* designation refers to how many elements in the bridge are strain-variable. A quarter bridge has 1 strain-variable element; a half bridge has 2; and a full bridge has 4. Each DBK16 channel has locations for bridge completion resistors. These resistors of fixed values are necessary to fill out the bridge configuration.

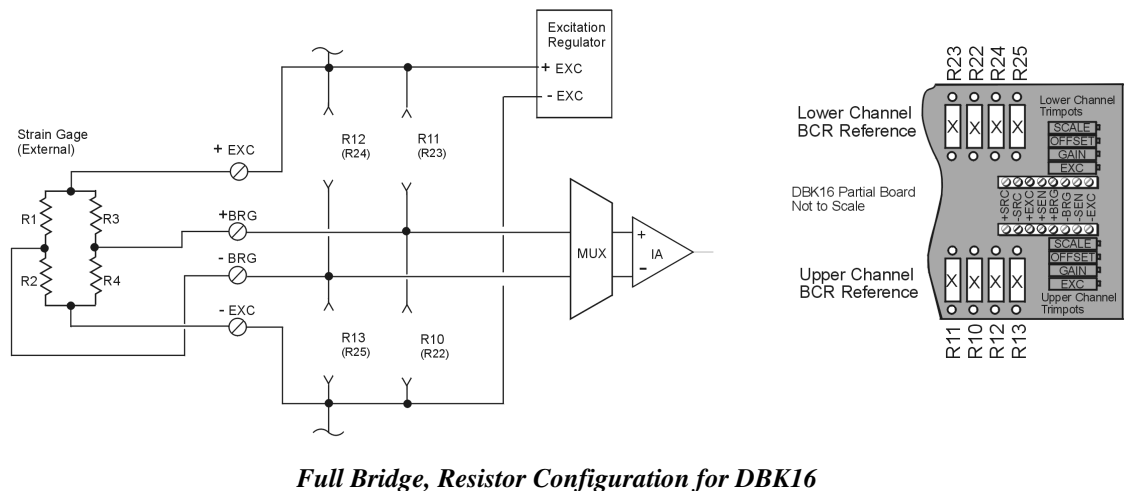
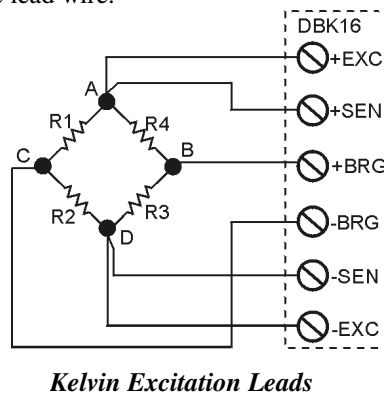
In the following diagram, a 4-element bridge-type strain gage is referenced to the upper and lower channel bridge completion resistor designations for the DBK16.



Bridge resistors are used in either the DBK16 or the strain gage, but not in both at the same time.



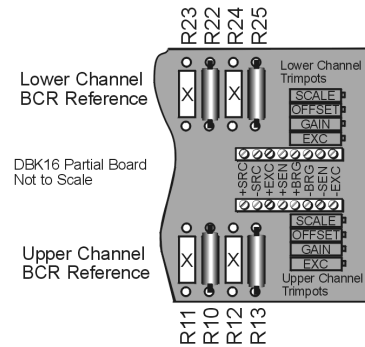
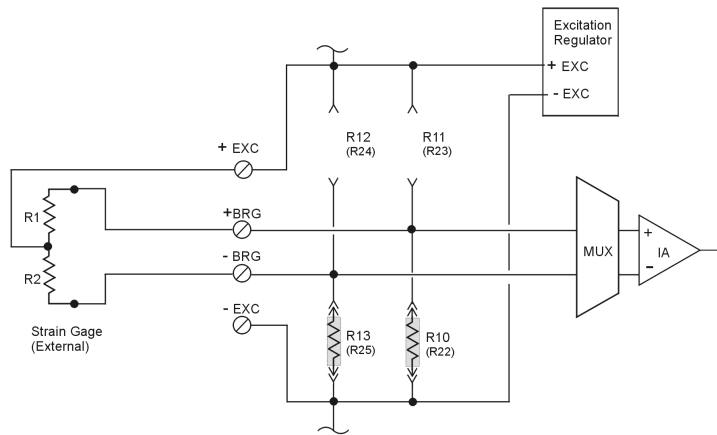
Connections are provided for Kelvin-type excitation. The excitation regulators stabilize the voltage at the points connected to the on-board sampling dividers. Unless you run separate sense leads to the excitation terminals of the strain gage, the voltage regulation is most accurate at the terminal blocks on the DBK16. In a Kelvin-type connection, six wires run to a 4-element strain gage, and the excitation regulation is optimized at the strain gage rather than at the terminal blocks. For high accuracy, this can be a worthwhile connection for as little as 10 feet of 22 gauge lead wire.



The full bridge configuration makes use of all four elements of the strain gage. When using a full bridge external strain gage (all four elements), the following applies to the DBK16 on board resistor configuration:

Upper Channel – R10, R11, R12, and R13 are not installed.

Lower Channel – R22, R23, R24, and R25 are not installed.



Half Bridge, ($\Delta R1\downarrow$ and $\Delta R2\uparrow$) $\Rightarrow \Delta E_{OUT}\uparrow$)
Resistor Configuration for DBK16

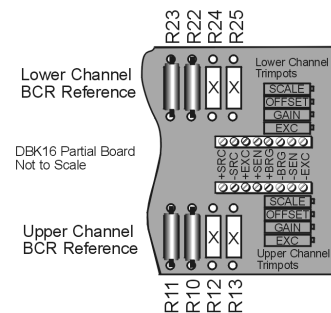
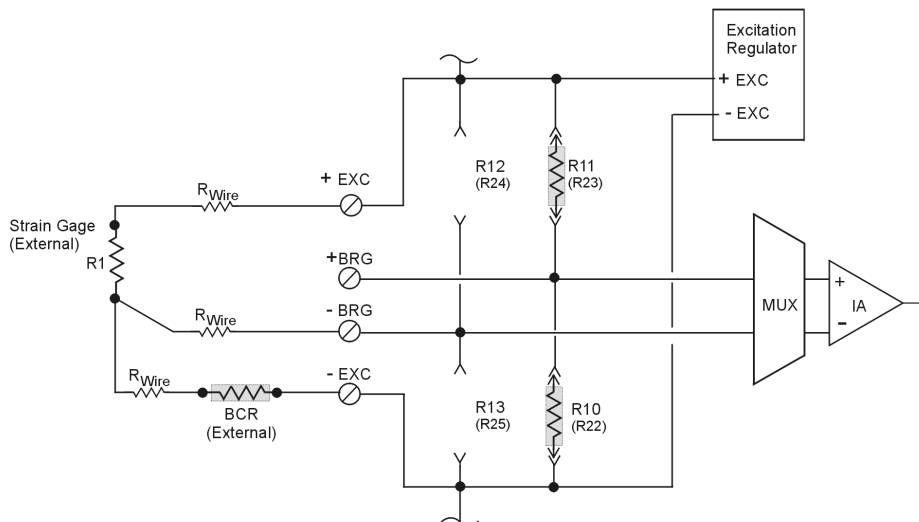
The half bridge configuration makes use of two elements of the strain gage. When using a half bridge external strain gage (two of four elements), the following applies to the DBK16 on board resistor configuration:

Upper Channel – R10 and R13 are to be installed.

Lower Channel – R22 and R25 are to be installed.

Note that other Half Bridge scenarios exist. The one illustrated applies to the equation:

$$\Delta R1\downarrow \text{ and } \Delta R2\uparrow \Rightarrow \Delta E_{OUT}\uparrow$$



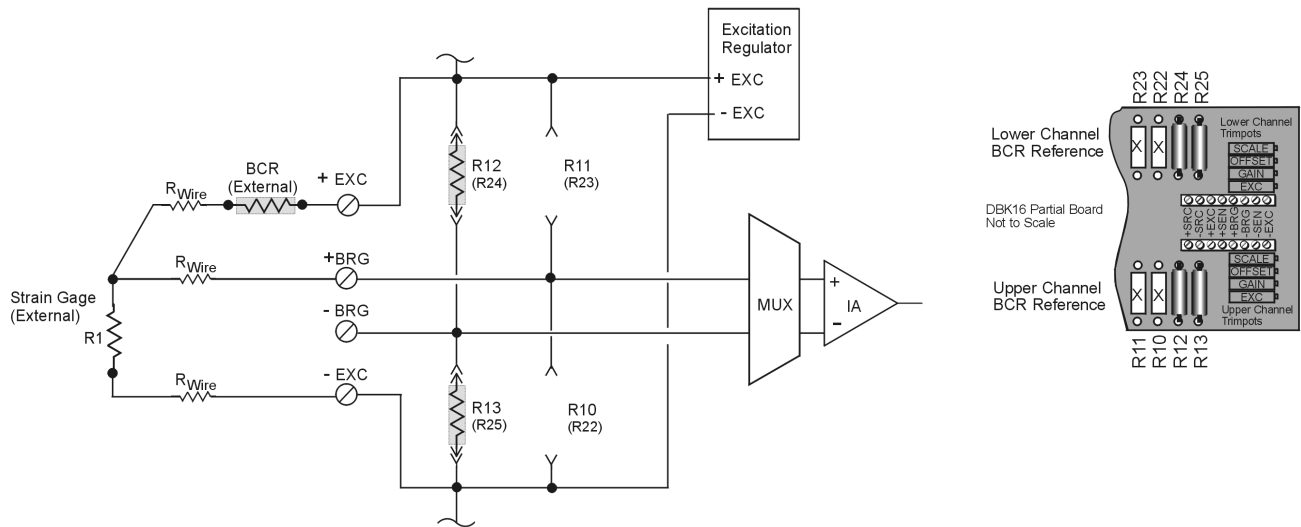
3-Wire, Quarter-Bridge, Negative ($\Delta R\uparrow \Rightarrow \Delta E_{OUT}\uparrow$) for DBK16

The quarter-bridge configuration makes use of one element of the strain gage. The three-wire, quarter-bridge can be configured as “positive” or “negative.” The above figure represents the negative (minus) configuration. In this setup, the magnitude of voltage out is directly proportional to the change in resistance ($\Delta R\uparrow \Rightarrow \Delta E_{OUT}\uparrow$). When using a quarter-bridge external strain gage in the “negative” configuration, the following applies:

Upper Channel – R10 and R11 are to be installed.

Lower Channel – R22 and R23 are to be installed.

An external BCR is to be placed in the –EXC to R1 line (see previous figure).



3-Wire, Quarter-Bridge, Positive ($\Delta R \downarrow \Rightarrow \Delta E_{OUT} \uparrow$) for DBK16

The quarter-bridge configuration makes use of one element of the strain gage. The three-wire, quarter-bridge can be configured as “positive” or “negative.” The above figure represents the positive (plus) configuration. In this setup, the magnitude of voltage out is inversely proportional to the change in resistance ($\Delta R \downarrow \Rightarrow \Delta E_{OUT} \uparrow$). When using a quarter-bridge external strain gage in the “positive” configuration, the following applies:

Upper Channel – R12 and R13 are to be installed.

Lower Channel – R24 and R25 are to be installed.

An external BCR is to be placed in the +EXC to R1 line (see previous figure).

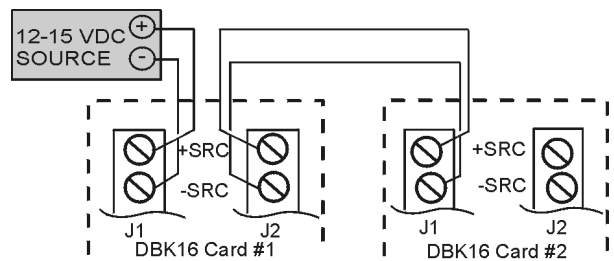
Excitation

To supply excitation voltage to a single DBK16:

Connect J1 (terminals SRC+ and SRC-) to a source of filtered (not necessarily regulated) DC between 12 and 15 V.

To supply excitation to multiple DBK16s:

1. Connect J1 (terminals SRC+ and SRC-) to a source of filtered (not necessarily regulated) DC between 12 and 15 V.
2. Connect J2 of the powered DBK16 to J1 of the next DBK16 (see figure). The excitation power terminals are wired in parallel to *daisy-chain* multiple DBK16s (in systems with more than 2 transducers).



Connecting Multiple DBK16s

The user-supplied excitation source is attached to a voltage regulator in the DBK16 circuitry. This regulator provides the excitation to the actual transducer (there is a separate regulator for each transducer, hence two regulators per DBK16). Each regulator has a maximum current of 50 mA. The maximum amount of excitation that can be provided by the DBK16 excitation regulator is represented by the following equation:

$$V_{EXC[MAX]} = 0.05 \times R_{GAGE}$$

Where R_{GAGE} = the resistance of 1 element in the bridge circuit.

The user-supplied excitation source should provide adequate current levels for all the DBK16s that are powered. The minimum current required for the user-supplied excitation source for each transducer (2 per DBK16) is:

$$I_{\text{MIN}} = \text{Excitation voltage}/R + 5 \text{ mA} \quad (\text{where } R = \text{the resistance of 1 element in the bridge circuit})$$

The user-supplied excitation source must be 12 to 15 VDC and connected with the proper polarity.

Enhanced DBK16 cards contain two additional jumpers (JP6 and JP7). Their configuration determines whether the channel excitation regulator's power source is *external* (default) or *internal*. Review the following **note** and **CAUTION** prior to selecting the *internal power source*.

- **JP6** – Selects the upper channel's source. Default is *external*.
- **JP7** – Selects the lower channel's source. Default is *external*.



It is possible to power excitation regulators from an internal +15 V on the LogBook's or Daq device's P1 if no other DBKs are being used. On enhanced DBK16 cards, two 3-pin headers (JP6 for upper channel and JP7 for lower channel) are set by default to use an *external* power source. Moving the jumpers to the *internal* position connects the excitation terminals to the +15 VDC rail from P1.

CAUTION



Avoid overloading LogBook's, DaqBook's or DaqBoard's +15 VDC power supply. The power supply can be overloaded if DBK16 jumpers JP6 and/or JP7 are set to "Internal" and one or more of the following conditions exist:

- Additional DBKs are being used.
- 120 Ω bridge-completion resistors are being used in the strain gage configuration.

Card Configuration

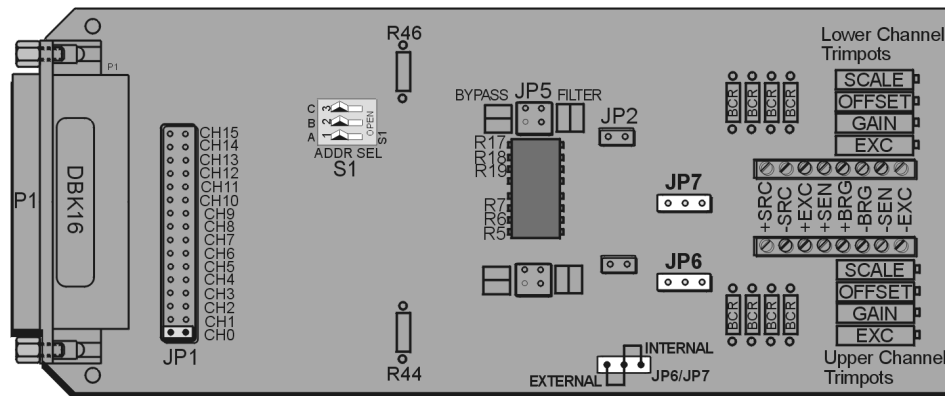
Factory Defaults:

- Bridge configuration – Full
- Coupling – DC
- Excitation source – External
- Low pass filter – Disabled (by-passed)

The cutoff frequency, if enabled, has a default of 3.7 Hz. This is obtained using 100k Ω resistors for R17, R18, and R19 for the lower channel; and using 100k Ω resistors for R5, R6, and R7 for the upper channel. See the following board layout for resistor locations.

The next few sections of this document module explain the following aspects of configuring DBK16.

- [AC Coupling and Low-Pass Filter Options](#)
- [Channel and Card Address Selection](#)



DBK16 Board Layout

AC Coupling, DC Coupling, and Low-Pass Filter Options

Headers on the board accommodate the coupling and low-pass filter options and the output channel selection (see above figure). Resistors can be removed to lower filter gain from $\times 2$ to $\times 1$. A filter frequency determining resistor network can be inserted into an IC socket.

The **AC or DC coupling** choice (on each channel) is set by the presence or absence of a **shunt jumper** on a two-pin header. If the shunt jumper is in place, the coupling is DC. If the shunt jumper is absent, the coupling is AC. **JP3** is used to configure the upper channel's coupling; **JP2** is used to configure the lower channel.

The choice of **using or bypassing the low-pass filter** (for each channel) is made by the orientation of shunt jumpers on a 2×2 -pin header. When the shunt jumpers are oriented in the same way as the "bypass" symbol (horizontal, parallel with labels on card), the filter is bypassed. When the shunt jumpers are oriented in the same way as the "filter" symbol (vertical), the filter is in the signal path. **JP4** is used to configure the upper channel; **JP5** is used to configure the lower channel.

The **corner frequency of the low-pass filters** is determined by three resistor values in each filter circuit. Located in the center of the card, the **lower channel resistors** are **R17-R18-R19**; and the **upper channel resistors** are **R5-R6-R7**. These resistor locations are arranged to allow the use of an 8-position DIP network (as a convenient means of changing all 6 resistors at once). The machined-pin socket allows you to insert individual resistors (should the two filter sections have different corner frequencies). The table to the right lists common frequencies, nominal resistance values, and Bourns part numbers.

| Frequency | Resistance (Ω) | Bourns Part Number |
|-----------|-------------------------|--------------------|
| 37Khz | 10 | 4116R-001-100 |
| 19Khz | 20 | 4116R-001-200 |
| 7Khz | 50 | 4116R-001-500 |
| 3.7Khz | 100 | 4116R-001-101 |
| 1.9Khz | 200 | 4116R-001-201 |
| 700Hz | 500 | 4116R-001-501 |
| 370Hz | 1K | 4116R-001-102 |
| 190Hz | 2K | 4116R-001-202 |
| 70Hz | 5K | 4116R-001-502 |
| 37Hz | 10K | 4116R-001-103 |
| 19Hz | 20K | 4116R-001-203 |
| 7Hz | 50K | 4116R-001-503 |
| 3.7Hz | 100K | 4116R-001-104 |

Note: Due to settling time, the filter should not be enabled during the DBK16 setup.



DBK16's active low-pass filters have an inherent gain of $\times 2$. You must factor this gain into your setup calculations. To change the gain to $\times 1$, remove the following 10 K Ω resistors: R44 for the upper channel, R46 for the lower channel.



Reference Note: Methods of calibrating DBK16 are discussed in the calibration section.

Channel and Card Address Selection

The lower and upper channels on the DBK16 are multiplexed into one of the channels (0 to 15). The base channel (that the DBK16 is multiplexed into) is set by the shunt jumper on the 16x2 header designated **JP1** (see previous figure, DBK16 Board Layout).

Each base channel can have up to 16 expansion channels multiplexed into it. Since the DBK16 represents two expansion channels, eight DBK16 cards can be multiplexed into each base channel. To distinguish channels, there is a card address bank of three switches on each DBK16. These switches are binary-weighted with eight possibilities (0-7).

| DIP Switch Setting | | | Card Channels (n) | |
|--------------------|--------|--------|-------------------|-------|
| C | B | A | Upper | Lower |
| Open | Open | Open | 1 | 0 |
| Open | Open | Closed | 3 | 2 |
| Open | Closed | Open | 5 | 4 |
| Open | Closed | Closed | 7 | 6 |
| Closed | Open | Open | 9 | 8 |
| Closed | Open | Closed | 11 | 10 |
| Closed | Closed | Open | 13 | 12 |
| Closed | Closed | Closed | 15 | 14 |

| Base Channel | First Expansion Channel Number (N) |
|--------------|------------------------------------|
| 0 | 16 |
| 1 | 32 |
| 2 | 48 |
| 3 | 64 |
| 4 | 80 |
| 5 | 96 |
| 6 | 112 |
| 7 | 128 |
| 8 | 144 |
| 9 | 160 |
| 10 | 176 |
| 11 | 192 |
| 12 | 208 |
| 13 | 224 |
| 14 | 240 |
| 15 | 256 |

The switch settings are: **open = 0, closed = 1 (enabled)**. The weights (when closed) are: **A = 1, B = 2, C = 4**. The table above shows the switch settings. The table to the right lists card channels (n) with respect to the base channel.

Since the LogBook or the Daq device has sixteen base channels, up to 128 DBK16s can be used, providing a maximum of 256 channels. To keep track of all base and expansion channels, the base channels are designated 0 to 15 and the expansion channels are designated 16 to 271. Channel 16 is the first channel on the first expansion board (lower channel on card address 0 with JP1 set to CH0). Channel 271 is the last channel on the last expansion board (upper channel on card address 7 with JP1 set to CH15).

To calculate the actual input channel, use the above tables and add the applicable “N” and “n.” The result is the expansion channel number. This number is needed when writing a program to read from that particular channel. For more information on multiplexing, refer to the [Signal Management](#) section in chapter 1.

Calibrating DBK16 for Daq Devices



Reference Note:

This section covers calibrating a DBK16 that is being used in a Daq device application.

LogBook users: refer to [Calibrating DBK16 and DBK43A for LogBook](#), which begins on page 15.

Bridge circuit transducers are used for many different applications, and the DBK16 is flexible enough to support most of them. Each DBK16 channel circuit has an excitation regulator, a high gain (100-1250) input amplifier with offset adjustment, a low-pass filter, a scaling (1-10) amplifier, and a calibration multiplexer.

There are 4 trimpots to set up each channel circuit. The trimpots are labeled to represent the following adjustments:

EXC for adjusting the Excitation Voltage to the transducer

GAIN for setting the gain of the input amplifier

OFFSET for adjusting the circuit offset for quiescent loads or bridge imbalance

SCALE for setting the gain of the scaling amplifier

Proper setup includes the use of software commands that control the calibration multiplexer in each circuit. The calibration multiplexer is used to switch the bridge circuit out and apply reference voltages to the input for use in the DBK16 setup. The calibration multiplexer also allows the Daq device to record the individual adjustments. The next table shows the setup commands, their binary codes, and a description of their function. These commands are accessible through DaqView and the Daq device driver as gain settings and through most third party software support as well as GageCal.

| Setup Command | Code | Description |
|---------------------|------|---|
| Dbk16ReadBridge | 00 | Reads bridge circuit with all gains and offsets included (normal operation) |
| Dbk16SetOffset | 01 | Applies a grounded input and allows the user to read the circuit offset voltage multiplied by the input amplifier and the low-pass filter gain. |
| Dbk16SetScalingGain | 10 | Applies 5 mV to the input and allows the user to read the voltage out of the circuit through the input gain amplifier, the low-pass filter* and the scaling gain amplifier. |
| Dbk16SetInputGain | 11 | Applies 5 mV to the input and allows the user to read the voltage out of the circuit through the input gain amplifier and low-pass filter only. |

The following equations represent the voltage recorded by the Daq device when the calibration mux is set in 1 of 4 possible settings.

| Code | Equation |
|------|--|
| 00 | $V_{out} = (\text{Scaling Gain})(\text{Filter Gain} * [(\text{Input Gain})(\text{bridge circuit voltage}) - \text{offset voltage}])$ |
| 01 | $V_{out} = (\text{Filter Gain} * (\text{Input Gain})(-\text{offset voltage}))$ |
| 10 | $V_{out} = \text{Filter Gain} * (\text{Scaling Gain}[(\text{Input Gain})(5 \text{ mV}) - \text{offset voltage}])$ |
| 11 | $V_{out} = (\text{Filter Gain} * (\text{Input Gain})(5 \text{ mV}) - \text{offset voltage})$ |

Asterisk (*) implies the filter is enabled.

A typical setup procedure is as follows:

1. Disable the low-pass filters (JP4 and/or JP5) and set DC coupling (install JP2 and/or JP3) for all the channels that are being setup. If you plan on using the filter during your acquisition, take note of the gain in the filter stage (default $\times 2$, or $\times 1$ with resistor removed) and allow for it in your setup.
2. Determine what the excitation for the transducer will be from the transducer specifications and the current limitations of the DBK16 excitation regulator.
3. Determine what the maximum voltage will be from the transducer at maximum load or strain, and calculate what the DBK16 channel total gain should be based on a full-scale Daq device
. (-5 V to +5 V for DaqBook and DaqBoard [ISA type] in bipolar mode; 0 to +10 V for DaqBook, DaqBoard [ISA type] and DaqBoard/2000 in unipolar mode; -10 to +10 V for DaqBoard/2000 in bipolar mode and Daq PC-Card). (See [examples](#) on page 12.)

4. Determine how the total gain will be distributed between input amplifier gain, filter gain and scaling amplifier gain. (See [examples](#) on page 12.)
5. Hook up the transducer to the terminal strips labeled Lower or Upper according to the figures in the *Card Connection* section. Install the appropriate bridge completion resistors if applicable.
6. Set the excitation voltage for the transducer by adjusting the trimpot labeled EXC and measuring the voltage with a voltmeter across the +EXC and -EXC terminals on the DBK16.
7. Send the DBK16SetOffset command (usually through a gain setting in the software support). Adjust the OFFSET trimpot for a reading of 0.00 volts. This removes all offset from the DBK16 channel circuit.
8. Send the DBK16SetInputGain command (usually through a gain setting in the software support). Adjust the GAIN trimpot for a voltage reading equal to (.005)(the desired input amplifier gain).
9. Send the DBK16SetScalingGain command (usually through a gain setting in the software). Adjust the SCALE trimpot for a voltage reading equal to (.005)(the desired input amplifier gain)(the desired scaling amplifier gain).
10. Send the DBK16 ReadBridge command (default). With the quiescent (normal or inactive) load or strain applied, adjust the OFFSET trimpot for a reading of 0.00 volts. This adds offset to the circuit to compensate for the quiescent load and allows maximum resolution for the measurement.
11. Enable the low-pass filter and/or AC coupling if required for your application.
12. From the transducer specifications and the total gain of the DBK16 channel, calculate the Daq device voltage/transducer units and apply it to your Daq device voltage readings through software.
13. Apply a known load or strain and verify the DBK16 and software settings.

Set-Up Notes:

- The offset adjustment is unipolar 0 to 5 V on the input amplifier output. If the offset can not be adjusted to 0.00 V at the end of the setup procedure, try swapping the +BRG and -BRG wire connections or dropping the input gain and increasing the scaling gain.
- For very high system gains, the Scaling Gain might have to be set first with the Input Gain low and then set the Input Gain (the Daq device can only measure up to 10 V).



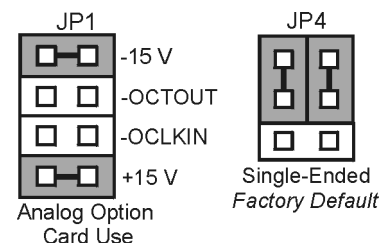
DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK16 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.

Note: This default position is necessary to power the interface circuitry of the DBK16 via the internal ± 15 VDC power supply. If using auxiliary power (e.g., a DBK32A or DBK33), you must remove both JP1 jumpers (refer to chapter 2, [Power Management](#) and to the [DBK32A](#) or [DBK33](#) sections as applicable).

2. For DaqBook/100, DaqBook /112 and DaqBook /120 *only*, place the JP4 jumper in *single-ended* mode.



Configuration Jumpers

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

GageCal Program



GageCal is not used for LogBook applications.

Note: GageCal is best suited for a load cell application

To install the GageCal program on your computer, close all other programs and run SETUP.EXE on Disk 1 (or CD-ROM, as applicable) from Windows 3.1, 3.11, or Windows 95/98/Me. Follow the installation instructions from the setup program.

Execute GAGECAL.EXE from a Windows environment to start the program. The first screen that appears will set up the Daq device interface. Input the correct Daq device interface information and click OK. If the program does not detect the Daq device, please check connections and try again or refer to the troubleshooting tips in the *Troubleshooting Tips* chapter.

Through GageCal, DBK16 channels can be configured and calibrated as needed. The typical procedure for using GageCal with a DBK16 is as follows:

1. Highlight the expansion channel number you want to configure and calibrate. Notice the channel numbers are listed 16 to 271 with respect to the Daq device (if necessary, see the section [Channel and Card Address Selection](#)).
2. Click on the CONFIGURE button. Setup and verify your hardware setting with the diagram on the screen. Please note that the coupling must be set to DC and the filter must be disabled to calibrate the DBK16. After the hardware is setup and verified, click on the ACCEPT button to configure the next channel or ACCEPT CONFIGURATION AND EXIT to return the main GageCal screen.
3. Highlight the first configured channel and click on the button labeled CALIBRATE. The Application Parameters screen appears. There are 2 types of calibration that the DBK16 can accommodate. **Nameplate calibration** allows you to enter specifications of your transducer and application; **Two-Point calibration** allows you to enter two points of millivoltage out of the transducer vs pounds or other physical units. From the parameters you enter, GageCal instructs you how to set up the DBK16.

Note: All application parameters entered will be used in the DBK16 setup. Any inaccuracies will result in the DBK16 being configured incorrectly.

4. Click on the CONTINUE button, and follow the instructions from the GageCal program. GageCal has a help file that will explain any questions on the different screens or menus. If you have trouble in your setup, a DIAGNOSTIC window can show a DBK16 circuit to help you troubleshoot the problem.
5. After GageCal completion, go to DaqView and convert ± 5 V to engineering units using $mx+b$.

Example

The following examples perform selected steps for a typical setup. There will be strain gage and load cell examples. Referring to the typical setup procedure, step 3 says to determine the maximum voltage from the transducer at maximum load or strain.

A strain gage example:

Most strain gages come with Gage Factors (GF) used to calculate the approximate output of the bridge circuit with a typical strain value. The formula is:

$$\frac{(\text{Excitation Voltage})(\text{Gage Factor})(\text{Strain in strain units})}{4} = \text{*Bridge circuit output voltage}$$

*linear estimate, some strain gages are not linear, refer to strain gage theory for more information.

If we have a 120 ohm strain gage with a gage factor of 2.1 and excitation voltage of 5 V (due to the current limitation of the excitation regulator on the DBK16, it must be less than 6 V) and we are measuring 4000 microstrain:

$$\text{Bridge output voltage for 4000 microstrain} = \frac{(5)(2.1)(4000 \times 10^{-6})}{4} = 10.5 \text{ mV}$$

A load cell example:

Load cells come with a mV/V specification which means for each volt of excitation at maximum load, the load cell will output a specific millivolt level.

Consider a 3000 pound load cell rated at 2.05 mV/V using 10 V of excitation (assume it is a 350 ohm load cell). When 3000 pounds are applied, the voltage out of the load cell is:

$$(10)(2.05 \times 10^{-3}) = 20.5 \text{ mV}$$

For 1000 pounds, it would be $(1000/3000)(10)(2.05 \times 10^{-3}) = 6.833 \text{ mV}$

Now that we know what our full-scale voltage will be from our sensor, we can calculate what the voltage gain should be on the DBK16 so the full-scale sensor output will correspond to the full-scale Daq device input. Full-scale Daq device inputs are:

-5 to +5 V for DaqBook and DaqBoard [ISA type] in bipolar mode

0 to +10 V for DaqBook, DaqBoard [ISA type], and DaqBoard/2000 in unipolar mode

-10 to +10 V for DaqBoard/2000 in bipolar mode and Daq PC-Card

To calculate the needed DBK16 gains, use the maximum voltage you want to represent the full-scale of the sensor (usually full-scale Daq device input with a little space to prevent saturation) divided by the full-scale sensor output.

Example: The strain gage above at 4000 microstrain will output 10.5 mV. If using a DaqBook in bipolar mode, full-scale is +5 V. Also, we will allow 0.5 V space on the full-scale input. The DBK16 gain should be:

$$4.5 \text{ V} / 10.5 \text{ mV} = 428.6$$

Now we must determine how to distribute the gain in the DBK16 (typical setup procedure step 4). There is the input amplifier that has a gain range of $\times 100$ to $\times 1250$, the filter gain ($\times 1$ or $\times 2$) and the scaling amplifier that has a range of $\times 1$ to $\times 10$. If we round off our gain to $\times 420$, any of these possible settings will work.

| | | | | |
|------------------------------|--------------------------------|------------------------------------|------------------------------------|--------------------------------|
| Input Gain | $\times 420$ | $\times 100$ | $\times 240$ | $\times 300$ |
| Filter Gain (enabled) | No | Yes ($\times 2$) | Yes ($\times 1$) | No |
| Scaling Gain | $\times 1$ | $\times 2.1$ | $\times 1.75$ | $\times 1.4$ |
| Total DBK16 Gain | $\times 420$ | $\times 420$ | $\times 420$ | $\times 420$ |

After we determine how all our gains will be distributed, the sensor can be hooked up to the DBK16, the bridge completion resistors installed, and the excitation voltage set. Then we can proceed to set the gains. We will use DaqView for this.

Launch DaqView and set it up for the DBK16 at the correct Daq device input channel determined by the setting of JP1 and S1. On return to the DaqView main spreadsheet screen, notice the **type** column in the spreadsheet. All the DBK16 channels should say **bridge**. Changing the type will allow us to set the offset and gains in the DBK16. When setting up the DBK16 gains, enable only the channel you are setting up. Turn all the others off in DaqView. Also, set DC coupling and disable the on-board filter during the gain and offset settings.

First, we want to remove all the offset adjustment from the circuit. Set the type to **Offset Gain**. Enable the input reading column from the Acquire menu or the tool bar. While reading the spreadsheet, set the trimpot labeled OFFSET to read a value of 0.00. Disable the input reading column.

Next, set the type to **Input Gain**. This allows us to set the input amplifier gain. The DBK16 has a 5 mV signal on the input, so the reading that we want to set the trimpot labeled GAIN to is (.005)(Input Gain). Enable the input reading column and set the Input Gain. Disable the input reading column.

Typical Input Gain settings:

| Gain | DaqView Reading | Gain | DaqView Reading |
|---|-----------------|------|-----------------|
| 100 | 0.5 volts | 200 | 1.0 volts |
| 300 | 1.5 volts | 400 | 2.0 volts |
| 500 | 2.5 volts | 600 | 3.0 volts |
| 700 | 3.5 volts | 750 | 3.75 volts |
| 800 | 4.0 volts | 900 | 4.5 volts |
| 1000 | 5.0 volts | 1200 | 6 volts * |
| * requires DaqBook/DaqBoard to be in unipolar mode. | | | |

Next set the type to **Scaling Gain**. This allows us to set the scaling amplifier gain. When setting the scaling gain, the input gain is also present and must be considered when making the adjustment. The scaling gain reading you want to read is (.005)(input gain)(scaling gain). Enable the input reading column, and set the Scaling Gain. Disable the input reading column.

For an input gain of 200, typical scaling gains are:

| Scaling Gain | DaqView reading |
|---|-----------------|
| 2 | 2.0 volts |
| 4 | 4.0 volts |
| 6 | 6.0 volts* |
| 8 | 8.0 volts* |
| 10 | 10.0 volts* |
| * requires DaqBook/DaqBoard to be in unipolar mode. | |

Now all the gains are set correctly, and we have to adjust the offset for any bridge circuit imbalance or quiescent loads. Enable the on-board filter. Set the type to **Bridge**. Make sure the quiescent load is applied. Enable the input reading column and adjust the trimpot labeled OFFSET for a reading of 0.00. If you can not adjust it to 0.00, try dropping your input gain and compensate for the drop by raising your scaling gain. If it still does not adjust to 0.00, swap the +BRG and -BRG wires to reverse the polarity of the signal. The offset adjustment is unipolar and only affects the input gain. **After the final offset is made, the gain readings will be incorrect (if you want to go back and check them) unless the circuit offset is removed.** (Step 7 in typical setup procedure.)

Using the DBK16 with 3-Wire Strain Gages

Each single-element 3-wire strain gage has 1 wire connected to one side of the gage element and 2 wires connected to the other. Follow these steps for using the DBK16 with the 3-wire single-element strain gages.

1. Install bridge completion resistors R12 and R13 (R24 and R25 for lower channel).
2. Attach the 1-wire side of the gage element to the -EXC and -SEN terminals.
3. Attach one wire on the 2-wire side of the gage to +BRG terminal.
4. Attach one more bridge completion resistor to the end of the other wire on the 2-wire side of the gage element.
5. Attach the other side of the 3rd bridge completion resistor to the +EXC terminal.



Calibrating DBK16 and DBK43A for *LogBooks*



Reference Note:

This section covers calibrating a DBK16 that is being used in a LogBook application.

Daq users: Refer to [Calibrating DBK16 and DBK43A for Daq Devices](#), which begins on page 9.

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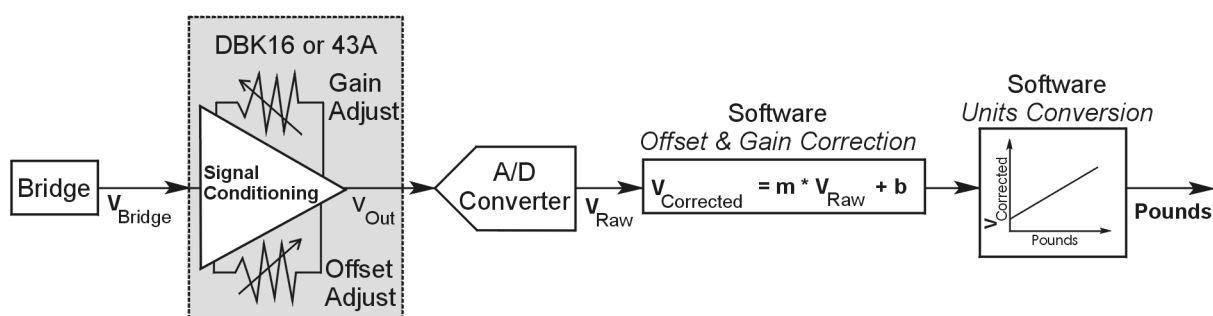
Creating a Units Conversion Transfer Function 30

Periodic Calibration Without Trimpots 31

Overview

Calibrating a strain gage channel includes:

- One-time adjusting of the bridge excitation.
- One-time tuning of the electronic gains and offset via trimpots to maximize performance and dynamic range.
- Applying a transfer function to the voltage output to convert it to engineering units, e.g., pounds, kilograms.
- Executing a software scale and offset adjustment periodically to maintain accuracy.



Example of a Unit Conversion from Voltage to Pounds

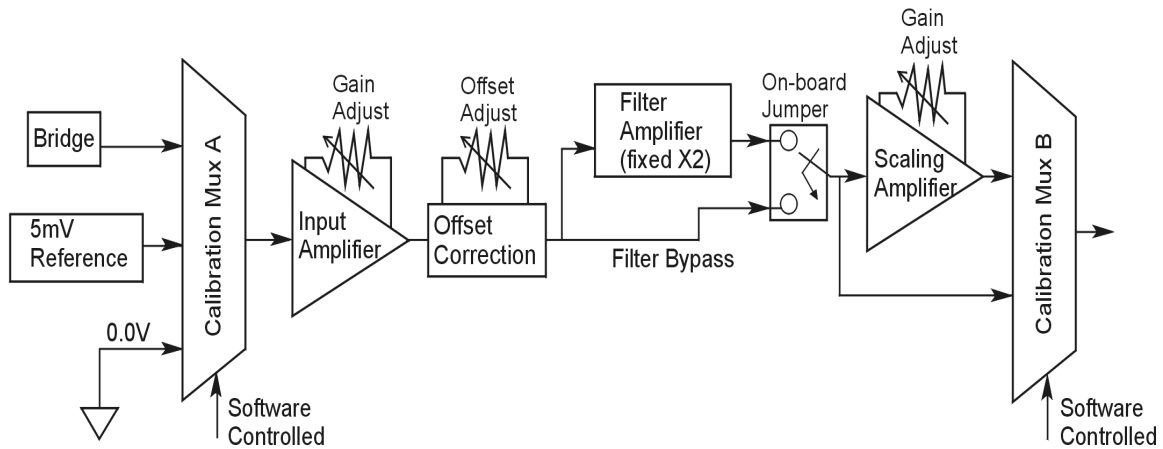
The trimpots provide course tuning so large quiescent offsets can be nulled and the bridge signal can be amplified to match the A/D input range. Once these adjustments are made, the operator can periodically fine-tune the calibration via software using LogView's 2-Point calibration feature. LogView's scale and offset features provide a simple means to apply a transfer function that converts the voltage to user units, for example, pounds, as in the above block diagram.

Bridge circuit transducers are used for many different applications, and the strain gage signal conditioning modules are flexible enough to support most of them. Each channel circuit has an excitation regulator, a high gain (x100 to x1250) input amplifier with offset adjustment, a low-pass filter, a scaling (x1 to x10) amplifier, and a calibration multiplexer.

By using software-controlled multiplexers, on-board reference voltages can be read by the data acquisition system so that precise gains and offsets can be set. LogView provides a means of easily controlling the calibration multiplexers so that the reference voltages can be displayed while the trimpots are being adjusted.

There are four trimpots to set up each channel circuit. The trimpots are labeled to represent the following adjustments:

- **EXC** - for adjusting the excitation voltage to the transducer
- **GAIN** - for setting the gain of the input amplifier
- **OFFSET** - for adjusting the circuit offset for quiescent loads or bridge imbalance
- **SCALE** - for setting the gain of the scaling amplifier



Signal-Flow Relationship of Software Controlled Multiplexers and On-Board Reference Voltages



This calibration procedure can only be executed while LogBook is attached to a PC that is running LogView.



To adjust trimpots, use one of the following calibration methods, as appropriate: Nameplate, 2-Point, Shunt, or Manual.

Calibration Methods

Several different calibration techniques are supported by strain gage signal conditioning modules. Calibration methods include; Nameplate, 2-Point, Shunt, and Manual. From the following discussion, select the calibration method that is best for your application.

Nameplate –uses the transducer’s published specs.

Nameplate calibration is typically used with packaged load cells with millivolt-per-volt (mV/V) transfer functions. Using the mV/V spec of the load cell or a strain gage’s Gage Factor (GF), the necessary system gain can be calculated and applied to a channel.

2-Point – uses 2 known loads, one of which might be “no load.”

The 2-Point calibration method requires the operator to apply two known loads to the load cell or strain gage, one at a time, while the data acquisition system takes measurements. Typically, the first point is with no load applied and the second point is close to the maximum load capacity of the gage. While measuring the first point the offset is nulled, and while measuring the second point the gain is adjusted to span the majority of the input range of the A/D. No gain calculations are required to perform this calibration method.

Shunt – applies a shunt resistor to the bridge to simulate a load.

Shunt calibration is identical to 2-Point calibration except that the second point is simulated so that applying a load near the gage's maximum load is unnecessary. To simulate a bridge imbalance, a shunt resistor is placed across one leg of the bridge. Once the shunt resistor value has been calculated, it is applied to the bridge to provide the desired simulated load. No gain calculations are required to perform this calibration method.

Manual – used to assign specific gains and offsets.

If a particular gain and offset are already known, these values can be used to setup a strain gage channel.

Procedures Common to All Calibration Steps (Required)

Set the Selected Channel(s) to DC Coupling

Since the applied calibration-signals are DC, set DC coupling for all the channels that are being adjusted.

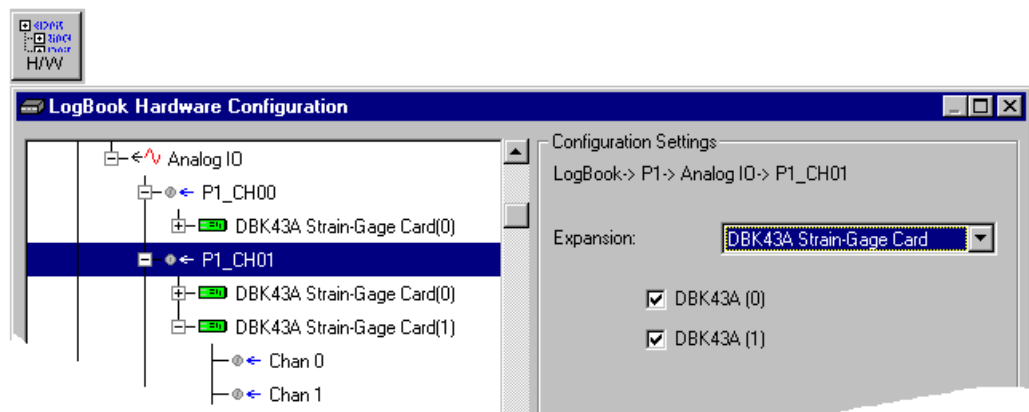
If your application requires AC coupling, don't forget to remove the jumpers when the adjustment procedure has been completed.

Determine Channel Parameters

Before adjusting the trimpots, the excitation needs to be determined. Typically, the supplier of the gage or load cell will recommend a suitable value, but make sure that the maximum output current of the excitation regulator is not exceeded.

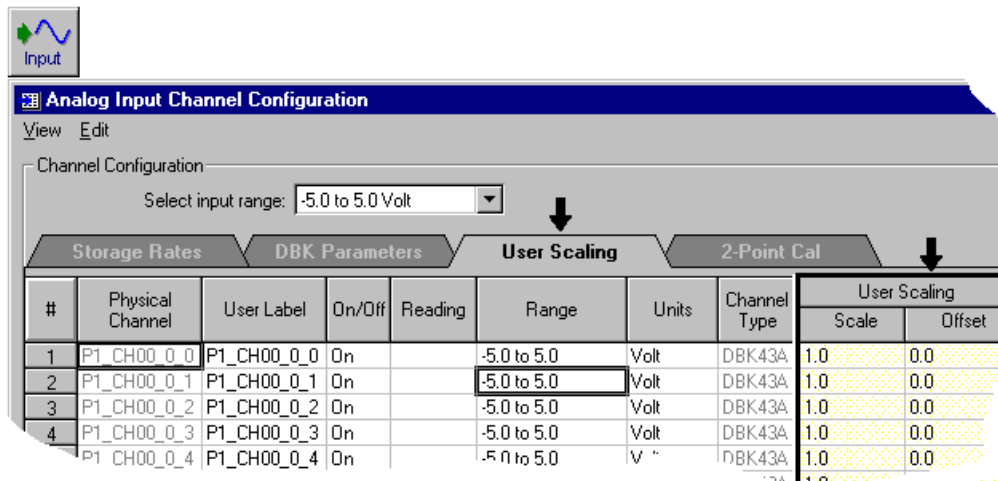
Initialize LogView

Launch LogView and use the *LogBook Hardware Configuration* window (hardware tree) to configure all of the DBK options that are to be used in the system. If needed, refer to the LogView chapter.



LogBook Hardware Configuration, Button and Screen

Open the *Analog Input Channel Configuration Window*. Click the User Scaling Tab and verify that all of the strain gage channels that are to be adjusted have scale and offset values of 1 and 0, respectively.



Analog Input Channel Configuration Window, Button and Screen ... “User Scaling” Tab Selected

For all of the strain gage channels that are to be adjusted, set their ranges to $\pm 5V$.

Click the *DBK Parameters* tab to expose the strain gage signal conditioning programmable settings.



Click the Attach button to substantiate a connection between the PC and the LogBook.

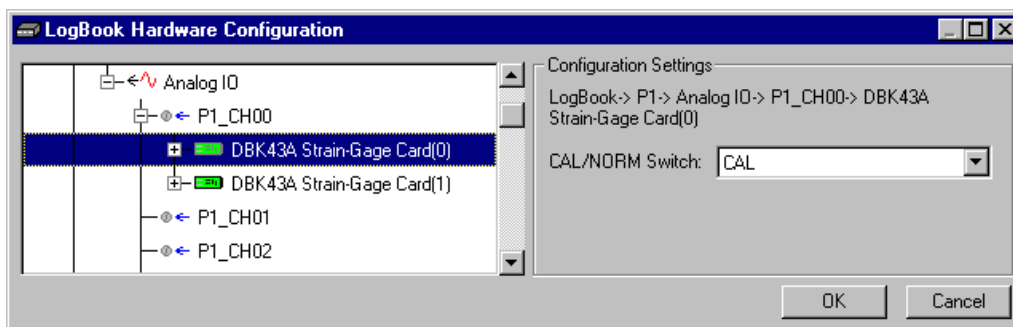
Adjust the Excitation - DBK16

For DBK16, set the excitation voltage for the transducer by adjusting the trimpot labeled EXC and measuring the voltage with a voltmeter across the +EXC and -EXC on the bridge or at the terminals of the signal conditioning module.

Adjust the Excitation - DBK43A

DBK43A is equipped with a switch that allows the excitation voltage to be read by the LogBook and displayed in LogView. For all DBK43A units to be adjusted, you must:

1. Reposition the DBK43A's “physical” calibration switch (located next to the Power LED) to the CAL position.
2. Select CAL in LogView. This is detailed in the following paragraph.
Open the *LogBook Hardware Configuration* window and select DBK43A (see following figure). In the Configurations settings box, set the CAL/NORM Switch to CAL. If the DBK43A is not displayed click the + to the left of the base channel (to which it is attached), this action expands the hardware tree in the *LogBook Hardware Configuration* window. Repeat this process for all DBK43A units that are to be adjusted. Click OK to lock in the changes.



Setting a DBK43A Cal/Norm Switch to “CAL”

3. In the Param1 column (see next figure for location), select all of the DBK43A channels that are to be adjusted.
4. Set Mode equal to Excitation from the drop down list (located above the DBK Parameters tab).
5. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.

Analog Input Channel Configuration

View Edit

Channel Configuration

Mode: **Excitation**

Storage Rates DBK Parameters User Scaling 2-Point Cal

| # | Physical Channel | User Label | On/Off | Reading | Range | Units | Channel Type | DBK Parameters | | |
|----|------------------|-------------|--------|---------|---------------|-------|--------------|-----------------|-------------|----------|
| | | | | | | | | Param. 1 | Param. 2 | Param. 3 |
| 1 | P1_CH00_0_0 | P1_CH00_0_0 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 2 | P1_CH00_0_1 | P1_CH00_0_1 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 3 | P1_CH00_0_2 | P1_CH00_0_2 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 4 | P1_CH00_0_3 | P1_CH00_0_3 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 5 | P1_CH00_0_4 | P1_CH00_0_4 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 6 | P1_CH00_0_5 | P1_CH00_0_5 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 7 | P1_CH00_0_6 | P1_CH00_0_6 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 8 | P1_CH00_0_7 | P1_CH00_0_7 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 9 | P1_CH00_1_0 | P1_CH00_1_0 | Off | | -10.0 to 10.0 | Volt | DBK43A | Mode=Bridge | Switch=NORM | |
| 10 | P1_CH00_1_1 | P1_CH00_1_1 | Off | | -10.0 to 10.0 | Volt | DBK43A | Mode=Bridge | Switch=NORM | |

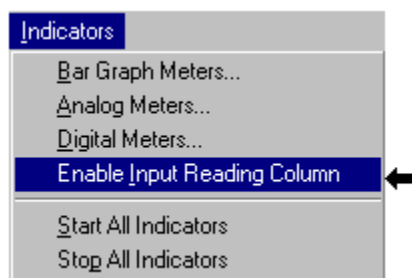
DBK card programmable parameter. Select from drop down list, or type in desired value.

Selecting "Mode = Excitation" for DBK Parameter 1

6. Click the Download button to send the current configuration to the LogBook.
7. Select Indicators \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.

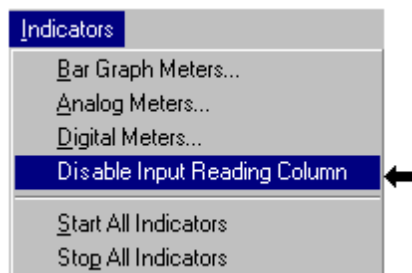


Download Button



Selecting "Enable Input Reading Column"(from the Indicators Pull-Down Menu)

8. Set the excitation voltage for each transducer by adjusting the trimpot labeled EXC for the associated channel while reading their values in LogView.
9. Select Indicators \ Disable Input Reading Column from the menu bar.



Selecting "Disable Input Reading Column"(from the Indicators Pull-Down Menu)

10. Return the physical calibration switches (of the applicable DBK43As) to the NORM position.
11. In LogView, open the *LogBook Hardware Configuration Window* (hardware tree) and select NORM for each DBK43A.

This completes the section entitled: “Procedures Common to All Calibration Steps (Required)”

Nameplate Calibration and Manual Calibration

To properly calibrate a strain gage channel using the **Nameplate method**, the required gain must first be calculated. If the desired gain and offset are already known [as in the **Manual calibration** method] skip to the section, *Determining the Gain of Each Amplification Stage*.

The following examples outline the necessary steps for determining the required gain for **Nameplate calibration**. Both *strain gage* and *load cell* examples are provided.

Calculating the Required Gain

Determining a Strain Gage’s Maximum Output Voltage

Most strain gages come with Gage Factors (GF) used to calculate the approximate output of the bridge circuit with a typical strain value. The formula is:

$$V_{BR} = (V_{EXC} * G * S * B) / 4 \quad \text{[See following important notice]}$$

Where: V_{BR} = Bridge output voltage

V_{EXC} = Excitation Voltage

G = Gage Factor

S = Strain in user units (in μStrain)

B = Configuration factor (1 for $\frac{1}{4}$ bridge, 2 for $\frac{1}{2}$ bridge, 4 for full bridge)



The equation, $V_{BR} = (V_{EXC} * G * S * B) / 4$ produces a linear estimate. If you are using a non-linear strain gage you should refer to strain gage theory for additional information as needed.

For a 120 ohm strain gage with a gage factor of 2.1 and excitation voltage of 5 V, applying 4000 microstrain would produce an bridge output of 10.5mV for a $\frac{1}{4}$ bridge configuration.

$$V_{BR} = (5 * 2.1 * 4000 \times 10^{-6}) / 4 = 10.5\text{mV}$$

Determining a Load Cell’s Maximum Output Voltage

Load cells come with a mV/V specification—for each volt of excitation at maximum load, the load cell will output a specific millivolt level.

$$V_{LC} = R * V_{EXC}$$

Where: V_{LC} = Load cell output voltage

R = Load cell spec (mV/V)

V_{EXC} = Excitation voltage

Consider a 3000 pound load cell rated at 2.05 mV/V using 10 V of excitation (assume a 350Ω load cell). When 3000 pounds is applied, the voltage out of the load cell is 20.5mV.

$$V_{LC} = (10 * 2.05 \times 10^{-3}) = 20.5 \text{ mV}$$

If 1000 pounds were applied, we would see 6.833 mV. This is arrived at as follows:

$$(1000/3000) * 10 * 2.05 \times 10^{-3} = 6.833 \text{ mV}$$

Using the Calculated Maximum Voltage to Determine the Necessary Gain

To maximize the resolution and dynamic performance of the system, the sensor's output should be amplified to correspond to the data acquisition system's input range.

Using the LogBook's ±5V input range, the required gain is calculated by dividing 5V by the maximum output voltage of the sensor. Before performing the calculation, it is typically a good idea to pad the maximum sensor voltage by about 5% so that, once amplified, it won't bump into the limit of the 5V range.

$$G = V_{LB} / (V_{GO} + V_{GO} * 5\%)$$

Where: **G** = Gain

V_{LB} = LogBook input range

V_{GO} = Maximum gage output

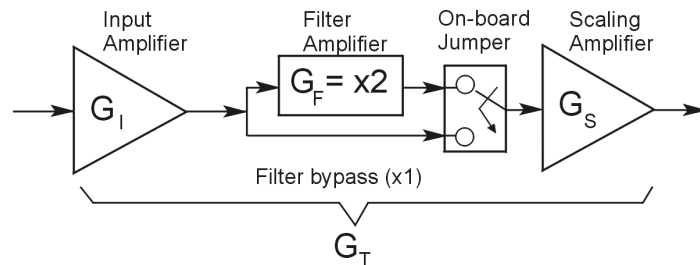
For the strain gage in the previous example with a maximum output of 10.5mV, the required gain is:

$$G = 5.0V / (0.0105V + 0.0105V * 0.05) = 453.5$$

For the above load cell with a maximum output of 20.5mV, the required gain is:

$$G = 5.0V / (0.0205V + 0.0205V * 0.05) = 232.3$$

Determining the Gain of Each Amplification Stage



The system's total gain is:

$$G_T = G_I * G_F * G_S$$

Where: **G_T** = Total gain

G_I = Input amplifier gain

G_F = Filter gain

G_S = Scaling amplifier gain

Note: Maximum gain calibration is x1000 for ±5V range.

The majority of the gain should be assigned to the Input Amplifier, with the Scaling Amplifier used for fine-tuning. If the filter is enabled, a gain of x2 is automatically introduced.

The input amplifier has a gain range of $\times 100$ to $\times 1250$; the filter gain $\times 1$ or $\times 2$; and the scaling amplifier has a range of $\times 1$ to $\times 10$. For the strain gage example, if we round off our gain to $\times 420$, any of these possible settings will work.

| | Option A | Option B | Option C | Option D |
|------------------------------|--------------|--------------------|------------------------------|--------------|
| Input Gain | $\times 420$ | $\times 100$ | $\times 240$ | $\times 300$ |
| Filter Gain (enabled) | No | Yes ($\times 2$) | Yes ($\times 2$) *See Note | No |
| Scaling Gain | $\times 1$ | $\times 2.1$ | $\times 1.75$ | $\times 1.4$ |
| Total Gain | $\times 420$ | $\times 420$ | $\times 420$ | $\times 420$ |



**For Option C, the LPF gain is typically x2.
For gains of x1 (if the filter is enabled), the following apply:**

DBK16 - For a gain of x1 (if the filter is enabled), 10K Ω resistors R44 and R46 must have been previously removed (for the low and high channels, respectively).

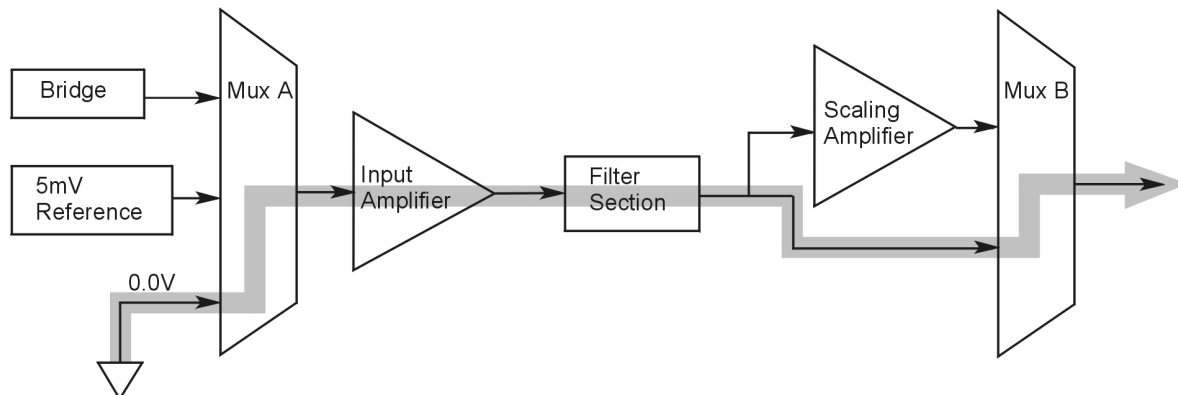
DBK43A - For a gain of x1 (if the channel filters are enabled), removal of the following 10 K Ω resistors applies: Ch0 – R144, Ch1 – R244, Ch3 – R444, Ch4 – R544, Ch5 – R644, Ch6 – R744, Ch7 – R844.

Channel Calibration Procedure

Adjust the Offset

The following steps are used to adjust the offset.

1. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted.
2. **Select Mode = SetOffset** from the drop down list above the grid. This selection commands the calibration multiplexer to route the 0.0V reference through the entire analog path (see following figure).



“Mode = Offset” 0.0 Volt Reference is Routed

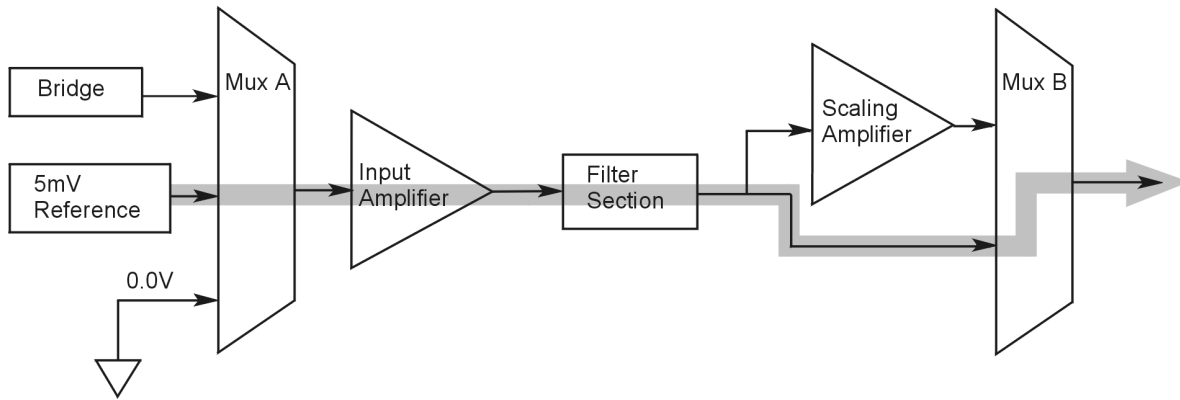
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button. This sends the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar. This displays the offset values for the enabled channels.
6. Set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET for the associated channel.
7. Select Indicators \ Disable Input Reading Column from the menu bar.

Adjust the Input Amplifier Gain

Perform the following steps to adjust the Input Amplifier Gain.

1. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted.
2. **Select Mode = SetInputGain** from the drop down list above the grid. This selection commands the calibration multiplexer to route a 5mV reference through the Input Amplifier and bypass the Scaling amplifier (see following figure).

Note: If the filter is enabled (not bypassed) accommodate an additional x2 gain stage.



“Mode = SetInputGain,” 5 milli-Volt Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the values for each channel.
6. For the associated channel, set the voltage to $[G_I * G_F * 0.005]$ for each transducer by adjusting the trimpot labeled GAIN. Use the Input Amplifier Gain (G_I) calculated earlier.

Note: If the filter is enabled, the filter gain (G_F) is 2; otherwise $G_F = 1$.

Example 1: If $G_I = 250$ and the filter is *disabled*;
the GAIN trimpot would be adjusted to obtain 1.25V.

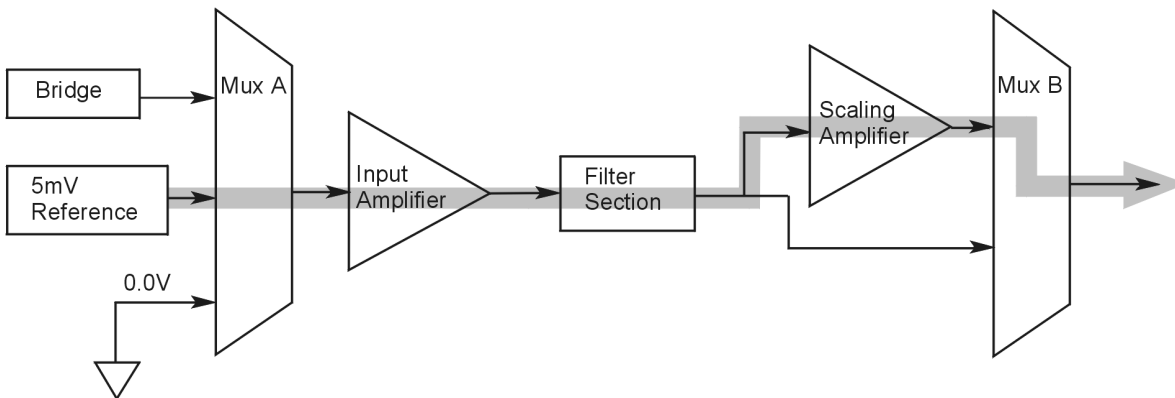
Example 2: If $G_I = 250$ and the filter is *enable*; the GAIN trimpot would
be adjusted to obtain 2.50V.

7. Select Indicators \ Disable Input Reading Column from the menu bar.

Adjust the Scaling Amplifier Gain

Adjust the Scaling Amplifier Gain as follows:

1. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = SetScalingGain** from the drop down list above the grid. This selection commands the calibration multiplexer to route a 5mV reference through all of the amplification stages as shown below.



“Mode = ScalingGain,” 5 milli-Volt Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the values for each channel.
6. For the associated channel, set the voltage to $[G_T * 0.005]$ for each transducer by adjusting the trimpot labeled SCALE. Use the total system gain (G_T) calculated earlier.

Example: If $G_T = 435.5$, the SCALE trimpot would be adjusted to obtain 2.17 V.

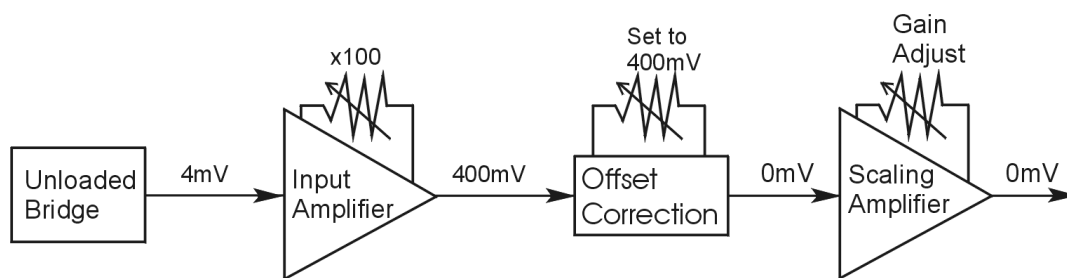
7. Select Indicators \ Disable Input Reading Column from the menu bar.

Trimming Bridge Quiescent Load

Most bridges have some level of offset, even if no quiescent load is present. In quarter and half bridge situations, use of 1% bridge completion resistors can cause up to 1mV/V of offset. If the bridge has 4mV of offset and the Input Amplifier is set to x100, the Offset potentiometer would need to nullify 400mV.

DBK16 – For DBK16s, the Offset Potentiometer can adjust out 0 to +5V of offset amplified by the Input Amplifier.

DBK43A – For DBK43As, the Offset Potentiometer can adjust out -1.25 to +5V of offset amplified by the Input Amplifier.

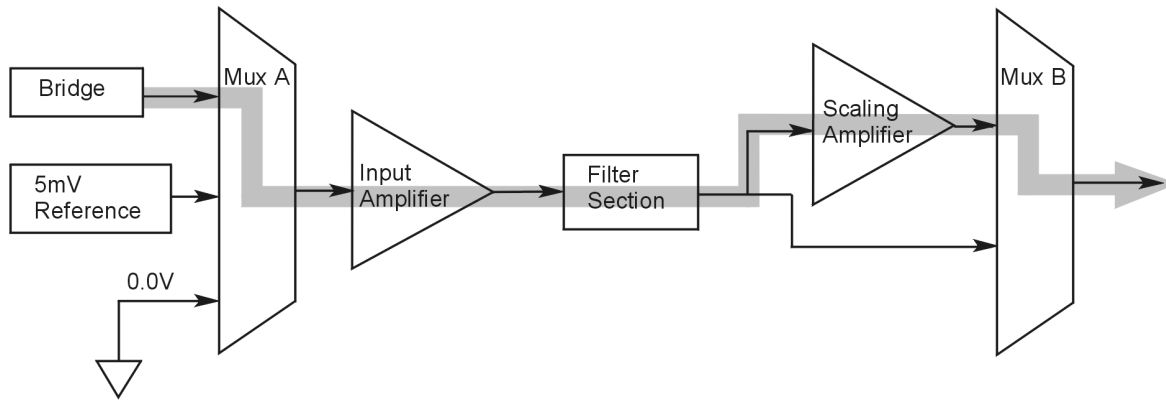


Trimming Bridge Quiescent Load

If a significant amount of quiescent offset is present and the Input Amplifier gain is set too high, the Offset Potentiometer will not have enough range to adequately nullify the offset. In this case, the gain of the Input Amplifier must be reduced while the gain of the Scaling Amplifier is increased proportionately.

Use the following steps to trim bridge quiescent load (unload the bridge).

1. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer output through the analog path as shown below.



“Mode = Bridge,” Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.

Note: If you are unable to nullify the quiescent offset of the bridge, your Input Amplifier gain may be too high. Information regarding gain redistribution can be found in the section entitled, [Determining the Gain of Each Amplification Stage](#).

7. Select Indicators \ Disable Input Reading Column from the menu bar.

2-Point Calibration



This 2-point calibration method makes use of trimpot adjustments. It should not be confused with the LogView software 2-Point Calibration (discussed in the LogView chapter in the LogBook User’s Manual).

In the 2-Point calibration method, the user places two known loads on the gage, one at a time, then adjust the trimpots until the expected value is reached. Typically, the first of loads is “no load.” In the case of a weight scale, the scale would first be unloaded to adjust the offset, then a known load (near maximum expected) would be applied to adjust the gain.

[Shunt calibration](#) (discussed immediately after this *2-Point Calibration* section) is the same as the 2-Point method, except the second load is applied in a simulated fashion by shunting 1 leg of the bridge with a shunt resistor. Shunt calibration is preferred in cases where applying a real load (near the maximum expected) is not practical.

Initialize the System

1. Download a single setup and continuously display data in LogView. The continuous display can remain throughout the procedure since the calibration multiplexers do not need reset between steps.
2. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted.
3. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.
4. Turn off all the channels in the system, except for those DBK43A channels that are to be adjusted.
5. Click the Download button to send the current configuration to the LogBook.
6. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.

Adjust the Offset

For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer. This is accomplished by adjusting the trimpot labeled OFFSET. If the first point is actually a calibrated load, you will need to move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

Complete the following steps to adjust the channel gain.

1. Apply the second load to each gage channel. The value of this load should approximate that of the maximum expected load. For the best results, a gain should be selected so that the bridge's maximum output equals 90% of the A/D's input range.
2. Calculate the desired voltage for the second point using the following equation:

$$V_D = (L_A/L_M) * V_I * 90\%$$

Where: V_D = Desired voltage for 2nd point of calibration

L_A = Applied load used in calibrating the 2nd point

L_M = Maximum load expected during usage

V_I = Input voltage range

Example: The load standard that will be applied to the gage as the 2nd point in the 2-Point calibration is 100lbs. The maximum expected load during usage is 150lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

In this example, we should adjust the GAIN and SCALE trimpots until a value of 3V is measured.

If 150lbs is applied to the gage, a voltage of 4.5V will be measured.

$$V_D = (150/150) * 5 * 0.90 = 4.5V$$

3. Apply the second calibrated load to each gage and set the voltage to V_D , as derived in step 2. Do this for each transducer by adjusting the trimpots labeled GAIN and SCALE for the associated channel. Note that the GAIN trimpot provides most of the amplification (course adjustment), while the SCALE trimpot allows for fine-tuning.

Repeating the Process



Since adjusting the gain for the first time will have an affect on the offset, it is recommended that offset and gain adjustment be performed twice for each channel.

Shunt Calibration

Shunt calibration is virtually identical to the 2-Point method just discussed, except that the second point is simulated. The simulated load is achieved by shunting one leg of the bridge with a shunt resistor. Shunt calibration is the preferred calibration method when applying a real load (of a value approximating the maximum expected load) is not practical. To adjust the channel gain, the shunt must be applied to the bridge.



Calculate and install the necessary shunt resistor before continuing.

- **DBK43A** has direct support for shunt calibration, accommodating the resistor in its enclosure and allowing the software to apply it when requested.
- **DBK16** does not have direct support, so the shunt resistor must be applied externally and switched in manually.

Adjust the Offset

Adjust the offset as follows.

1. In the Param1 column, select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.



If the first point is an actual calibrated load, you must move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

For the best results, a gain should be selected so that the bridge's maximum output equals 90% of the A/D's input range.

1. Use the following equation to calculate the desired shunt voltage (V_D).

$$V_D = (L_s/L_M) * V_I * 90\%$$

Where: V_D = Desired voltage from the after amplification when the shunt is applied

L_s = Simulated load produced by shunt

L_M = Maximum load expected during usage

V_I = Input voltage range

Example: The simulated load produced by the shunt 100lbs. The maximum expected load during usage is 150lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

In this example, we would adjust the GAIN and SCALE trimpots until a value of 3V is measured.

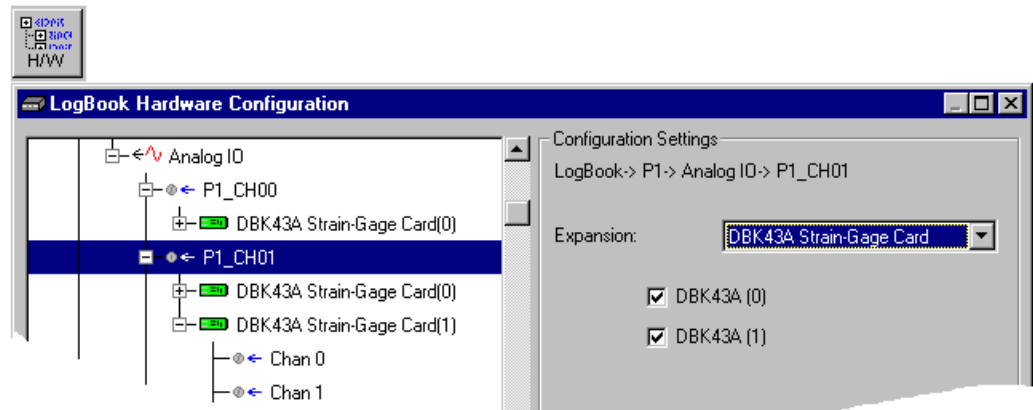
If 150lbs is applied to the gage, a voltage of 4.5V will be measured.

$$V_D = (150/150) * 5 * 0.90 = 4.5V$$

For DBK16, only ... Externally apply the shunt resistor and set the voltage to V_D , as derived above for each transducer. This is done by adjusting the trimpots labeled GAIN and SCALE for the associated channel. The GAIN trimpot is used for course adjustment; and the SCALE trimpot for fine-tuning.

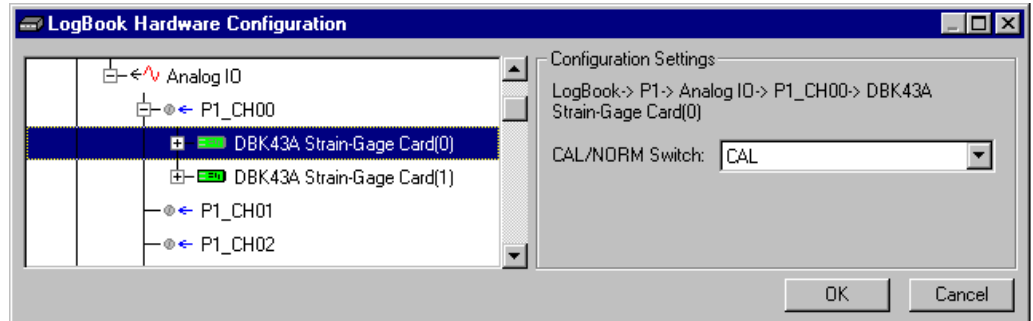
For DBK43A only ... DBK43 is equipped with a physical switch that allows the shunt to be applied when directed by the software. For each DBK43A to be adjusted, move this physical switch from NORM to CAL.

2. In LogView, open the *LogBook Hardware Configuration window* and select the DBK43A.



LogBook Hardware Configuration, Button and Screen

3. Select the DBK43A from the *LogBook Hardware Configuration window's* hardware tree.
4. Set the list box to the right to CAL. If the DBK43A is not displayed click the + to the left of the base channel to which it is attached to expand the hardware tree.



Setting a DBK43A Cal/Norm Switch to "CAL"

5. Repeat this process for each DBK43A that is to be adjusted.
6. Click OK to lock in the changes.
7. Open the Analog Input Channel Grid. In the Param1 column (see [page 19](#) for location), select all of the DBK43A channels that are to be adjusted. Select **Mode = Shunt** from the drop down list above the grid. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
8. Click the Download button to send the current configuration to the LogBook.
9. Select Indictors \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.
10. Set the voltage to V_D , as derived above, for each transducer. This is accomplished by adjusting the trimpots labeled GAIN and SCALE for the associated channel. The GAIN trimpot provides for course adjustment. The SCALE trimpot provides for fine tuning.
11. Select Indictors \ Disable Input Reading Column from the menu bar.

12. Return the physical NORM/CAL switches (of the applicable DBK43As) to the NORM position.
13. In LogView, open the *LogBook Hardware Configuration window* and return each DBK43A back to NORM.

Repeating the Process



Since adjusting the gain for the first time will have an affect on the offset, it is recommended that offset and gain adjustment be performed twice for each channel.

Creating a Units Conversion Transfer Function

To make the data from your gage more useful, it should be recorded in terms of units appropriate to your application, such as pounds, kilograms, inches, mm, or Hg. A transfer function is needed to convert volts to these more meaningful units.

For this purpose, LogView provides a means of assigning a mathematical scale and offset to each channel. Scale and offset information from that chapter has been repeated below for convenience.

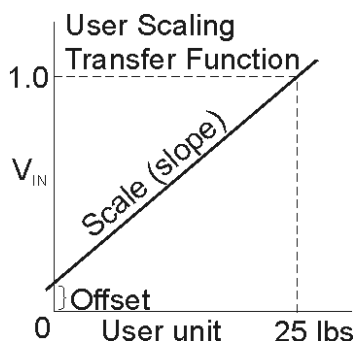
| Storage | | DBK Parameters | | User Scaling | | 2-Point Cal | | | |
|---------|------------------|----------------|--------|--------------|---------------|-------------|--------------|--------------|--------|
| # | Physical Channel | User Label | On/Off | Reading | Range | Units | Channel Type | User Scaling | |
| | | | | | | | | Scale | Offset |
| 1 | P1_CH00 | P1_CH00 | On | | 0.1 to 500.1 | lbs | Local | 25.0 | 0.1 |
| 2 | P1_CH01 | P1_CH01 | On | | 0.0 to 2000.0 | apples | Local | 100.0 | 0.0 |
| 3 | P1_CH02 | P1_CH02 | On | | -10.0 to 10.0 | Volt | Local | 1.0 | 0.0 |

In *User Scaling*, you can create a **transfer function**. The function allows LogView to display units that could be more useful to you than volts. For example, you could obtain readings with pounds as the designated **Units**. The reading (in pounds) will be based on the raw input value, typically Volts, and the indicated Scale and Offset adjustment.

To create the transfer function:

1. Type the desired unit name in the Units column.
2. Select an appropriate range (e.g. unipolar).
3. Enter the linear *scale* relation to Volts (e.g. 25 pounds per Volt).
4. Enter any *offset* from 0, for example, an empty basket used in an application reads 0.1 V.

The reading and range columns will automatically change to the adjusted values.



Periodic Calibration Without Trimpots

Once the trimpots have been adjusted during initial installation, periodic trimming can be performed through LogView's 2-Point software calibration. The LogView procedure does not require the use of trimmpots and should not be confused with the 2-point method discussed in this section of the manual.

Refer to the LogView chapter in the LogBook User's Manual for information regarding 2-point calibration via software.

DBK16 – Specifications

Name/Function: 2-Channel Strain-Gage Input Card

Input Connectors: Screw terminals for signal connections

Output Connector: DB37 male, mates with P1 using CA-37-x cable

Number of Channels: 2

Excitation Voltage Range: 1.50 to 10.50 VDC @ 50 mA (on-board adjustment for external source)

Gain Range: $\times 100$ -1250

Types of Bridges Accommodated:

- Full Bridge, Kelvin Excitation (6-wire)
- Full Bridge (4-wire)
- Half Bridge (3-wire)
- Quarter Bridge (2-wire)

Bridge Resistors: On-board provisions for 4 bridge-completion resistors per channel.

Type Input: Differential DC

Input Impedance: 100 M Ω (in parallel with 150 pF)

CMRR: 115 dB

Excitation Voltage Source: External 13-18 VDC @ 50 mA/circuit

Excitation Current Output: 50 mA max, current limited at 60 mA

Excitation Sensing: Local or Remote

Excitation Regulation:

- Line Regulation: 0.025%
- Load Regulation: 0.05%

Reference Voltages: 2.500 VDC

- Reference Accuracy: 0.05%
- Reference Drift: 3 ppm/ $^{\circ}$ C

Gain Calibration Reference: 5.00 mVDC

- Reference Accuracy: 0.2%
- Reference Drift: 20 ppm/ $^{\circ}$ C

Committed instrumentation amplifier [for each section], with a gain adjust from $\times 100$ to $\times 1250$ via externally accessed 15-turn trimpot.

Gain Accuracy: 0.5%

Gain Drift: 50 ppm/ $^{\circ}$ C

Input Offset: 100 μ V max

Offset Drift: 4 μ V/ $^{\circ}$ C

Output Offset: 20 μ V

Offset Drift: 200 μ V/ $^{\circ}$ C

Offset Adjustment: 0-100% of range, 0-5.00 VDC (15-Turn trimpot)

Full-Scale Sensitivity Range:

- @ 5.00 VDC Excitation: 0.8 to 10 mV/V
- @ 10.00 VDC Excitation: 0.4 to 5 mV/V

Scaling Amplifier Gain Range: $\times 1$ to $\times 10$ (15-Turn trimpot)

Low-Pass Filter: 3 pole Butterworth, User By-Passable;
-9dB @ User-set Corner Frequency



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Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

Each DBK17 simultaneous sample-and-hold (SSH) card provides 4 channels of voltage input to a LogBook or a Daq device system. Each of the 16 analog input channels can accept 4 DBK17 cards, for a maximum of 256 analog input channels. The simultaneous sample-and-hold function is activated at the beginning of each channel scan and freezes all signals present on DBK17 inputs for the duration of the scan, allowing for non-skewed readings of all channels.

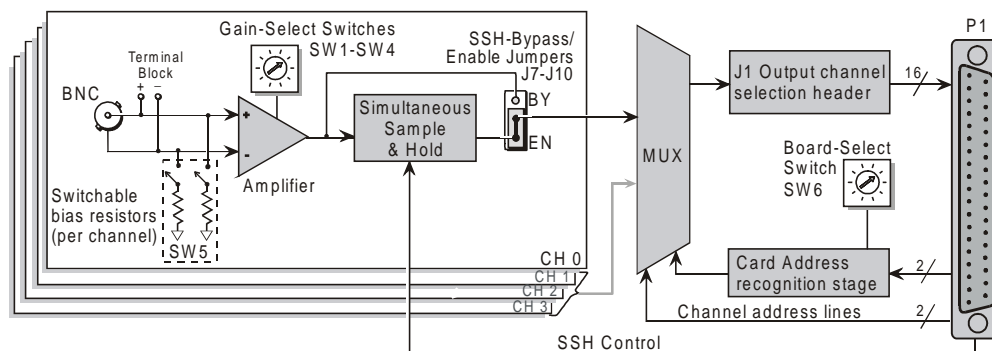


A DBK17 channel should never be the first channel in a scan due to timing of the SSH line.

DBK17 features an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a user-selected gain resistor for custom gain selection instead of the unity gain ($\times 1$) setting.

Four separate sample-and-hold stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled-output MUX allows up to 4 DBK17s to share a common analog input channel.

The input connectors are BNC type connectors. The differential inputs are provided with switchable $100\text{ K}\Omega$ bias resistors to analog common. User gain can be set to any value between unity and $\times 500$ by installing a resistor in the user-location of each channel.



DBK17 Block Diagram

Why use Simultaneous Sample and Hold?

Some applications require every channel in a scan group to be read *at the same instant*, as opposed to being read with a delay, e.g., 10 μ s between channels. Simultaneous Sample and Hold (SSH) is a means of obtaining such instantaneous data on multiple channels while avoiding time-skew problems.

A sample case in which SSH is desirable:

A performance analysis of an engine is a classic example of a case in which SSH is desirable. In our engine analysis example data is gathered on the following parameters:

- cylinder pressure
- cylinder temperature
- piston strain
- piston stroke position
- valve position
- engine rpm
- vibration

For a more exact correlation of the data, it needs to be obtained at the same instant, without time-skew. By using SSH, such as provided by the DBK17, each input signal continuously passes through an instrumentation amplifier and into a sample-and-hold stage. When the sample enable line goes high, each channel's sample-and-hold stage will "freeze" the current analog value. The values for all channels are separately "latched" within 50 ns of each other. The signals are held in a stable condition while the multiplexer switches through all channels and sends the signals [one-by-one] to the Daq device or the LogBook. At the Daq device or the LogBook, the ADC digitizes each reading. The resulting data is a snapshot of conditions at a selected instant although the multiplexing and analog-to-digital conversions are spread out over a longer interval. The simultaneous sample and hold circuit allows you to gather up to 256 simultaneous samples via sixty-four DBK17s.

Hardware Setup

Card Connection

The DBK17 is equipped with BNC connectors for easy access to all of the analog inputs. Connections are provided for four differential inputs. The card also includes a terminal block as a connection-option to the BNC connectors.

Note: New versions of the DBK17 have been enhanced by the addition of a terminal block. The BNC connectors are still usable, and board functions have not been changed.

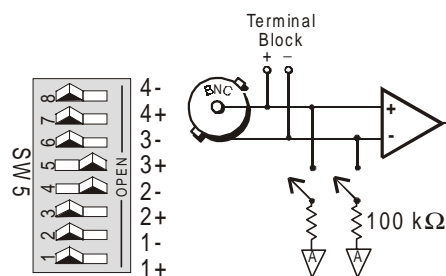
Card Configuration

Factory Defaults

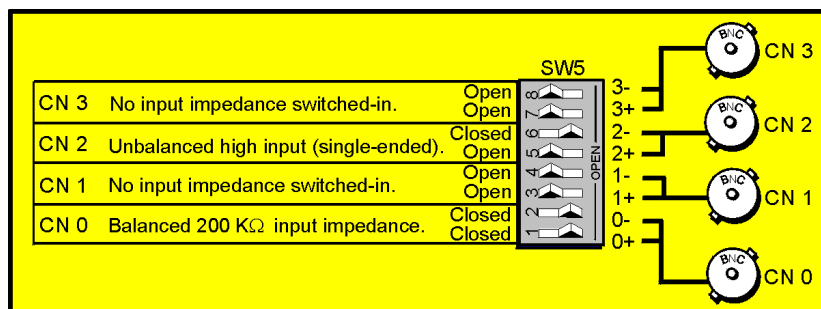
- **100K bias resistors – Enabled**
- **SSH — Enabled. No disable option.**
- **Gain – x1**

Input Termination

DBK17 provides two 100 K Ω bias resistors for each analog input. For balanced 200 K Ω input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The input circuit and switch positions are shown in the figure. The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required.



Input Impedance/Termination



Examples of Bias Resistor Selection Options

SSH Configuration

Each channel's Simultaneous-Sample-and-Hold circuit can be enabled (EN) or bypassed (BY) by placement of the jumper on J7 for channel 0, J8 for channel 1, J9 for channel 2, or J10 for channel 3. The factory-default setting is **enabled (EN)** for each channel.

Gain Settings

On the card, each channel has a gain-set switch labeled GAIN 1 (SW1) to GAIN 4 (SW4) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the card. The value of the gain resistor is determined by the formula:

$$R_{\text{GAIN}} = [40,000 / (\text{Gain} - 1)] - 50 \, \Omega$$

| Gain Values | Gain Switch |
|-------------|-------------|
| 0 ×1 | |
| 1 ×10 | |
| 2 ×100 | |
| 3 ×200 | |
| 4 ×500 | |

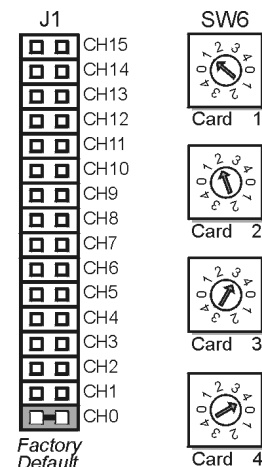
Setting Channel Gains

Address Configuration

As many as four DBK17s can be connected to each analog channel. With sixteen channels (and four inputs per DBK17) 256 inputs are possible. Since this is a daisy-chain interface, each card must have a unique address (channel and card number). Note that the default setting of SW6 is Card 1.

To configure the card, locate the 16 × 2-pin header (labeled J1) near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card. Four cards in the daisy-chain can have the same channel number as long as their card number is unique.

Set switch SW6 for each of four DBK17s on a single channel. Verify that only one card in the system is set to a particular channel *and* card number.



Address Configuration

CE Compliance



Reference Notes:

Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.



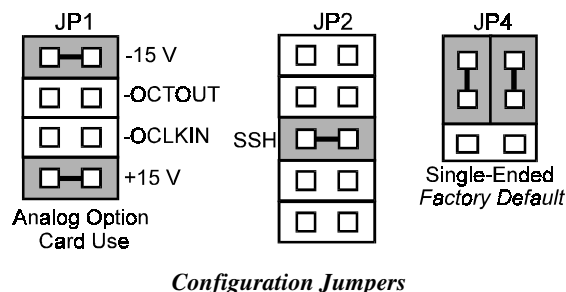
DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK17 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.

Note: This default position is necessary to power the interface circuitry of the DBK17 via the internal +15 VDC power supply. If using auxiliary power (e.g., a DBK32A or a DBK33) you must remove both JP1 jumpers (refer to chapter 2, [Power Management](#) and the DBK32A and DBK33 modules as applicable).

2. Place the JP2 jumper in the SSH position.



CAUTION



When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

3. For DaqBook/100, /112 and /120 *only*, place the JP4 jumper in *single-ended* mode.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK17 – Specifications

Name/Function: Simultaneous Sample-Hold Card

Number of Channels: 4

Input Connections: 4 BNC connectors

Output Connector: DB37 male, which mates with P1 using CA-37-x cable

Number of Cards Addressable: 64

Input Type: Differential

Voltage Input Ranges:

0 to ± 5000 mVDC

0 to ± 500 mVDC

0 to ± 50 mVDC

0 to ± 25 mVDC

0 to ± 10 mVDC

Input Amplifier Slew Rate: 12 V/ μ s minimum

Acquisition Time:

0.6 μ s (10 V excursion to 0.1%)

0.7 μ s (10 V excursion to 0.01%)

Channel-to-Channel Aperture Uncertainty: 50 ns

Output Droop Rate: 0.1 μ V/ μ s

Input Gains: $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$ & User-Set

Input Offset Voltage: 500 μ V + 5000/G maximum (nullable)

Input Offset Drift: ± 5 + 100/G μ V/ $^{\circ}$ C maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

Input Impedance: 5×10^{12} parallel with 6 pF

Switchable Bias Resistors: 100 K Ω (each to analog common)

Gain Errors:

0.04% @ $\times 1$

0.1% @ $\times 10$

0.2% @ $\times 100$

0.4% @ $\times 200$

1.0% @ $\times 500$

Gain vs Temperature:

$\times 1$ @ ± 20 ppm/ $^{\circ}$ C

$\times 10$ @ ± 20 ppm/ $^{\circ}$ C

$\times 100$ @ ± 40 ppm/ $^{\circ}$ C

$\times 200$ @ ± 60 ppm/ $^{\circ}$ C

$\times 500$ @ ± 100 ppm/ $^{\circ}$ C

Non-Linearity:

$\times 1$ to $\pm 0.015\%$ full-scale

$\times 10$ to $\pm 0.015\%$ full-scale

$\times 100$ to $\pm 0.025\%$ full-scale

$\times 200$ to $\pm 0.025\%$ full-scale

$\times 500$ to $\pm 0.045\%$ full-scale

Common-Mode Rejection Ratio (CMRR):

70 dB minimum @ $\times 1$

87 dB minimum @ $\times 10$

100 dB minimum @ $\times 100$

100 dB minimum @ $\times 200$

100 dB minimum @ $\times 500$

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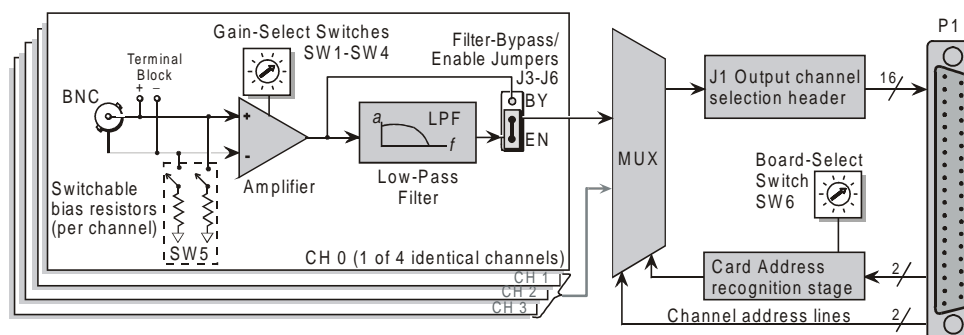
Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

Each DBK18 low-pass filter (LPF) card provides 4 input channels to a LogBook or a Daq device system. Each of sixteen channels can accept four DBK18 cards for a maximum of 256 analog inputs. The input connectors are BNC type connectors. The differential inputs are provided with switchable 100 K Ω bias resistors to analog common.

The DBK18 features an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a gain resistor for custom gain selection instead of unity gain ($\times 1$). Gain for any channel can be set to any value between unity and $\times 500$ by installing an appropriate resistor. Four separate filter stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled output MUX allows up to four DBK18s to share a common analog base channel.



DBK18 Block Diagram

Hardware Setup

Card Connection

The DBK18 is equipped with BNC connectors for easy access to all of the analog inputs. Connections are provided for 4 differential inputs. The card also includes a terminal block as a connection-option to the BNC connectors.

Note: New versions of the DBK18 have been enhanced by the addition of a terminal block. The BNC connectors are still usable, and board functions have not been changed.

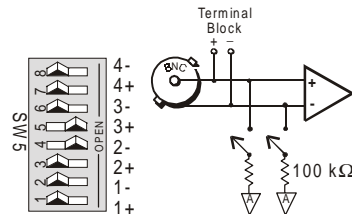
Card Configuration

Factory Defaults

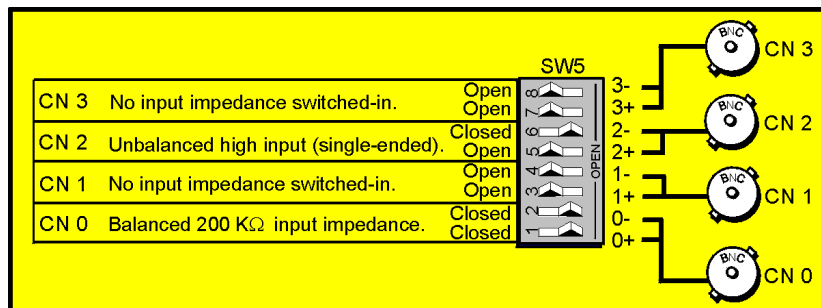
- **100K bias resistors – Enabled**
- **Low-Pass Filter – Disabled**
- **Gain – x1**

Input Termination

DBK18 provides two 100 K Ω bias resistors for each analog input. For balanced 200 K Ω input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The input circuit and switch positions are shown in the figure. The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required.



Input Impedance/Termination



Examples of Bias Resistor Selection Options

Gain Settings

On the card, each channel has a gain-set switch labeled GAIN 1 (SW1) to GAIN 4 (SW4) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the card. The value of the gain resistor is determined by the formula:

$$R_{\text{GAIN}} = [40,000 / (\text{Gain} - 1)] - 50 \Omega$$

| Gain Values | Gain Switch |
|-------------|-------------|
| 0 x1 | |
| 1 x10 | |
| 2 x100 | |
| 3 x200 | |
| 4 x500 | |

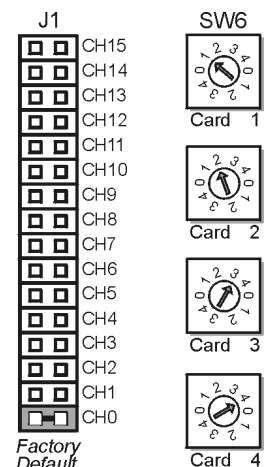
Setting Channel Gains

Address Configuration

Up to 4 DBK18s can be connected to each analog channel. Since this is a daisy-chain interface, each card must have a unique address (channel number and card number). Note that the default setting of SW6 is Card 1.

To configure the card, locate the 16 x 2-pin header labeled JP1 near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card. Four cards in the daisy-chain can have the same channel number as long as each card number is unique.

Set switch SW6 for each of the 4 DBK18s on a single channel. Verify that only one card in a system is set to a particular channel and card number.



Address Configuration

CE Compliance



Reference Notes:

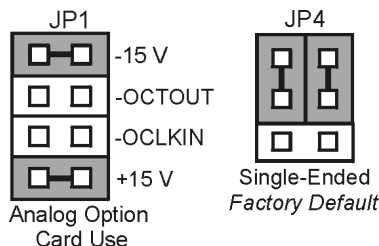
Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK18 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.



Configuration Jumpers

Note: The default position is necessary to power the interface circuitry of the DBK18 via the internal ± 15 VDC power supply. If using auxiliary power (e.g., DBK32A, DBK33), you must remove both JP1 jumpers (refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 modules as applicable).

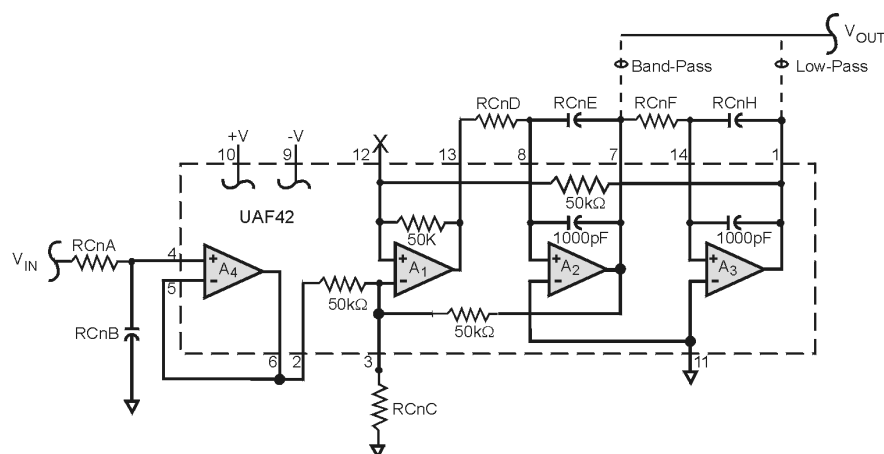
2. For DaqBook/100, /112, and /120 *only*, place the JP4 jumper in single-ended mode.

Note: Analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

Configuring DBK18 Filter Sections

There are 4 low-pass, 3-pole active filters on the DBK18. Each filter can be enabled (EN) or bypassed (BY) by placement of the jumper on J3 for channel 0, J4 for channel 1, J5 for channel 2, or J6 for channel 3. The factory-default setting is **enabled (EN)** for each channel. Each filter can be configured as a Butterworth, Bessel, or Chebyshev filter with corner frequencies up to 50 kHz. Filter properties depend on the values of resistors and capacitors installed in several circuit locations. Above 10 Hz, installing capacitors is unnecessary because capacitors in the ICs are sufficient. In all cases, three resistors are required to complete the active filter circuits contained mostly within the UAF42 ICs.

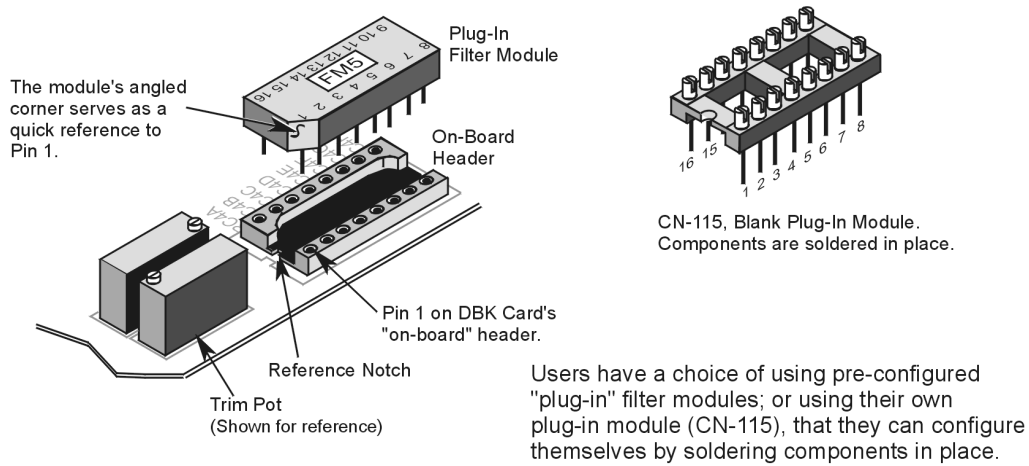
The following circuit diagram shows the active filter IC in a typical section of the DBK18. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is the channel number; and the 4th character corresponds to the socket position (A-H).



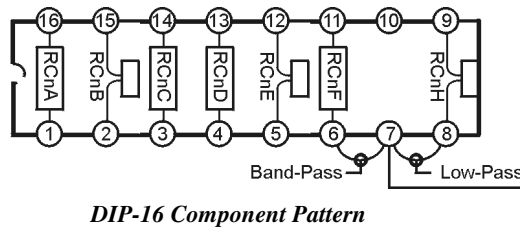
Filter Circuit Diagram

A machined-pin IC socket in each filter RC location can accept resistors and capacitors that plug directly into the socket; however, this is not recommended. Two much better approaches exist. The first is to use pre-configured plug-in filter modules; the second is to configure your own plug-in module using a blank CN-115. Both of these options are depicted in the following illustration.

The use of plug-in modules provides excellent “gold-to-gold” contact between the components of the plug-in module and the on-board header.



The following figure shows the DIP-16 component pattern typical of the 4 filter sections.



Note: In the DIP-16 figure, “n” corresponds to “channel number.”

Note: In the DIP-16 figure, pin 7 of the DIP-16 socket:

- connects to pin 8 for low-pass filtering
- connects to pin 6 for band-pass filtering

The following table lists values of components for common corner frequencies in Butterworth filters. If designing your own filter, software from Burr-Brown provides the component values to create the desired filter. Note that the design math is beyond the scope of this manual.

| 3-Pole Butterworth Filter Components | | | | | | | | |
|--|---------|----------|------|---------|---------|---------|------|---------|
| 3dB (Hz) | RCnA | RCnB | RCnC | RCnD | RCnE | RCnF | RCnG | RCnH |
| 0.05 | 3.16 MΩ | 1 μF | none | 3.16 MΩ | 1 μF | 3.16 MΩ | none | 1 μF |
| 0.10 | 1.58 MΩ | 1 μF | none | 1.58 MΩ | 1 μF | 1.58 MΩ | none | 1 μF |
| 0.20 | 787 kΩ | 1 μF | none | 787 kΩ | 1 μF | 787 kΩ | none | 1 μF |
| 0.50 | 3.16 MΩ | 0.1 μF | none | 3.16 MΩ | 0.1 μF | 3.16 MΩ | none | 0.1 μF |
| 1 | 1.58 MΩ | 0.1 μF | none | 1.58 MΩ | 0.1 μF | 1.58 MΩ | none | 0.1 μF |
| 2 | 787 kΩ | 0.1 μF | none | 787 kΩ | 0.1 μF | 787 kΩ | none | 0.1 μF |
| 5* | 3.16 MΩ | 0.01 μF | none | 3.16 MΩ | 0.01 μF | 3.16 MΩ | none | 0.01 μF |
| 10* | 1.58 MΩ | 0.01 μF | none | 1.58 MΩ | 0.01 μF | 1.58 MΩ | none | 0.01 μF |
| 20 | 787 kΩ | 0.01 μF | none | 787 kΩ | 0.01 μF | 787 kΩ | none | 0.01 μF |
| 50 | 3.16 MΩ | 0.001 μF | none | 3.16 MΩ | none | 3.16 MΩ | none | none |
| 100* | 1.58 MΩ | 0.001 μF | none | 1.58 MΩ | none | 1.58 MΩ | none | none |
| 200 | 787 kΩ | 0.001 μF | none | 787 kΩ | none | 787 kΩ | none | none |
| 500* | 316 kΩ | 0.001 μF | none | 316 kΩ | none | 316 kΩ | none | none |
| 1000* | 158 kΩ | 0.001 μF | none | 158 kΩ | none | 158 kΩ | none | none |
| 2000 | 78.7 kΩ | 0.001 μF | none | 78.7 kΩ | none | 78.7 kΩ | none | none |
| 5000 | 31.6 kΩ | 0.001 μF | none | 31.6 kΩ | none | 31.6 kΩ | none | none |
| 10000 | 15.8 kΩ | 0.001 μF | none | 15.8 kΩ | none | 15.8 kΩ | none | none |
| *These pre-configured Butterworth frequency modules are available from the manufacturer. | | | | | | | | |

You have the option to configure the filter sections as band-pass filters rather than low-pass filters. The component selection program provides band-pass component values. The program also computes and displays phase and gain characteristics of the filter sections as a function of frequency.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK18 – Specifications

Name/Function: Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors

Output Connector: DB37 male, connects to P1 with a CA-37-x cable

Number of Cards Addressable: 64

Input Type: Differential

Voltage Input Ranges:

0 to ± 5000 mVDC

0 to ± 500 mVDC

0 to ± 50 mVDC

0 to ± 25 mVDC

0 to ± 10 mVDC

Input Amplifier Slew Rate: 12 V/ μ s minimum

Input Gains: $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$ and user-set

Input Offset Voltage: 500 μ V + 5000/G maximum (nullable)

Input Offset Drift: $\pm 5 + 100/G$ μ V/ $^{\circ}$ C maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

Input Impedance: 5×10^{12} parallel with 6 pF

Switchable Bias Resistors: 100 K Ω each to analog common

Gain Errors:

0.04% @ $\times 1$

0.1% @ $\times 10$

0.2% @ $\times 100$

0.4% @ $\times 200$

1.0% @ $\times 500$

Gain vs Temperature:

$\times 1$ @ ± 20 ppm/ $^{\circ}$ C

$\times 10$ @ ± 20 ppm/ $^{\circ}$ C

$\times 100$ @ ± 40 ppm/ $^{\circ}$ C

$\times 200$ @ ± 60 ppm/ $^{\circ}$ C

$\times 500$ @ ± 100 ppm/ $^{\circ}$ C

Non-Linearity:

$\times 1$ to ± 0.015 % full-scale

$\times 10$ to ± 0.015 % full-scale

$\times 100$ to ± 0.025 % full-scale

$\times 200$ to ± 0.025 % full-scale

$\times 500$ to ± 0.045 % full-scale

Common-Mode Rejection:

70 dB minimum @ $\times 1$

87 dB minimum @ $\times 10$

100 dB minimum @ $\times 100$

100 dB minimum @ $\times 200$

100 dB minimum @ $\times 500$

Active Filter Device: UAF42 (Burr-Brown)

Number of Poles/Filter: 3

Types of Filters: Bessel, Butterworth, Chebyshev

Frequency Range:

0.1 Hz to 20 kHz

The frequency is set by the installation of 4-6 resistors, and/or capacitors, in sockets.

Default Frequency:

1 Hz

Other frequencies may be implemented by soldering resistors, and/or capacitors, to locations on the 4 blank plug-in headers. Values for common frequencies and their component values are provided with the blank headers.

[Overview 1](#)

[Hardware Setup 2](#)

Card Connection 2

Card Configuration 3

DaqBook and DaqBoard [ISA type] Configuration 3

[Software Setup 3](#)

[DBK19 – Specifications 4](#)



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.
- Refer to Chapter 1 for information regarding [Two-Point Calibration of a Temperature Measurement System](#).

Overview



DaqView Users: When a DBK19 is used with a DaqBoard/2000 Series or a cPCI DaqBoard/2000c Series Board, the Internal Clock Speed should be set to 100 kHz as described in [Chapter 4, DBK Setup in DaqView](#).

The DBK19 can attach to 14 thermocouples (T/C) for temperature measurements. The DBK19 features an on-board cold junction sensor and a programmable-gain amplifier for measuring type J, K, T, E, N28, N14, S, R, or B thermocouples. The table shows the temperature range for each thermocouple type.

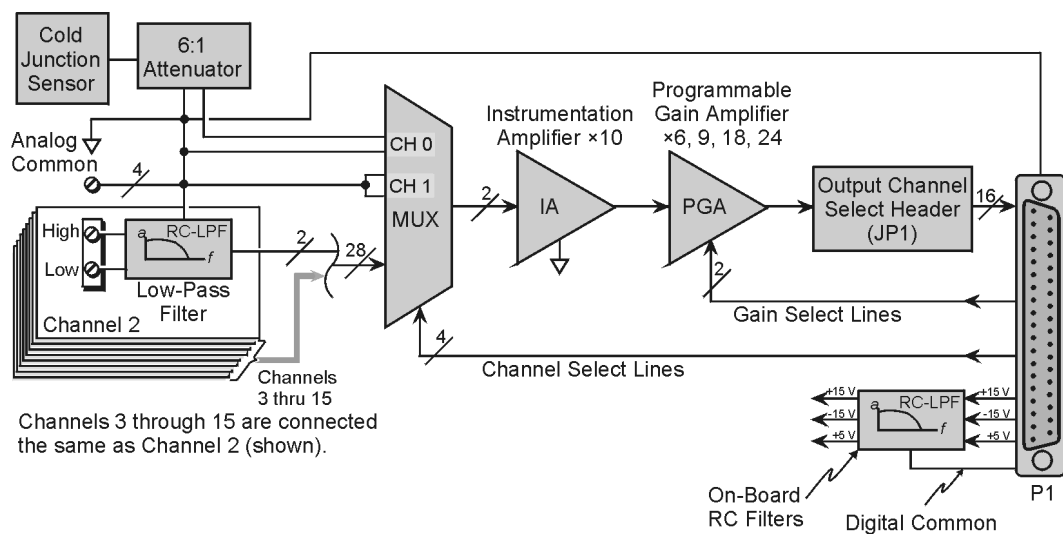
| T/C Type | J | K | T | E | N28 | N14 | S | R | B |
|----------------------|--------------|--------------|-------------|--------------|-------------|------------|------------|------------|------------|
| Temperature Range °C | -200 to 760 | -200 to 1260 | -200 to 400 | -270 to 1000 | -270 to 400 | 0 to 1300 | 0 to 1780 | 0 to 1780 | 0 to 1820 |
| Temperature Range °F | -328 to 1400 | -328 to 2300 | -328 to 752 | -454 to 1832 | -454 to 752 | 32 to 2372 | 32 to 3236 | 32 to 3236 | 32 to 3308 |

True differential measurements of thermocouples require a bias current referenced to analog common; therefore, resistors connect each input terminal to the analog common. Filter capacitors across each input operate with input protection resistors to form single-pole RC low-pass filters.

Each DBK19 includes a cold-junction compensation circuit wired to channel 0. Channels 2 through 15 accept external thermocouples. The DBK19s can be used with other analog expansion cards and feature screw terminals for direct connection. Up to 16 DBK19s can be attached to a single LogBook or a Daq Device to measure up to 224 (16 × 14) temperatures.

Note: LogView and DaqView software includes functions for the conversion and linearization of thermocouple readings into temperature data.

Programmers using Daq devices should refer to related sections in the *Programmer's Manual*.



DBK19 Block Diagram

Hardware Setup

Card Connection

Connect the T/C input wires to the intended input terminals. The DBK19 uses screw terminals to connect different types of thermocouples as well as several analog ground access points. Connections are provided for 14 thermocouples.

Thermocouples have polarities that must be observed. Thermocouple types J, K, T, E, N28, N14, S, R and B can be connected to DBK19 channels CH2 through CH15.

- CH0 is reserved for the cold-junction compensation sensor (factory installed).
- CH1 is permanently shorted to common to allow software-driven auto-zero to compensate for temperature drift.

Thermocouple wire is standardized and color-coded as shown in the table. T/Cs have a very small output. Long T/C leads can pickup lots of noise. Use shielding as needed, and average several readings in software to minimize noise effects.

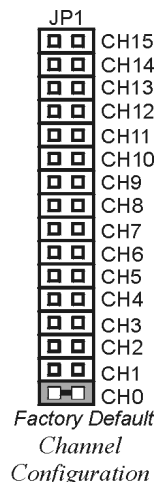
After all connections are in place, secure wires to captive areas (pre-drilled holes) at the rear edge of the board. Nylon tie wraps (not included) work well for this purpose.

| T/C Type | (+) Lead to Channel-Hi | (-) Lead to Channel-Lo |
|----------|------------------------|------------------------|
| J | White | Red |
| K | Yellow | Red |
| T | Blue | Red |
| E | Violet | Red |
| N28 | Orange | Red |
| N14 | Orange | Red |
| S | Black | Red |
| R | Black | Red |
| B | Gray | Red |

Card Configuration

Assign a LogBook or Daq device channel number to the DBK19 card. Up to 16 DBK19s can connect to a LogBook or a Daq device. (Optional DBK10 expansion card enclosure may be used.) Since this is a daisy-chain interface, each card must have a unique channel address.

To configure the card, locate the 16×2-pin header (labeled JP1) near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card; each card in the system must have a unique jumper setting.

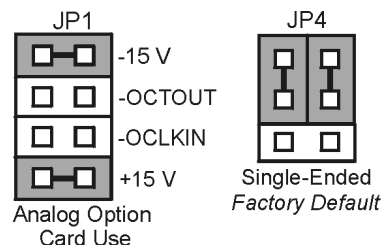


DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK19 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.

Note: The JP1 default position (above) is necessary to power the interface circuitry of the DBK19 via the internal ± 15 VDC power supply. If using auxiliary power (e.g., a DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the [DBK32A](#) or [DBK33](#) sections as applicable.



2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in the *single-ended* mode.

DaqBook/DaqBoard Jumpers for DBK19

Note: Analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).
- **DBK19 Calibration Disk** – Each DBK19 card is shipped with a calibration disk with constants used to correct gain and offset errors inherent in the hardware. This calibration is done automatically by DaqView and LogView. Refer to the **readme.txt** file on the disk. Refer to Chapter 1 for information regarding [Two-Point Calibration of a Temperature Measurement System](#).



DaqView Users: When a DBK19 is used with a DaqBoard/2000 Series or a cPCI DaqBoard/2000c Series Board, the Internal Clock Speed should be set to 100 kHz as described in Chapter 4, [DBK Setup in DaqView](#).

The DBK19 selection allows the user to define the thermocouple types by using the Type column of the analog input spreadsheet.

Each DBK19 card is shipped with a calibration disk with constants used **to correct gain and offset errors** inherent in the hardware. This gain and offset calibration is done automatically by DaqView and LogView. See the DBK19 readme.txt file on the disk shipped with the board for details on creating this file.

DBK19 - Specifications

Name/Function: High-Accuracy Thermocouple Card

Connector: DB37 male mates with P1 pinouts. Thermocouples attach to on-board screw terminals.

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: x60, x90, x180, x240

Inputs:

- 14 differential thermocouples
- 1 cold-junction compensation
- 1 auto zero

Cold Junction Sensor Output: 100mV/°C

Voltage Ranges Gains:

- 0 to 80 mV @ x60
- 0 to 50 mV @ x90
- 0 to 25 mV @ x180
- 0 to 20 mV @ x240
- 0 to ±10 mVDC

Input Impedance: 20 KΩ

Input RC Filter: -3 dB Frequency: 15.9 kHz

Gain Accuracy:

- Uncalibrated: 0.15%
- Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Thermocouple Type/Range/Accuracy/Resolution: refer to the following table

Thermocouple Reference

| Type | Range | | Accuracy | | Resolution | | | |
|------|--------|--------|----------|--------|-------------|-------------|-------------|-------------|
| | Min | Max | (<0°C) | (>0°C) | 12-bit <0°C | 12-bit >0°C | 16-bit <0°C | 16-bit >0°C |
| J | -200°C | 760°C | 0.6°C | 0.6°C | 1.2°C | 0.5°C | 0.1°C | 0.1°C |
| K | -200°C | 1260°C | 1.6°C | 1.0°C | 1.1°C | 0.8°C | 0.1°C | 0.1°C |
| T | -200°C | 400°C | 1.4°C | 0.8°C | 0.8°C | 0.3°C | 0.1°C | 0.1°C |
| E | -270°C | 1000°C | 1.4°C | 0.9°C | 1.6°C | 0.7°C | 0.1°C | 0.1°C |
| N28 | -270°C | 400°C | 0.8°C | 0.8°C | 1.0°C | 1.0°C | 0.1°C | 0.1°C |
| N14 | 0°C | 1300°C | — | 1.0°C | — | 5.0°C | — | 5.0°C |
| S | 0°C | 1780°C | — | 1.6°C | — | 1.3°C | — | 0.1°C |
| R | 0°C | 1780°C | — | 1.6°C | — | 1.7°C | — | 0.1°C |
| B | 0°C | 1820°C | — | 1.8°C | — | 1.5°C | — | 0.1°C |

[Overview 1](#)

[Hardware Setup 1](#)

[Card Connection 1](#)

[Card Configuration 2](#)

[LogBook Connection 2](#)

[DaqBook and DaqBoard Connection 2](#)

[Software Setup 3](#)

[DBK20 – Specifications 5](#)

[DBK21 – Specifications 5](#)

DBK20 – Provides Screw Terminals.

DBK21 – Provides DB37 male connectors.



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

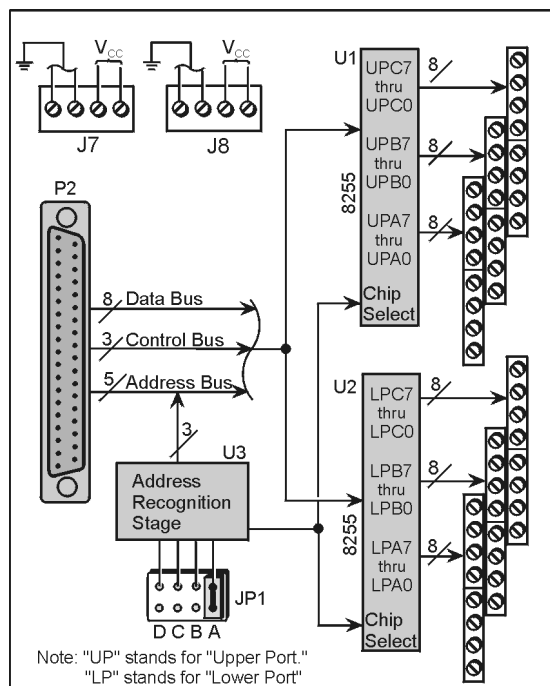
Overview

The DBK20 and DBK21 are general purpose digital I/O cards that can increase available digital I/O lines by 48 per card. The DBK20 uses screw terminals; the DBK21 uses DB37 connectors. Both cards connect to the P2 digital I/O port via the interface cable (CA-37-x).

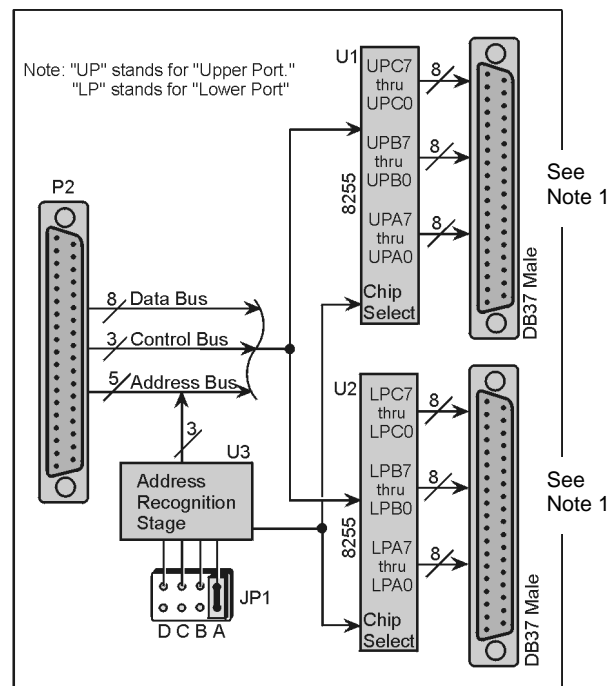
Note: DBK20 and DBK21 require a P2 interface and therefore, can not be used with Daq PC-Cards.

Note: For DaqBoard/2000 Series and /2000c Series board applications, the P2 interface is derived via use of an appropriate P4 adapter. P4 adapters are discussed in the DBK200 Series document modules.

Up to four DBK20s or DBK21s can be attached for a maximum of 192 lines (4x48). The local I/O lines cannot be used while expansion cards are attached. Thus, the first expansion card increases the number of usable digital I/O lines from 24 to 48, and subsequent cards each add 48 additional lines of programmable digital I/O.



DBK20 Block Diagram



DBK21 Block Diagram

Note 1: Page 3 of this document module includes a pinout of the DBK21's male DB37 connectors.

Hardware Setup

Card Connection

1. Connect wire leads to terminal blocks (if using a DBK20) or ribbon cable(s) terminated in 37-pin female connectors (if using a DBK21).
2. Once all connections are in place, secure wires to the board at captive areas at the end of the card. Nylon tie wraps (not included) work well for this purpose.

Card Configuration

The header shunt must be set on the proper JP1 position for the intended address. The table shows the 4 choices available.

Note: In multiple card systems, only 1 card at a time can have any given setting.

Set JP1 header for the desired base address by placing the shunt jumper in one of the positions noted in the table (A to D). JP1 is labeled ADDRESS SELECT and is located at the card's lower left side.

| Address Select | Hex Value | Bank |
|----------------|--------------|------|
| A | 0x63 0x67 | 0 |
| B | 0x6B 0x6F | 1 |
| C | 0x73 0x77 | 2 |
| D | 0x7B 0x7F | 3 |

LogBook Connection

The DBK20 or DBK21s attach to the LogBook's P2 digital I/O connector.



**P2 expansion cables must be kept short for proper operation.
Do not exceed 14" per attached DBK card.**

1. If using the optional DBK10 enclosure, slide the DB37 end of the board into a rear opening, and secure with hold-in screw-washer at rear panel.
2. Connect an accessory ribbon cable (with -x indicating the number of cards to be connected) from the digital I/O port (P2) of the LogBook to the DB37 connector at the end of the option card.

Note: A series of interface cables is available for connection of up to four DBK20 or DBK21 option cards.

DaqBook and DaqBoard Connection

The DBK20 or DBK21s attach to the DaqBook, DaqBoard [ISA type] P2 digital I/O connector or, for a DaqBoard/2000 Series or /2000/c Series board, to the P2 connector of an appropriate P4 adapter. P4 adapters are discussed in DBK200 Series document modules.



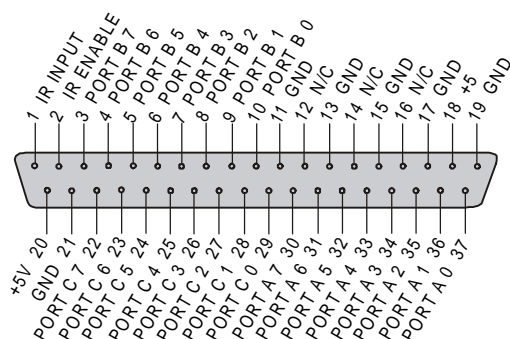
**P2 expansion cables must be kept short for proper operation.
Do not exceed 14" per attached DBK card.**

A series of interface cables are available for connecting up to 4 DBK20 or DBK21 cards.

1. If using the optional DBK10 enclosure, slide the DB37 end of the board into a rear opening, and secure with hold-in screw-washer at rear panel.
2. Connect an accessory ribbon cable (with -x indicating the number of cards to be connected) from the digital I/O port (P2) of the Daq devices or adapter to the DB37 connector at the end of the option card.

DaqBook and DaqBoard Configuration

There are no hardware configuration setups internal to DaqBooks and DaqBoards to allow expanded TTL I/O usage.



Note: There are two male DB37 connectors per DBK21 card.

| 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 , chapter 2) |
| 19 | GND | Digital ground |
| 20 | +5 V | +5 V supply (Refer to Power Management , chapter 2) |
| 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 |

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

Note: Refer to the [full-page table](#) on the next page for valid hex codes.

DBK20 - Specifications

Name/Function: General Purpose Digital I/O Card

Number of Channels: 48 I/O channels

Connector: Screw terminals

Device: 82C55 x 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 μ A

DBK21 - Specifications

Name/Function: General Purpose Digital I/O Card

Number of Channels: 48 I/O channels

Connector: DB37 male, corresponds to P2 pinout

Device: 82C55 x 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 μ A



| | |
|---|----------|
| Overview | 1 |
| Power Requirements | 1 |
| Hardware Setup | 2 |
| Card Connection | 2 |
| Card Configuration | 3 |
| DaqBook and DaqBoard Connection | 3 |
| DaqBoard/2000 Series Board Connection | 3 |
| DaqBook and DaqBoard Configuration | 4 |
| LogBook Connection | 4 |
| Software Setup | 4 |
| DBK23 – Specifications | 6 |



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

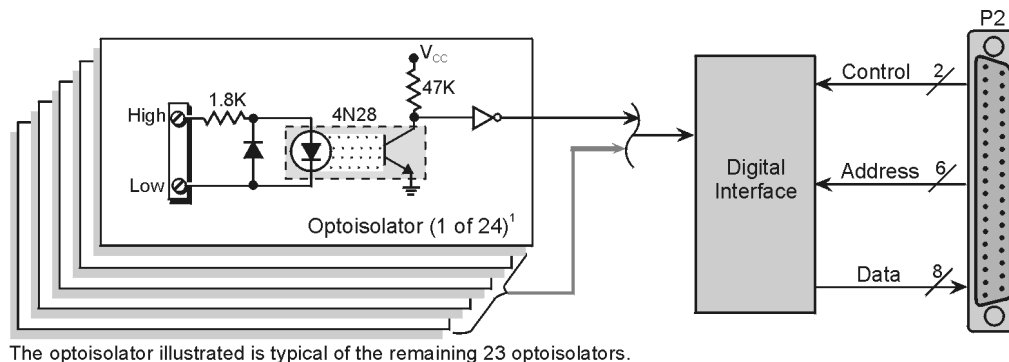
Overview

The DBK23 is a 3-port by 8-bit digital input chassis that connects to the LogBook's, DaqBook or DaqBoard[ISA type] P2 Digital I/O Port or, for the DaqBoard/2000 Series boards [except DaqBoard/2003], to an appropriate P4 adapter. These adapters are discussed in the DBK200 series document modules.

The DBK23 provides 500 V isolation from the DaqBook/DaqBoard or LogBook system and from channel-to-channel. Up to 8 DBK23s can attach to the LogBook or to the DaqBook/DaqBoard (not the Daq PC-Card), offering up to 192 bits of isolated digital input.

The DBK23 provides screw terminal access to each of its 24 isolated inputs. A slide-out PCB allows easy access to the controls and connectors. The input circuitry allows input voltages ranging from 0 to 30.0 V.

Note: The local digital I/O cannot be used while any DBK23s are attached.



DBK23 Block Diagram

Power Requirements

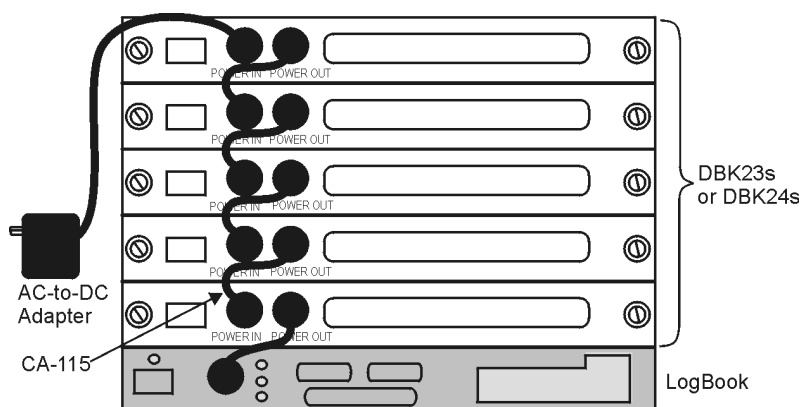
The DBK23 can be powered from a 9 to 24 VDC source such as an adapter, a standard 12 volt car battery, or an optional rechargeable nickel-cadmium battery module (DBK30A). This power flexibility makes the DBK23 ideal for field and remote data acquisition applications.

Power supplied to the DBK23 powers the on-board regulator. Connect the power supply (AC adapter) to the 5-pin DIN (labeled POWER IN) located on the front panel of the DBK23 chassis. Note the two power indicators on the rear panel of the DBK23. Check that both SYSTEM and LOCAL power LEDs are on at all times during operation. The second 5-pin DIN connector (labeled POWER OUT) can be cascaded to another accessory. A single power source can supply multiple DBK23 units.

CAUTION



Excessive power consumption can cause equipment damage. Calculate system power requirements prior to daisy-chaining.

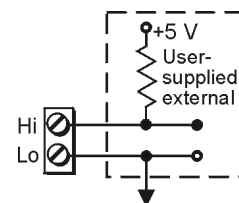


Power Daisy-Chain

Hardware Setup

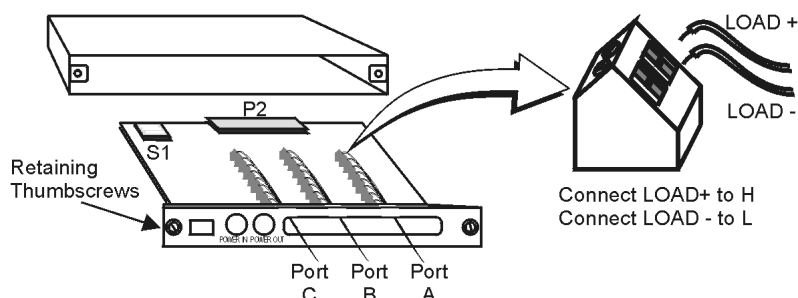
Card Connection

Open the DBK23 case by loosening the two retaining screws on the chassis front panel. Slide out the DBK23 board in order to connect wires to terminal blocks. Each input channel (or bit) is equipped with a discrete two-pole screw terminal block for isolated HI and LOW termination. The terminals accept 12 AWG to 22 AWG wire. Insulated wire types selected should meet or exceed 500 V isolation specifications.



Typical Circuit Use

Strip insulation from the ends of wires (no more than 1/4"). Insert wire into the screw terminal receptacle so that only the bare portion of wire extends into the opening. Bare wire should not extend more than 1/16" beyond the receptacle. These steps are essential to maintaining proper voltage isolation. Once the wire ends are in place, turn the slot head screw at the top of the block until the receptacle grips the wire firmly. Do not over tighten. Captive holes have been placed in appropriate locations to secure groups of wires to the board. Nylon lock ties (not included) work well for this purpose.



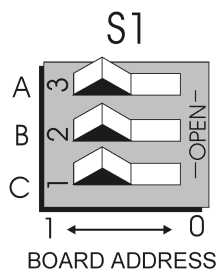
DBK23 Card/Signal Connection

Card Configuration

The LogBook, DaqBook, and DaqBoard can each support up to eight DBK23s in a daisy-chain configuration using an accessory cable (see figure). Each unit is then configured via the on-board DIP switch (S1) for its unique base address. No more than one unit in a common chain may have the same S1 setting. The table shows possible switch settings and addresses. The XI/O addresses can be used by programmers to access specific ports on specific cards.



Software constants have been predefined in the API as follows: **DdpExpnA**; **DdpExpnB**; **DdpExpnC**. Where “n” is replaced by the card number shown in the address table; and A, B, or C is the port for that card.



| Bank | Card No. | S1 Configuration | | | XI/O Address Value (Hex) | | |
|------|----------|------------------|---|---|--------------------------|--------|--------|
| | | C | B | A | Port C | Port B | Port A |
| 0 | 0 | 0 | 0 | 0 | 0x62 | 0x61 | 0x60 |
| | 1 | 0 | 0 | 1 | 0x66 | 0x65 | 0x64 |
| 1 | 2 | 0 | 1 | 0 | 0x6A | 0x69 | 0x68 |
| | 3 | 0 | 1 | 1 | 0x6E | 0x6D | 0x6C |
| 2 | 4 | 1 | 0 | 0 | 0x72 | 0x71 | 0x70 |
| | 5 | 1 | 0 | 1 | 0x76 | 0x75 | 0x74 |
| 3 | 6 | 1 | 1 | 0 | 0x7A | 0x79 | 0x78 |
| | 7 | 1 | 1 | 1 | 0x7E | 0x7D | 0x7C |

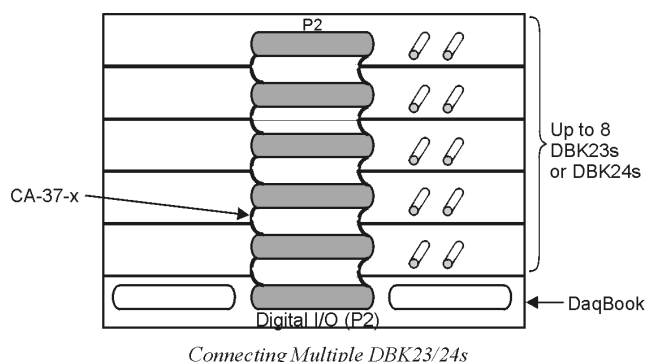
DaqBook and DaqBoard Connection

Connect the P2 digital I/O port of the DaqBook or DaqBoard [ISA type] or, for a DaqBoard/2000 Series board [except DaqBoard/2003] to an appropriate P4 adapter, to the P2 connector of the DBK23 using an accessory cable. Select up to 8 positions for a total of 192 programmable isolated inputs.

Note that P4 adapters are discussed in the DBK200 Series document modules.

DaqBoard/2000 Series Board Connection

Use a 37 pin accessory cable to connect the P2 digital I/O port of an appropriated DaqBoard/2000 Series P4 adapter to DBK23's P2. Note that you can select up to eight positions for a total of 192 programmable isolated inputs.



P4 adapters are discussed in the [DBK200 Series document modules](#).



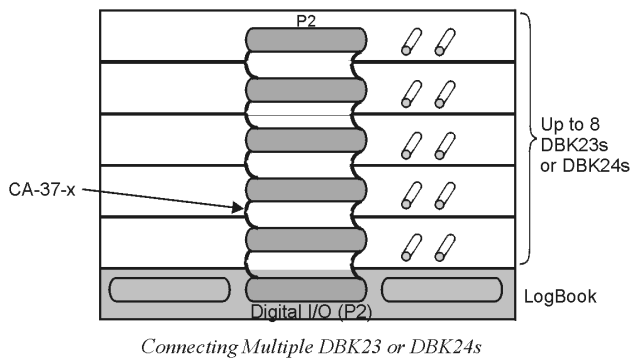
P2 expansion cables must be kept short for proper operation. Do not exceed 14' per attached DBK card.

DaqBook and DaqBoard Configuration

There are no hardware configuration setups internal to the DaqBook or DaqBoard required for the DBK23.

LogBook Connection

Connect the P2 digital I/O port of the LogBook to the P2 connector of the DBK23 using an accessory cable. Select up to 8 positions for a total of 192 programmable isolated inputs.



Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

Note: Refer to the full-page table on the next page for valid hex codes.

DBK23, pg. 5

DBK23 – Specifications

Name/Function: General Purpose Optically Isolated Digital Input Module

Channels: 24 I/O channels

Connector: Screw terminals for signal outputs

Input Voltage Levels:

Range: 3 to 30 VDC

Input Current: 1.5 to 15 mA

Operating Voltage Range: 9 to 24 VDC

Module Power Requirements: 0.25 W; AC adapter included

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

Channel Address: Set by DIP switch

| | |
|---|----------|
| Overview | 1 |
| Power Requirements | 2 |
| Hardware Setup | 2 |
| Card Connection | 2 |
| Card Configuration | 3 |
| DaqBook and DaqBoard Connection | 4 |
| DaqBoard/2000 Series Board Connection | 5 |
| DaqBook and DaqBoard Configuration | 5 |
| LogBook Connection | 5 |
| Software Setup | 5 |
| DBK24 – Specifications | 7 |



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

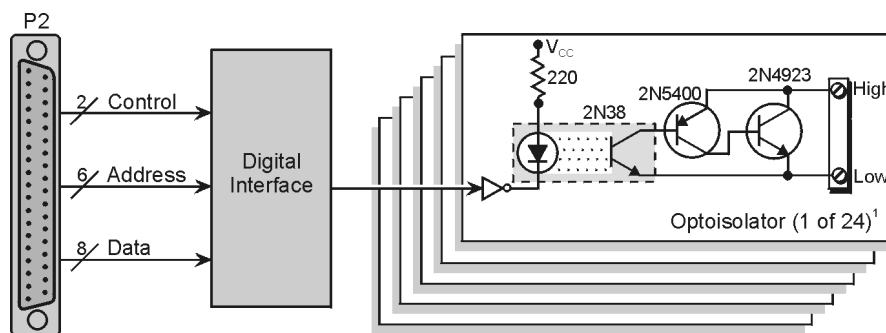
The DBK24 is a 3×8-channel digital output chassis that connects to the LogBook's, DaqBook's, or DaqBoard's [ISA type] P2 Digital I/O Port or, for a DaqBoard/2000 Series board [except DaqBoard/2003] to an appropriate P4 adapter. These adapters are discussed in the DBK200 Series document modules.

The DBK24 provides 500 V isolation from the system and from channel-to-channel. Up to 8 DBK24s can attach to the LogBook, DaqBook, or DaqBoard (not the Daq PC-Card), offering up to 192 bits of isolated digital output.

The DBK24 provides screw-terminal access to each of its 24 isolated outputs. A slide-out PCB allows easy access to the controls and connectors. The output circuitry allows output voltages as high as 60 V at currents up to 1 A.



The local digital I/O cannot be used while any DBK24s are attached.




The optoisolator illustrated is typical of the remaining 23 optoisolators.

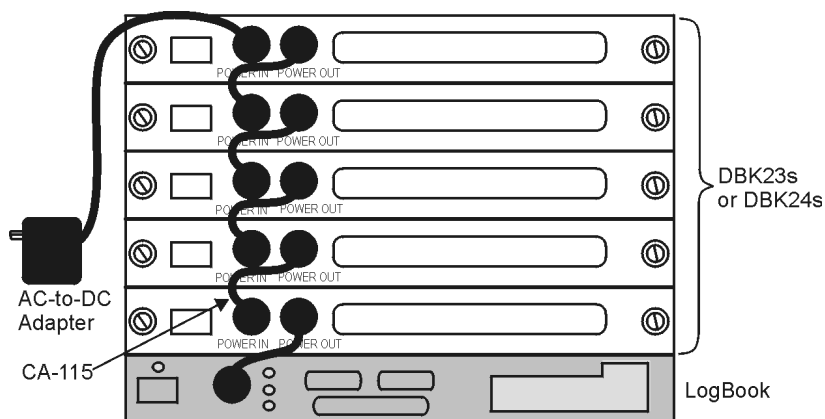
DBK24 Block Diagram

Power Requirements

The DBK24 can be powered by an included AC adapter, a standard 12-V car battery, or an optional rechargeable nickel-cadmium battery module (DBK30A). This power flexibility makes the DBK24 ideal for field and remote data acquisition applications.

Power supplied to the DBK24 powers the on-board regulator. Connect the power supply (AC adapter) to the 5-pin DIN (labeled POWER IN) located on the front panel of the DBK24 chassis. Note the two power indicators on the rear panel of the DBK24. Check that both SYSTEM and LOCAL power LEDs are on at all times during operation. The second 5-pin DIN connector (labeled POWER OUT) can be cascaded to another accessory. A single power source can supply multiple DBK24 units.

| CAUTION | |
|---|---|
|  | Excessive power consumption can cause equipment damage. Calculate system power requirements prior to daisy-chaining. Refer to chapter 2, Power Management, for calculation tables. |

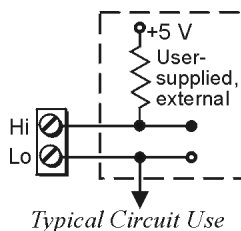


Power Daisy-Chain

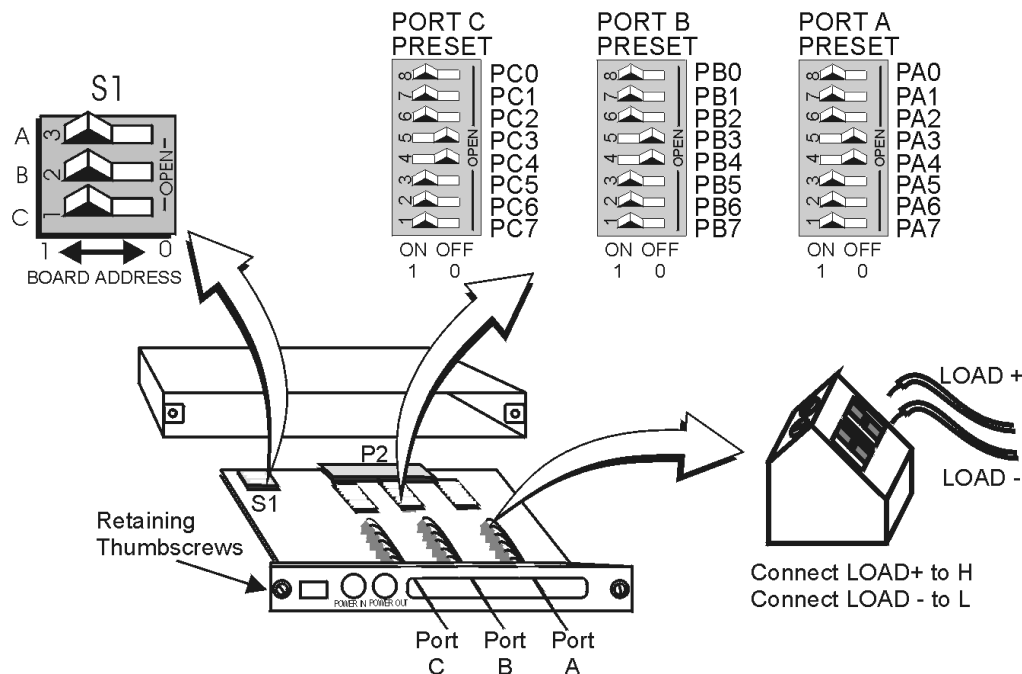
Hardware Setup

Card Connection

Open the DBK24 case by loosening the two retaining screws on the chassis front panel. Slide out the DBK24 board in order to connect wires to terminal blocks. Each input channel (or bit) is equipped with a discrete two-pole screw terminal block for isolated HI and LOW termination. The terminals accept 12 to 22 AWG wire. Insulated wire types selected should meet or exceed 500 V isolation specifications.



Typical Circuit Use



DBK24 simplified Component Layout

Strip some insulation from the ends of the wires (no more than 1/4"). Insert wire into the screw terminal receptacle so that only the bare portion of wire extends into the opening. Bare wire should not extend more than 1/16" beyond the receptacle. These steps are essential to maintaining proper voltage isolation. After the wire ends are in place, turn the slot-head screw at the top of the block until the receptacle grips the wire firmly. Do not over tighten. Captive holes have been placed in appropriate locations to secure groups of wires to the board. Nylon lock ties (not included) work well for this purpose.

Card Configuration

Factory Default: Power-up output state – Hi (ON)

Presetting the Outputs

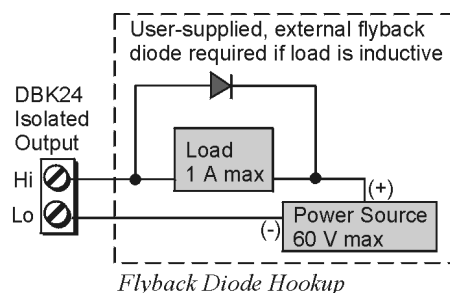
Each of the 24 outputs of the DBK24 can be configured to be ON or OFF at system power-on time. Each port has an 8-pole DIP switch (Port A Preset, Port B Preset, and Port C Preset). Before applying power to the LogBook, DaqBook/DaqBoard, or the DBK24:

1. Locate the DIP switch (Port A Preset, Port B Preset, or Port C Preset) for the bit you wish to preset.
2. Move the applicable micro-switch to the desired state [ON or OFF] for the output.
3. First power on the DBK24, then the primary acquisition device, i.e., the LogBook, DaqBook, or DaqBoard. All outputs will be operating in accordance with their corresponding DIP switch.

Note: The first write command received by the DBK24 will override the switch settings until the unit is again power-cycled. Subsequently, until the first write command is received, the switches may also be used to control the outputs.

User Output Configuration

The outputs of the DBK24 are designed to switch levels as high as 60 V at 1 A. The next figure shows a typical output hookup with a protective flyback diode in parallel with the load. When driving inductive loads without built-in flyback protection, you must provide this diode.



CAUTION



Failure to provide adequate flyback protection may result in damage to DBK24's output stage.

Each unit is configured via the on-board DIP switch (S1) for its unique base address. No more than one unit in a common chain may have the same S1 setting. Below is a table of possible switch settings and addresses.

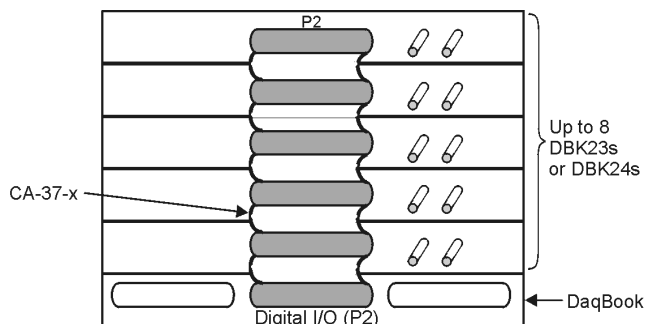
| Bank | Card No. | S1 Configuration | | | Address Value (Hex) | | |
|------|----------|------------------|---|---|---------------------|--------|--------|
| | | C | B | A | Port C | Port B | Port A |
| 0 | 0 | 0 | 0 | 0 | 0x62 | 0x61 | 0x60 |
| | 1 | 0 | 0 | 1 | 0x66 | 0x65 | 0x64 |
| 1 | 2 | 0 | 1 | 0 | 0x6A | 0x69 | 0x68 |
| | 3 | 0 | 1 | 1 | 0x6E | 0x6D | 0x6C |
| 2 | 4 | 1 | 0 | 0 | 0x72 | 0x71 | 0x70 |
| | 5 | 1 | 0 | 1 | 0x76 | 0x75 | 0x74 |
| 3 | 6 | 1 | 1 | 0 | 0x7A | 0x79 | 0x78 |
| | 7 | 1 | 1 | 1 | 0x7E | 0x7D | 0x7C |



Software constants have been predefined in the DaqBook/DaqBoard driver language interface files for all languages as follows: DdpExpnA, DdpExpnB, DdpExpnC; where “n” is replaced by the card number in the address table; and A, B, or C is the port for that card.

DaqBook and DaqBoard Connection

Connect the P2 digital I/O port of the DaqBook or DaqBoard [ISA type] or, for a DaqBoard/2000 Series board [except DaqBoard/2003] to an appropriate P4 adapter, to the P2 connector of the DBK24 using an accessory cable (with -x indicating the number of expansion units to be connected). Select up to 8 positions for a total of 192 programmable isolated inputs.



DaqBoard/2000 Series Board Connection

Use a 37 pin accessory cable to connect the P2 digital I/O port of the DaqBoard/2000 Series P4 adapter to the P2 connector of the DBK24 using an accessory cable (with -x indicating the number of expansion units to be connected). Select up to 8 positions for a total of 192 programmable isolated inputs.

P4 adapters are discussed in the [DBK200 document modules](#).



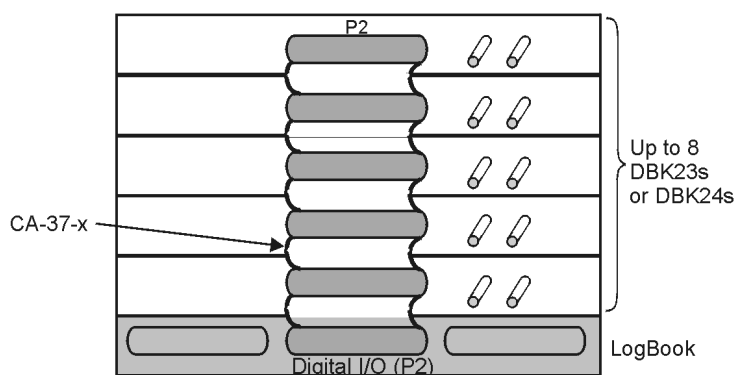
P2 expansion cables must be kept short for proper operation. Do not exceed 14" per attached DBK card.

DaqBook and DaqBoard Configuration

The DBK24 requires no hardware configuration setups internal to the DaqBook or DaqBoard.

LogBook Connection

Connect the P2 digital I/O port of the LogBook to the P2 connector of the DBK24 using an accessory cable (with -x indicating the number of expansion units to be connected). Select up to 8 positions for a total of 192 programmable isolated inputs.



Connecting Multiple DBK23 or DBK24s

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

Note: Refer to the full-page table on the next page for valid hex codes.

DBK24 - Specifications

Name/Function: General Purpose Optically Isolated Digital Output Module

Channels: 24 I/O channels

Connector: Screw terminals for signal outputs

Output Channel Ratings:

Maximum current/channel: 1 A

Voltage drop @ 1 A and 25°C: 1 V

Maximum open circuit voltage: 60 VDC

Off-state leakage: 10 μ A

Module Power Requirements: 1.5 W

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

Channel Address: Set by DIP switch

Maximum Module Power Dissipation:

@ 25°C 12 W

@ 50°C 6 W



Overview 1**Hardware Setup 2**

Card Connection 2

Card Configuration 2

DaqBook and DaqBoard and DaqBoard/2000 Connection 4

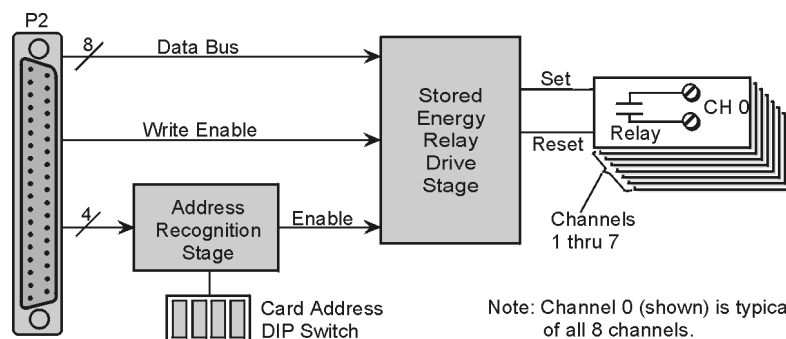
DaqBook and DaqBoard Configuration 4

Software Setup 4**DBK25 – Specifications 4****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.
- DBK25 users may be interested in the **DBK208** module. DBK208 is a *Carrier Board for Opto-22 Compatible Solid-State-Relays*. Refer to the [DBK208 document module](#) for additional information.

Overview

DBK25 provides 8 normally-open relay contacts for isolated switching of AC or DC loads or signals via the LogBook's P2 digital port or via the Daq device's or adapter's P2 digital port. The P2 port operating in the expanded-I/O mode can address up to 32 DBK25s (256 relays max). The DigiBook/72 with 3 P2 ports can address 96 DBK25s for up to 768 relay contacts. The relays are 2-coil sub-miniature latching relays and do not require continuous current to stay closed. Such bi-stable relays can act as an 8-bit non-volatile write-only memory byte.



DBK25 Block Diagram

The steady-state power drain of the DBK25 is very low, less than 1 mA at 5 VDC. It is practical, even operating on a battery, to have hundreds of relay contacts. The stored-energy operation of the DBK25 does limit the practical on/off speed (or the ability to generate 50% duty cycles) to about 10 Hz. The relay's operating time is less than 15 ms.

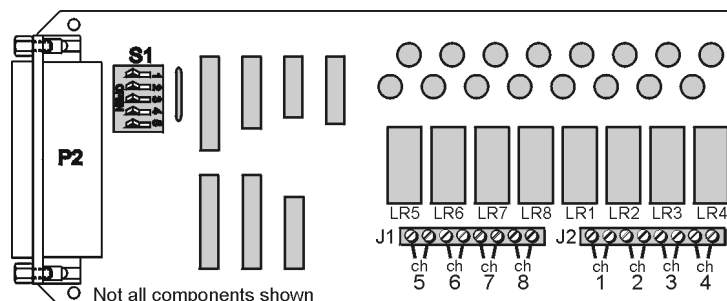
Hardware Setup

Card Connection

There are 16 screw terminals on the DBK25 to connect to 8 separate pairs of output contacts:

- J1 for channels 5 through 8
- J2 for channels 1 through 4

The board contains holes for use of wire ties.



DBK25 Board Layout

Card Configuration

You must set DIP switch S1 to a 5-bit address to correspond to the desired card address. (S1 is located next to the DB37 connector.) The following table lists the switch settings for 32 system card numbers. The XI/O addresses can be used in custom programming to access specific cards.

| System Card # | XI/O Address | S1 Position OPEN = OFF | | | | | System Card # | XI/O Address | S1 Position OPEN = OFF | | | | |
|---------------|--------------|---------------------------|-----|-----|-----|-----|---------------|--------------|---------------------------|-----|-----|-----|----|
| | | 1 | 2 | 3 | 4 | 5 | | | 1 | 2 | 3 | 4 | 5 |
| 0 | H60 | OFF | OFF | OFF | OFF | OFF | 16 | H70 | OFF | OFF | OFF | OFF | ON |
| 1 | H61 | ON | OFF | OFF | OFF | OFF | 17 | H71 | ON | OFF | OFF | OFF | ON |
| 2 | H62 | OFF | ON | OFF | OFF | OFF | 18 | H72 | OFF | ON | OFF | OFF | ON |
| 3 | H63 | ON | ON | OFF | OFF | OFF | 19 | H73 | ON | ON | OFF | OFF | ON |
| 4 | H64 | OFF | OFF | ON | OFF | OFF | 20 | H74 | OFF | OFF | ON | OFF | ON |
| 5 | H65 | ON | OFF | ON | OFF | OFF | 21 | H75 | ON | OFF | ON | OFF | ON |
| 6 | H66 | OFF | ON | ON | OFF | OFF | 22 | H76 | OFF | ON | ON | OFF | ON |
| 7 | H67 | ON | ON | ON | OFF | OFF | 23 | H77 | ON | ON | ON | OFF | ON |
| 8 | H68 | OFF | OFF | OFF | ON | OFF | 24 | H78 | OFF | OFF | OFF | ON | ON |
| 9 | H69 | ON | OFF | OFF | ON | OFF | 25 | H79 | ON | OFF | OFF | ON | ON |
| 10 | H6A | OFF | ON | OFF | ON | OFF | 26 | H7A | OFF | ON | OFF | ON | ON |
| 11 | H6B | ON | ON | OFF | ON | OFF | 27 | H7B | ON | ON | OFF | ON | ON |
| 12 | H6C | OFF | OFF | ON | ON | OFF | 28 | H7C | OFF | OFF | ON | ON | ON |
| 13 | H6D | ON | OFF | ON | ON | OFF | 29 | H7D | ON | OFF | ON | ON | ON |
| 14 | H6E | OFF | ON | ON | ON | OFF | 30 | H7E | OFF | ON | ON | ON | ON |
| 15 | H6F | ON | ON | ON | ON | OFF | 31 | H7F | ON | ON | ON | ON | ON |

The full-page table on the following page shows all possible relay settings and their associated binary and hex values.

DBK Option Cards and Modules 08-14-01 DBK25, pg. 3

DaqBook and DaqBoard and DaqBoard/2000 Connection

Use a 37 pin accessory cable to connect DBK25 to the P2 connector of an appropriate P4 adapter. These adapters are discussed in the DBK200 document modules.



**P2 expansion cables must be kept short for proper operation.
Do not exceed 14" per attached DBK card.**

DaqBook and DaqBoard Configuration

No hardware configuration setups internal to the DaqBook or DaqBoard are needed for expanded TTL I/O.

Software Setup



Reference Notes:

- **DaqView Users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView Users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK25 – Specifications

Name/Function: 8-Channel Relay Output Card

Connectors: Screw terminals for signal outputs

Max Number of Cards: 32

Contact Rating:

2 A @ 28 VDC; 0.6 A @ 120 VAC

Isolation:

Channel-to-System: 250 V

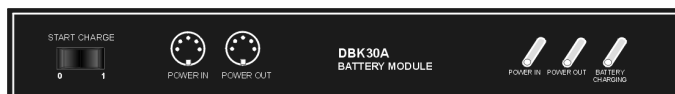
Channel-to-Channel: 150 V

| | |
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| Configuration | 3 |
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| Charging the Battery Module | 5 |
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**Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview



DBK30A Front Panel

DBK30A contains two rechargeable nickel-cadmium batteries and shares the same base dimensions as other LogBook, DaqBook, and related DBK module products, allowing for convenient stacking with included splice plates and dual-lock tabs.

The included power adapter converts AC power to 24 VDC for charging DBK30A's two battery packs. Automatic charging circuits recharge the internal batteries quickly and safely when connected to the supplied AC adapters. For trouble-free operation you must fully charge the batteries before use. The charged battery runtime depends on the current load and mode of operation.

An internal slide switch (SW2) determines the unit's mode. The two modes are:

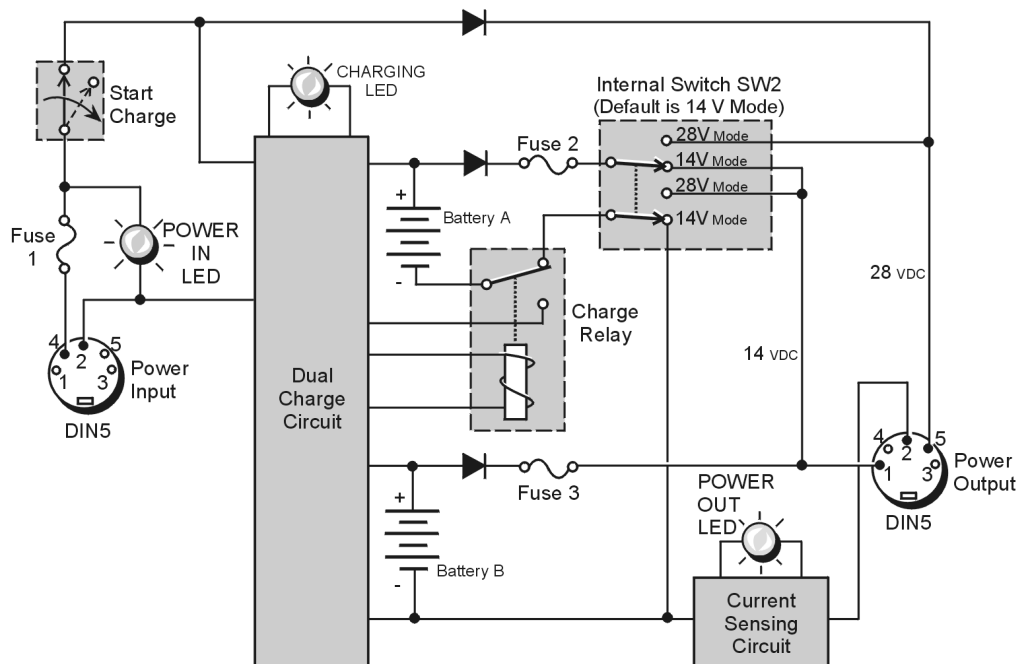
- **14 VDC Mode (default)**
- **28 VDC Mode**



You should check the power requirements of each component in your system, and then verify that the power source can provide sufficient power to meet your runtime requirements.



Fully charge DBK30A's batteries before use.



DBK30A Block Diagram

14 VDC Mode (default)

This mode provides 14 VDC for 3.4 A-hr. The typical battery runtime is from 3 to 6 hours depending on the load. Unless 28 VDC is required, the 14 VDC mode should be used in your LogBook applications.



Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

28 VDC Mode

The 28 VDC mode actually provides *both* 14 VDC *and* 28 VDC. Loop currents for two-wire, 4-20 mA transmitters (1.7 A-hr) require 28 VDC. The battery run-time typically ranges from 1 to 6 hours, depending on system configuration. In this mode, 14 VDC is used for unregulated bridge excitation (for bridge-configured sensors, such as load cells), and power to DBK expansion products.



Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

Hardware Setup

Configuration

The only configuration option is the choice of modes (**14 VDC**, or **28 VDC**). If you do not need 28 V, leave SW2 in the default position.



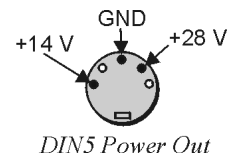
If you are using a pre-owned DBK30A, or are unsure of the mode selected, use the following steps to check SW2's position. Note that new units are always shipped with SW2 selected to the 14 VDC mode.

Internal switch SW2 is located on the printed circuit board, near the front center of the unit. To change or verify the mode:

1. Remove DBK30A's cover by removing one screw and sliding the cover forward until it separates from the module.
2. Look near the front center of the circuit board and locate slide switch SW2.
3. Check SW2's selection. The silkscreen indicates the 14 and 28 VDC positions.
4. Change the selection, if required. If you do not need 28 V, SW2 should be in the default position (14 VDC).
5. Replace the top cover, and secure with screw.

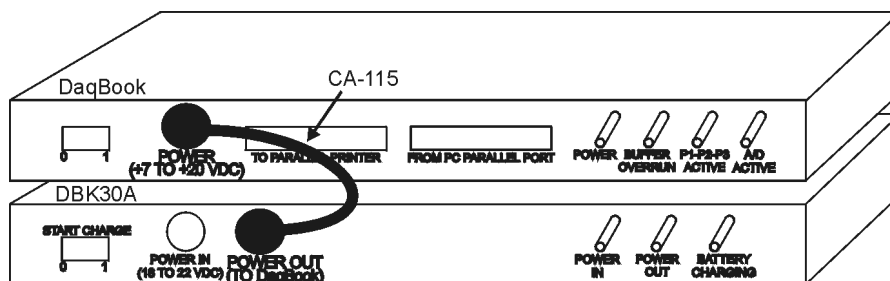
Power

Connection. The figure shows the pinout for the POWER OUT DIN5 connector. The 28 V pin is only active in the 28 VDC mode; however, the 14 V pin is active regardless of the mode selected.



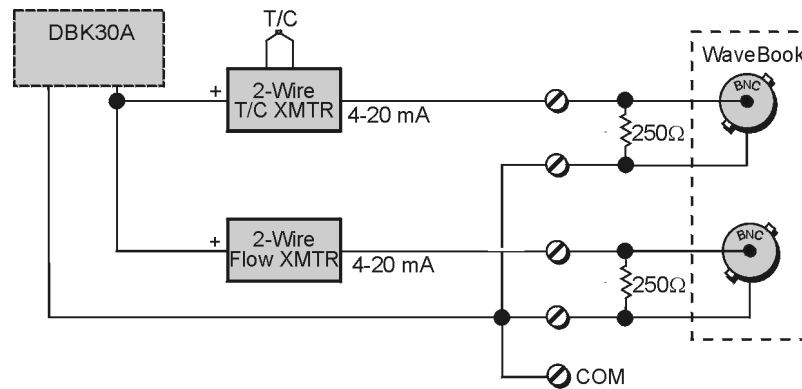
Cable CA-115 is included in the DBK30A package. The cable connects to DBK30A's POWER OUT connector and a LogBook, DaqBook, or WaveBook DIN5 POWER IN connector. The cable can be used to daisy-chain a DBK30A unit to a DBK or WBK expansion module.

The DBK30A package includes a short connecting cable (CA-115) to connect to the LogBook or Daq device. This cable connects the POWER OUT connector on the DBK30A to the POWER IN connector on the Daq device or LogBook (see next figure).



DBK30A to DaqBook Connection

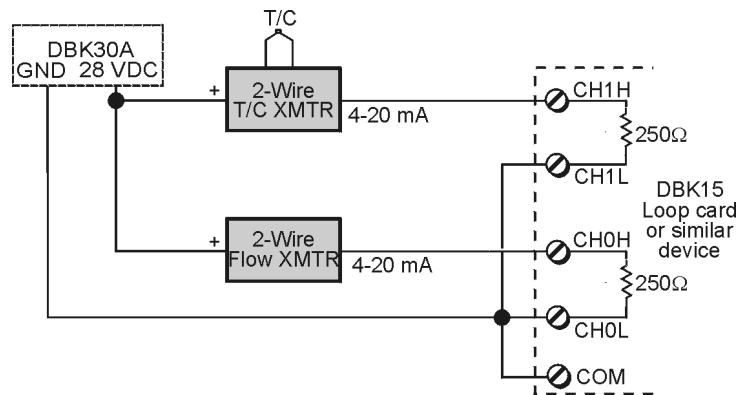
28 VDC Mode. The primary purpose of the 28 VDC mode is to provide power for external loop transmitters. The hookup is simple, as shown below.



Connecting Loop Transmitters

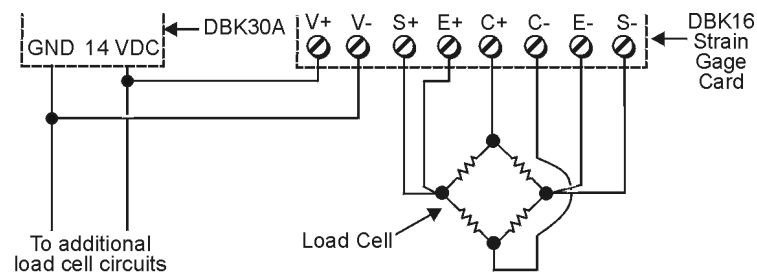
Another use of the 28 VDC mode is to provide excitation for bridge-type sensors, such as load cells (strain gages).

The primary purpose of the 28 VDC mode is to power external user-supplied loop transmitters. The hookup is simple, as shown below. A DIN5 connector allows easy connection of lead wires.



Connecting Loop-Transmitter Wires

The 28 VDC mode can also be used to provide a 14 VDC excitation source for bridge-type sensors such as load cells (strain gages). The excitation voltage is not regulated by the DBK30A; so, this voltage must be externally regulated to 10.00 V for most load cells.



Using Load Cells



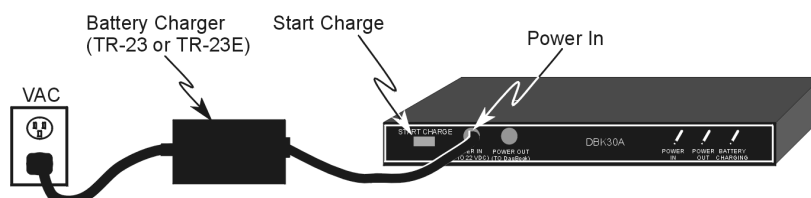
Excitation voltage from DBK30A is not regulated by the unit, and must therefore be regulated externally. For most load cells, excitation voltage should be regulated to 10 V.

Charging the Battery Module

To charge the DBK30A batteries:

1. Connect the adapter to DBK30A's POWER IN connector.
2. Plug the adapter into the AC power receptacle.

Note: The charge cycle will begin automatically whenever AC power is applied after an interruption. The charge cycle will automatically end when the batteries are fully charged.



Charging DBK30A's Batteries

3. To manually initiate a charge cycle, press the START CHARGE momentary rocker-arm switch. Note that subsequent charge cycles applied to a fully-charged DBK30A will have no ill effect. The module will sense the fully-charged status and revert to the trickle-charge state within a few minutes.

Three LEDs on the DBK30A provide status information on the charging process or the external load.

| LED Indicators & Descriptions | |
|-------------------------------|--|
| POWER IN | Indicates the charger is connected to a source of AC power and to the battery module. |
| BATTERY CHARGING | Steady Light - Indicates the battery is in the high-current (2 A) charge mode. Flashing - One or two flashes at a time indicates the batteries are fully charged. |
| POWER OUT | Indicates power is flowing out to an external device. |

CAUTION



Periodically, fully discharge the DBK30A to inhibit “lazy chemistry” (memory) in the nickel-cadmium cells. To manually discharge a battery pack, connect the primary acquisition device, e.g., WaveBook, DaqBook, or LogBook, to the DBK30A and leave it powered-on until the indicator lights go out.

Use While Charging.

- Both operating modes are capable of powering data acquisition devices while the DBK30A is being charged; however, the charging current will be reduced, and the charging time will increase.
- If AC power is interrupted, a new charge cycle will begin automatically when AC power returns.

CAUTION



Even with the AC adapter, the batteries will eventually discharge under an operating load. Charging DOES NOT BEGIN AUTOMATICALLY (except on power-up). You must manually initiate the next charge cycle. Do not expect a device powered by a DBK30A to operate as if connected to an uninterruptable power supply.

DBK30A – Specifications

Name/Function: Rechargeable Battery Module

Battery Type: Nickel-cadmium

Number of Battery Packs: 2

Battery Pack Configuration: 12 series-connected sub-C cells

Output Voltage: 14.4 V or 28.8 V (depending on the selected mode)

Output Fuses: 2 A

Battery Amp-Hours: 3.4 A-hr (1.7 A-hr/pack)

Charge Termination: Peak detection

Charge Time: 2 hours

Charging Voltage from Supplied AC Adapter: 22 to 26 VDC @ 2 A

AC Adapter Input: 95 to 265 VAC @ 47 to 63 Hz

Size: 221 mm × 285 mm × 35 mm (11" × 8-1/2" × 1-3/8")

Weight: 2.4 kg (6 lb)

Overview 1**Hardware Setup 2**

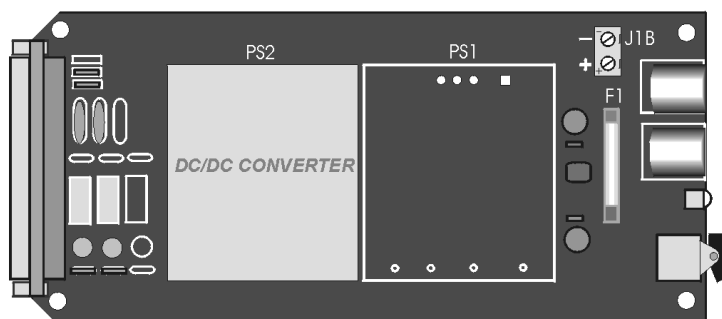
LogBook/DBK Connection 2

DaqBook and DaqBoard [ISA type] Configuration 2

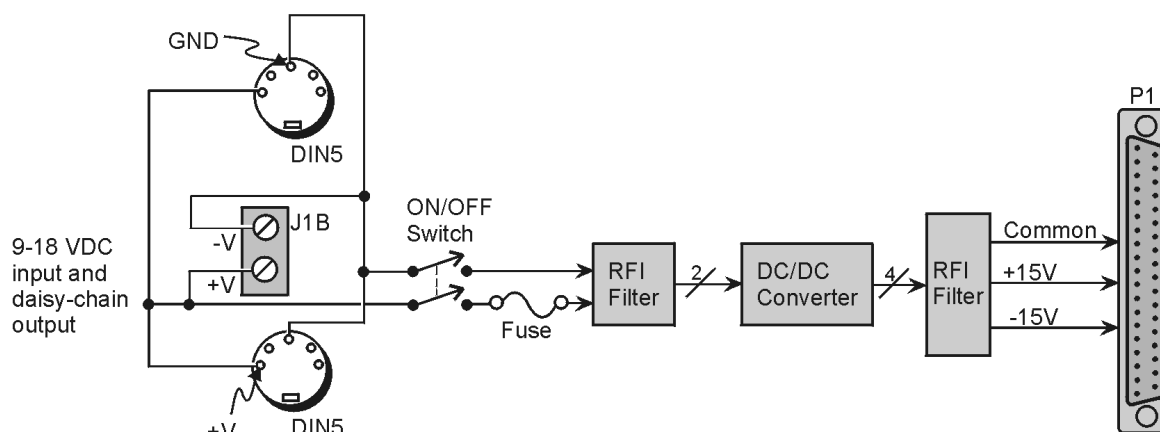
DaqBook and DaqBoard Connection 3

DBK32A – Specifications 4**Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview**DBK32A Power Supply Card**

The DBK32A provides added power in configurations where the number of expansion cards exceeds the power available from a LogBook, DaqBook, or DaqBoard. For power, the DBK cards rely on voltages supplied via the P1 connection. The DBK32A supplies ± 15 V via the P1 bus and is compatible with all analog DBK cards.

**DBK32A Block Diagram**

The DBK32A does not provide +5 V. If +5 V is required by the DBKs in use, you should use the DBK33 Triple-Output Power Supply. Refer to the [DBK33 Document Module](#) for additional information.

Hardware Setup

LogBook and DBK Module Connections

The DBK32A has two DIN5 power connectors to allow daisy-chaining of multiple DBK32As or to share a common power source with a LogBook or a compatible DBK Module. Terminal block J1B can be used instead of the DIN5s (e.g., custom wiring with a DBK60). The DBK32A can be powered from the included AC adapter, a DBK30A battery module, or a 10-20 VDC source (e.g., a car battery).

Connect the DBK32A much like any other expansion card on a ribbon cable or inside an expansion chassis. The DBK32A can be installed into a DBK10, DBK60, or DBK41.



DaqBook and DaqBoard [ISA type] Configuration

CAUTION



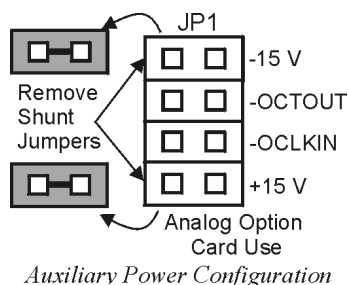
You must configure the DaqBook or DaqBoard [ISA type] before connecting the DBK32A. Do not connect the P1 cable without first removing the shunt jumpers from JP1 inside the DaqBook or DaqBoard [ISA type]. Failure to remove these jumpers can result in damage to the DBK32A and the DaqBook or DaqBoard [ISA type].

CAUTION



Do not place jumpers on the -OCTOUT and -OCLKIN pins. If configured such, damage to the 8254 timer chip will result.

Using a DBK32A requires you to entirely remove the shunt jumpers from header JP1 inside the DaqBook or DaqBoard [ISA type], as shown in the figure. DaqBooks and DaqBoards [ISA type] are shipped with these shunts positioned to deliver analog power to P1.



JP1 default position will not work with a DBK32A. Shunt jumpers must be removed before connecting DBK32A. See previous Cautions.

DaqBook and DaqBoard Connections

The DBK32A can be powered from the included AC adapter, a DBK30A battery module, or a 10-20 VDC source (e.g., a car battery).

The DBK32A has two DIN5 power connectors to allow daisy-chaining of multiple DBK32As or to share a common power source with a DaqBook or DaqBoard.

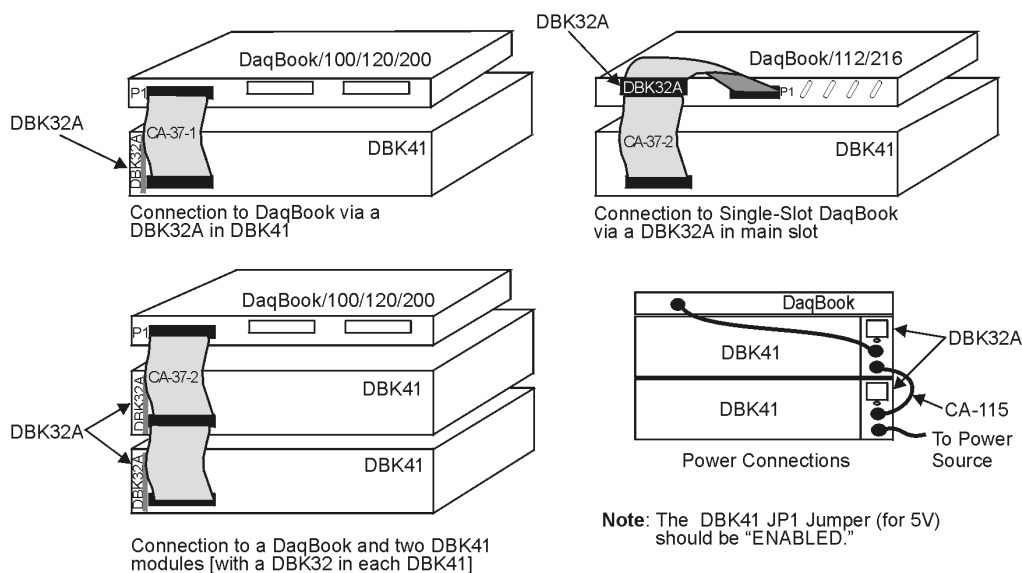
Note: Terminal block J1B can be used instead of the DIN5s; for example, in an application involving custom wiring with a DBK60. In regard to screw-terminal identification, J1B's positive terminal (+) is the one closest to fuse F1.

Connect the DBK32A much like any other expansion card on a ribbon cable or inside an expansion chassis. The DBK32A can be installed into a DaqBook/112/216's internal expansion slot, a 3-Slot DBK10, a 3-slot DBK60, or a 10-Slot DBK41.

In regard to positioning a DBK32A, any slot within the DBK10 may be used.



If you will be using a 3-port DaqBook, i.e., DaqBook/100, /120, /200, or /260, with a DBK41, then the right-hand end-slot of the DBK41 [when facing the DBK41's rear panel] is the best location for the DBK32A.



Examples of DBK32A Connections and Cascading Power

DBK32A – Specifications

Name/Function: Auxiliary Power Supply Card

Isolation, Input to Output:

DBK32A: 500 VDC

(DBK32: 250 VDC)

Output Voltages:

DBK32A: +15 VDC (nominal) @ 500 mA

-15 VDC (nominal) @ 500 mA

DBK32: +15 VDC (nominal) @ 250 mA

-15 VDC (nominal) @ 250 mA)

Line Regulation: 0.5% (maximum)

Load Regulation: 1.0% (maximum)

Total Output Power: 7.5 VA (full load)

Input Voltage Range: 10-24 VDC

Input Current Range: 0.8 - 2.0 A

Size: 3-1/4" x 8-1/4" x 3/4"

Efficiency: 60% Typical

Input Connections: DIN-5 (x2 for daisy-chaining)

Output Connections: DB37 Male

Parallel Provision: OR-ing diodes in output lines

Controls: ON/OFF rocker arm switch

Indicators: LED driven by positive output

Over-Voltage Protection: Hardware SCR crowbar on (+) side

Switching Frequency: 150 kHz

Operating Temperature Range: 0-50°C

Input Fuse Size: 2 A (Littelfuse)

[Overview 1](#)

[Hardware Setup 2](#)

[LogBook and DBK Modules 2](#)

[DaqBook and DaqBoard \[ISA type\] 2](#)

[DaqBoard/2000 Series and /2000c Series Boards 3](#)

[Cascading Power Connection 3](#)

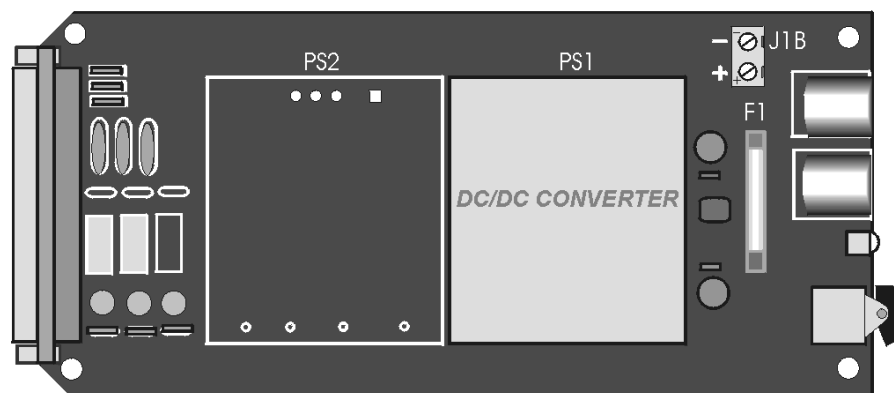
[DBK33 – Specifications 4](#)



Reference Notes:

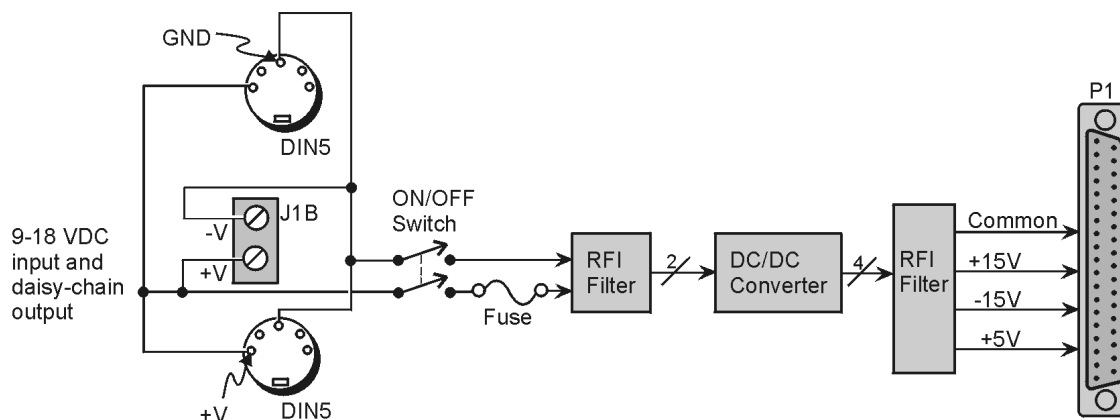
- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview



DBK33 Triple-Outlet Power Supply Card

The DBK33 provides added power (± 15 VDC and +5 VDC) via P1 in configurations where the expansion cards require more power than available from a LogBook, DaqBook, DaqBoard, or DaqBoard/2000 Series board or other power source. The card is compatible with all analog DBK cards and typically can support up to 12 DBK cards.



DBK33 Block Diagram

Note: If +5 V is not needed by the DBKs in use, you can use the DBK32A in place of the DBK33.

Hardware Setup

LogBook and DBK Modules

The DBK33 has two DIN5 power connectors to allow daisy-chaining of multiple DBK33s or to share a common power source with a LogBook or a compatible DBK Module. Terminal block J1B can be used instead of the DIN5s (e.g., custom wiring with a DBK60). The DBK32A can be powered from the included AC adapter, a DBK30A battery module, or a 10-20 VDC source (e.g., a car battery).

Connect the DBK33 much like any other expansion card on a ribbon cable or inside an expansion chassis. The DBK33 can be installed into a DBK10, DBK60, or DBK41.



DaqBook and DaqBoard [ISA type]

CAUTION



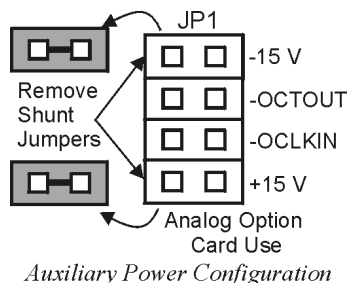
You must configure the DaqBook or DaqBoard [ISA type] before connecting the DBK33. Do not connect the P1 cable without first removing the shunt jumpers from JP1 inside the DaqBook or DaqBoard [ISA type]. Failure to remove these jumpers can result in damage to the DBK33 and DaqBook or DaqBoard [ISA type].

CAUTION



Do not place jumpers on the -OCTOUT and -OCLKIN pins. If configured such, damage to the 8254 timer chip will result.

Using a DBK33 requires you to entirely remove the shunt jumpers from header JP1 inside the DaqBook or DaqBoard [ISA type], as shown in the figure. DaqBooks and DaqBoards [ISA type] are shipped with these shunts positioned to deliver analog power to P1.



The JP1 default position will not work with a DBK33. Shunt jumpers must be removed before connecting DBK33. See previous Cautions.

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards

For configurations pertaining to DaqBoard/2000 Series boards or cPCI DaqBoard/2000c Series boards, you will most likely power DBK33 from the included AC adapter.

The DBK33 has 2 DIN5 power connectors to allow daisy-chaining of multiple DBK33s or to share a common power source with a DaqBoard/2000 Series [or /2000c Series] board.

Note: DBK33 has been enhanced by the addition of a terminal block. Terminal block J1B can be used instead of the DIN5s (e.g., custom wiring with a DBK60). The DIN5 connectors are still usable, and board functions have not been changed.

DBK33 connects much like an expansion card on a ribbon cable (or inside an expansion chassis). In relation to DaqBoard/2000 Series [or /2000c Series] expansion, DBK33 can be installed in a 3-Slot DBK10, a 3-slot DBK60, or a 10-Slot DBK41.

Cascading Power Connection

The DBK33 can be powered from the included AC adapter, a DBK30A battery module, or a 9-18 VDC source (e.g., a car battery).

The DBK33 has two DIN5 power connectors to allow daisy-chaining of multiple DBK33s or to share a common power source with a LogBook, DaqBook, or DaqBoard.

Note: Terminal block J1B can be used instead of the DIN5s; for example, in an application involving custom wiring with a DBK60. In regard to screw-terminal identification, J1B's positive terminal (+) is the one closest to fuse F1.

Connect the DBK33 much like any other expansion card on a ribbon cable or inside an expansion chassis. The DBK33 can be installed into a DaqBook/112 or DaqBook/216 internal expansion slot, a 3-Slot DBK10, a 3-slot DBK60, or a 10-Slot DBK41.

In regard to positioning a DBK33, any slot within the DBK10 may be used.



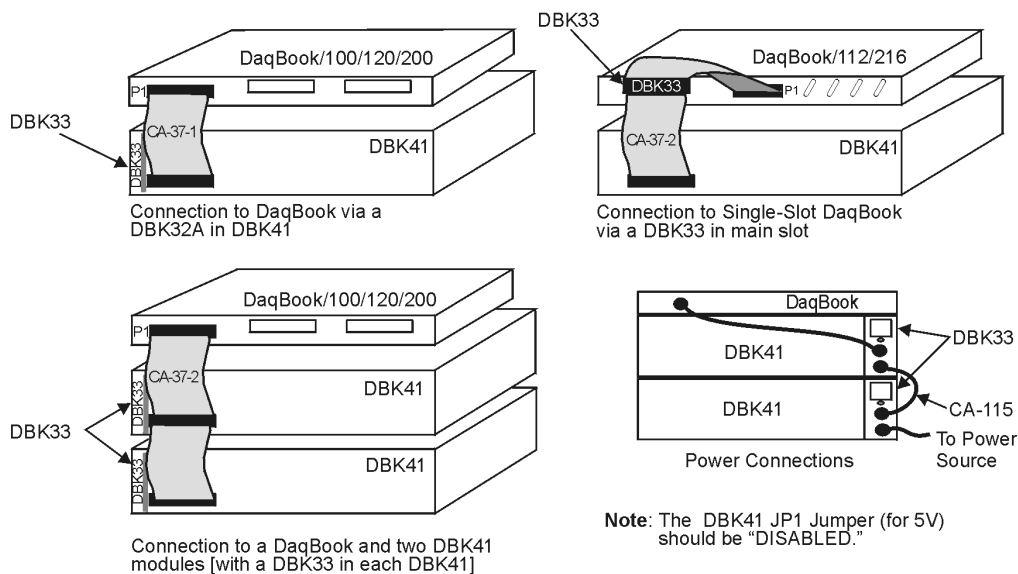
Tip If you will be using a 3-port DaqBook, i.e., DaqBook/100, /120, /200, or /260, with a DBK41, then the right-hand end-slot of the DBK41 [when facing the DBK41's rear panel] is the best location for the DBK33.



Note! **For DBK41 Users:** When using a DBK33 in a DBK41, the DBK41's JP1 [a three-pin jumper] must be set to pins 2 and 3 (DISABLE +5 VDC). This disconnects the host P1 +5 VDC from the internal +5 VDC output. Refer to the [DBK41 Document Module](#) as needed.



Note! **For DBK60 Users:** When using a DBK33 in a DBK60, the DBK60's JP2 [two-pin jumper] must be removed from the JP2 header pins located on the DBK60's P1 interconnect board. This action disconnects the host P1 +5 VDC from the internal +5 VDC output. Refer to the [DBK60 Document Module](#) as needed.



Examples of DBK32A Connections and Cascading Power

DBK33 - Specifications

Name/Function: Triple-Output Power Supply Card

Isolation, Input to Output: 500 VDC

Output Voltages:

+15 VDC nominal @ 250 mA

-15 VDC nominal @ 250 mA

+5 VDC nominal @ 1000 mA

Line Regulation: 0.2% max (+5 V); 5% max (± 15 V)

Load Regulation: 0.5% max (+5 V); 5% max (± 15 V)

Total Output Power: 15 VA (full load)

Input Voltage Range: 9 to 18 VDC

Included AC Adapter: 15 VDC @ 0.9 A

Size: 3-1/4" x 8-1/4" x 3/4"

Full-Load Efficiency: 80% Typical

Full-Load Input Current Range:

2.10 A @ 9VDC

1.05 A @ 18 VDC

Input Connections: DIN5 (x2 for daisy-chaining)

Output Connections: DB37 Male

Parallel Provision: OR-ing diodes on output lines allow use of multiple DBK33s in larger systems

Controls: ON/OFF rocker-arm switch

Indicators: LED driven by input voltage

Over-Voltage Protection: Fuse followed by 19 V zener clamp

Switching Frequency: 100 kHz min

Operating Temperature Range: -20 to 70°C

Input Fuse: 3 A (Littelfuse 251003)

Overview 1

Hardware Setup 2

 Configuration 2

 Connection 3

DBK34 Operation 3

Environmental Concerns 4

Fuse Replacement 4

DBK34 – Specifications 5



DBK34 is similar to DBK34A in appearance and operation; but there are differences. Before proceeding with this section, verify that your device is a DBK34. If your device has an “A” suffix, use the document module regarding the DBK34A UPS /Battery Module instead of this document module.



Reference Notes:

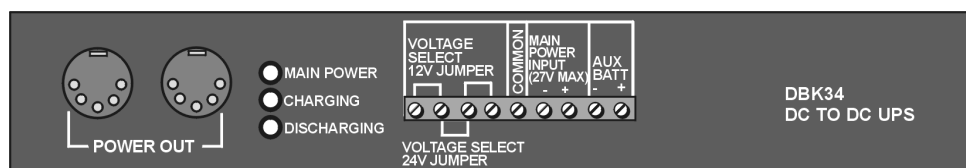
- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK34 can power a data acquisition system in portable and in-vehicle applications (both 12 and 24 V systems). Power storage capacity is 5 A-hr @ 12 VDC or 2.5 A-hr @ 24 VDC.

For reliable data acquisition in a vehicle, the DBK34 provides clean and consistent operating power:

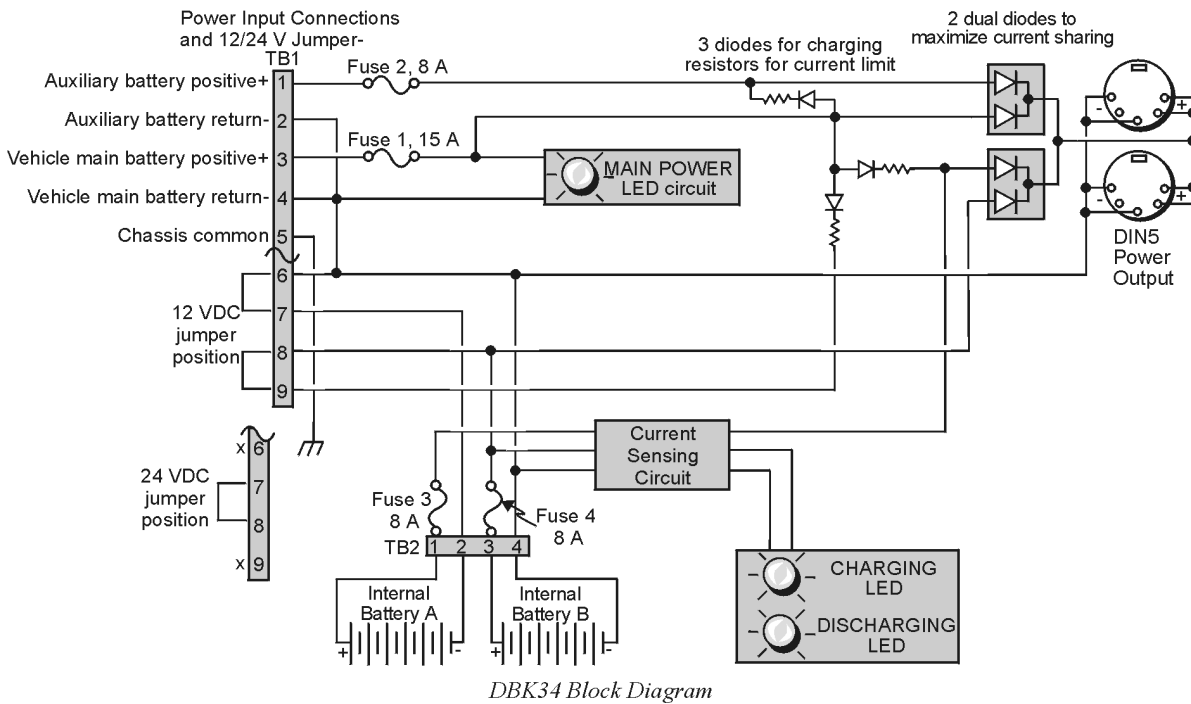
- Prior to engine/generator start
- During engine start-up (battery sag due to the high-current demand of starter motor and solenoid)
- After engine turn off.



DBK34 Front Panel

The DBK34 contains two sealed-lead rechargeable batteries and associated charging circuits and current indicators. Typically, these batteries can last more than 500 full cycles and up to 10 years standby lifetime at room temperature. Recharging is fast, and extreme temperature performance is good. The DBK34 can be used with the LogBook, DaqBook, WaveBook, and related DBKs and WBKs. The unit's rugged metal package has a compatible 8x11" footprint for convenient stacking with dual-lock tabs and optional splice plates and handles for carrying.

Main and auxiliary power input comes from 12 or 24 VDC via a terminal block on the unit's front panel (12 or 24 V modes are set by front-panel jumpers). Automatic charging circuits recharge the internal batteries quickly and safely. For trouble-free operation, you must fully charge the batteries before use. The charged battery runtime will depend on the load and mode of operation.



Note: TB1 pin numbers read from right to left as viewed from the front panel.

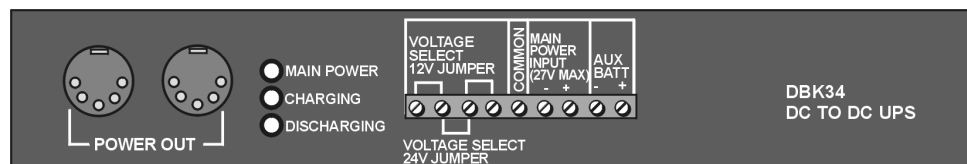
Hardware Setup

Configuration

The DBK34 is configured for 12 volt or 24 volt operation via placement of jumpers on the front panel's screw-terminal block (TB1).



From left to right, when viewed from the front panel, DBK34's screw-terminal numbers read: 9, 8, 7, 6, 5, 4, 3, 2, 1. Thus, Aux Batt (+) is screw -terminal 1. See following figure.



For 12 Volt Operation:

- (1) Remove jumper from terminals 8 and 7, if present.
- (2) Use a jumper to short terminals 9 and 8
- (3) Use a jumper to short terminals 7 and 6

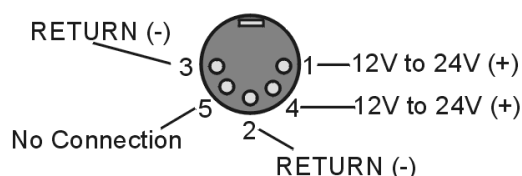
For 24 Volt Operation:

- (1) Remove jumpers from terminals 9 and 8, if present
- (2) Remove jumpers from terminals 7 and 6, if present.
- (3) Use a jumper to short terminals 8 and 7

Connection

Power In - (vehicle main/auxiliary batteries, 12 or 24 VDC only) Connect main battery positive to terminal 3 of TB1 and main negative to terminal 4. If an auxiliary battery is used, connect its positive to terminal 1 and negative to terminal 2.

Power Out - The pinout at the right applies to DBK34's two POWER OUT DIN5 connectors.



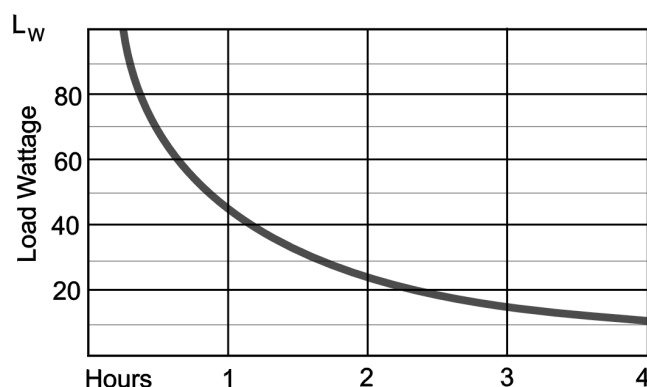
DBK34 Operation

Indicators: 3 LEDs on the DBK34 provide status information on the power and charging process.

| LED | Meaning |
|-------------|--|
| MAIN POWER | Lights when the DBK34 is connected to a live vehicle (main) battery. |
| CHARGING | Lights when internal batteries are being charged at a rate of 0.025 to 0.050 A or greater. |
| DISCHARGING | Lights when internal batteries are discharging at a rate of 0.025 to 0.050 A or greater. |

Runtime: Approximate runtime under various loads can be computed from the storage capacity (5 A-hr in 12 V mode; 2.5 A-hr in 24 V mode) and the load (main unit and other DBKs).

The following graph of Load vs. Battery Life is for a typical new battery that is initially at full charge.



Graph indicates approximate battery life under the indicated Load Wattage @ 25°C (77°F).

The following equation can be used to estimate the life of a fully charged battery for a given Load Wattage (L_w).

$$\text{Hours} \cong \frac{56 - L_w/3.33}{L_w}$$

DBK34 and DBK34A Load/Life Graph

Charging: In general, lead-acid batteries require charging at 120% of drain energy (e.g., the 5 A-hr DBK34 requires a charge equal to or greater than 6 A-hr). Charging times vary; but 4 to 5 hours at 14 V are typical for a totally empty battery.

CAUTION



Voltage applied to charge a DBK34 must not exceed 15 VDC in 12 V mode, or 30 VDC in 24 V mode. If not charging from the vehicle, use of a generic automobile battery charger (3 A) in 12 V mode is recommended.

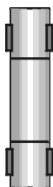
Environmental Concerns

CAUTION



The DBK34's batteries contain toxic materials (Pb and H₂SO₄). After the battery's life cycle is over (up to 500 full cycles or 5-10 years of use), sealed-lead batteries must be recycled or properly disposed of.

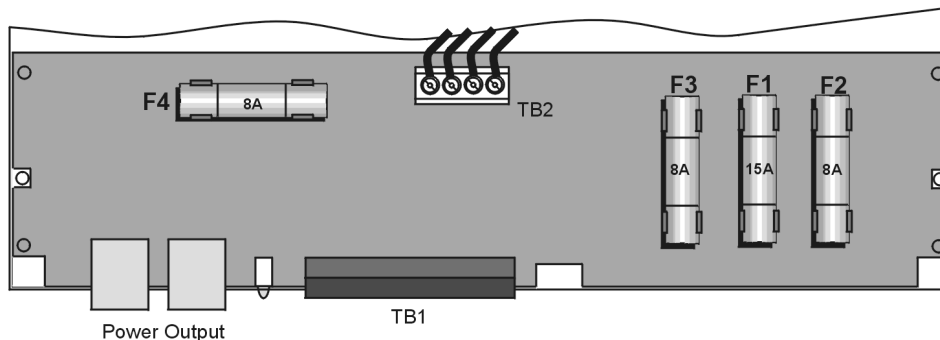
Fuse Replacement



DBK34 contains four glass fuses that can be replaced by the user. Note that you should always check your unit for blown fuses prior to sending it back to the factory for repair. This could save you time and money.

The following table indicates the probable reason that a particular fuse may have blown, and includes part numbers and amperage.

| Fuse | Rating | Probable Cause of Blowing Fuse | Replacement Fuse |
|------|--------|--------------------------------|------------------------------|
| F1 | 15 A | Overload on input power. | 15A, 32V, LITTLEFUSE# 311015 |
| F2 | 8 A | Output overload. | 8A, 32V, LITTLEFUSE# 312008 |
| F3 | 8 A | Output overload. | 8A, 32V, LITTLEFUSE# 312008 |
| F4 | 8 A | Auxiliary Battery overload. | 8A, 32V, LITTLEFUSE# 312008 |



DBK34 Fuse Locations

To replace a fuse:

1. Disconnect the DBK34 from loads and from supply power.
2. Remove the DBK34's cover plate. This requires the removal of 4 screws.
3. Examine the fuses (F1 through F4) to see which, if any, have blown. Note that you can usually see the blown element through the fuse's glass body.
4. Replace the blown fuse with the appropriate replacement fuse (see preceding table).
5. Replace the DBK34 cover and secure with screws (removed in step 2).

DBK34 - Specifications

Name/Function: Vehicle UPS Module

Battery Type: Sealed-lead rechargeable

Number of Battery Packs: 2

Battery Pack Configuration: 6 series-connected D cells

Output Voltage: 12 V or 24 V (depending on jumpers)

Output Fuses: 8 A on each internal battery (2)

Input Fuses: 8 A for auxiliary battery, 15 A for vehicle battery

Battery Capacity (Amp-Hours):

5 A-hr in 12 V mode (parallel)

2.5 A-hr in 24 V mode (series)

Operating Temperature: -20°F to 122°F (-29°C to 50°C)

Size: 8½ × 11 × 1¾ in. (216 × 279 × 44 mm)

Weight: 7.2 lb (3.27 kg)



| | |
|--|----------|
| <i>Hardware Setup for 12 Volt (Default) or 24 Volt Operation</i> | <i>3</i> |
| <i>Indicators</i> | <i>4</i> |
| <i>Runtime</i> | <i>4</i> |
| <i>Charging</i> | <i>4</i> |
| <i>Fuse Replacement</i> | <i>5</i> |
| <i>Environmental Concerns</i> | <i>6</i> |
| <i>DBK34A – Specifications</i> | <i>6</i> |



DBK34A is similar to DBK34 in appearance and operation; but there are differences. Before proceeding with this document module, verify that your device is a DBK34A. If your device does not have the “A” suffix, use the *DBK34 Document Module* instead of this one.



Reference Note:

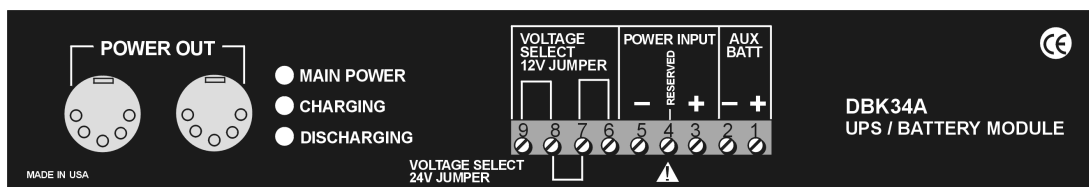
- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK34A can power a data acquisition system in portable or in-vehicle UPS applications (both 12 V and 24 V systems). Power storage capacity is 5 A-hr @ 12 VDC or 2.5 A-hr @ 24 VDC.

For reliable data acquisition in a vehicle, the DBK34A provides clean and consistent operating power:

- Prior to engine/generator start
- During engine start-up (battery sag due to the high-current demand of starter motor and solenoid)
- After engine turn off.
- Before and after connection to the vehicle



DBK34A Front Panel

The DBK34A contains two sealed-lead rechargeable batteries (Gel-Packs), associated charging circuits and current indicators. Typically, these batteries can last more than 500 full cycles and up to 10 years standby lifetime at room temperature. Recharging is fast, and extreme temperature performance is good. The DBK34A can be used with the LogBook, DaqBook, WaveBook, and related DBKs and WBKs. The unit's rugged metal package has a compatible 8×11" footprint for convenient stacking with Velcro tabs and optional splice plates and handles for carrying.

Main and auxiliary power input comes from 12 or 24 VDC via a terminal block on the unit's front panel (12 or 24 V modes are set by front-panel jumpers). Automatic, temperature-compensated charging circuits recharge the internal batteries quickly and safely. For trouble-free operation, you must fully charge the batteries before use. The charged battery runtime will depend on the load and mode of operation.

During use of the internal batteries, the Charging LED blinks and a beeper sounds when battery life is almost exhausted. Within a few minutes, internal cutoff circuits disconnect the load from the batteries to prevent the possibility of deep-cycle damage.

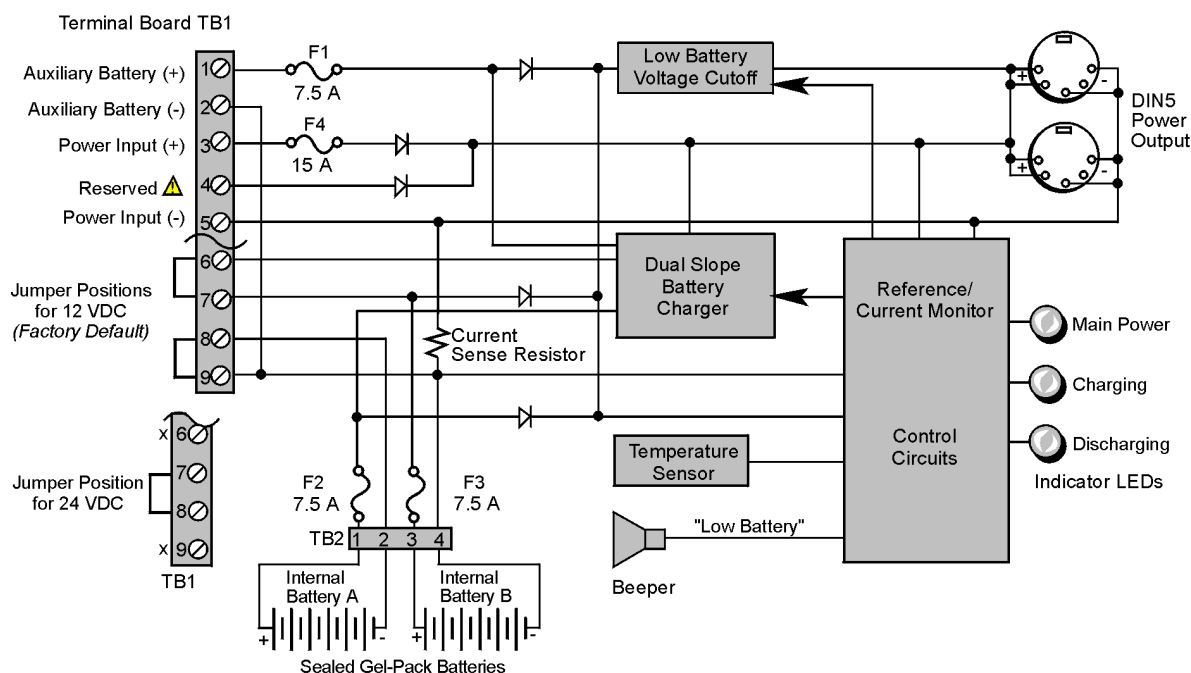
Note: Current protection is provided by four fuses: Two 7.5A fuses for the unit's internal batteries, one 7.5 A fuse for an auxiliary (external) battery, and a 15 A fuse for the power input.



You can use a CA-172 cable to connect a vehicle battery (via a cigarette lighter) to the DBK34A terminal board. The cable is six feet long, contains a cigarette lighter adapter at one end, and stripped leads (for terminal connection) at the other.



For trouble-free operation, fully charge the batteries before use.

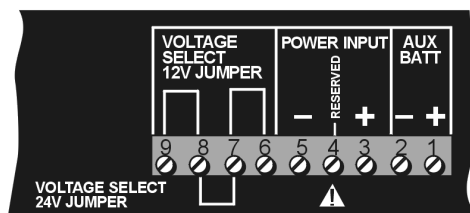


⚠ TB1's Terminal 4 is reserved for factory use and is not to be connected by the user.

DBK34A Block Diagram

Hardware Setup for 12 Volt (Default) or 24 Volt Operation

The DBK34A is configured for 12 volt or 24 volt operation via placement of jumpers on the front panel's screw-terminal block (TB1). DBK34A's screw-terminal numbers read as follows, when read from left to right: 9, 8, 7, 6, 5, 4, 3, 2, 1.



DBK34A's Screw Terminal Board, TB1

For 12 Volt Operation:

1. Remove jumper from terminals 8 and 7, if present.
2. Use a jumper to short terminals 9 and 8.
3. Use a jumper to short terminals 7 and 6.

For 24 Volt Operation:

1. Remove jumpers from terminals 9 and 8, if present.
2. Remove jumpers from terminals 7 and 6, if present.
3. Use a jumper to short terminals 8 and 7.

Power In (12 or 24 VDC only).

1. Connect the MAIN POWER INPUT (+) positive to Terminal 3 of TB1.
2. Connect MAIN POWER INPUT (-) negative to Terminal 5 of TB1.

TB1's Terminal 4 is reserved for factory use and is not to be connected by the user.
The use of an optional auxiliary battery will extend run-time.

Auxiliary Batteries.

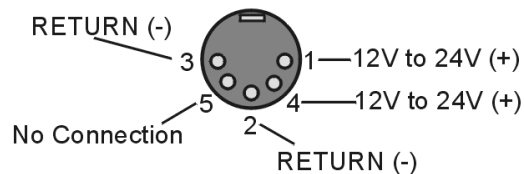
Auxiliary batteries for use with DBK34A, must be: (a) of lead-acid chemistry, (b) in the 2 to 3 A-Hr range, and (c) of the same voltage as that set by the Voltage Select Jumpers. Auxiliary batteries charge and discharge in the same manner as the internal batteries.

If an auxiliary battery is to be used:

1. Connect AUX BATT (+) *positive* to Terminal 1 (of TB1).
2. Connect AUX BATT (-) *negative* to Terminal 2 (of TB1).

Power Out.

The pinout at the right applies to the two POWER OUT DIN5 connectors.



DIN5 Power Output Connector (2 per DBK34A)

Indicators

Three front-panel LED indicators provide power and charging status information.

| LED Indicators & Descriptions | |
|-------------------------------|--|
| MAIN POWER | Lights when the DBK34A power input is connected to a source of at least 12.25 VDC |
| CHARGING | Lights when the internal batteries are being fast-charged at a rate of 0.1 amp/cell or greater. |
| DISCHARGING | Lights when internal batteries (or auxiliary batteries) are discharging at a rate of 0.25A or greater. |

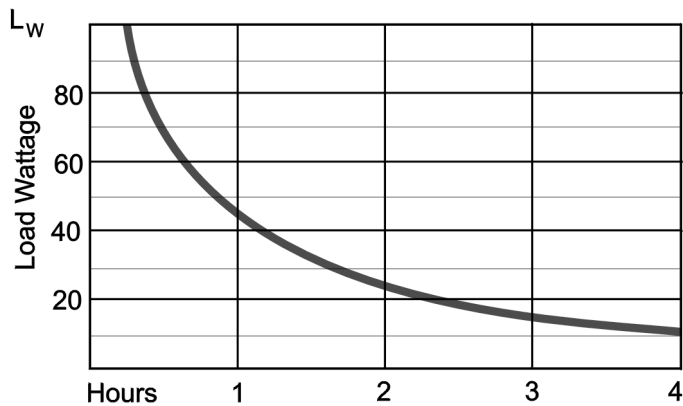
Runtime



For trouble-free operation, you must fully charge the batteries before use.
Charged battery runtime depends on the load and on the mode of operation.

Approximate runtime under various loads can be computed from the storage capacity (5 A-hr in 12 V mode; 2.5 A-hr in 24 V mode) and the load (main unit and other DBKs). See chapter 2, [Power Management](#).

The following Load Wattage vs. Hours graph is for a typical new battery that is fully charged.



Graph indicates approximate battery life under the indicated Load Wattage @ 25°C (77°F).

The following equation can be used to estimate the life of a fully charged battery for a given Load Wattage (L_w).

$$\text{Hours} \cong \frac{56 - L_w / 3.33}{L_w}$$

DBK34 and DBK34A Load/Life Graph

Charging

In general, lead-acid batteries [and related Gel-Packs] require charging at 120% of drain energy (e.g., the 5 A-hr DBK34A requires a charge equal to or greater than 6 A-hr). Charging times vary; but 4 to 5 hours at 14 V is typical for a completely discharged battery; after which, charging may continue indefinitely.

Note that 16 to 18 VDC at the power input is required for optimal charging.

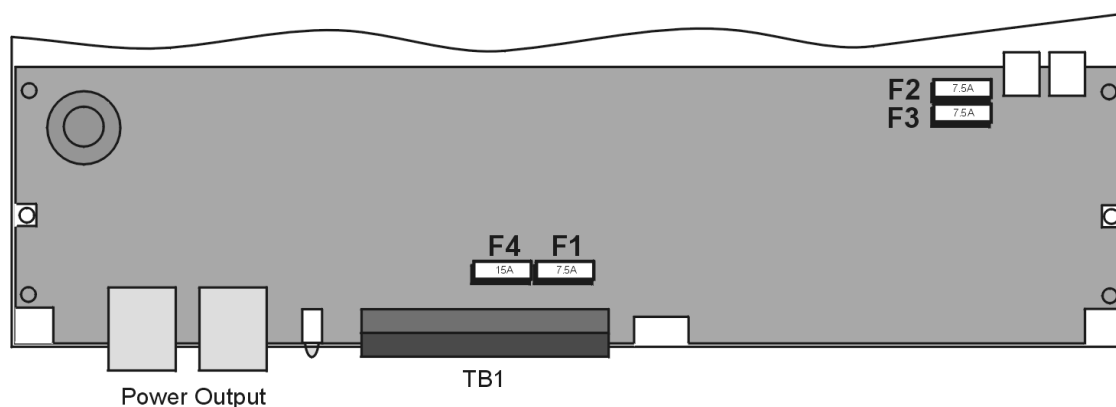
CAUTION
Voltage applied to a DBK34A must not exceed 30 VDC.

Fuse Replacement

DBK34A contains four MINI ATO fuses that can be replaced by the user. Note that you should always check your unit for blown fuses prior to sending it back to the factory for repair. This could save you time and money.

The following table indicates the probable reason that a particular fuse may have blown, and includes part numbers and fuse rating.

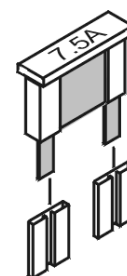
| Fuse | Rating | Probable Cause of Blowing Fuse | Replacement Fuse |
|------|--------|--------------------------------|-------------------------------------|
| F1 | 7.5 A | Auxiliary Battery overload. | 7.5A MINI ATO, LITTLEFUSE# 297-07.5 |
| F2 | 7.5 A | Output overload. | 7.5A MINI ATO, LITTLEFUSE# 297-07.5 |
| F3 | 7.5 A | Output overload. | 7.5A MINI ATO, LITTLEFUSE# 297-07.5 |
| F4 | 15 A | Input overload. | 15A MINI ATO, LITTLEFUSE# 297-015 |



DBK34A, Fuse Location Reference

To replace a fuse:

1. Disconnect the DBK34A from loads and from supply power.
2. Remove the DBK34A's cover plate. This requires the removal of 4 screws (2 per side).
3. Examine the fuses (F1 through F4) to see which, if any, have blown. Note that you can usually see the blown element through the fuse's transparent casing.
4. Replace the blown fuse with the appropriate replacement fuse (see preceding table). Note that the fuse value is present on top of the fuse; also, the fuses are color coded as an aid to identification.
5. Replace the DBK34A cover and secure with screws (removed in step 2).



Environmental Concerns



CAUTION

DBK34A Gel-Pack batteries contain toxic materials (Pb and H₂SO₄). At the end of the battery life cycle the Gel-Packs must be recycled or properly disposed of.

DBK34A – Specifications

Name/Function: UPS / Battery Module

Battery Type: sealed-lead gel-pack

Number of Battery Packs: 2

Battery Pack Configuration: 6 series-connected D cells

Output Voltage: 12 V or 24 V (set by jumpers on TB1)

Output Fuses: F2 and F3; one 7.5 A fuse for each internal gel-pack battery

Input Fuses: F1: 7.5 A for auxiliary battery, F4: 15 A for input overload

Battery Capacity (Amp-Hours):

5 A-hr in 12 V mode (parallel)

2.5 A-hr in 24 V mode (series)

Operating Temperature: -20°F to 122°F (-29°C to 50°C)

Size: 8½ × 11 × 1¼ in. (216 × 279 × 44 mm)

Weight: 7.2 lb (3.27 kg)

[Overview 1](#)
[Hardware Setup 2](#)
[Using the DBK40 2](#)
[DBK40 – Specifications 3](#)

**Reference Note:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

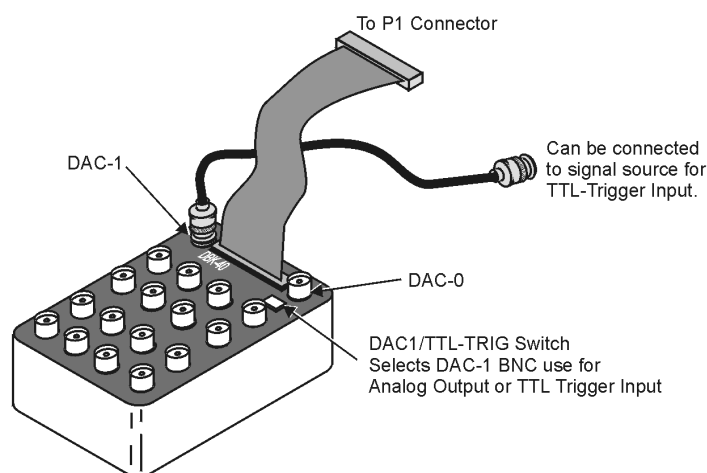
Overview

The DBK40 is a termination panel consisting of 18 BNC connectors. The unit provides an easy means of attaching analog signals from BNC cables to a DB-37 connector, such as P1 on a LogBook, a Daq device, or a DBK module.

The panel includes:

- 16 analog input channels
- 2 analog output channels (DAC-0 and DAC-1)
- a slide switch (DAC1/TTL-TRIG Switch)
- a male DB37 connector

The DAC1/TTL-TRIG Switch is used to select the mode of the DAC-1 BNC connector. DAC-1 can be used as an analog output channel, or as a TTL Trigger Input.



DBK40

Hardware Setup

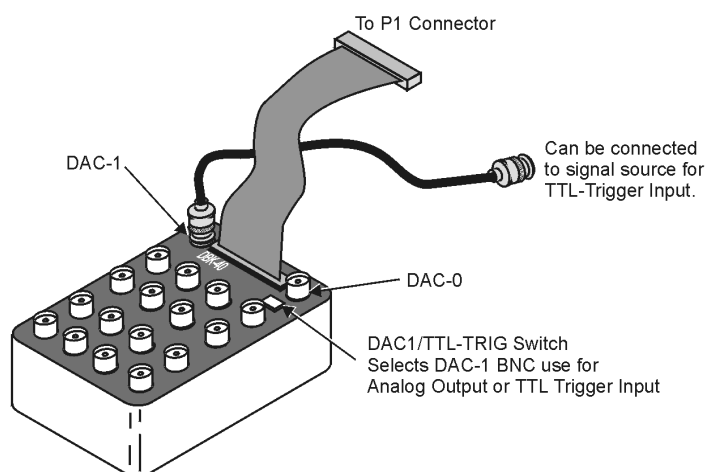
The DBK40 has a male DB37 connector that is pin-compatible with the P1 port. Typically a 6-foot ribbon cable is provided to attach the DBK40 to the P1 connector of the primary acquisition device, e.g., a LogBook or DaqBook.

CAUTION



Connecting the DBK40 to a port other than P1 may result in damage to the system.

Connect one end of the ribbon cable to the DB37 connector of the DBK40 and the cable's other end to the Analog I/O Port (P1) of the primary data acquisition device.



Using the DBK40

The DBK40 is equipped with BNC connectors for 16 single-ended or 8 differential inputs. Also provided are BNC terminals for DAC0 and DAC1 analog outputs.

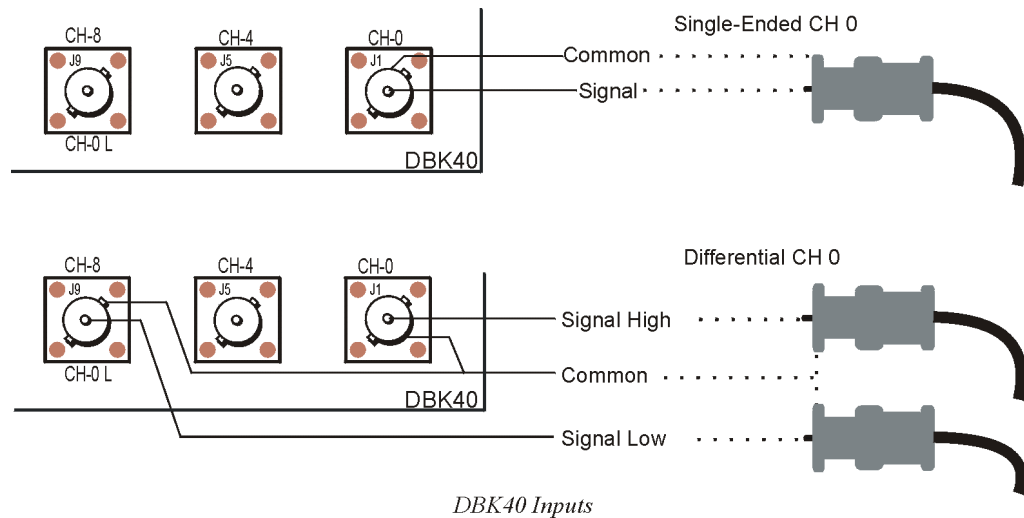
The DAC-1 connector may be used for access to the LogBook or Daq Device Analog I/O TTL trigger input. The position of the DBK40 slide switch determines the use of DAC-1, as indicated in the following table. Verify that this switch is in the correct position for your application.

| Switch Setting | Description |
|----------------|--|
| TTL/TRIG | Allows the connector to be used for TTL trigger input. |
| DAC-1 | Allows the connector to be used DAC-1 output. |

The collars of all of the BNC connectors are common to each other and analog ground. When the TTL trigger input is selected (via the slide switch), the isolated ground plane of the TTL-TRG/DAC1 connector is referenced to digital or TTL ground. Most of the top area of the DBK40's PC board is ground plane that provides excellent low-impedance, low-noise signal interfacing.

Connect your analog signals to the unit as you would to any other BNC connector. The outer shell is ground; the center pin is the signal.

The figure below shows connections for single-ended and differential inputs. In the differential mode, channels 0 to 7 are high; 8 to 15 are low (0 & 8, 1 & 9, 2 & 10, etc).



DBK40 - Specifications

Name/Function: BNC Analog Interface Module

Connection: Male DB37 mates with P1.

Analog Input Connection: One BNC connector for each of 16 analog input channels.

Single-Ended Mode: Center conductor carries signal, outer conductor carries signal ground.

Differential Mode: Center conductor of two adjacent BNC connectors carries high and low input signals; the outer conductors of both are attached to system ground.

Analog Output Connection: One BNC connector for each of 2 analog output channels; center conductor carries signal, outer conductor carries signal ground.

TTL Trigger Input Connection: One analog output BNC connector can be switched to provide a TTL trigger input connection; in TTL mode, the second analog output channel is unavailable on the BNC connector.

Size: 6.8" wide x 5.3" long x 2.3" high

Weight: 21 oz

Length of Supplied Cable: 6 ft



| | |
|--|----------|
| Overview | 1 |
| Hardware Setup | 2 |
| Card Configuration | 2 |
| Power Configuration | 2 |
| Card Insertion | 3 |
| EMI Shield Plates for CE Compliance | 4 |
| System Connection | 5 |
| DBK41 – Specifications | 5 |



Reference Note:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

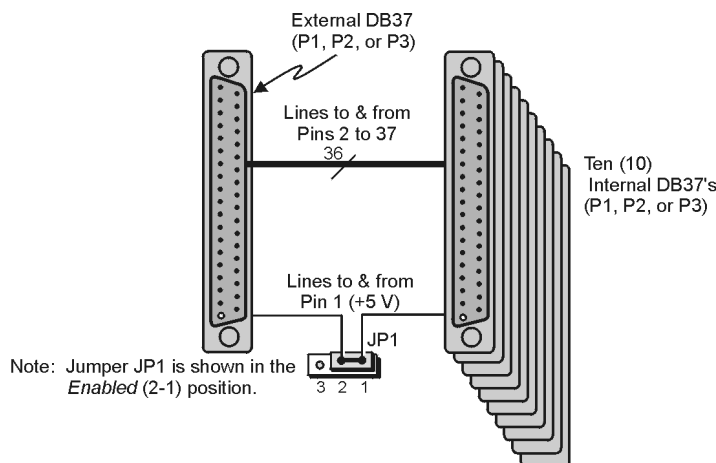
The DBK41 is a metal enclosure that holds up to 10 DBK cards. The exterior front panel has a male DB37 connector that leads to the LogBook or Daq device or further expansion via a CA-37-x cable. On the inside of the front panel, a backplane printed circuit board (PCB) uses 10 female DB37s with their pins connected in parallel to distribute the P1 interface (can also be used with P2 or P3). From the rear panel, the DBKs' signal input lines exit to their respective transducers.

An optional EMI kit provides shield plates for the rear panel to make the DBK41 CE-compliant and prevent EMI from DBKs entering the test environment (or vice-versa). The EMI kit also functions as an electrical safety barrier.

Some DBK cards require a lot of power, in relation to other cards, and the use of power is an important concern. DBK cards can obtain power externally from a LogBook, DaqBook, DaqBoard; or internally from a DBK32A or DBK33 card. (See chapter 2, [Power Management](#) and the power card modules)



A power card in any slot (other than the slot leftmost from rear view) will power the other cards via the backplane. A front panel LED will light whenever power from any source is on the backplane. DBK41's JP1 jumper can be positioned to disable the +5 V power line from the external DB37. This prevents a DBK33 power supply from interfering with other devices.



DBK41 Block Diagram

Hardware Setup

Setup concerns include card and power configuration, proper card insertion, the use of [EMI shields](#) for CE compliance, and mounting [or stacking] of hardware components.

In regard to mounting: metal splice plates can be used to rigidly mount a LogBook or DaqBook on top of a DBK41 or other device that shares the same footprint. For applications in which temporary mounting is convenient: a LogBook, DaqBook or notebook PC can be temporarily mounted to a DBK41 with the use of industrial-strength *dual-lock* pads or strips.

Card Configuration

Each DBK card should be checked for proper configuration, and re-configured if needed, before being inserted into the DBK41. Refer to the individual DBK Document Modules that are applicable to your system.

Power Configuration

Power must be configured to prevent multiple power supplies from interfering with each other via the P1 interface. DBK41, LogBook/360, DaqBook, and ISA-type DaqBoards each have JP1 jumpers that must be properly configured in regard to power. Details for each follow.

JP1 in the DBK41

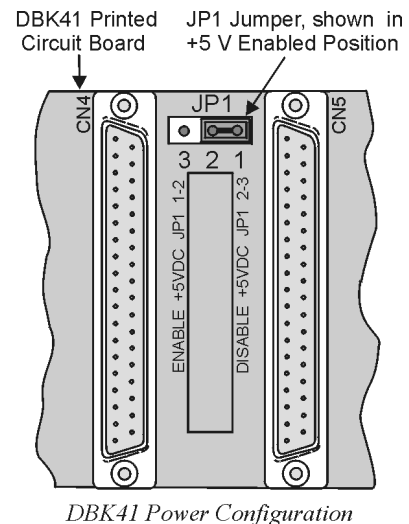
On the DBK41 backplane, JP1 is a 3-pin jumper positioned between DB37 connectors for card number 4 (CN4) and card number 5 (CN5). Two settings are possible, as follows:

ENABLE +5 VDC JP1 1-2

When JP1 pins 1 and 2 are jumpered, the +5 VDC line to the external P1 connector is enabled. The 5 V (VCC) is externally supplied to pin 1 for cards 1 through 10 (CN1 through CN10). The +5 VDC power can come from a LogBook, DaqBook, or DaqBoard through a CA-37-x cable on pin 1 of P1. If not using a DBK33, JP1 should be enabled.

DISABLE +5 VDC JP1 2-3

When JP1 pins 2 and 3 are jumpered, the +5 VDC line to the external P1 connector is disabled. When using a DBK33 power card in the DBK41, the JP1 jumper must be set on pin 2 and 3. The JP1 2-3 setting prevents the DBK33's +5 V from interfering with external devices via the P1 interface.



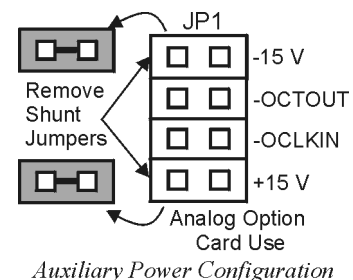
JP1 in the DaqBook and DaqBoard [ISA type]

CAUTION

**DBK power cards must not be connected until JP1 jumpers have been removed. Otherwise, equipment damage could result.**

If a DBK32A or DBK33 is used, you must remove the shunt jumpers from the JP1 header located inside the DaqBook or DaqBoard [ISA type]. DaqBooks and DaqBoards [ISA type] are shipped with these shunts positioned to deliver ± 15 V analog power to P1.

Note: The jumpers can be placed on the -OCTOUT and -OCLKIN pins but should be removed if there is interference with card operation (counter-timer).



JP1 and JP2 in LogBook/360

Proper jumper configuration limits LogBook/360's P1 bus to one power source. There should never be more than one power source. The jumpers are located inside the chassis, on the unit's *P1 Interconnect Board*.

JP1. Only remove LogBook/360's JP1 jumper if a DBK33 is used with the system.

JP2. Only remove the LogBook/360's JP2 jumper if DBK cards are to be powered from LogBook/360's internal PCB.



Reference Note:

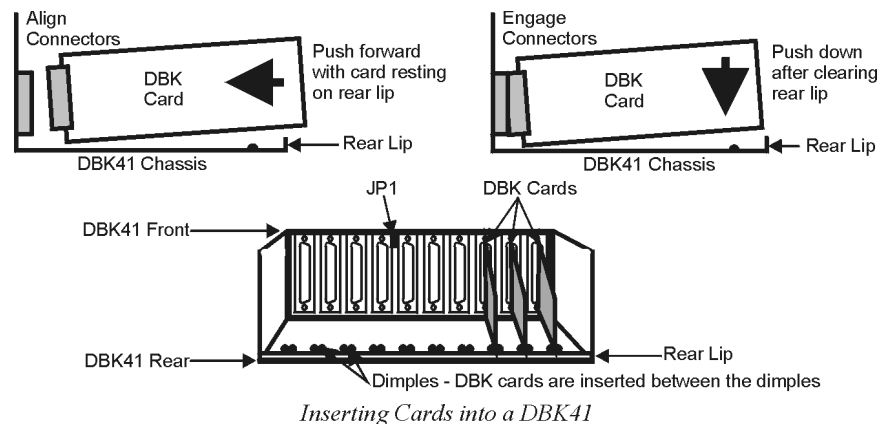
Refer to the *LogBook User's Manual*, 461-0901 for information regarding LogBook systems.

Card Insertion

Each DBK card has a DB37 male connector which mates with the DB37 female connectors inside the DBK41 chassis. To insert DBK cards into the DBK41 chassis, refer to the figure and perform the following steps.

Note: Cards using screw-connectors for signal input lines must be wired before insertion.

1. Disconnect power from all units to be connected.
2. Place the DBK41 on a flat surface; loosen the two thumbscrews on rear of the case; and remove the top cover by sliding it off.
3. Align the DBK card with the DBK41 connector to be used (CN1 to CN10). The first slot must always be occupied; however, a DBK32A or DBK33 power card may not occupy the first slot. Any of the remaining 9 slots can be used or unused.
4. To clear the lip on the rear panel, tilt the rear of the card upward. Engage the P1 connectors of the card and chassis, and press together gently to avoid damage to the pins.
5. Press down the rear of the card, aligning it within the metal dimples at the rear of the DBK41.
6. After cards are in place, reassemble the DBK41's top cover and attach optional shield plates (described next); then re-connect and power up the system.



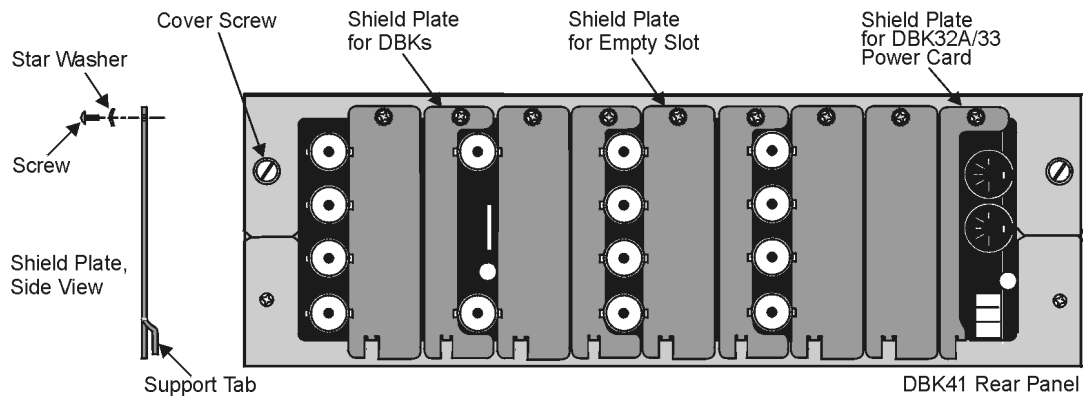
EMI Shield Plates for CE Compliance

To reduce electro-magnetic interference (EMI) escaping from (or entering into) the enclosure, a CE kit provides shield plates that attach to the rear of the DBK41. The kit also functions as an electrical safety barrier. With shield plates attached (a combination of 3 types supplied), the system meets CE standards. The kit includes:

- Full shield plates to cover empty (unused) slots
- Partial shield plates to surround DBKs in a slot (except a power card)
- Partial shield plates to surround a DBK32A or DBK33 power card
- Screws and star washers to secure the shields to the chassis

Note: The CE kit is included with the DBK41/CE and an optional accessory for a DBK41.

The shields have a support tab that slides over the edge of the bottom plate and a screw hole for attachment to the top plate. When tightened, the screws cause the washers to pierce the surface coating into the metal to make a good contact with chassis ground.



EMI Shield Plates on DBK41 Rear Panel



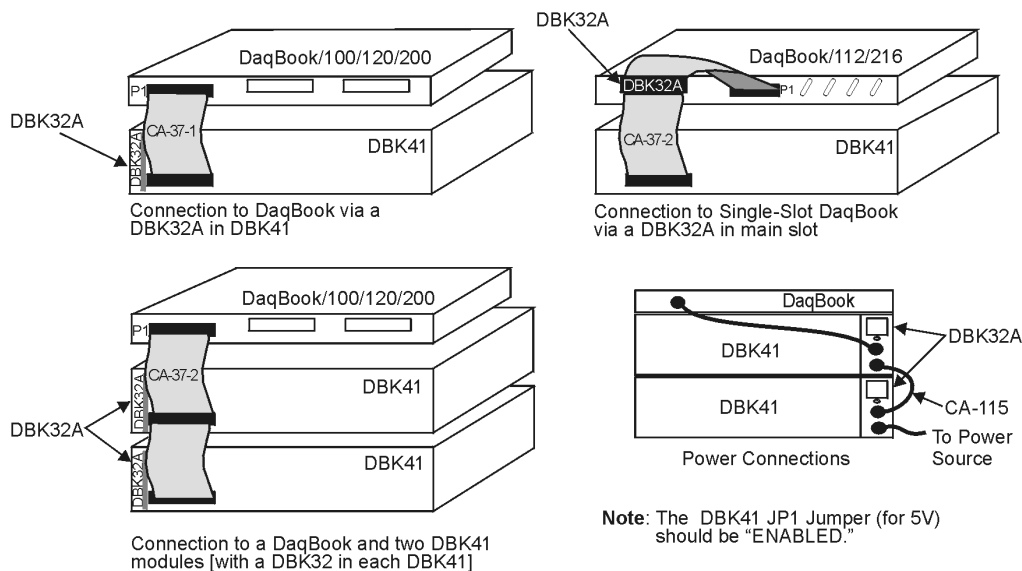
Reference Note:

[Chapter 1](#) contains additional information pertaining to CE Compliance.

System Connection

A short ribbon cable (CA-37-x) attaches the DBK41 to the main unit. Connecting the DBK41 to any port other than P1 may damage devices in the system. Likewise, only analog expansion cards may be installed in the DBK41.

Note: For CE compliance, the CA-37-x cable must be replaced with a CA-143-7 or CA-143-18. Multiple chassis require a “T” connector (part # CN-143) for branching.



Examples of DBK41 Connections [with DBK32A] and Cascading Power

DBK41 - Specifications

Name/Function: 10-Slot Analog Expansion Module

Card Capacity: 10 slots to hold standard DBK option cards

Weight: 4 lb (with no cards installed)

Cable (optional): 8" ribbon with DB37 female to DB37 female (CA-37-x)

Power Indicator: LED powered by external device's 5 VDC

Connection: Male DB37, mates via CA-37-x cable with P1



Overview 1**Hardware Setup 2**

DBK42 Connection 2

DBK42 Configuration 2

5B Module Connection 2

Power Considerations 3

Terminal Block Connections 3

DaqBoard/2000 Series and

cPCI DaqBoard/2000c Series Connections 5

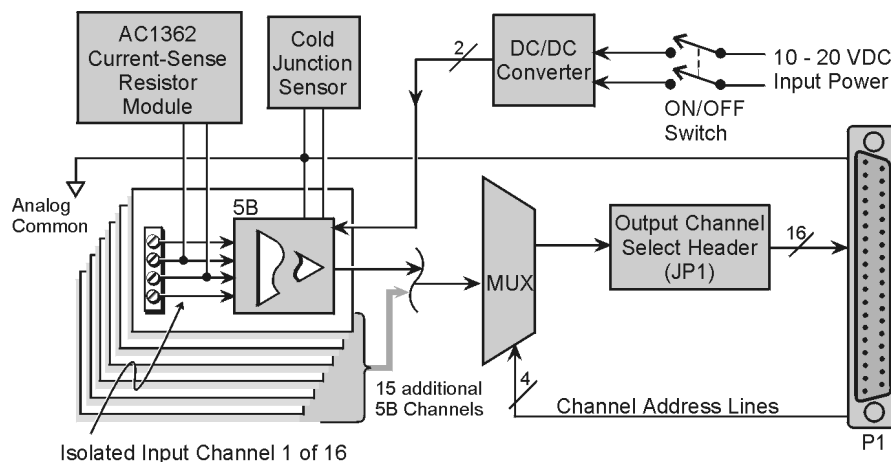
DaqBook and ISA-Type DaqBoard Configuration 5

Software Setup 5**mx+b Values for 5B Modules 6****DBK42 – Specifications 7****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK42 allows LogBook or Daq device systems to work with up to 16 5B signal conditioning modules. Modules are available for various signal types (e.g., low-level thermocouple signals, strain-gage signals, etc). The DBK42 offers 500 V isolation from the system and between channels. The DBK42 is compatible with all 5B output modules, and the configuration is very flexible. You can select the type of signal attached to each channel.



An accessory cable connects the DBK42's output to the P1 analog input connector. One LogBook or Daq device can support up to 16 DBK42 units with a maximum of 256 isolated analog input channels. The LogBook or Daq device scans the DBK42 channels at the same 10 μ s/channel rate as other DBKs (256 scans in 2.56 ms in a full system).

The DBK42 can obtain power from an included AC adapter, an optional DBK30A rechargeable battery module, or directly from a 12 VDC source (such as a car battery). The built-in power supply can serve a fully-configured system using bridge excitation.

For DaqBoard/2000 Series applications, DBK42 is typically powered from an included AC adapter. The unit's built in power supply can serve a fully-configured system using bridge excitation.

Each terminal block contains 4 terminals (per channel) for access to input and excitation features of 5B modules.

The optional CN-71 and CN-72 signal connection blocks provide a convenient way of connecting analog signals to the DBK42.

- **The CN-71 is for non-thermocouple use.**
- **The CN-72 (with cold junction sensors) is for thermocouple use.** The CN-72 has a clear plastic shield over its screw terminals to protect you from high voltage on the input terminals.

Hardware Setup

DBK42 Connection

The DBK42 has screw-terminal connectors for easy access to the analog inputs. 2-wire and 4-wire hookups are shown later in this section.

Note: Analog channels are isolated from each other, and no analog ground is provided.

DBK42 Configuration

Up to 16 DBK42s can connect to a LogBook or a Daq device. As a daisy-chain interface, each module must appear unique and use a different channel.

To configure the module, locate the 16×2-pin header (JP1) near the front of the DBK42 board. Note the 16 jumper locations labeled CH0 through CH15 representing the base Analog Input Channels. Place the jumper on the channel you wish to use.



Only one jumper is used on a single DBK42. No two cards in a system can use the same JP1 setting.

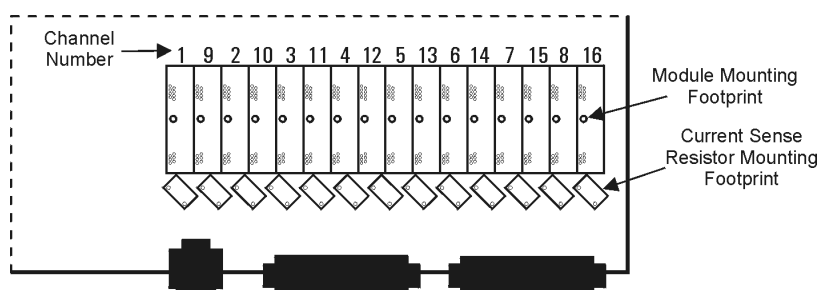
| JP1 | |
|-------------------------------------|------|
| <input type="checkbox"/> | CH15 |
| <input type="checkbox"/> | CH14 |
| <input type="checkbox"/> | CH13 |
| <input type="checkbox"/> | CH12 |
| <input type="checkbox"/> | CH11 |
| <input type="checkbox"/> | CH10 |
| <input type="checkbox"/> | CH9 |
| <input type="checkbox"/> | CH8 |
| <input type="checkbox"/> | CH7 |
| <input type="checkbox"/> | CH6 |
| <input type="checkbox"/> | CH5 |
| <input type="checkbox"/> | CH4 |
| <input type="checkbox"/> | CH3 |
| <input type="checkbox"/> | CH2 |
| <input type="checkbox"/> | CH1 |
| <input checked="" type="checkbox"/> | CH0 |

*Factory Default
Channel
Configuration*

5B Module Connection

Each input of the DBK42 is processed through a user-installed 5B signal-conditioning module. Different 5B modules are used with different transducer and signal sources. To install the modules:

1. Match the footprint of the module with the footprint on the circuit board (see figure).
2. Gently place the module into the footprint, and screw it down.
3. When installing current input modules (SC-5B32 series), install the supplied current-sense resistor (SC-AC-1362) in the resistor footprint adjacent to the module mounting footprint.
4. Record the module's channel number; label all units and connectors for identification.



Module Installation

Power Considerations

The DBK42 has an internal, isolated switching-type power supply that operates on 10-20 VDC at varying input currents depending on the input voltage and 5B-module loading. The power drain at a given output load is constant; input current will vary inversely with the input voltage.

A DBK42 populated with strain-gage modules will draw more current than with other types of input modules. The table shows the DC input requirements for the worst-case setup (with 16 strain-gage modules or 16 thermocouple modules).

| Input Volts | With Strain-Gage Modules | With Thermocouple Modules |
|-------------|--------------------------|---------------------------|
| | Input Amperes | Input Amperes |
| 10 VDC | 3.0 A | 0.60 A |
| 11 VDC | 2.7 A | 0.54 A |
| 12 VDC | 2.4 A | 0.48 A |
| 13 VDC | 2.2 A | 0.44 A |
| 14 VDC | 2.0 A | 0.40 A |
| 15 VDC | 1.9 A | 0.38 A |
| 16 VDC | 1.8 A | 0.36 A |
| 17 VDC | 1.7 A | 0.34 A |
| 18 VDC | 1.6 A | 0.32 A |
| 19 VDC | 1.5 A | 0.30 A |
| 20 VDC | 1.4 A | 0.28 A |

Power sources include:

- The standard TR-25 AC plug-in power pack (provided with the DBK42) can supply 900 mA at 15 VDC. The optional TR-40U can supply 2700 mA at 15 VDC.
- The DBK30A battery pack can supply power for a typical DBK42 configuration; however, in a fully-populated strain-gage configuration, the battery run-time will be limited to about 1½ hours.
- A 12 V lead-acid gel-cell type battery can easily power a fully-populated strain-gage configuration. The battery drain will be about 2.4 A-hr; battery size should be considered for systems with long run-times. (For example, a common-size 5.0 A-hr battery will operate for about 2 hours). A typical automotive 12-V lead-acid battery (e.g., 60 A-hr) can easily power a DBK42 for long run-times (about 24 hours).

The input fuse is a 4-A Slo-Blo 1-1/4" × 1/4" glass-type such as Littelfuse 313004 or Bussman MDL-4.

Terminal Block Connection

Input signals (and excitation leads) must be wired to the DBK42 signal termination panel. Sixteen 4-terminal blocks accept up to 16 inputs. These connectors are located on a removable PC board that plugs into two DIN96 rectangular connectors on the rear panel.

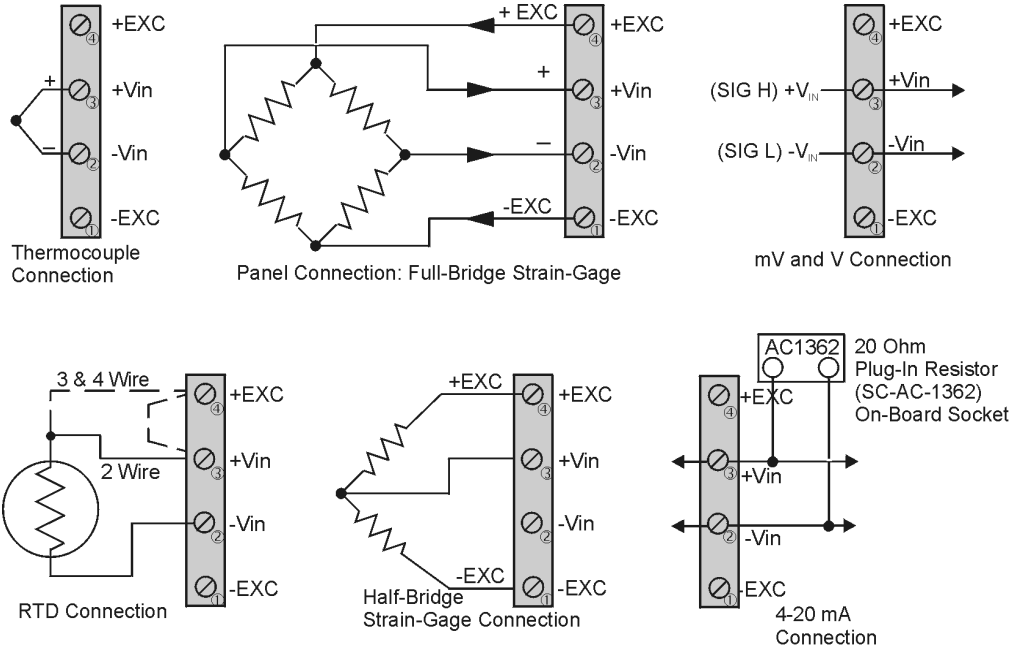
| WARNING | |
|---|---|
|  | Shock Hazard! The DBK42 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK42 before changing the wiring or configuration. |

Terminal blocks are connected internally to their corresponding signal conditioning module. The terminal blocks accept up to 14-gage wire into quick-connect screw terminals. Terminals on each block are numbered 1 through 4. Each type of input signal or transducer (such as a thermocouple or strain gage) should be wired to its terminal block as shown in the figure. Wiring is shown for RTDs, thermocouples, 20 mA circuits, mV/V connections, and for full- and half-bridge strain gages.

WARNING



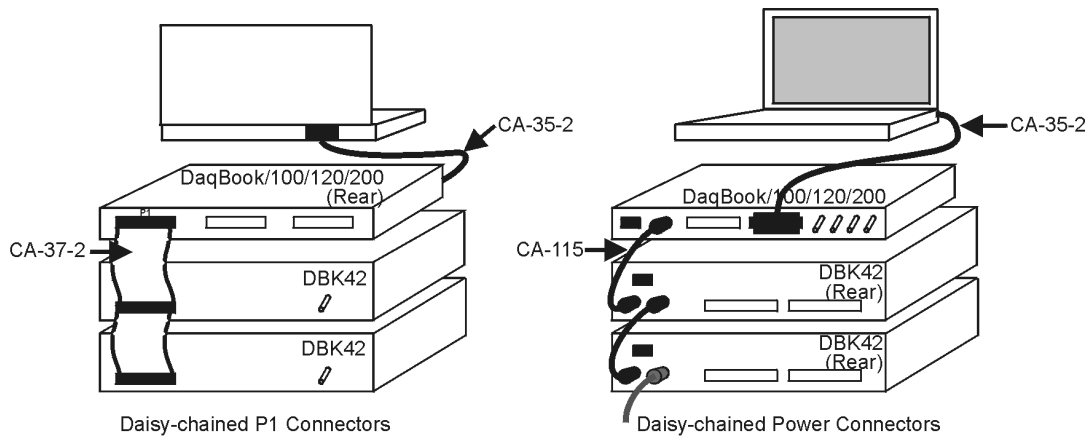
Shock Hazard! The DBK42 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK42 before changing the wiring or configuration.



DBK42 Terminal Connections

P1 Connection. The DBK42 attaches to the P1 analog I/O connector or to a DBK200 series P4-Adapter's P1 analog I/O connector. (Up to 16 units can be attached to one LogBook or Daq device.) Connect the appropriate ribbon cable (with -x indicating the number of cards to be connected) from the LogBook's, Daq device's, or adapter's P1 port to the DB37 connector at the end of the option card.

Note: A series of interface cables are available for connecting up to sixteen DBK42s.



Daisy-Chaining DBK42s

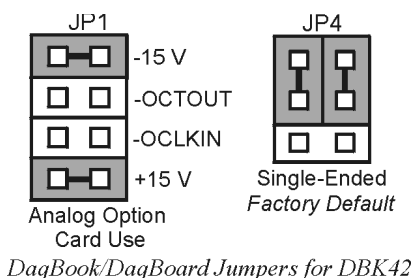
DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Connections

DBK42 can be connected to the P1 connector of DaqBoard/2000 Series P4-adapters. Up to 16 units can be attached to one DaqBoard/2000 Series board.

Connect the appropriate ribbon cable (with -x indicating the number of cards to be connected) from the adapter's P1 port to the DB37 connector at the end of the option card.

Note: A series of interface cables is available for connecting up to 16 DBK42s.

DaqBook and ISA-Type DaqBoard Configuration



The DBK42 requires two setup steps in DaqBooks and DaqBoards [ISA type]—jumpers JP1 and JP4.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.

Note: This default position is necessary to power the interface circuitry of the DBK42 via the internal ± 15 VDC power supply. If using auxiliary power (DBK32A, or DBK33), you must remove both JP1 jumpers (refer to chapter 2, [Power Management](#) and the DBK32A and DBK33 sections).

2. For DaqBook/100, /112, and /120 *only*, place the JP4 jumper in the DaqBook or ISA-type DaqBoard in *single-ended* mode. Analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

$mx+b$ Values for 5B Modules

The $mx+b$ calculations for most 5B modules are included within LogView software. The table shows the m and b values for various 5B modules.

| 5B Module | m Value | b Value | Engineering Unit(s) |
|---|---------|---------|---------------------|
| Isolated Voltage Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B31-01 | 1/5 | 0 | mV, V |
| SC-5B31-02 | 1 | 0 | mV, V |
| SC-5B31-03 | 2 | 0 | mV, V |
| SC-5B31-04 | 2/5 | -1 | mV, V |
| SC-5B31-05 | 2 | -5 | mV, V |
| SC-5B31-06 | 4 | -10 | mV, V |
| Isolated Wideband Voltage (5 V Current Requirement, 30mA) | | | |
| SC-5B41-01 | 1/5 | 0 | V |
| SC-5B41-02 | 1 | 0 | V |
| SC-5B41-03 | 2 | 0 | V |
| SC-5B41-04 | 2/5 | -1 | V |
| SC-5B41-05 | 2 | -5 | V |
| SC-5B41-06 | 4 | -10 | V |
| Isolated Millivolt Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B30-01 | 2 | 0 | mV |
| SC-5B30-02 | 10 | 0 | mV |
| SC-5B30-03 | 20 | 0 | mV |
| SC-5B30-04 | 4 | -10 | mV |
| SC-5B30-05 | 20 | -50 | mV |
| SC-5B30-06 | 40 | -100 | mV |
| Isolated Wideband Millivolt (5 V Current Requirement, 30 mA) | | | |
| SC-5B40-01 | 2 | 0 | mV |
| SC-5B40-02 | 10 | 0 | mV |
| SC-5B40-03 | 20 | 0 | mV |
| SC-5B40-04 | 4 | -10 | mV |
| SC-5B40-05 | 20 | -50 | mV |
| SC-5B40-06 | 40 | -100 | mV |
| Isolated Linearized T/C Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B47-J-01 | 152 | 0 | °C |
| SC-5B47-J-02 | 80 | -100 | °C |
| SC-5B47-J-03 | 100 | 0 | °C |
| SC-5B47-K-04 | 200 | 0 | °C |
| SC-5B47-K-05 | 100 | 0 | °C |
| SC-5B47-T-06 | 100 | -100 | °C |
| SC-5B47-T-07 | 40 | 0 | °C |
| SC-5B47-E-08 | 200 | 0 | °C |
| SC-5B47-R-09 | 250 | +500 | °C |
| SC-5B47-S-10 | 250 | +500 | °C |
| SC-5B47-S-11 | 260 | +500 | °C |
| Isolated RTD Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B34-01 | 40 | -100 | °C |
| SC-5B34-02 | 20 | 0 | °C |
| SC-5B34-03 | 40 | 0 | °C |
| SC-5B34-04 | 120 | 0 | °C |
| SC-5B34-C-01 | 24 | 0 | °C |
| SC-5B34-C-02 | 24 | 0 | °C |
| SC-5B34-N-01 | 24 | 0 | °C |
| Isolated Current Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B32-01 | 3.2 | 4 | mA |
| SC-5B32-02 | 4 | 0 | mA |
| Voltage Switch Input | | | |
| SC-AC-1367 | 1 | 0 | V |

DBK42 – Specifications

Name/Function: 16-Slot 5B Signal Conditioning Module

Module Capacity: 16 (input only) 5B modules

Size: 8.5" x 11" x 3.5" (11" x 11" x 3.5" with optional CN-71 or CN-72)

Weight: 4 lb (with no modules installed)

Cable (optional): CA-37-1

Power Requirements: 10-24 VDC @ 2.6 - 0.3 A

With 16 thermocouple-type modules:

12 VDC @ 0.50 A

15 VDC @ 0.40 A

18 VDC @ 0.35 A

With 16 strain-gage type modules:

12 VDC @ 1.9 A

15 VDC @ 1.5 A

18 VDC @ 1.3 A

DC Input Fuse: 3A

Power Indicator: LED powered by internal 5 VDC

Power Connection: DIN5 x2 for daisy-chaining

AC Power Pack::

120 VAC to 15 VDC converter

120 VAC to 15 VDC @ 2.0 A (optional)

Input Connections: DIN96 rectangular, standard, screw terminal adapter (optional)

Connection: Male DB37 mates via CA-37-1 cable with P1

DC/DC Converter: 10-24 VDC to 5 VDC (isolated)

Isolation:

Input Power to System: 500 VDC

Signal Inputs to System: 1500 VDC

Input Channel-to-Channel: 500 VDC



| | |
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Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Note: Because of the DBK43A's flexibility in configuration, please review the entire section before attempting setup and operation.

Overview

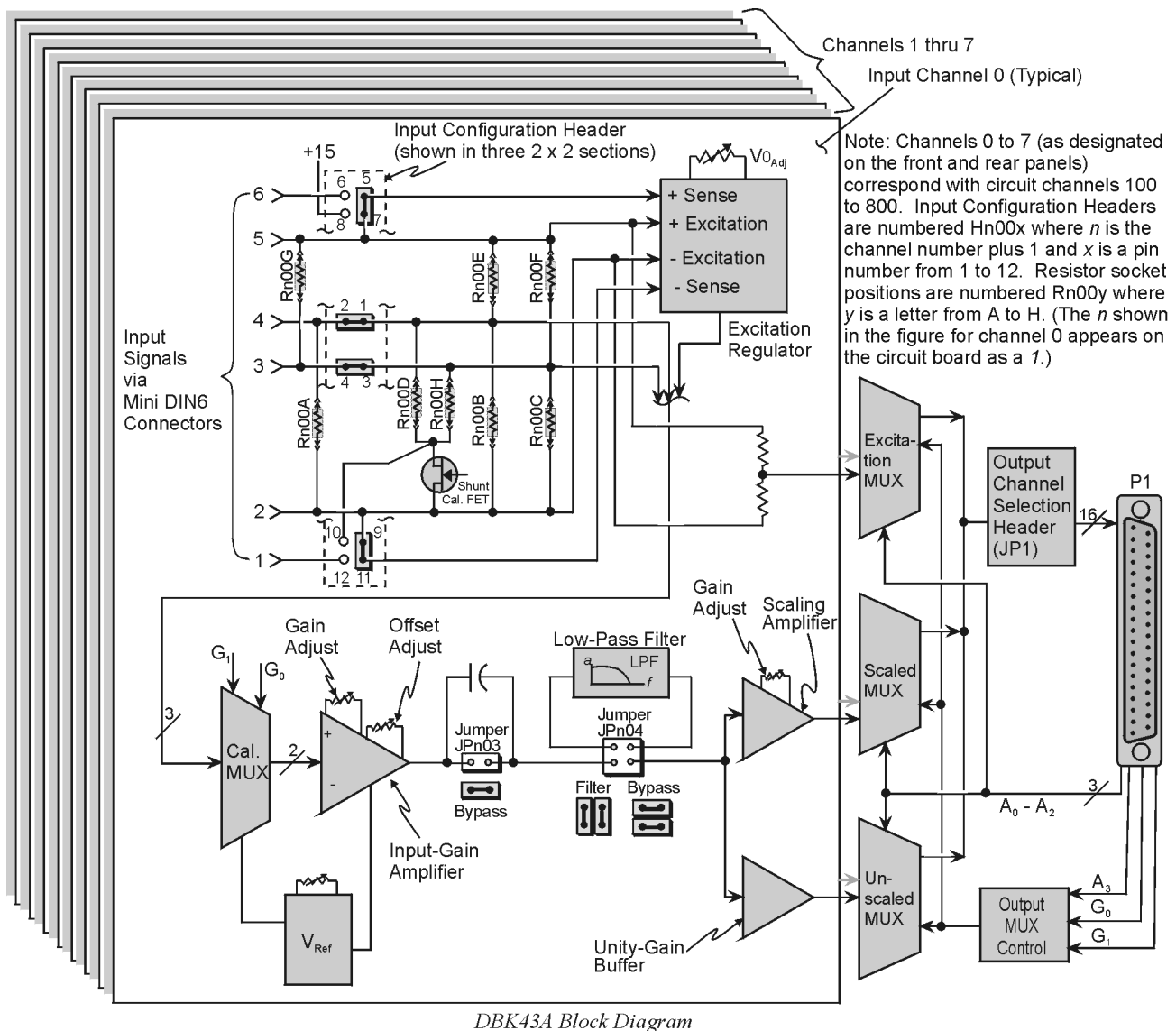
The DBK43A will condition signals from most bridge-circuit transducers that have a signal output of less than 50 mV. Strain gages and load cells are common types. As needed, refer to the block diagram (below) and the board layout (later).



For half-bridge and quarter-bridge strain gages, the DBK43A can accommodate user-supplied BCRs (bridge-completion resistors) that complete the bridge circuit. The bridge circuit must be complete for the DBK43A to operate correctly.

Each channel of the DBK43A offers a selectable 3-pole, low-pass filter with a user-set cut-off frequency. Remote-sense terminals are provided to make 6-wire Kelvin connections. Up to 2 DBK43A modules can be connected to each of 16 analog base channels for up to 256 input signals.

The DBK43A provides an amplifier gain range of $\times 100$ to $\times 1250$ for use with strain gages having 0.4 to 10 mV/V sensitivities. Most strain gages are specified for a full-scale value of weight, force, tension, pressure, or deflection with an output of mV/V of excitation. For example, a strain gage with a full-scale rating of 1000 lb of tension might output 2 mV/V of excitation at full load. With an excitation of 10 VDC, 1000 pounds of load would produce an output of 20 mV.



The module's 0 to 5 VDC offset and output-scaling permit nulling of large quiescent (inactive or motionless) loads and expansion of the dynamic range for maximum resolution. Typically, the quiescent output is non-zero. Prior to a force being applied, a mounted strain gage can be in a state of partial deflection resulting in an output. In the case of a tension gage, this output may be due to the weight of a hook or empty container.

The DBK43A includes an internal excitation voltage source. The wide-range excitation regulator is adjustable from 1.5 to 10.5 VDC with a current limit of 50 mA.

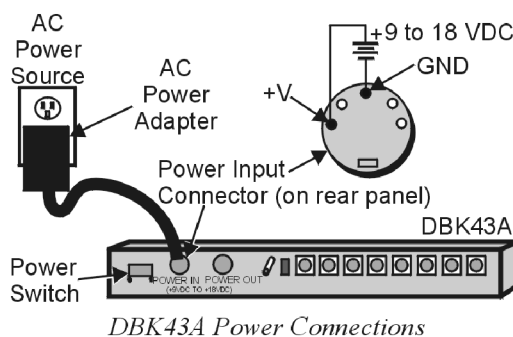
Hardware Connection

Power Connection

The DBK43A requires input voltage between +9 and +18 VDC. The DC source should be filtered but not necessarily regulated—the DBK30A is recommended for portable use. The DBK43A's isolated DC/DC converter-based power supply provides all excitation voltages and biasing for its amplifier circuits. Each of the eight on-board excitation regulators can be adjusted from 1.5 to 10.5 VDC. These outputs have remote sensing terminals and feature 50 mA current limiting to prevent damage from short-circuit or overload. The regulators' wide voltage range can accommodate any resistive or semi-conductive gage type.

The DBK43A may be powered with the supplied AC adapter that plugs into any standard AC wall outlet or from any isolated 9-18 VDC source of 16 W (see figure). Before plugging unit in, make sure the power switch is in the "0" (OFF) position.

- If using an AC power adapter, plug it into an AC outlet and attach the low voltage end to the jack on the DBK43A.
- If using another 9 VDC to 18 VDC source, make sure the leads are connected to the proper DIN terminals.



CAUTION




POWER IN : The power connectors are rated at 5 amps maximum DC current. The power supply provided with the DBK43A can power the unit but not any auxiliary devices. If using the DBK43A's power supply, do not use the POWER OUT terminal. If using another power supply to power auxiliary devices from the POWER OUT terminal, make sure that power supply is current-rated for the units connected (up to 5 amps DC).

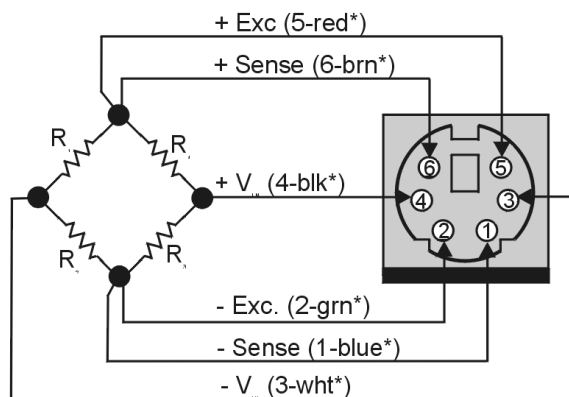


POWER OUT : Maximum output current is 3 amps DC. Use a power supply capable of supplying 5 amps DC at POWER IN.

Signal Connection

| CAUTION | |
|---|---|
|  | The maximum channel signal input from input pin #4 (V+) to pin #3 (V-) is 50 mV. There is no common-mode isolation between inputs (common-mode voltage between inputs must be 0 V). |

The following figure shows the 6-pin signal connector (1 of 8) on the back of the DBK43A, and a full-bridge with remote sensing configuration.



* Mini-DIN6 connector pin; color code of CA-132 cable

DBK43A Signal Input Connection

Hardware Configuration

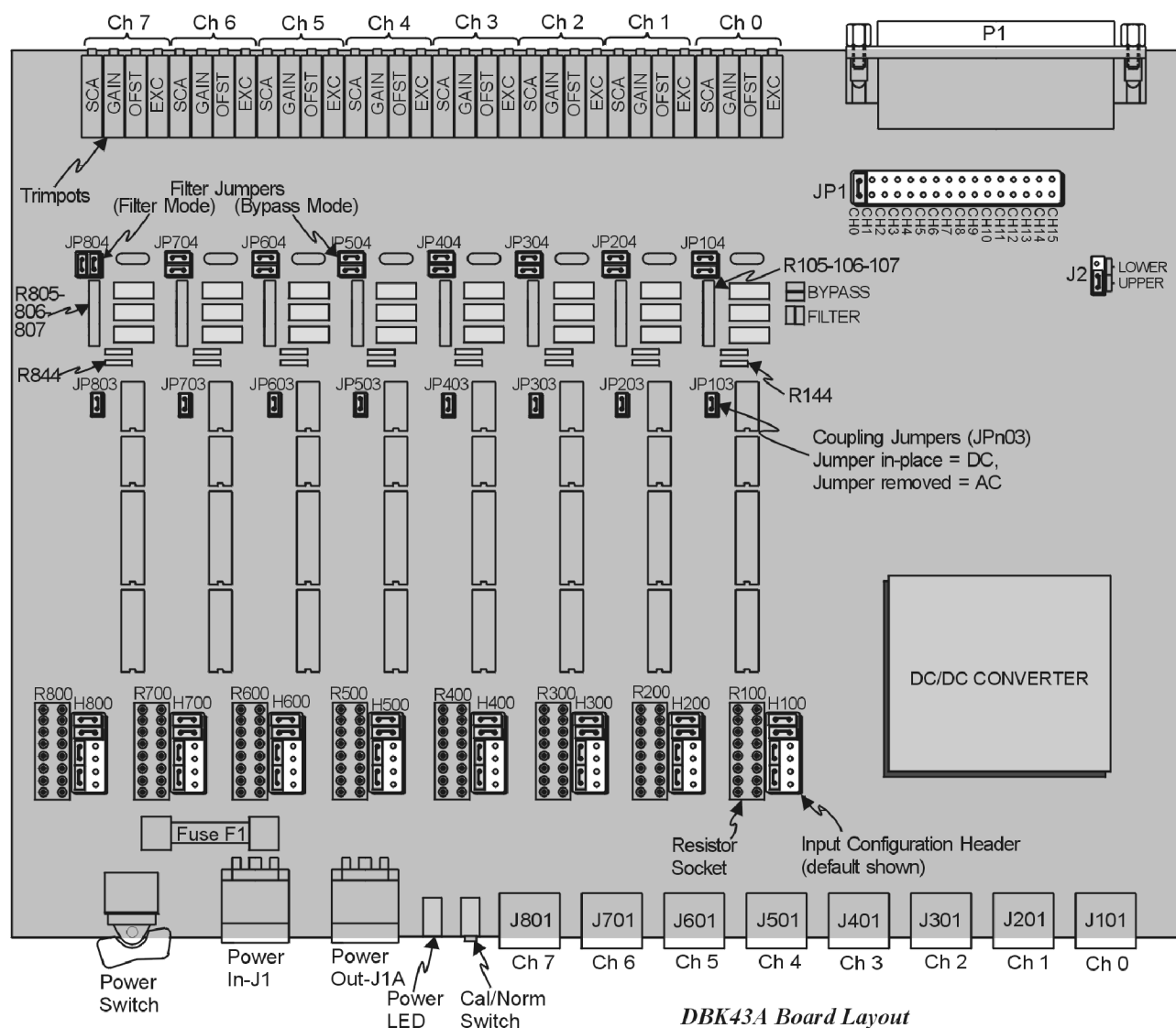
Factory Defaults:

- **Bridge configuration: Full**
- **Coupling: DC**
- **Low pass filter: Disabled (bypassed); resulting in 3.8 Hz cutoff-frequency**

Configuration options on the DBK43A are:

- Bridge Applications using various bridge-completion resistors and jumpers
- AC Coupling and Low-Pass Filter Options
- P1 Output Channel and Card Address Selection

The following board layout can be referred to for jumper, switch, and resistor locations.



Bridge Applications

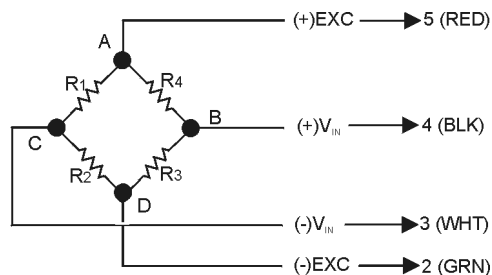
There are several ways to hook-up strain gages—all are configured into a 4-element bridge (the 4 legs in a bridge circuit). The *quarter-*, *half-* or *full-* designation for a strain gage refers to how many elements in the bridge are strain-variable. A quarter bridge has 1 strain-variable element; a half bridge has 2 strain-variable elements; and a full bridge has four strain-variable elements. Each channel of the DBK43A has locations for bridge-completion resistors when using quarter- and half-bridge strain gages. These resistors are fixed values necessary to fill out the 4-element bridge configuration.

The following is a standard symbol for a 4-element bridge type strain gage. The figure makes use of bridge-completion resistor designations for a DBK43A channel.

If R1 - R4 is a fixed resistor, it may be placed internally in the Rn locations on the resistor plug. "n" is the channel number + 1.

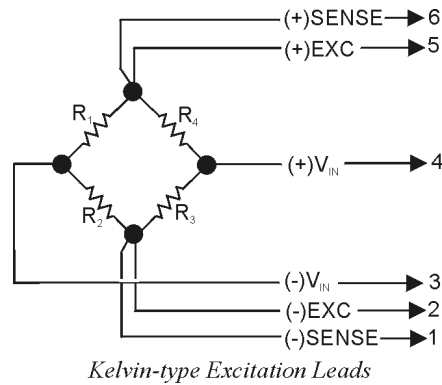
R1 = Rn00F
R2 = Rn00C
R3 = Rn00E
R4 = Rn00B

Example:
R3 in channel 7 = R800E location



Bridge-Completion Resistors

Any or all of the 4 resistive elements may be strain-variable. Where an element is a fixed resistor, the fixed resistor may be installed in the internal location provided. (The n is the channel number +1; for an internal resistor on channel 7, the location is R800E.)



Connections are provided for Kelvin-type excitation. The excitation regulators stabilize the voltage at the points connected to the on-board sampling dividers. Unless you run separate sense leads to the excitation terminals of the strain gage, the voltage regulation is most accurate at the terminal blocks on the DBK43A. In a Kelvin-type connection, six wires run to a 4-element strain gage, and the excitation regulation is optimized at the strain gage rather than at the terminal blocks. This connection works with as little as 10 feet of 22 gauge lead wire if accuracy is critical. (See *Full-Bridge with Remote Excitation Sensing Configuration* in full-page figure.)

The Kelvin connection using the remote sensing lines performs best when the entire bridge is localized (no bridge-completion resistors inside the DBK43A) and all leads are contained in a multi-conductor cable. If individual wire leads are used, the two sense wires should be tightly twisted to form a pair. Likewise, the two excitation wires and the two bridge-output wires should be twisted together).

The internal excitation source is attached to a voltage regulator in the DBK43A circuitry. This regulator provides the excitation to the actual transducer (there is a separate regulator for each transducer, hence 8 regulators per DBK43A). Each regulator has a maximum current of 50 mA. The maximum excitation voltage that can be provided by the DBK43A excitation regulator is: $0.05 \times R$ (where R = the resistance in ohms of 1 element in the bridge circuit).

CAUTION

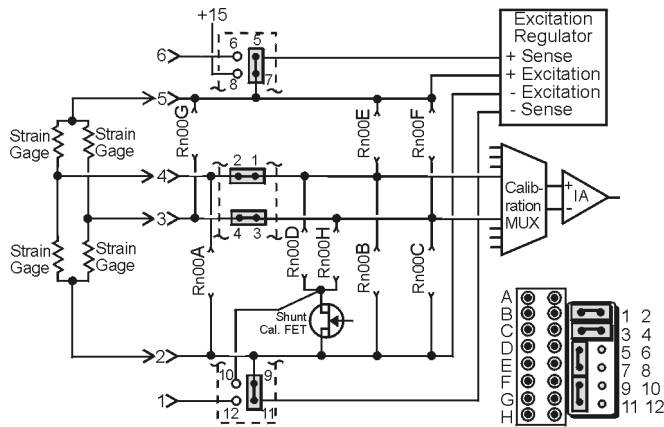


Setting the excitation voltage above the maximum voltage allowed can cause the DBK43A to fail. The maximum allowable excitation voltage is determined by the following equation.

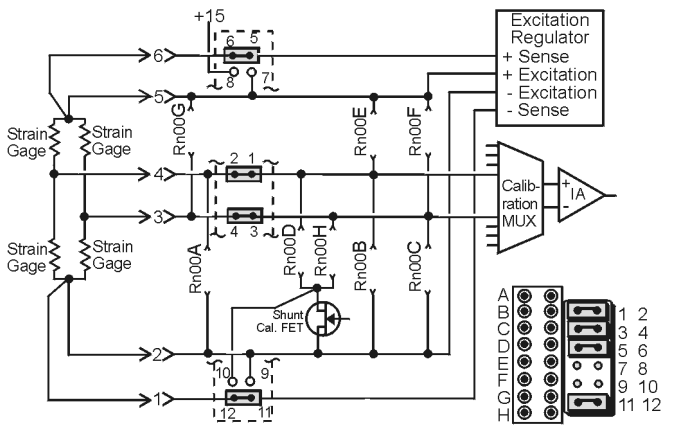
$$V_{\text{MAX[EXC]}} = 0.05 \times R$$

R is the resistance in ohms of 1 element in the bridge circuit.

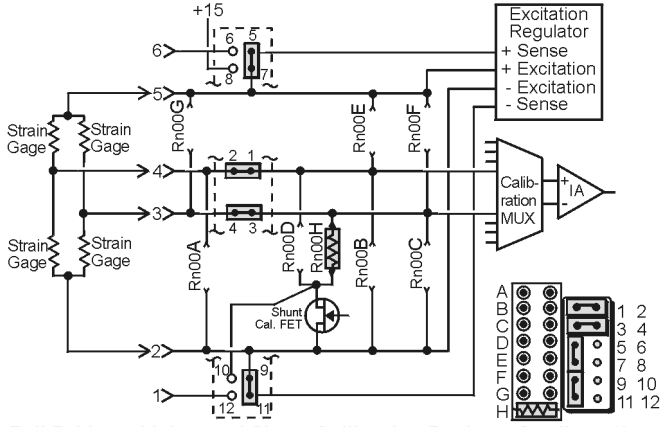
The following full-page figure shows various strain-gage configurations.



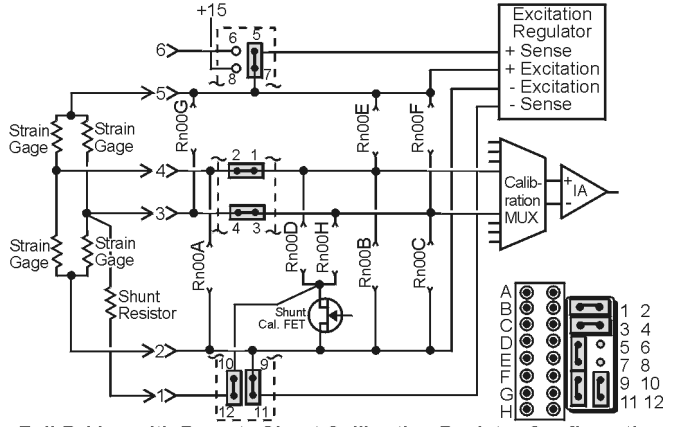
Full-Bridge Configuration



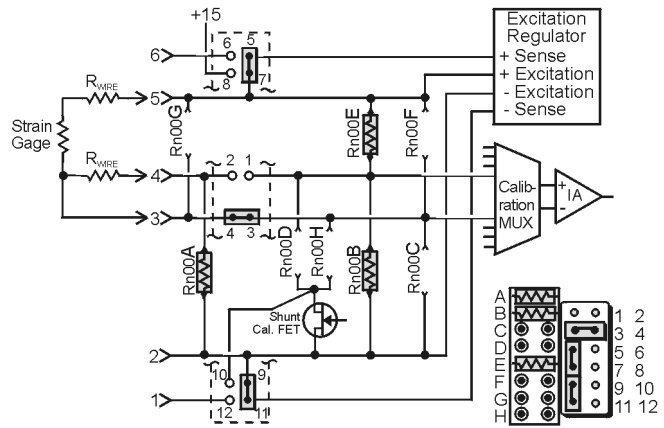
Full-Bridge with Remote Excitation Sensing Configuration



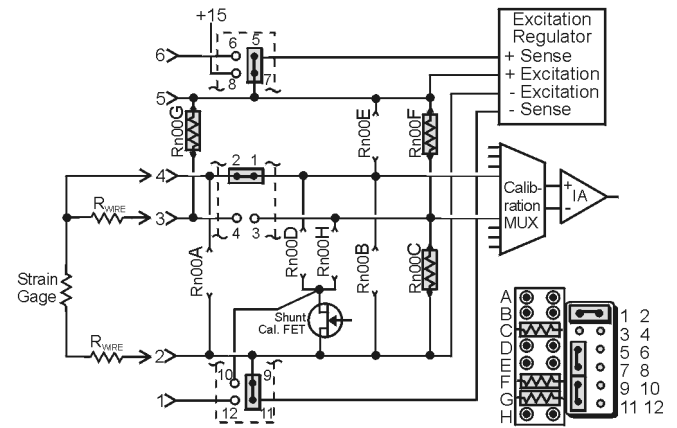
Full-Bridge with Internal Shunt Calibration Resistor Configuration



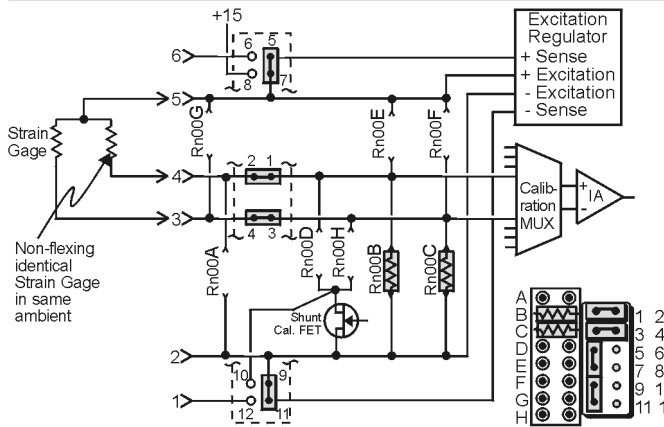
Full-Bridge with Remote Shunt Calibration Resistor Configuration



3-Wire Quarter (-) Bridge Configuration ($\Delta R \uparrow \rightarrow \Delta E_{out} \uparrow$)



3-Wire Quarter (+) Bridge Configuration ($\Delta R \downarrow \rightarrow \Delta E_{out} \uparrow$)



3-Wire Temperature-Compensated Half-Bridge Configuration ($\Delta R \uparrow \rightarrow \Delta E_{out} \uparrow$)

Configuration Notes:

Solder the resistors to the supplied plugs in the positions indicated for your configuration.

- 1- Handle plugs with care to avoid damaging pins.
- 2- To prevent heat damage to the plug and ensure proper fit, perform soldering with plug in a mating socket.
- 3- To prevent contact with other components, snip resistor leads after soldering, just long enough to mount on the forked support.
- 4- Install or remove these pre-configured plugs into the appropriate sockets as needed.

Bridge-completion resistor values are typically $350 \pm 0.1\%$ ohm or $120 \pm 0.1\%$ ohm. Use the resistor value to match the particular strain gage in use.

Input Configuration Headers

Eight 2×6 pin-headers with pin numbers 1 to 12 are on the board, 1 for each channel designated H100 (channel 0) to H800 (channel 7). The user can position jumpers on this header to configure inputs from a variety of bridge types.

- Jumping header pins 1-to-2 and 3-to-4 connects the +Vin and -Vin to the calibration MUX for different bridge configurations.
- Jumping pins 5-to-7 and 9-to-11 allows **internal sense regulation** of the excitation regulator.
- Jumping pins 5-to-6 and 11-to-12 allows for **remote excitation sensing**.
- Jumping pin 10-to-12 allows the use of a remote shunt-calibration resistor.

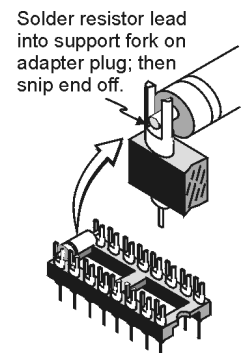
See previous figure for header configurations that correspond with different bridge-wiring schemes.

Resistor Sockets and Adapter Plugs

Eight 2×8 resistor sockets with rows numbered A to H are on the board; 1 socket for each channel and designated R100 (channel 0) to R800 (channel 7). An adapter plug for soldering resistors is included for each channel; user-soldered plugs facilitate changing configurations as needed.

- Bridge-completion resistors include: Rn00B, Rn00C, Rn00E, and Rn00F. Resistors Rn00A and Rn00G are used to complete 3-wire strain-gage configurations.
- Rn00D and Rn00H are internal shunt resistors from +V in and -V in respectively to -excitation.

Just inserting resistors into the socket makes an unreliable connection and is not recommended. To achieve a reliable connection, solder resistors to the adapter plug to match the proper row as shown in the previous figure, *DBK43A Bridge-Configuration Settings*. Soldering should be done with the plug inserted into the resistor socket; otherwise, heat from soldering can distort the shape of the plug. After soldering, the resistor leads should be snipped off close to the support to prevent contact with other components.



Handle the adaptor plugs with care to prevent pin damage.

Shunt-Calibration Resistors

The DBK43A provides physical locations for internal shunt-calibration resistors. Each channel has resistor locations that can be shunted across one or the other of the lower bridge arms by a hardware and software-accessible solid state switch (FET transistor) to create a repeatable bridge imbalance with a precision resistor.

For any balanced bridge, a resistance value can be applied in parallel with one of the four bridge elements to create a predictable imbalance and output voltage. For example, a 350Ω 2mV/V strain gage will deliver full output if one arm drops by 0.8% (about 2.80Ω) to 347.2Ω. A 43.4 KΩ resistance shunted across one or the other lower bridge elements will result in full-positive (Rn00H) or full-negative (Rn00D) output. For best results, Rn00H and Rn00D should be across the strain element when it is switched in.

A formula used to calculate the shunt-cal resistance value is:

$$R_{\text{Shunt}} = [R_{\text{Gage}} / F_G(\epsilon)] - R_{\text{Gage}}$$

Where:

R_{Shunt} = the shunt calibration resistor value

R_{Gage} = the resistance of the gage

F_G = the gage factor

ϵ = the strain value of the gage

Example:

An engineer wants to know the shunt calibration resistor value for a strain gage with the following parameters.

resistance: 120 Ω

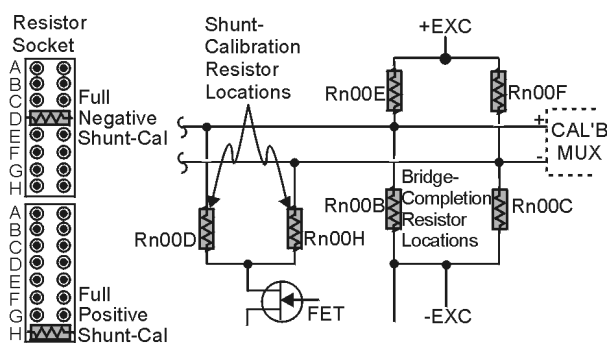
gage factor: 2.0

strain: 5000 micro-strain, i.e., 5000×10^{-6}

Plugging the values into the equation, we get:

$$\begin{aligned} R_{\text{Shunt}} &= [R_{\text{Gage}} / F_G(\epsilon)] - R_{\text{Gage}} \\ &= [120 / 2.0(5000 \times 10^{-6})] - 120 \\ &= [120 / .01] - 120 \\ &= 12000 - 120 \\ &= 11,880 \Omega \end{aligned}$$

In all cases, the resistance of the solid-state switch will be negligible when compared to the shunt resistance. Changing the CAL/NORM switch (on the rear panel) to the CAL position while reading the bridge will activate the shunt-calibration resistors. After reading the offset, return the switch to the NORM position for normal bridge readings.



Shunt-Calibration Resistors can be used with any full-, half-, or quarter-bridge configuration.

AC Coupling and Low-Pass Filter Options

Per channel, the DBK43A accommodate coupling and low-pass filter options including:

- AC coupling, or DC coupling
- Using or bypassing the filter
- Choice of the filter's corner frequency via a SIP resistor network
- Filter gain (default of $\times 2$ can be changed to $\times 1$).

The AC coupling, or DC coupling choice on each channel is set by the presence or absence of shunt jumpers on 2-pin headers. If the shunt jumper is in place, the coupling is DC. If the shunt jumper is absent, the coupling is AC. See table for channels and corresponding headers.

| Channel | Header |
|---------|--------|
| 0 | JP103 |
| 1 | JP203 |
| 2 | JP303 |
| 3 | JP403 |
| 4 | JP503 |
| 5 | JP603 |
| 6 | JP703 |
| 7 | JP803 |

The choice of using or bypassing the low-pass filter for each channel is made by the orientation of two shunt jumpers on a 2 \times 2 pin header. When the shunt jumpers are oriented horizontally (like the “bypass” symbol on the circuit board) the filter is bypassed. When the shunt jumpers are oriented vertically (like the “filter” symbol), the filter is in the signal path.

| Channel | Header |
|---------|--------|
| 0 | JP104 |
| 1 | JP204 |
| 2 | JP304 |
| 3 | JP404 |
| 4 | JP504 |
| 5 | JP604 |
| 6 | JP704 |
| 7 | JP804 |

The corner frequency of a low-pass filter is determined by three resistor values in each filter circuit. The resistors are listed in the following table. These resistor locations have been physically arranged to allow the use of a 6-pin SIP network as a convenient means of changing all 3 resistors. The machined-pin socket will also allow you to insert individual resistors.

| Channel | Resistors |
|---------|----------------|
| 0 | R105-R106-R107 |
| 1 | R205-R206-R207 |
| 2 | R305-R306-R307 |
| 3 | R405-R406-R407 |
| 4 | R505-R506-R507 |
| 5 | R605-R606-R607 |
| 6 | R705-R706-R707 |
| 7 | R805-R806-R807 |

The next table is a list of some common frequencies, the nominal resistance value, and a Bourns part number for a suitable network.

| Frequency | Resistance (Ω) | Bourns P/N |
|-----------|-------------------------|---------------|
| 37Khz | 10 | 4606X-102-100 |
| 19Khz | 20 | 4606X-102-200 |
| 7Khz | 50 | 4606X-102-500 |
| 3.7Khz | 100 | 4606X-102-101 |
| 1.9Khz | 200 | 4606X-102-201 |
| 700Hz | 500 | 4606X-102-501 |
| 370Hz | 1K | 4606X-102-102 |
| 190Hz | 2K | 4606X-102-202 |
| 70Hz | 5K | 4606X-102-502 |
| 37Hz | 10K | 4606X-102-103 |
| 19Hz | 20K | 4606X-102-203 |
| 7Hz | 50K | 4606X-102-503 |
| 3.7Hz | 100K | 4606X-102-104 |

The active low-pass filters on the DBK43A have a gain of $\times 2$. This gain can be factored into the setup calculations, or the filter gain can be changed to $\times 1$. To change the gain to $\times 1$ (unity) for the corresponding channels, de-solder (or snip leads) and remove the resistors shown in the table.

Note: The default $\times 2$ gain option meets the needs of most applications.

| Channel | R (10K) |
|---------|---------|
| 0 | R144 |
| 1 | R244 |
| 2 | R344 |
| 3 | R444 |
| 4 | R544 |
| 5 | R644 |
| 6 | R744 |
| 7 | R844 |

P1 Output Channel and Card Address Selection

All 8 channels on the DBK43A are multiplexed into 1 of the LogBook or Daq Device base channels (0 to 15). The base channel (that the DBK43A is multiplexed into) is set by the shunt jumper on the 16x2 header designated JP1.

Each base channel can have up to 16 expansion channels multiplexed into it. Since the DBK43A represents 8 expansion channels, 2 DBK43A modules can be multiplexed into each LogBook base channel. To distinguish channels, there is a 3-pole header (designated J2) with a shunt jumper that can be placed in 1 of 2 positions for either LOWER (0 to 7) or UPPER (8 to 15) expansion channels.

With the LogBook or Daq device's 16 base channels, up to 32 DBK43As can be used for a maximum of 256 channels. These channels are identified differently in the API for custom programming and in DaqView and GageCal.

For the API, the base channels are designated 0 to 15; and expansion channels are designated 16 to 271. Channel 16 is the first channel on the first expansion board (for DBK43A, channel 0 on lower DBK43A with JP1 set to CH0) and channel 271 is the last channel on the last expansion board (for DBK43A, channel 7 on upper DBK43A with JP1 set to CH15). The table shows the base channel and the first expansion channel number (N) associated with that particular base channel. To calculate the actual input channel, add "N" to "n". (If J2 is set to LOWER, the n-values for input channels 0 to 7 range from n = 0 to n = 7; if J2 is set to UPPER, the n-values range from n = 8 to n = 15.) This expansion channel number is also needed when writing a program to read from that particular channel.

| Daq Device Base Channel | First Expansion Channel Number (N) |
|-------------------------|------------------------------------|
| 0 | 16 |
| 1 | 32 |
| 2 | 48 |
| 3 | 64 |
| 4 | 80 |
| 5 | 96 |
| 6 | 112 |
| 7 | 128 |
| 8 | 144 |
| 9 | 160 |
| 10 | 176 |
| 11 | 192 |
| 12 | 208 |
| 13 | 224 |
| 14 | 240 |
| 15 | 256 |

For DaqView, LogView and GageCal, these same 256 channels are identified from ch0-0-0 to ch15-2-7. The first field (0 to 15) is the base channel; the second field is the lower (1) or upper (2) sub-channel selected on J2; and the third field (0 to 7) is the 8 channels on a single DBK43A.



Reference Note:

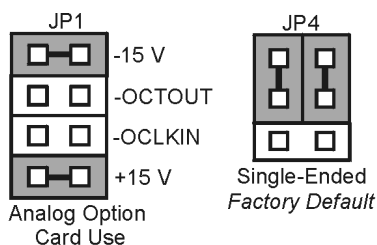
For more information on channel multiplexing, refer to the [Signal Management](#) section in Chapter 1.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK43A requires setting jumpers in DaqBooks and ISA-type DaqBoards.

1. If not using auxiliary power, place the JP1 jumper in the expanded analog mode.



DaqBook/DaqBoard Jumpers for DBK43A

Note: This default position is necessary to power the interface circuitry of the DBK43A via the internal ± 15 VDC power supply. If using auxiliary power (DBK32A or DBK33), you must remove both JP1 jumpers. Refer to Chapter 2, [Power Management](#), and to the [DBK32A](#) and [DBK33](#) document modules as needed.

2. For DaqBook/100, DaqBook/112 and DaqBook/120, place the JP4 jumper in *single-ended* mode

Note: To use a DBK43A with a Daq PC-Card, you must an appropriate power module must be used.

Hardware Adjustment

Bridge circuit transducers are used for many different applications, and the DBK43A is flexible enough to support most of them. Each DBK43A channel circuit has an excitation regulator, a high gain (100-1250) input amplifier with offset adjustment, a low-pass filter, a scaling (1-10) amplifier, and a calibration multiplexer.

Trim pots

The DBK43A's front panel has a slot to allow access to 4 potentiometers to trim (adjust) the accuracy for each channel circuit. The trim pots are labeled to represent the following adjustments:

EXC for adjusting the excitation voltage to the transducer

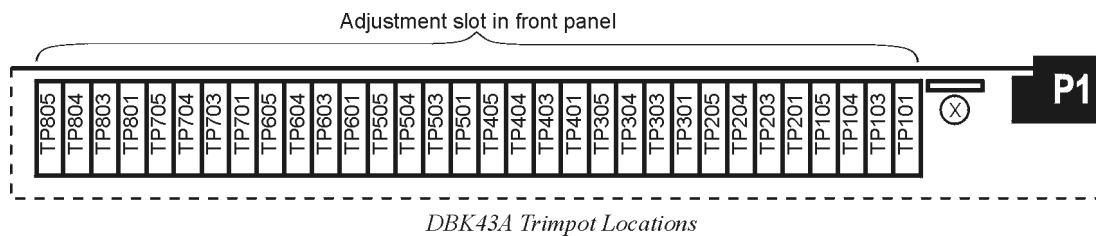
GAIN for setting the gain of the input amplifier

OFFSET for adjusting the circuit offset for quiescent loads or bridge imbalance

SCALE for setting the gain of the scaling amplifier

| | CH0 | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|
| EXC | TP101 | TP201 | TP301 | TP401 | TP501 | TP601 | TP701 | TP801 |
| GAIN | TP104 | TP204 | TP304 | TP404 | TP504 | TP604 | TP704 | TP804 |
| OFFSET | TP103 | TP203 | TP303 | TP403 | TP503 | TP603 | TP703 | TP803 |
| SCALE | TP105 | TP205 | TP305 | TP405 | TP505 | TP605 | TP705 | TP805 |

The figure shows trimpot locations.



CAL/NORM Switch

The CAL/NORM switch is located between the CH7 input and the power LED on the rear panel.

- In the NORM position, the function of the primary data acquisition is identical with that of the DBK43.
- In the CAL position, the shunt calibration offset and the excitation voltage can be read depending on the software function control described next.

Software-Controlled Setup

Proper setup includes the use of software to control the calibration multiplexer in each circuit. The calibration multiplexer is used to switch the bridge circuit out and apply internal reference voltages to the input for use in the DBK43A setup. The calibration multiplexer also allows the recording of the individual adjustments.

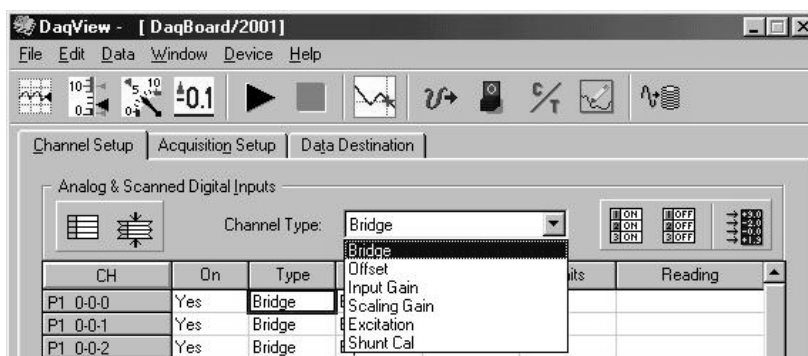
The next two tables identify functions available through DaqView and LogView, respectively. Note that DaqView uses the term “Channel Type;” and LogView uses the term “Mode.” The tables include equations in which “V_{OUT}” (voltage out) represents the voltage recorded by the primary data acquisition device, i.e., a LogBook, DaqBook, DaqBoard, or other Daq device.

Selecting Channel Types in DaqView



Reference Notes:

- LogView user's refer to [Selecting Channel Modes in LogView](#) on page 14.
- [Typical setup steps with embedded examples](#) begin on page 15. The steps can be used for LogBook and Daq device applications.



Selecting Channel Type for DBK43A In DaqView

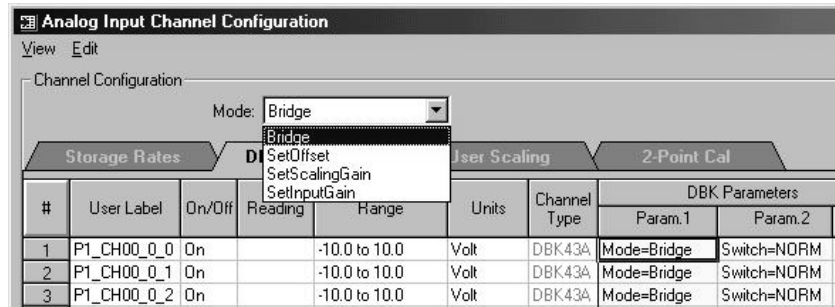
| Using DBK43A Channel Types in DaqView | | |
|--|------------------------------|--|
| Channel Type | CAL/NORM Switch ¹ | Function and Associated V _{OUT} Equation |
| Bridge | NORM | Sets the channel to read the value of the bridge circuit with all gains and offsets in effect. This is the normal operation. $V_{out} = (\text{Scaling Gain})(\text{Filter Gain}^*)(\text{Input Gain})(\text{bridge circuit voltage}) - \text{offset voltage}$ |
| Offset | NORM | Applies a grounded input to the channel. Sets the channel to read the circuit offset voltage multiplied by the input amplifier and the low-pass filter gain. $V_{out} = (\text{Filter Gain}^*)(\text{Input Gain})(-\text{offset voltage})$ |
| Input Gain | NORM | Applies 5 mV to the input channel. Sets the channel to read the voltage out of the circuit through the input gain amplifier and the low-pass filter [if enabled]. $V_{out} = (\text{Filter Gain}^*)(\text{Input Gain})(5 \text{ mV}) - \text{offset voltage}$ |
| Scaling Gain | NORM | Applies 5 mV to the input channel. Sets the channel to read the voltage out of the circuit through the input gain amplifier, the low-pass filter [if enabled], and the scaling gain amplifier. $V_{out} = \text{Filter Gain}^*(\text{Scaling Gain}[(\text{Input Gain})(5 \text{ mV}) - \text{offset voltage}])$ |
| Excitation | CAL | Sets excitation. $V_{out} = (\text{Excitation Voltage})$ |
| Shunt Cal | CAL | Activates shunt-cal resistors. $V_{out} = (\text{Scaling Gain})(\text{Filter Gain}^*)(\text{Input Gain})(\text{bridge circuit voltage with shunt}) - \text{offset voltage}$ |
| ¹ The CAL/NORM Switch is located on the DBK43A Module, next to the Power LED. * In the equations, the asterisk indicates the conditional clause, “if the filter is enabled.” | | |

Selecting Channel Modes in LogView



Reference Notes:

- DaqView user's refer to [Selecting Channel Types in DaqView](#) on page 13.
- [Typical setup steps with embedded examples](#) begin on page 15. The steps can be used for LogBook and Daq device applications.



Selecting Channel Mode for DBK43A In LogView

| Using DBK43A Channel Modes in LogView | | |
|---------------------------------------|------------------------------|--|
| Mode | CAL/NORM Switch ¹ | Function and Associated V _{out} Equation |
| Bridge | NORM | Sets the channel to read the value of the bridge circuit with all gains and offsets in effect. This is the normal operation. $V_{out} = (\text{Scaling Gain})(\text{Filter Gain})[(\text{Input Gain})(\text{bridge circuit voltage}) - \text{offset voltage}]$ |
| SetOffset | NORM | Applies a grounded input to the channel. Sets the channel to read the circuit offset voltage multiplied by the input amplifier and the low-pass filter gain. $V_{out} = (\text{Filter Gain})(\text{Input Gain}) - \text{offset voltage}$ |
| SetInputGain | NORM | Applies 5 mV to the input channel. Sets the channel to read the voltage out of the circuit through the input gain amplifier and the low-pass filter [if enabled]. $V_{out} = (\text{Filter Gain})(\text{Input Gain})(5 \text{ mV}) - \text{offset voltage}$ |
| SetScaling Gain | NORM | Applies 5 mV to the input channel. Sets the channel to read the voltage out of the circuit through the input gain amplifier, the low-pass filter [if enabled], and the scaling gain amplifier. $V_{out} = \text{Filter Gain}(\text{Scaling Gain}[(\text{Input Gain})(5 \text{ mV}) - \text{offset voltage}])$ |
| SetOffset | CAL | Sets excitation. $V_{out} = (\text{Excitation Voltage})$ |
| Bridge | CAL | Activates shunt-cal resistors. $V_{out} = (\text{Scaling Gain})(\text{Filter Gain})[(\text{Input Gain})(\text{bridge circuit voltage with shunt}) - \text{offset voltage}]$ |

¹The CAL/NORM Switch is located on the DBK43A Module, next to the Power LED.

* In the equations, the asterisk indicates the conditional clause, "if the filter is enabled."

A Typical Setup Procedure, with Embedded Examples



Reference Notes:

- Prior to using DBK43A with DaqView you must select the DBK43A from DaqView's **Configure Hardware Settings** screen. If needed, refer to Chapter 4, *DBK Setup in DaqView*.
 - Prior to using DBK43A with LogView you must select the DBK43A from LogView's **Hardware Configuration** screen. If needed, refer to Chapter 5, *DBK Setup in LogView*.
 - Refer to the [board layout](#) on page 5 for jumper locations, jumper setting orientations, and trimpot locations, as needed.
 - For **Calibration of DBK43A** – DaqView users should refer to the [GageCal](#) segment beginning on page 19. LogView users should refer to the section titled [Calibrating DBK16 and DBK43A for LogBook Applications](#), beginning on page 23.
1. Verify that the low-pass filters are set to BYPASS. The filters are set via jumpers JPn04 where n is the channel number (1 through 8); for example, JP104 sets the filter for channel 1, and JP804 sets the filter for channel 8.
Note: If you plan to use filters during your acquisition, you should still select BYPASS at this point. Enabling the filters comes into play later in the procedure. However, if you do plan to enable filters, note the gain in the filter stage (default ×2, or ×1 with resistor removed) and allow for it in your setup.
 2. Coupling is set via jumpers JPn03 where n is the channel number (1 through 8). Verify that the “Coupling” jumpers are installed. When installed, the channels are set for DC coupling.
Note: If you plan to use AC Coupling during your acquisition, you should still select DC Coupling at this point. Selecting AC Coupling comes into play later in the procedure.
 3. Determine the *excitation for the transducer*. This is based on the transducer specifications and from the current limitations of the DBK43A excitation regulator.
 4. Determine the *maximum voltage* that can result from the transducer for a strain gage or for a load cell. The values can be calculated as follows:

Strain Gage Example

Most strain gages come with Gage Factors (GF). To calculate the approximate output of the bridge circuit with a typical strain value, use the formula:

$$\frac{(\text{Excitation Voltage})(\text{Gage Factor})(\text{Strain in strain units})}{4} = \text{*Bridge circuit output voltage}$$

In this strain gage example, let's assume the following:

- We have a 120 ohm strain gage.
- The gage factor is 2.1.
- The excitation voltage is 5 V. This is due to the current limitation of the excitation regulator on the DBK43A [note that the excitation voltage must be less than 6 V]
- We are measuring 4000 micro-strain

By applying these values to the preceding equation we find that the bridge output voltage is 10.5 mV.

$$\text{Bridge output voltage for 4000 microstrain} = \frac{(5)(2.1)(4000 \times 10^{-6})}{4} = 10.5 \text{ mV}$$

*linear estimate (some strain gages are not linear); refer to strain-gage theory for more information.

Load Cell Example

Load cells come with a mV/V specification; for each volt of excitation at maximum load, the load cell will output a specific millivolt level. The following equation applies:

$$\text{Load Cell Output Voltage} = (\text{Load}_{\text{Applied}} / \text{Load}_{\text{Rated}})(\text{Excitation Voltage})(\text{Load Cell Rating})$$

For this example, let's assume the following:

- We have a 350 ohm, 3000 pound load cell.
- The load cell is rated at 2.05 mV/V
- We are using an excitation of 10 V

By applying these values to the preceding equation we find that the Load Cell Output Voltage is 20.5 mV.

$$\text{Load Cell Output Voltage} = (3000/3000)(10)(2.05 \times 10^{-3}) = 20.5 \text{ mV}$$

For 1000 pounds applied load, the Load Cell Output Voltage would be one third of the 20.5 mV value, i.e., $20.5 \text{ mV} / 3 = 6.833 \text{ mV}$. If we used the entire equation we would see:

$$\text{Load Cell Output Voltage} = (1000/3000)(10)(2.05 \times 10^{-3}) = 6.833 \text{ mV}$$

Now that we know our sensor's full-scale voltage, we can calculate the DBK43A's voltage gain. The proper voltage gain allows the full-scale sensor output to correspond to the full-scale input of the data acquisition device. Full-scale device inputs are:

- 5 to +5 V for DaqBook and DaqBoard [ISA type] in bipolar mode
- 0 to +10 V for DaqBook, DaqBoard [ISA type], and DaqBoard/2000 Series in unipolar mode
- 10 to +10 V for DaqBoard/2000 Series in bipolar mode and for Daq PC-Card
- 10 to +10V for LogBooks in bipolar mode
- 0 to +20 V for LogBooks in unipolar mode

5. Calculate the *channel total gain* based on the full-scale LogBook or Daq device.

The following equation is used to calculate DBK43A total gain.

$$\text{Gain}_{\text{TOTAL}} = (\text{Sensor Output Voltage}_{\text{FULL-SCALE}} - \text{Voltage}_{\text{OFFSET}}) / \text{Strain or Load Voltage}_{\text{OUTPUT}}$$

In this example we will use:

- a full-scale sensor output voltage of +5 V [for a DaqBook in bipolar mode].
- a 0.5 V offset (from full-scale) to prevent saturation
- the 10.5 mV Bridge Output Voltage [for 4000 microstrain] from Example 1.

Using the gain equation we get:

$$\text{Gain}_{\text{TOTAL}} = (5.0 \text{ V} - 0.5 \text{ V}) / 10.5 \text{ mV} = 4.5 \text{ V} / 0.0105 \text{ V} = 428.6$$

6. Determine how the total gain will be distributed between the input amplifier gain, filter gain, and scaling amplifier gain.

An Example of Total Gain Distribution: If we round the gain of x428.6 [calculated in the previous step] down to x420, then the gain distributions indicated by the following table are possible.

| Gain Distribution Options for a Total Gain of x420 | | | | |
|--|-----------------------------|----------|----------|----------|
| Gain Stage & Associated Range | Possible Gain Distributions | | | |
| | Option A | Option B | Option C | Option D |
| Input Gain x100 to x1250 | x420 | x100 | x240 | x300 |
| Filter Gain x1 or x2 | Disabled | x2 | x1 | Disabled |
| Scaling Gain x1 to x10 | x1 | x2.1 | x1.75 | x1.4 |
| Total Gain | x420 | x420 | x420 | x420 |

After we decide on a distribution option, the sensor can be hooked up to the DBK43A, the bridge completion resistors can be installed, the excitation voltage set, followed by setting the gains. In this example we will be using DaqView. Steps for other programs will be similar.

7. Connect the transducer to the DBK43A according to the figures in the [Signal Connection](#) (page 4) and [Bridge Applications](#) (page 5). Install the appropriate bridge-completion resistors if applicable.
8. Adjust the **Excitation** voltage.

Note: For DaqView versions 5.05 and higher the reading will already be correctly scaled.

 - (a) Set the DBK43A's CAL/NORM switch to "CAL." In addition, LogView users set the software CAL/NORM switch, in Hardware Configuration, to "CAL."
 - (b) DaqView users: select "Excitation" for the Channel Type.
LogView users: select "SetOffset" for the Mode.
 - (c) With the Reading column enabled, set the excitation voltage for the transducer by adjusting the trimpot labeled EXC. Note that each of the eight channels has a channel-specific trimpot for excitation.
 - (d) After the excitation voltage is set, stop the Readings.
 - (e) Return the CAL/NORM switch to the NORM position. In addition, LogView users set the software CAL/NORM switch to "NORM."
9. Adjust the **Offset**.
 - (a) Verify that the DBK43A's CAL/NORM switch is in the NORM position. In addition, LogView users verify that the software CAL/NORM switch is selected to "NORM."
 - (b) DaqView user's: select "Offset" for the Channel Type.
LogView users: select "SetOffset" for the Mode.
 - (c) With the Reading column enabled, adjust the OFFSET trimpot (OFST) to obtain a channel reading of 0.00 volts. This removes all offset from the DBK43A channel circuit. Note that each of the eight channels has a designated, channel-specific, trimpot for offset.
 - (d) After the Offset is adjusted to 0.00, stop the Readings.
10. Adjust the **Input Gain**.
 - (a) DaqView users: select "Input Gain" for the Channel Type.
LogView users: select "SetInputGain" for the Mode.
 - (b) With the Reading column enabled, adjust the GAIN trimpot to obtain a voltage reading equal to $0.005 \times G_I$, where " G_I " is the desired input amplifier gain. Note that each of the eight channels has a channel-specific trimpot for Input Gain.
 - (c) Stop the Readings.



For very high system gains you may need to first, set the Input Gain low, then set the Scaling Gain, and then reset the Input Gain.

Typical input gain settings are shown in the following table.

| Input Gains and Typical Readings | |
|----------------------------------|------------|
| Input Gain | Reading |
| x100 | 0.5 volts |
| x200 | 1.0 volts |
| x300 | 1.5 volts |
| x400 | 2.0 volts |
| x500 | 2.5 volts |
| x600 | 3.0 volts |
| x700 | 3.5 volts |
| x750 | 3.75 volts |
| x800 | 4.0 volts |
| x900 | 4.5 volts |
| x1000 | 5.0 volts |
| x1200 | 6 volts * |

* requires primary acquisition device to be in unipolar mode.

11. Adjust the **Scaling Gain**.

- (a) DaqView users: select “Scaling Gain” for the Channel Type.
LogView users: select “SetScalingGain” for the Mode.
- (b) With the Reading column enabled, adjust the SCALE trimpot (SCA) for a voltage reading equal to $.005 \times G_I \times G_S$, where “ G_I ” is the desired input amplifier gain and “ G_S ” is the desired scaling amplifier gain. Note that each of the eight channels has a channel-specific, trimpot for Scaling Gain.
- (c) Stop the Readings.

| Scaling Gains Typical with an Input Gain of x200 | |
|--|-------------|
| Scaling Gain | Reading |
| x2 | 2.0 volts |
| x4 | 4.0 volts |
| x6 | 6.0 volts* |
| x8 | 8.0 volts* |
| x10 | 10.0 volts* |

* requires primary acquisition device to be in unipolar mode.

12. Adjust the **Offset** while the bridge circuit is being read.

- (a) Select “Bridge.”
- (b) With the Reading column enabled, and with the quiescent (normal or inactive) load or strain applied, adjust the OFFSET trimpot for a reading of 0.00 volts. This adds offset to the circuit to compensate for the quiescent load and allows maximum resolution for the measurement.
- (c) After adjusting the Offset to 0.00, stop the Readings.



The Offset adjustment is unipolar 0 to 5 V on the input amplifier output. If the Offset can not be adjusted to 0.00 V at the end of the setup procedure, swap the V_{in+} (4) and V_{in-} (3) wire connections, or reduce the Input Gain and increase the Scaling Gain.

- 13. *If required for your application*, enable the low-pass filters. The filters are set via jumpers JPn04 where n is the channel number (1 through 8); for example, JP104 sets the filter for channel 1, and JP804 sets the filter for channel 8.
- 14. *If required for your application*, set AC Coupling. Coupling is set via jumpers JPn03 where n is the channel number (1 through 8). To set AC Coupling, remove the JPn03 jumpers.
- 15. Calculate the LogBook or Daq device voltage/transducer units. Do this using the transducer specifications and the total gain of the DBK43A channel. Apply the units to your readings.
- 16. Verify the software settings by using a known load or strain and comparing the value to that observed in DaqView’s Reading column.

Note: Gain adjustments can be made by activating a shunt-cal resistor that is calculated to be at maximum load.

To enable shunt-cal resistors:

- (a) Select “Shunt Cal” as the Channel Type.
- (b) Place the DBK43A’s CAL/NORM switch in the CAL position.
- (c) LogView users: set the software CAL/NORM switch, in Hardware Configuration, to “CAL.”

Settings can be verified via shunt-calibration.



After the final offset is made, the gain readings will be incorrect unless the circuit offset is removed.

GageCal, Calibration Program for DBK16 and DBK43A in Daq Applications



GageCal is intended for DBK16, DBK43, and DBK43A load cell applications in conjunction with Daq devices.

GageCal is not used for LogBook applications.

GageCal is a calibration aid for use with DBK16, DBK43, and DBK43A devices that are being used in Daq device data acquisition systems. The program, which is independent of DaqView, provides an on-screen walk-through for setting jumpers, switches and adjusting trimpots.

With GageCal you can:

- Use a graphic representation of a strain-gage board as a guide to configure switches, jumpers, and other hardware settings.
- Enter all the parameters pertaining to your strain gage application.
- Follow step by step prompting to adjust trimpots for scale gain, input gain, and offset to ensure the channel provides the desired input range.

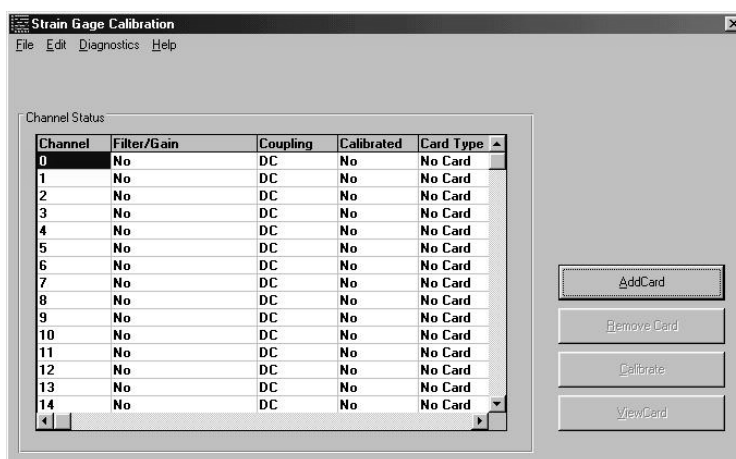
GageCal is installed from the Master Setup screen of the data-acquisition CD-ROM as part of the DaqBook/DaqBoard Support option. After your DaqBook/DaqBoard support has been installed you can access and use GageCal as follows.

1. Access GageCal from a desktop shortcut, or by navigating from the desktop as follows:
Start ⇒ Programs ⇒ IOtech DaqXSoftware [or Omega DaqXSoftware] ⇒ GageCal
A Select Device window will appear, similar to that shown in the following figure.



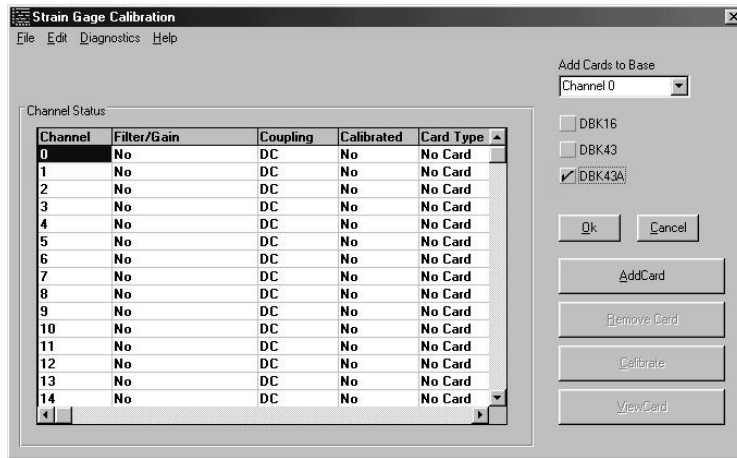
GageCal – Select Device

2. From the Select Device window, highlight the applicable DaqBook or DaqBoard, then click the <OK> button. The Strain Gage Calibration window will appear.



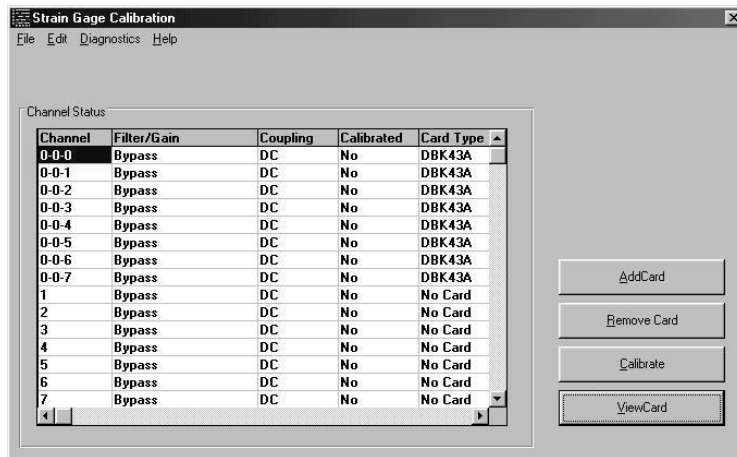
GageCal's Strain Gage Calibration Window

3. Click the <AddCard> button. Then select one of the following, as applicable:
DBK16, DBK43, or DBK43A. See following figure.



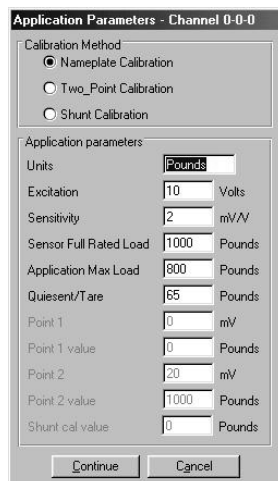
Selecting DBK43A

- Click the <OK> button. The Strain Gage Calibration window will provide 3 digit channel numbers in the form of “n₁-n₂-n₃,” where n₁ is the card number, n₂ is the bank number on the card, and n₃ is the channel number. See following figure.



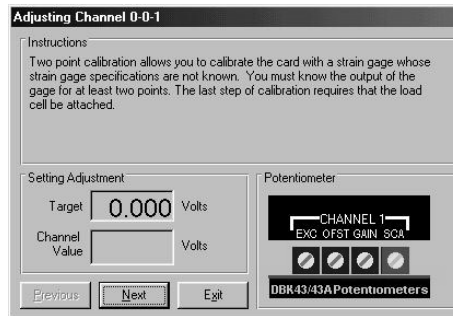
Strain Gage Calibration Window after Adding a Card

- Click the <Calibrate> button. An Applications Parameter box appears. See following figure.



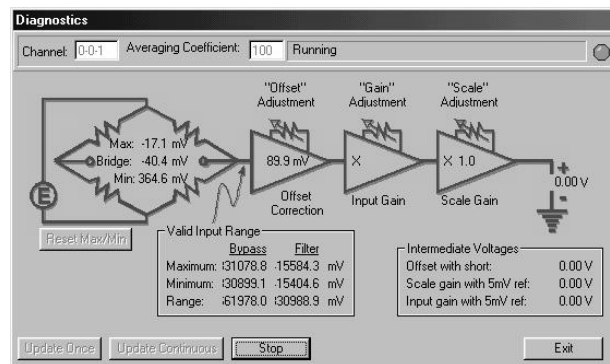
Application Parameters for Channel 0-0-0

6. Select the type of calibration to be performed, i.e., Nameplate, Two-Point, or Shunt. Then edit the Application Parameters, if applicable. A brief description of the three calibration methods follows. When done, click the <Continue> button.
 - **Nameplate calibration** provides a way to enter parameters for your strain gage and its application. The final step of the procedure includes attaching the strain gage (load cell).
 - **Two-Point calibration** provides a way to calibrate a DBK16, DBK43, or DBK43A that is using a strain gage with unknown specifications. In this method, the user enters two points of transducer output [milli-volts] vs. engineering units, e.g., pounds. Gage call provides set up instructions based on the parameters entered. The final step of the procedure includes attaching the strain gage (load cell).
 - **Shunt calibration** provides a means calibrating channels with use of user-supplied shunts to simulate a physical load. With this method, 1 or 2 shunt resistors (Rn00D and Rn00H) are added for each of the 8 channels to be calibrated. You must set J3 to the position closest to TP9 for the shunt calibration to work correctly. Shunt calibration is performed with the load-cell attached.
7. Follow GageCal's screen prompts to complete the calibration.



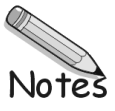
Example Screen Shot from GageCal

Note: You can use GageCal's "Diagnostics" feature to view a graphic representation of the strain gage and the card's gain stages.



GageCal Diagnostics

8. After completion, go to DaqView and convert ± 5 V to engineering units using $mx+b$.



Calibrating DBK16 and DBK43A for LogBook Applications

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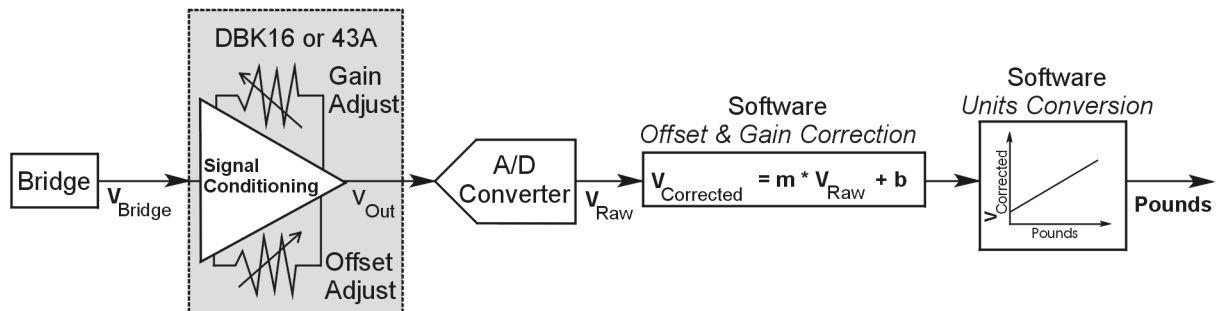
Creating a Units Conversion Transfer Function38

Periodic Calibration Without Trimpots38

Overview

Calibrating a strain gage channel includes:

- One-time adjusting of the bridge excitation.
- One-time tuning of the electronic gains and offset via trimpots to maximize performance and dynamic range.
- Applying a transfer function to the voltage output to convert it to engineering units, e.g., pounds, kilograms.
- Executing a software scale and offset adjustment periodically to maintain accuracy.



Example of a Unit Conversion from Voltage to Pounds

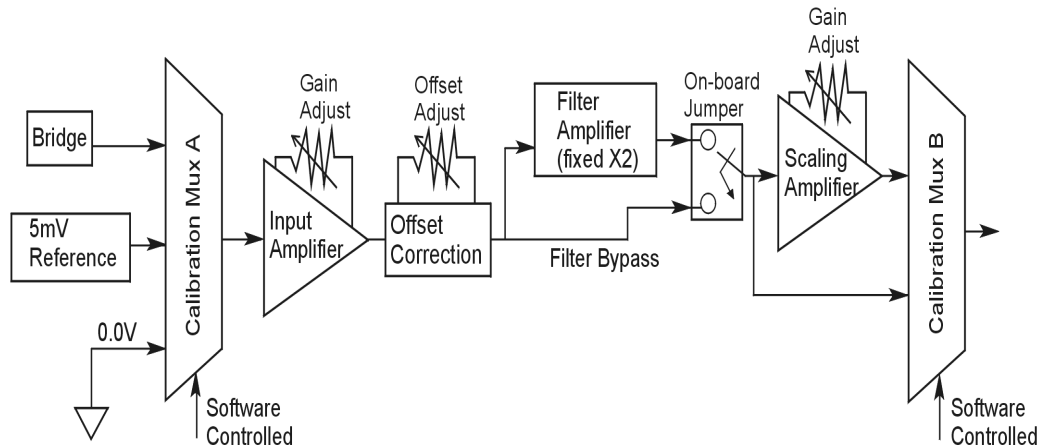
The trimpots provide course tuning so large quiescent offsets can be nulled and the bridge signal can be amplified to match the A/D input range. Once these adjustments are made, the operator can periodically fine-tune the calibration via software using LogView's 2-Point calibration feature. LogView's scale and offset features provide a simple means to apply a transfer function that converts the voltage to user units, for example, pounds, as in the above block diagram.

Bridge circuit transducers are used for many different applications, and the strain gage signal conditioning modules are flexible enough to support most of them. Each channel circuit has an excitation regulator, a high gain (x100 to x1250) input amplifier with offset adjustment, a low-pass filter, a scaling (x1 to x10) amplifier, and a calibration multiplexer.

By using software-controlled multiplexers, on-board reference voltages can be read by the data acquisition system so that precise gains and offsets can be set. LogView provides a means of easily controlling the calibration multiplexers so that the reference voltages can be displayed while the trimpots are being adjusted.

There are four trimpots to set up each channel circuit. The trimpots are labeled to represent the following adjustments:

- **EXC** - for adjusting the excitation voltage to the transducer
- **GAIN** - for setting the gain of the input amplifier
- **OFFSET** - for adjusting the circuit offset for quiescent loads or bridge imbalance
- **SCALE** - for setting the gain of the scaling amplifier



Signal-Flow Relationship of Software Controlled Multiplexers and On-Board Reference Voltages



Note! This calibration procedure can only be executed while LogBook is attached to a PC that is running LogView.

To adjust trimpots, use one of the following calibration methods, as appropriate.

Calibration Methods

Several different calibration techniques are supported by strain gage signal conditioning modules. Calibration methods include; Nameplate, 2-Point, Shunt, and Manual. From the following discussion, select the calibration method that is best for your application.

Nameplate – Used to setup the channel using the transducer's published specs.

Nameplate calibration is typically used with packaged load cells with millivolt-per-volt (mV/V) transfer functions. Using the mV/V spec of the load cell or a strain gage's Gage Factor (GF), the necessary system gain can be calculated and applied to a channel.

2-Point – Used to setup the channel using 2 known loads, one of which might be "no load."

The 2-Point calibration method requires the operator to apply two known loads to the load cell or strain gage, one at a time, while the data acquisition system takes measurements. Typically, the first point is with no load applied and the second point is close to the maximum load capacity of the gage. While measuring the first point the offset is nulled, and while measuring the second point the gain is adjusted to span the majority of the input range of the A/D. No gain calculations are required to perform this calibration method.

Shunt – Used to setup the channel using a shunt resistor applied to the bridge to simulate a load.

Shunt calibration is identical to 2-Point calibration except that the second point is simulated so that applying a load near the gage's maximum load is unnecessary. To simulate a bridge imbalance, a shunt resistor is placed across one leg of the bridge. Once the shunt resistor value has been calculated, it is applied to the bridge to provide the desired simulated load. No gain calculations are required to perform this calibration method.

Manual – Used to assign specific gains and offsets.

If a particular gain and offset are already known, these values can be used to setup a strain gage channel.

Procedures Common to All Calibration Steps (Required)

Set the Selected Channel(s) to DC Coupling

Since the applied calibration-signals are DC, set DC coupling for all the channels that are being adjusted.

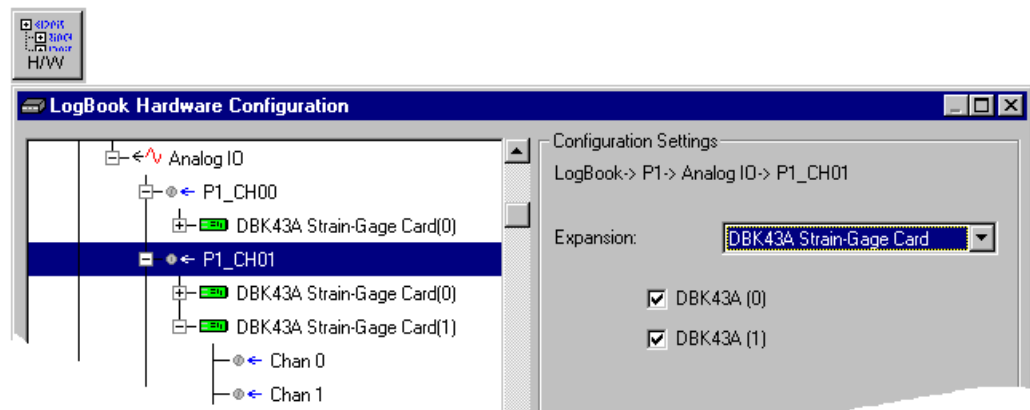
If your application requires AC coupling, don't forget to remove the jumpers when the adjustment procedure has been completed.

Determine Channel Parameters

Before adjusting the trimpots, the excitation needs to be determined. Typically, the supplier of the gage of load cell will recommend a suitable value, but make sure that the maximum output current of the excitation regulator is not exceeded.

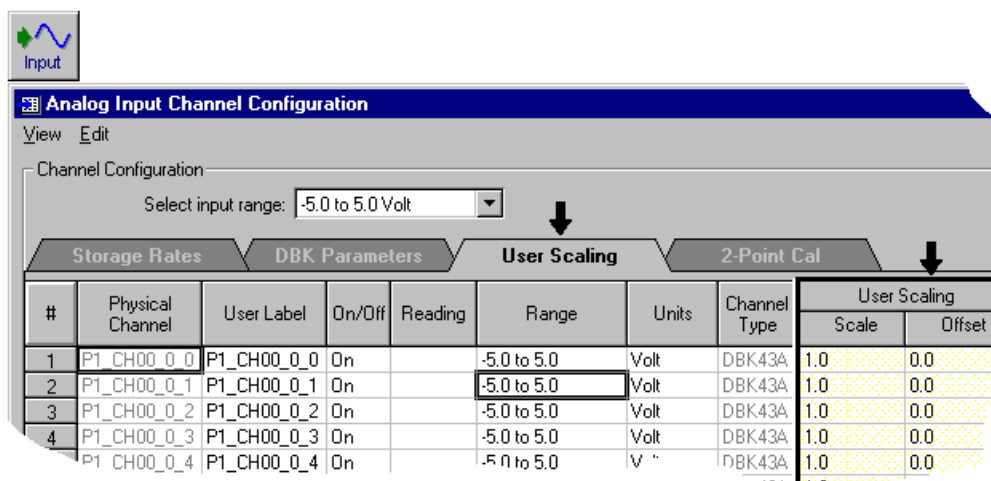
Initialize LogView

Launch LogView and use the *LogBook Hardware Configuration window* (hardware tree) to configure all of the DBK options that are to be used in the system. If needed, refer to the LogView chapter of the LogBook User's Manual (p/n 461-0901).



LogBook Hardware Configuration, Button and Screen

Open the *Analog Input Channel Configuration Window*. Click the User Scaling Tab and verify that all of the strain gage channels that are to be adjusted have scale and offset values of 1 and 0, respectively.



Analog Input Channel Configuration Window, Button and Screen ... “User Scaling” Tab Selected

For all of the strain gage channels that are to be adjusted, set their ranges to $\pm 5V$.

Click the *DBK Parameters* tab to expose the strain gage signal conditioning programmable settings.



Click the Attach button to substantiate a connection between the PC and the LogBook.

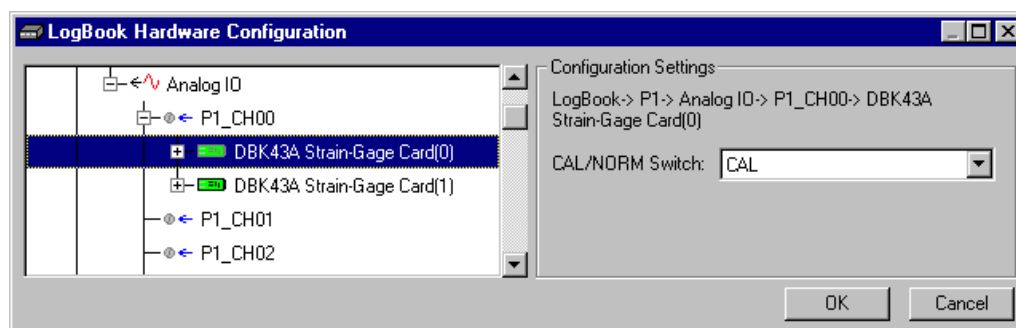
Adjust the Excitation - DBK16

For DBK16, set the excitation voltage for the transducer by adjusting the trimpot labeled EXC and measuring the voltage with a voltmeter across the +EXC and -EXC on the bridge or at the terminals of the signal conditioning module.

Adjust the Excitation - DBK43A

DBK43A is equipped with a switch that allows the excitation voltage to be read by the LogBook and displayed in LogView. For all DBK43A units to be adjusted, you must:

1. Reposition the DBK43A’s “physical” calibration switch (located next to the Power LED) to the CAL position.
2. Select CAL in LogView. This is detailed in the following paragraph.
Open the *LogBook Hardware Configuration* window and select DBK43A (see following figure). In the Configurations settings box, set the CAL/NORM Switch to CAL. If the DBK43A is not displayed click the + to the left of the base channel (to which it is attached), this action expands the hardware tree in the *LogBook Hardware Configuration* window. Repeat this process for all DBK43A units that are to be adjusted. Click OK to lock in the changes.



Setting a DBK43A Cal/Norm Switch to “CAL”

3. In the Param1 column (see next figure for location), select all of the DBK43A channels that are to be adjusted.
4. Set Mode equal to Excitation from the drop down list (located above the DBK Parameters tab).
5. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.

Analog Input Channel Configuration

View Edit

Channel Configuration

Mode: **Excitation**

Storage Rates DBK Parameters User Scaling 2-Point Cal

| # | Physical Channel | User Label | On/Off | Reading | Range | Units | Channel Type | DBK Parameters | | |
|----|------------------|-------------|--------|---------|---------------|-------|--------------|-----------------|-------------|---------|
| | | | | | | | | Param.1 | Param.2 | Param.3 |
| 1 | P1_CH00_0_0 | P1_CH00_0_0 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 2 | P1_CH00_0_1 | P1_CH00_0_1 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 3 | P1_CH00_0_2 | P1_CH00_0_2 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 4 | P1_CH00_0_3 | P1_CH00_0_3 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 5 | P1_CH00_0_4 | P1_CH00_0_4 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 6 | P1_CH00_0_5 | P1_CH00_0_5 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 7 | P1_CH00_0_6 | P1_CH00_0_6 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 8 | P1_CH00_0_7 | P1_CH00_0_7 | On | | -10.0 to 10.0 | Volt | DBK43A | Mode=Excitation | Switch=CAL | |
| 9 | P1_CH00_1_0 | P1_CH00_1_0 | Off | | -10.0 to 10.0 | Volt | DBK43A | Mode=Bridge | Switch=NORM | |
| 10 | P1_CH00_1_1 | P1_CH00_1_1 | Off | | -10.0 to 10.0 | Volt | DBK43A | Mode=Bridge | Switch=NORM | |

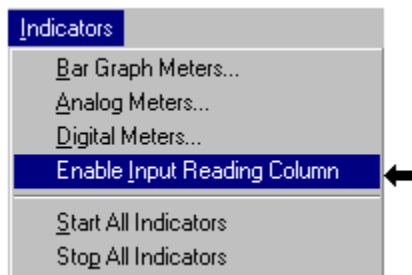
DBK card programmable parameter. Select from drop down list, or type in desired value.

Selecting "Mode = Excitation" for DBK Parameter 1



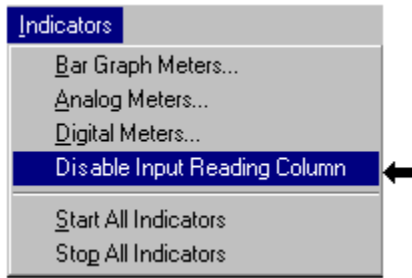
6. Click the Download button to send the current configuration to the LogBook.

7. Select Indictors \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.



**Selecting "Enable Input Reading Column"
(from the Indictors Pull-Down Menu)**

8. Set the excitation voltage for each transducer by adjusting the trimpot labeled EXC for the associated channel while reading their values in LogView.
9. Select Indictors \ Disable Input Reading Column from the menu bar.



Selecting “Disable Input Reading Column”(from the Indicators Pull-Down Menu)

10. Return the physical calibration switches (of the applicable DBK43As) to the NORM position.
11. In LogView, open the *LogBook Hardware Configuration Window* (hardware tree) and select NORM for each DBK43A.

This completes the section entitled: “Procedures Common to All Calibration Steps (Required)”

Nameplate Calibration and Manual Calibration

To properly calibrate a strain gage channel using the **Nameplate method**, the required gain must first be calculated. If the desired gain and offset are already know [as in the **Manual calibration** method] skip to the section, *Determining the Gain of Each Amplification Stage*.

The following examples outline the necessary steps for determining the required gain for **Nameplate calibration**. Both *strain gage* and *load cell* examples are provided.

Calculating the Required Gain

Determining a Strain Gage’s Maximum Output Voltage

Most strain gages come with Gage Factors (GF) used to calculate the approximate output of the bridge circuit with a typical strain value. The formula is:

$$V_{BR} = (V_{EXC} * G * S * B) / 4 \quad [\text{See following important notice.}]$$

Where: V_{BR} = Bridge output voltage

V_{EXC} = Excitation Voltage

G = Gage Factor

S = Strain in user units (in uStrain)

B = Configuration factor (1 for ¼ bridge, 2 for ½ bridge, 4 for full bridge)



The equation, $V_{BR} = (V_{EXC} * G * S * B) / 4$ produces a linear estimate. If you are using a non-linear strain gage you should refer to strain gage theory for additional information as needed.

For a 120 ohm strain gage with a gage factor of 2.1 and excitation voltage of 5 V, applying 4000 microstrain would produce an bridge output of 10.5mV for a ¼ bridge configuration.

$$V_{BR} = (5 * 2.1 * 4000 \times 10^{-6}) / 4 = 10.5 \text{ mV}$$

Determining a Load Cell's Maximum Output Voltage

Load cells come with a mV/V specification—for each volt of excitation at maximum load, the load cell will output a specific millivolt level.

$$V_{LC} = R * V_{EXC}$$

Where: V_{LC} = Load cell output voltage

R = Load cell spec (mV/V)

V_{EXC} = Excitation voltage

Consider a 3000 pound load cell rated at 2.05 mV/V using 10 V of excitation (assume a 350 Ω load cell). When 3000 pounds is applied, the voltage out of the load cell is 20.5mV.

$$V_{LC} = (10 * 2.05 \times 10^{-3}) = 20.5 \text{ mV}$$

If 1000 pounds were applied, we would see 6.833 mV. This is arrived at as follows:

$$(1000/3000) * 10 * 2.05 \times 10^{-3} = 6.833 \text{ mV}$$

Using the Calculated Maximum Voltage to Determine the Necessary Gain

To maximize the resolution and dynamic performance of the system, the sensor's output should be amplified to correspond to the data acquisition system's input range.

Using the LogBook's $\pm 5V$ input range, the required gain is calculated by dividing 5V by the maximum output voltage of the sensor. Before performing the calculation, it is typically a good idea to pad the maximum sensor voltage by about 5% so that, once amplified, it won't bump into the limit of the 5V range.

$$G = V_{LB} / (V_{GO} + V_{GO} * 5\%)$$

Where: G = Gain

V_{LB} = LogBook input range

V_{GO} = Maximum gage output

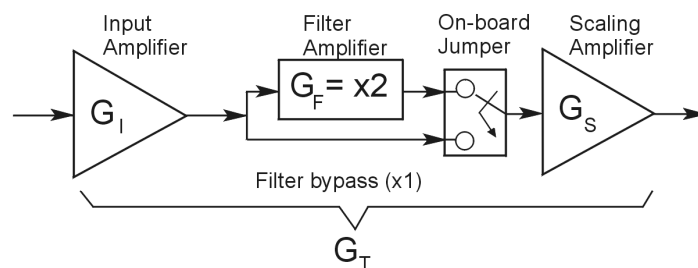
For the strain gage in the previous example with a maximum output of 10.5mV, the required gain is:

$$G = 5.0V / (0.0105V + 0.0105V * 0.05) = 453.5$$

For the above load cell with a maximum output of 20.5mV, the required gain is:

$$G = 5.0V / (0.0205V + 0.0205V * 0.05) = 232.3$$

Determining the Gain of Each Amplification Stage



The system's total gain is:

$$G_T = G_I * G_F * G_S$$

Where: G_T = Total gain

G_I = Input amplifier gain

G_F = Filter gain

G_S = Scaling amplifier gain

Note: Maximum gain calibration is $\times 1000$ for $\pm 5V$ range.

The majority of the gain should be assigned to the Input Amplifier, with the Scaling Amplifier used for fine-tuning. If the filter is enabled, a gain of $\times 2$ is automatically introduced.

The input amplifier has a gain range of $\times 100$ to $\times 1250$; the filter gain $\times 1$ or $\times 2$; and the scaling amplifier has a range of $\times 1$ to $\times 10$. For the strain gage example, if we round off our gain to $\times 420$, any of these possible settings will work.

| | Option A | Option B | Option C | Option D |
|------------------------------|--------------|--------------------|------------------------------|--------------|
| Input Gain | $\times 420$ | $\times 100$ | $\times 240$ | $\times 300$ |
| Filter Gain (enabled) | No | Yes ($\times 2$) | Yes ($\times 2$) *See Note | No |
| Scaling Gain | $\times 1$ | $\times 2.1$ | $\times 1.75$ | $\times 1.4$ |
| Total Gain | $\times 420$ | $\times 420$ | $\times 420$ | $\times 420$ |



For Option C, the LPF gain is typically $\times 2$.

For gains of $\times 1$ (if the filter is enabled), the following apply:

DBK16 - For a gain of $\times 1$ (if the filter is enabled), $10K\Omega$ resistors R44 and R46 must have been previously removed (for the low and high channels, respectively).

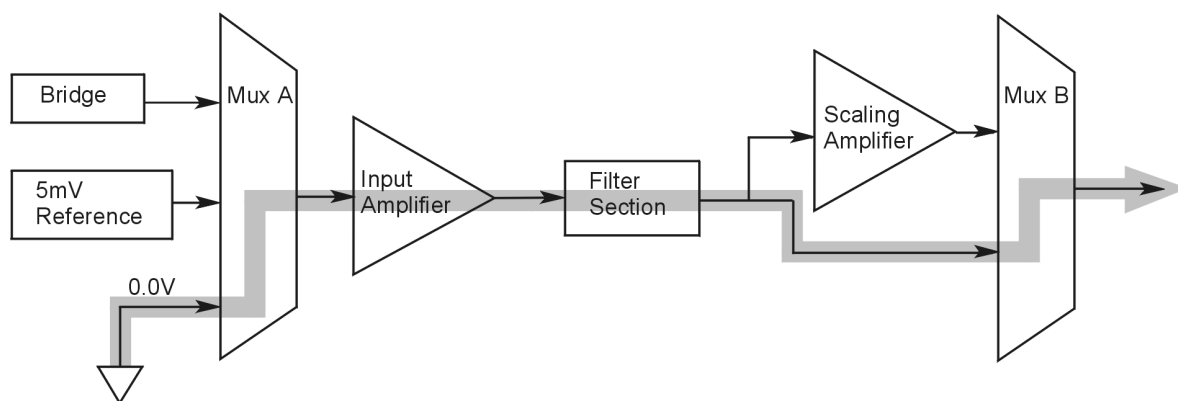
DBK43A - For a gain of $\times 1$ (if the channel filters are enabled), removal of the following $10 K\Omega$ resistors applies: Ch0 – R144, Ch1 – R244, Ch3 – R444, Ch4 – R544, Ch5 – R644, Ch6 – R744, Ch7 – R844.

Channel Calibration Procedure

Adjust the Offset

The following steps are used to adjust the offset.

1. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted.
2. **Select Mode = SetOffset** from the drop down list above the grid. This selection commands the calibration multiplexer to route the 0.0V reference through the entire analog path (see following figure).



“Mode = Offset” 0.0 Volt Reference is Routed

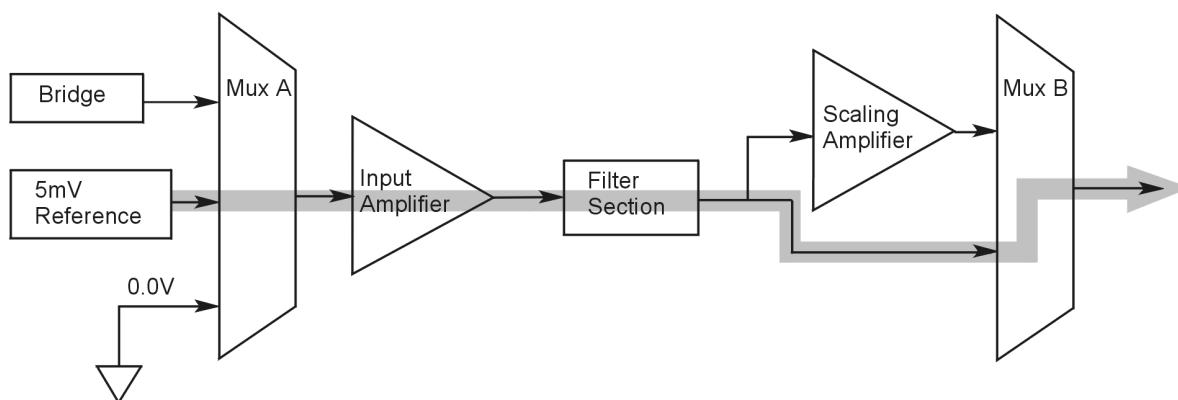
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button. This sends the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar. This displays the offset values for the enabled channels.
6. Set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET for the associated channel.
7. Select Indicators \ Disable Input Reading Column from the menu bar.

Adjust the Input Amplifier Gain

Perform the following steps to adjust the Input Amplifier Gain.

1. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted.
2. **Select Mode = SetInputGain** from the drop down list above the grid. This selection commands the calibration multiplexer to route a 5mV reference through the Input Amplifier and bypass the Scaling amplifier (see following figure).

Note: If the filter is enabled (not bypassed) accommodate an additional x2 gain stage.



“Mode = SetInputGain,” 5 milli-Volt Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the values for each channel.
6. For the associated channel, set the voltage to $[G_I * G_F * 0.005]$ for each transducer by adjusting the trimpot labeled GAIN. Use the Input Amplifier Gain (G_I) calculated earlier.

Note: If the filter is enabled, the filter gain (G_F) is 2; otherwise $G_F = 1$.

Example 1: If $G_I = 250$ and the filter is *disabled*; the GAIN trimpot would be adjusted to obtain 1.25V.

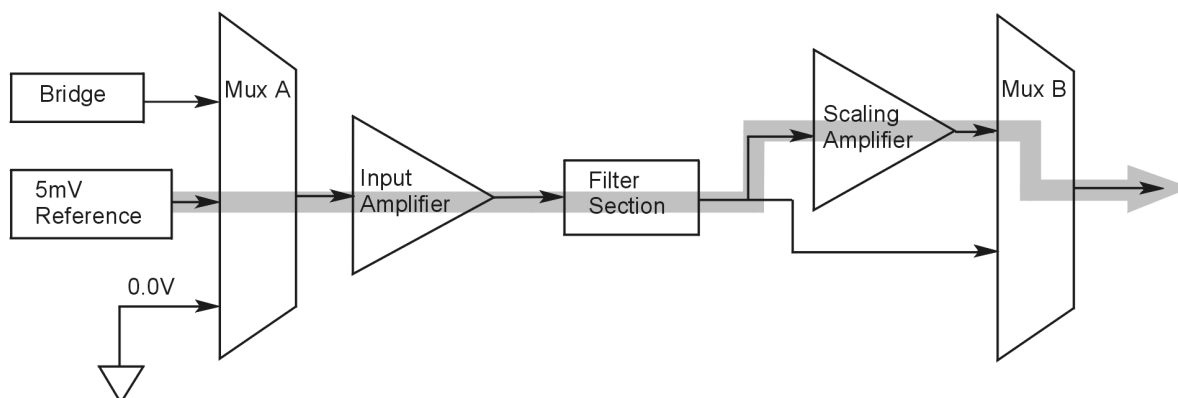
Example 2: If $G_I = 250$ and the filter is *enable*; the GAIN trimpot would be adjusted to obtain 2.50V.

7. Select Indicators \ Disable Input Reading Column from the menu bar.

Adjust the Scaling Amplifier Gain

Adjust the Scaling Amplifier Gain as follows:

1. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = SetScalingGain** from the drop down list above the grid. This selection commands the calibration multiplexer to route a 5mV reference through all of the amplification stages as shown below.



“Mode = ScalingGain,” 5 milli-Volt Reference Route

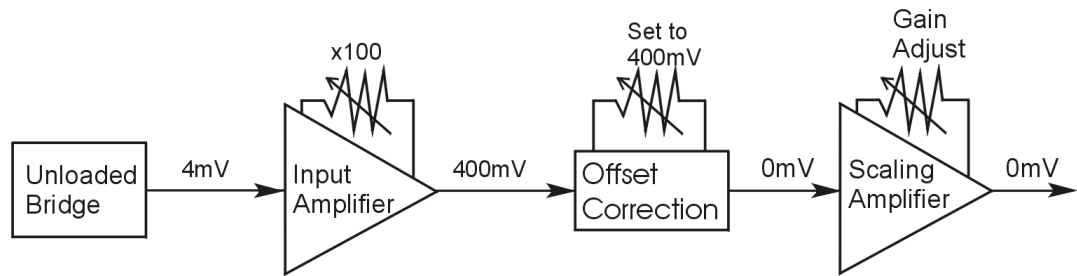
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indictors \ Enable Input Reading Column from the menu bar to display the values for each channel.
6. For the associated channel, set the voltage to $[G_T * 0.005]$ for each transducer by adjusting the trimpot labeled SCALE. Use the total system gain (G_T) calculated earlier.
Example: If $G_T = 435.5$, the SCALE trimpot would be adjusted to obtain 2.17 V.
7. Select Indictors \ Disable Input Reading Column from the menu bar.

Trimming Bridge Quiescent Load

Most bridges have some level of offset, even if no quiescent load is present. In quarter and half bridge situations, use of 1% bridge completion resistors can cause up to 1mV/V of offset. If the bridge has 4mV of offset and the Input Amplifier is set to x100, the Offset potentiometer would need to nullify 400mV.

DBK16 – For DBK16s, the Offset Potentiometer can adjust out 0 to +5V of offset amplified by the Input Amplifier.

DBK43A – For DBK43As, the Offset Potentiometer can adjust out -1.25 to +5V of offset amplified by the Input Amplifier.

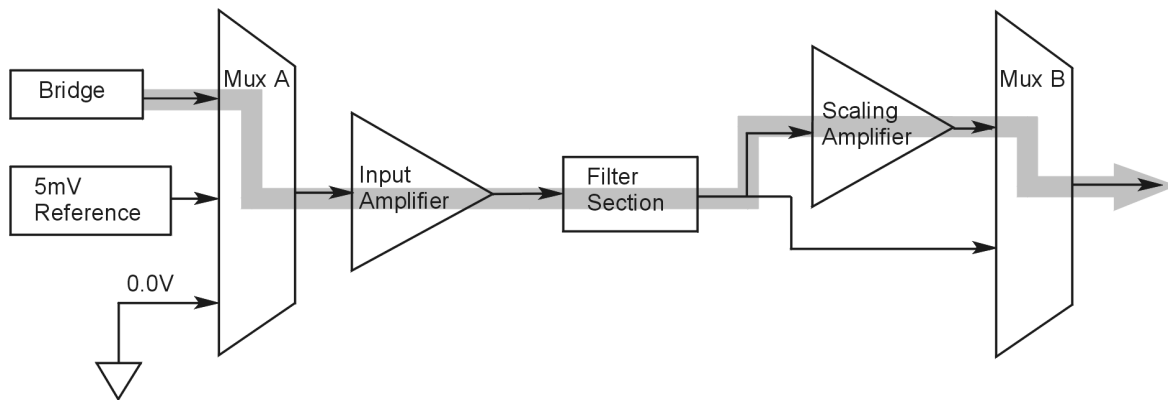


Trimming Bridge Quiescent Load

If a significant amount of quiescent offset is present and the Input Amplifier gain is set too high, the Offset Potentiometer will not have enough range to adequately nullify the offset. In this case, the gain of the Input Amplifier must be reduced while the gain of the Scaling Amplifier is increased proportionately.

Use the following steps to trim bridge quiescent load (unload the bridge).

1. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer output through the analog path as shown below.



“Mode = Bridge,” Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indictors \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.

Note: If you are unable to nullify the quiescent offset of the bridge, your Input Amplifier gain may be too high. Information regarding gain redistribution can be found in the section entitled, *Determining the Gain of Each Amplification Stage*.

7. Select Indictors \ Disable Input Reading Column from the menu bar.

2-Point Calibration



This 2-point calibration method makes use of trimpot adjustments. It should not be confused with the LogView software 2-Point Calibration (discussed in the LogView chapter in the LogBook User’s Manual).

In the 2-Point calibration method, the user places two known loads on the gage, one at a time, then adjust the trimpots until the expected value is reached. Typically, the first of loads is “no load.” In the case of a weight scale, the scale would first be unloaded to adjust the offset, then a known load (near maximum expected) would be applied to adjust the gain.

Shunt calibration (discussed immediately after this *2-Point Calibration* section) is the same as the 2-Point method, except the second load is applied in a simulated fashion by shunting 1 leg of the bridge with a shunt resistor. Shunt calibration is preferred in cases where applying a real load (near the maximum expected) is not practical.

Initialize the System

1. Download a single setup and continuously display data in LogView. The continuous display can remain throughout the procedure since the calibration multiplexers do not need reset between steps.
2. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted.
3. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.

4. Turn off all the channels in the system, except for those DBK43A channels that are to be adjusted.
5. Click the Download button to send the current configuration to the LogBook.
6. Select Indictors \ Enable Input Reading Column from the menu bar to display the offset values for each channel.

Adjust the Offset

For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer. This is accomplished by adjusting the trimpot labeled OFFSET. If the first point is actually a calibrated load, you will need to move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

Complete the following steps to adjust the channel gain.

1. Apply the second load to each gage channel. The value of this load should approximate that of the maximum expected load. For the best results, a gain should be selected so that the bridge's maximum output equals 90% of the A/D's input range.
2. Calculate the desired voltage for the second point using the following equation:

$$V_D = (L_A/L_M) * V_I * 90\%$$

Where: V_D = Desired voltage for 2nd point of calibration

L_A = Applied load used in calibrating the 2nd point

L_M = Maximum load expected during usage

V_I = Input voltage range

Example: The load standard that will be applied to the gage as the 2nd point in the 2-Point calibration is 100lbs. The maximum expected load during usage is 150lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

In this example, we should adjust the GAIN and SCALE trimpots until a value of 3V is measured.

If 150 lbs is applied to the gage, a voltage of 4.5V will be measured.

$$V_D = (150/150) * 5 * 0.90 = 4.5V$$

3. Apply the second calibrated load to each gage and set the voltage to V_D , as derived in step 2. Do this for each transducer by adjusting the trimpots labeled GAIN and SCALE for the associated channel. Note that the GAIN trimpot provides most of the amplification (course adjustment), while the SCALE trimpot allows for fine-tuning.

Repeating the Process



Since adjusting the gain for the first time will have an affect on the offset, it is recommended that offset and gain adjustment be performed twice for each channel.

Shunt Calibration

Shunt calibration is virtually identical to the 2-Point method just discussed, except that the second point is simulated. The simulated load is achieved by shunting one leg of the bridge with a shunt resistor. Shunt calibration is the preferred calibration method when applying a real load (of a value approximating the maximum expected load) is not practical. To adjust the channel gain, the shunt must be applied to the bridge.



Calculate and install the necessary shunt resistor before continuing.

- **DBK43A** has direct support for shunt calibration, accommodating the resistor in its enclosure and allowing the software to apply it when requested.
- **DBK16** does not have direct support, so the shunt resistor must be applied externally and switched in manually.

Adjust the Offset

Adjust the offset as follows.

1. In the Param1 column, select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indictors \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.



If the first point is an actual calibrated load, you must move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

For the best results, a gain should be selected so that the bridge's maximum output equals 90% of the A/D's input range.

1. Use the following equation to calculate the desired shunt voltage (V_D).

$$V_D = (L_s/L_M) * V_I * 90\%$$

Where: V_D = Desired voltage from the after amplification when the shunt is applied

L_s = Simulated load produced by shunt

L_M = Maximum load expected during usage

V_I = Input voltage range

Example: The simulated load produced by the shunt 100lbs. The maximum expected load during usage is 150 lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

In this example, we would adjust the GAIN and SCALE trimpots until a value of 3V is measured.

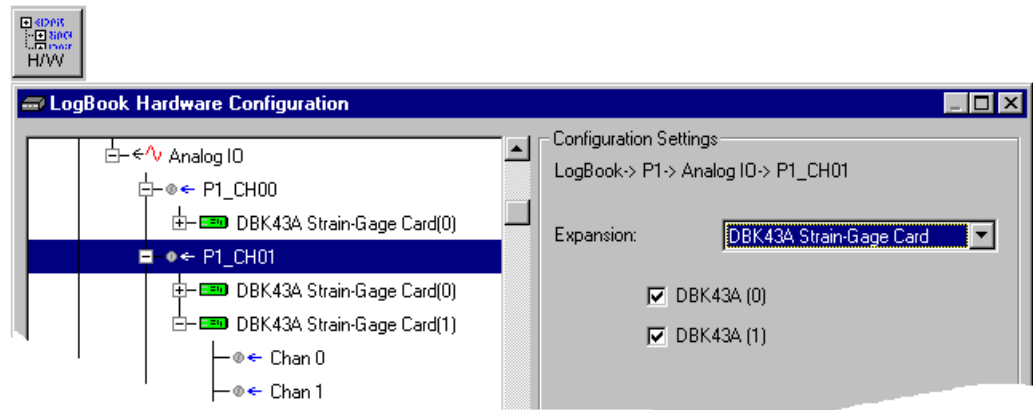
If 150lbs is applied to the gage, a voltage of 4.5V will be measured.

$$V_D = (150/150) * 5 * 0.90 = 4.5V$$

For **DBK16, only** ... Externally apply the shunt resistor and set the voltage to V_D , as derived above for each transducer. This is done by adjusting the trimpots labeled GAIN and SCALE for the associated channel. The GAIN trimpot is used for course adjustment; and the SCALE trimpot for fine-tuning.

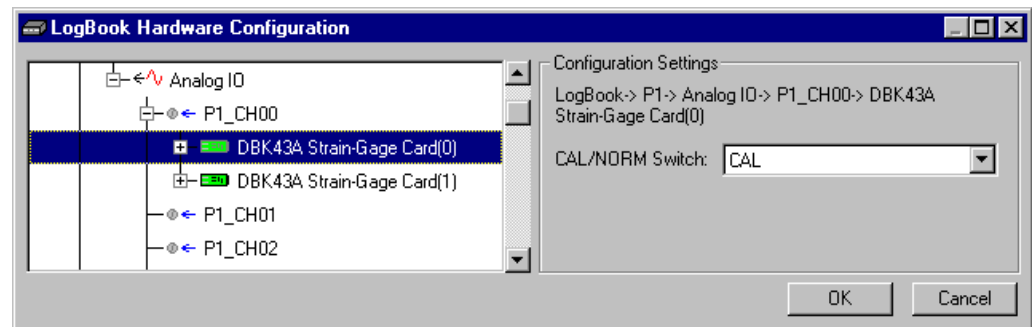
For **DBK43A only** ... DBK43 is equipped with a physical switch that allows the shunt to be applied when directed by the software. For each DBK43A to be adjusted, move this physical switch from NORM to CAL.

2. In LogView, open the *LogBook Hardware Configuration window* and select the DBK43A.



LogBook Hardware Configuration, Button and Screen

3. Select the DBK43A from the *LogBook Hardware Configuration window's* hardware tree.
4. Set the list box to the right to CAL. If the DBK43A is not displayed click the + to the left of the base channel to which it is attached to expand the hardware tree.



Setting a DBK43A Cal/Norm Switch to "CAL"

5. Repeat this process for each DBK43A that is to be adjusted.
6. Click OK to lock in the changes.
7. Open the Analog Input Channel Grid. In the Param1 column (see [page 27](#) for location), select all of the DBK43A channels that are to be adjusted. Select **Mode = Shunt** from the drop down list above the grid. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
8. Click the Download button to send the current configuration to the LogBook.
9. Select Indicators \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.

10. Set the voltage to V_D , as derived above, for each transducer. This is accomplished by adjusting the trimpots labeled GAIN and SCALE for the associated channel. The GAIN trimpot provides for course adjustment. The SCALE trimpot provides for fine tuning.
11. Select Indictors \ Disable Input Reading Column from the menu bar.
12. Return the physical NORM/CAL switches (of the applicable DBK43As) to the NORM position.
13. In LogView, open the *LogBook Hardware Configuration window* and return each DBK43A back to NORM.

Repeating the Process



Since adjusting the gain for the first time will have an affect on the offset, it is recommended that offset and gain adjustment be performed twice for each channel.

Creating a Units Conversion Transfer Function

To make the data from your gage more useful, it should be recorded in terms of units appropriate to your application, such as pounds, kilograms, inches, mm, or Hg. A transfer function is needed to convert volts to these more meaningful units.

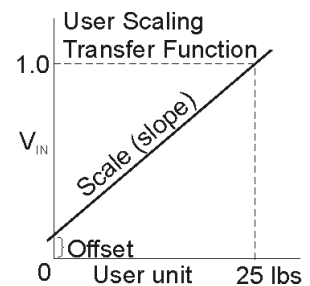
For this purpose, LogView provides a means of assigning a mathematical scale and offset to each channel. Scale and offset information from that chapter has been repeated below for convenience.

| Storage | | DBK Parameters | | User Scaling | | 2-Point Cal | | | |
|---------|------------------|----------------|--------|--------------|---------------|-------------|--------------|--------------|--------|
| # | Physical Channel | User Label | On/Off | Reading | Range | Units | Channel Type | User Scaling | |
| | | | | | | | | Scale | Offset |
| 1 | P1_CH00 | P1_CH00 | On | | 0.1 to 500.1 | lbs | Local | 25.0 | 0.1 |
| 2 | P1_CH01 | P1_CH01 | On | | 0.0 to 2000.0 | apples | Local | 100.0 | 0.0 |
| 3 | P1_CH02 | P1_CH02 | On | | -10.0 to 10.0 | Volt | Local | 1.0 | 0.0 |

In *User Scaling*, you can create a **transfer function**. The function allows LogView to display units that could be more useful to you than volts. For example, you could obtain readings with pounds as the designated **Units**. The reading (in pounds) will be based on the raw input value, typically Volts, and the indicated Scale and Offset adjustment.

To create the transfer function:

1. Type the desired unit name in the Units column.
2. Select an appropriate range (e.g. unipolar).
3. Enter the linear *scale* relation to Volts (e.g. 25 pounds per Volt).
4. Enter any *offset* from 0, for example, an empty basket used in an application reads 0.1 V.



The reading and range columns will automatically change to the adjusted values.

Periodic Calibration Without Trimpots

Once the trimpots have been adjusted during initial installation, periodic trimming can be performed through LogView's 2-Point software calibration. The LogView procedure does not require the use of trimmpots and should not be confused with the 2-point method discussed in this section of the manual.

Refer to the LogView chapter in the LogBook User's Manual for information regarding 2-point calibration via software.

DBK43A – Specifications

Name/Function: Strain-Gage Module

Connectors: DB37 mates with P1; mini-DIN6 provided for strain-gage or external excitation connections

Number of Channels: 8

Excitation Voltage Adjustment Ranges: 1.50 to 10.50 VDC @ 50 mA

Input Gain Range: $\times 100$ -1250; separate instrumentation amplifier for each channel with gain adjustable via externally accessible 15-turn trimpot

Accommodated Bridge Types:

Full bridge, Kelvin excitation (6-wire)

Full bridge (4-wire)

Half bridge (3-wire)

Quarter bridge (2-wire)

Bridge-Completion Resistors: On-board resistor socket locations (Rn00A, Rn00B, Rn00C, Rn00E, Rn00F, and Rn00G) for 6 bridge-completion resistors per channel

Input Type: Differential

Input Impedance: 100 M Ω

CMMR: 115 dB

Excitation Current Output: 50 mA max (current limited @ 60 mA)

Excitation Sensing: Local or remote

Excitation Regulation

Line Regulation: 0.025%

Load Regulation: 0.05%

Reference Voltages: 2.5 VDC

Reference Accuracy: 0.05%

Reference Drift: 3 ppm/ $^{\circ}$ C

Gain Calibration Reference: 5 mVDC

Gain Calibration Reference Accuracy: 0.2%

Gain Calibration Reference Drift: 20 ppm/ $^{\circ}$ C

Gain Accuracy: 0.5%

Gain Drift: 50 ppm/ $^{\circ}$ C

Input Offset: 100 μ V max

Offset Drift: 4 μ V/ $^{\circ}$ C

Output Offset: 20 μ V

Offset Drift: 200 μ V/ $^{\circ}$ C

Offset Adjustment: 0-100% of range, 0-5 VDC (15-turn trimpot)

Full-Scale Sensitivity Range

5.00 VDC Excitation: 0.8-10 mV/V

10.00 VDC Excitation: 0.4-5 mV/V

Scaling Amplifier Gain Range: $\times 1$ -10 (15-turn trimpot)

Low-Pass Filter:

3-pole, user-selected

Corner frequency (Fc) set by user component

Attenuation -3 dB at Fc

Gain $\times 2$

Power: 9 to 18 VDC, external supply provided, 16 Watts maximum



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Power Considerations 2

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Terminal Block Connection 4

P1 Connection 4

CE Compliance 5

DaqBook and DaqBoard [ISA type] Configuration 5

Software Setup 5**mx+b Values for 5B Modules 6****DBK44 – Specifications 7****Reference Notes:**

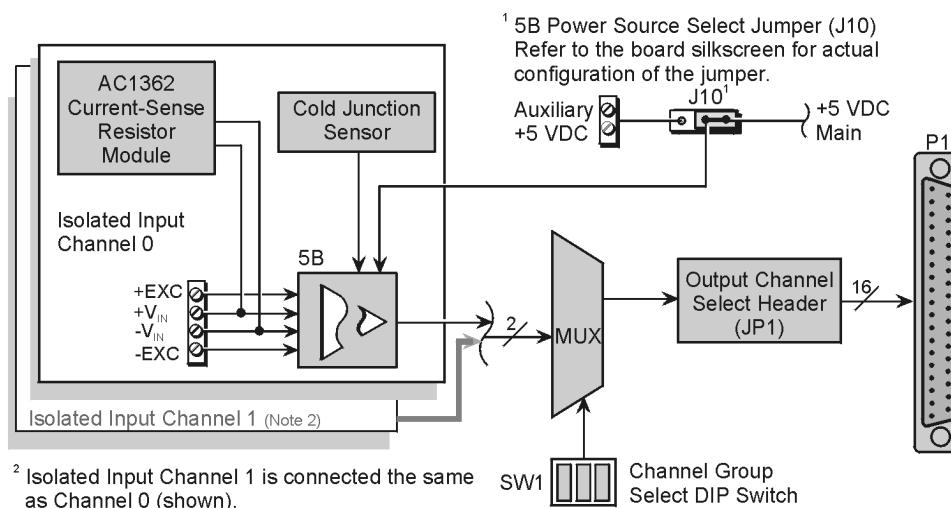
- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

**Reference Note:**

Users of the DBK44 signal-conditioning card may be interested in the [DBK207](#) and [DBK207/CJC](#), *Carrier Boards for 5B Compatible Analog I/O Modules*. Each DBK207 and DBK207/CJC board includes a 100-pin P4 connector for DaqBoard/2000 Series and /2000c Series compatibility, two P1 connectors for analog expansion, a power connection terminal, and 16 signal terminal blocks. In addition, the DBK207/CJC board includes CJC (Cold Junction Compensation) for thermocouple applications. DBK207 and DBK207/CJC can be mounted in Nema-type panels.

Overview

The 2-channel DBK44 allows LogBook or Daq device systems to use any combination of 5B signal-conditioning modules. 5B modules can accommodate a variety of signals (low-level thermocouple signals to strain-gage signals, etc). Configuration options are flexible. You can select the type of signal attached to each channel. One LogBook or Daq device can support up to 128 DBK44 cards, providing up to 256 isolated, analog input channels.



DBK44 Block Diagram

The LogBook or Daq device scans the DBK44's channels at the same 10 μ s/channel rate as other DBKs (256 scans in 2.56 ms in a full system). Each user-installed 5B module offers 500 V isolation from the system and between channels. The DBK44 has convenient screw-terminal blocks for signal inputs and excitation outputs (for use with a strain gage or RTD). Cold junction compensators (CJC) are installed and ready to use with thermocouple 5B modules. Sockets are provided for AC1362 current-sense resistor modules.

Hardware Setup

Power Considerations

The DBK44 requires +5 and ± 15 VDC from a LogBook, Daq device P1 connector, or auxiliary power supply. In some applications, the DBK44 can draw enough power from the LogBook's internal power supply via the P1 connector. However, the 5B power requirements (+5 VDC only) may be greater than the LogBook or DaqBook/DaqBoard can provide (see table). The Daq PC-Card must use a CDK10 Power Module.



For applications with more than 4 channels, it may be better to use the DBK42 instead of the DBK44. The DBK42 is a 16-channel module with a built-in power supply.

External power can be obtained from any regulated 5 V source or from a TR-4 power supply. External power attaches to the DBK44 via onboard screw-terminal connections (the Auxiliary Power Input J9 Combicon terminal at the rear of the board).



The 5B38 series strain-gage modules with excitation output require an external power source. Auxiliary power is also necessary in systems equipped with more than one DBK44. Prior to using auxiliary power, you must select AUXL on the Power Source Select Jumper (J10).

| 5B Model | Current Required |
|--|------------------|
| 5B30 | 30 mA |
| 5B31 | 30 mA |
| 5B32 | 30 mA |
| 5B34 | 30 mA |
| 5B37 | 30 mA |
| 5B38 | 200 mA |
| 5B39 | *170 mA |
| 5B40 | 30 mA |
| 5B41 | 30 mA |
| 5B47 | 30 mA |
| * Maximum output load resistance is 750 Ω | |

CAUTION

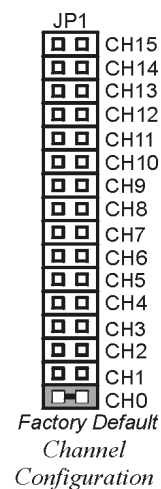


Auxiliary power input must not exceed +5 VDC. DBK44 does not regulate auxiliary power input.

Card Configuration

Up to 128 DBK44s may connect to a LogBook or a Daq device system. Since this is a daisy-chain interface, each module must appear unique and use a different analog input channel. To configure the card's channel, you must set the JP1 jumper and the SW1 DIP switch to your chosen channel as follows.

1. Locate the 16x2-pin header (labeled JP1) near the front of the card. Note the 16 jumper locations labeled CH0 through CH15 to match the main channel.
2. Place the JP1 jumper on the channel you wish to use. Only one jumper is used per card, but up to 8 DBK44s can occupy one main channel and use the same JP1 setting (but with different SW1 settings).
3. Locate the SW1 DIP switch that serves as a channel group select switch and can distinguish up to 8 cards on a channel.
4. Place the 3 mini switches (CBA) in the position that corresponds to your chosen channel as shown in the table below. For each JP1 setting, there are 8 possible SW1 settings to allow two input channels per card).

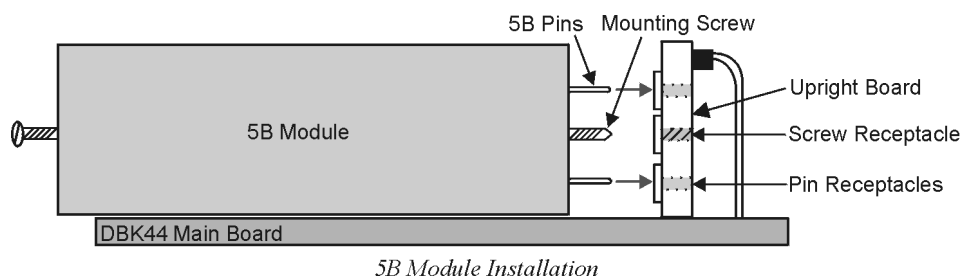


| Channel Pair Determined by JP1 and SW1 | | | | | | | | |
|--|------------------------|---------|---------|---------|---------|---------|---------|---------|
| JP1 Jumper | SW1 DIP Switch Setting | | | | | | | |
| | CBA | CBA | CBA | CBA | CBA | CBA | CBA | CBA |
| | 0 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
| CH0 | 16-17 | 18-19 | 20-21 | 22-23 | 24-25 | 26-27 | 28-29 | 30-31 |
| CH1 | 32-33 | 34-35 | 36-37 | 38-39 | 40-41 | 42-43 | 44-45 | 46-47 |
| CH2 | 48-49 | 50-51 | 52-53 | 54-55 | 56-57 | 58-59 | 60-61 | 62-63 |
| CH3 | 64-65 | 66-67 | 68-69 | 70-71 | 72-73 | 74-75 | 76-77 | 78-79 |
| CH4 | 80-81 | 82-83 | 84-85 | 86-87 | 88-89 | 90-91 | 92-93 | 94-95 |
| CH5 | 96-97 | 98-99 | 100-101 | 102-103 | 104-105 | 106-107 | 108-109 | 110-111 |
| CH6 | 112-113 | 114-115 | 116-117 | 118-119 | 120-121 | 122-123 | 124-125 | 126-127 |
| CH7 | 128-129 | 130-131 | 132-133 | 134-135 | 136-137 | 138-139 | 140-141 | 142-143 |
| CH8 | 144-145 | 146-147 | 148-149 | 150-151 | 152-153 | 154-155 | 156-157 | 158-159 |
| CH9 | 160-161 | 162-163 | 164-165 | 166-167 | 168-169 | 170-171 | 172-173 | 174-175 |
| CH10 | 176-177 | 178-179 | 180-181 | 182-183 | 184-185 | 186-187 | 188-189 | 190-191 |
| CH11 | 192-193 | 194-195 | 196-197 | 198-199 | 200-201 | 202-203 | 204-205 | 206-207 |
| CH12 | 208-209 | 210-211 | 212-213 | 214-215 | 216-217 | 218-219 | 220-221 | 222-223 |
| CH13 | 224-225 | 226-227 | 228-229 | 230-231 | 232-233 | 234-235 | 236-237 | 238-239 |
| CH14 | 240-241 | 242-243 | 244-245 | 246-247 | 248-249 | 250-251 | 252-253 | 254-255 |
| CH15 | 256-257 | 258-259 | 260-261 | 262-263 | 264-265 | 266-267 | 268-269 | 270-271 |

5B Module Connection

Each input of the DBK44 is processed through a user-installed 5B signal-conditioning module. Different 5B modules are used with different transducer and signal sources. To install the modules:

1. Remove all power from the DBK44.
2. Match the footprint of the module with the footprint on the circuit board (see figure).
3. Gently place the module into the footprint, and screw it down.
4. Record the channel the module was placed in.



When installing current input modules (SC-5B32 series), be sure to install the current-sense resistor (SC-AC-1362 shipped with the SC-5B32) in the resistor socket (J4 for ch 0, J3 for ch 1) near the input screw-terminal block (see figure).



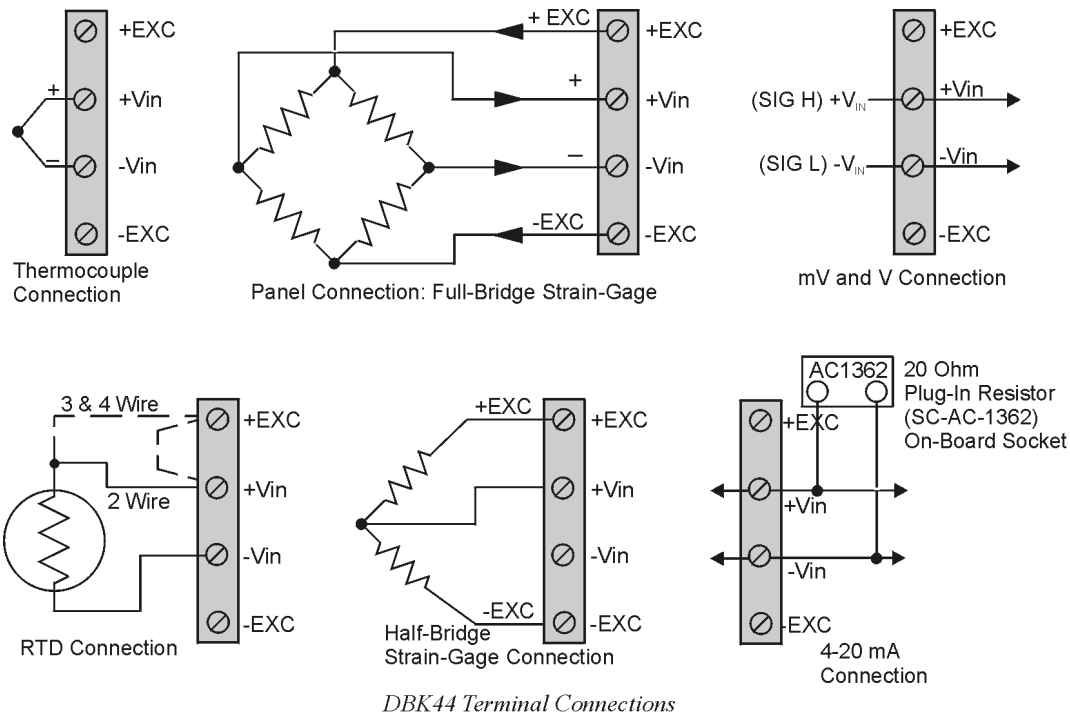
Terminal Block Connection

WARNING



Shock Hazard. De-energize circuits connected to the DBK44 before changing the wiring or configuration. The DBK44 is designed to sense signals that may carry dangerous voltages.

Input signals (and excitation leads) must be wired to the DBK44 via the 4-contact terminal blocks at the end of the card. These terminal blocks connect internally to their corresponding signal conditioning module. The terminal blocks accept up to 14-gage wire into quick-connect screw terminals that are labeled as to their function. Each type of input signal or transducer (such as a thermocouple or strain gage) should be wired to its terminal block as shown in the figure. Wiring is shown for RTDs, thermocouples, 20 mA circuits, mV/V connections, and for full- and half-bridge strain gages.



P1 Connection



Reference Notes:

[Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4.

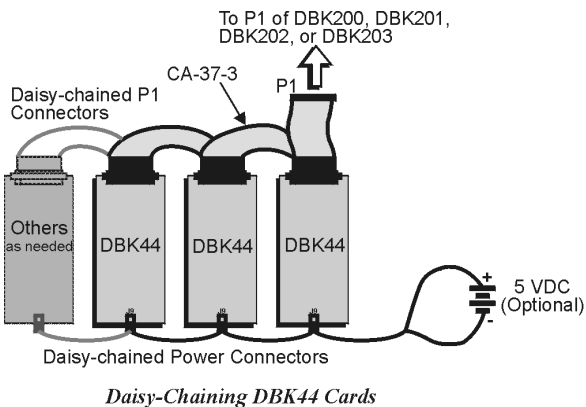
Refer to the pinouts that are applicable to your system, as needed.

The DBK44 attaches to the LogBook's or Daq Device's P1 analog I/O connector. Connect the CA-37-*x* accessory ribbon cable (with *x* indicating the number of cards to be connected) from P1 to the DB37 connector at the end of the DBK44 card.

Note: A series of interface cables are available to connect up to 128 DBK44s. You can also use a DBK41 10-slot expansion chassis.

DBK44 can be connected to the P1 connector of DBK200, DBK201, DBK202, or DBK203. Connect the CA-37-*x* accessory ribbon cable (with *x* indicating the number of cards to be connected) from P1 to the DB37 connector at the end of the DBK44 card.

Note: Interface cables are available to connect up to 128 DBK44s.



CE Compliance



Reference Notes:

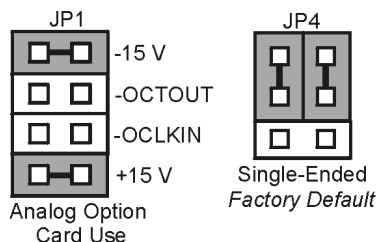
Should your data acquisition system need to comply with CE standards, refer to the [CE Compliance](#) section of Chapter 1.



DaqBook and DaqBoard [ISA type] Configuration

The DBK44 requires two setup steps in DaqBooks and DaqBoards [ISA type]—jumpers JP1 and JP4.

1. If not using auxiliary power, ensure the JP1 jumper is configured for Analog Option Card Use (expanded analog mode).



DaqBook/DaqBoard Jumpers for DBK44

Note: This default position is necessary to power the interface circuitry of the DBK44 via the internal ± 15 VDC power supply. If using auxiliary power from a DBK32A or DBK33 card, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) to the DBK32A and DBK33 document modules, as applicable.

2. For DaqBook/100, /112, and /120 *only*, place the JP4 jumper in the DaqBook or DaqBoard [ISA type] in *single-ended* mode. Note that analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

Note: The configuration of the JP3 jumper depends on the output range of the 5B module. For example, a 5B31 volt input module has an output range of -5 to +5 V in bipolar mode. A 5B47 T/C module (output 0 to +5 V) could use bipolar mode, but unipolar mode is more appropriate.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

mx+b Values for 5B Modules

The $mx+b$ values for many 5B modules are included within LogView; some are shown in table below.

| 5B Module | m Value | b Value | Engineering Unit(s) |
|---|---------|---------|---------------------|
| Isolated Voltage Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B31-01 | 1/5 | 0 | mV, V |
| SC-5B31-02 | 1 | 0 | mV, V |
| SC-5B31-03 | 2 | 0 | mV, V |
| SC-5B31-04 | 2/5 | -1 | mV, V |
| SC-5B31-05 | 2 | -5 | mV, V |
| SC-5B31-06 | 4 | -10 | mV, V |
| Isolated Wideband Voltage (5 V Current Requirement, 30mA) | | | |
| SC-5B41-01 | 1/5 | 0 | V |
| SC-5B41-02 | 1 | 0 | V |
| SC-5B41-03 | 2 | 0 | V |
| SC-5B41-04 | 2/5 | -1 | V |
| SC-5B41-05 | 2 | -5 | V |
| SC-5B41-06 | 4 | -10 | V |
| Isolated Millivolt Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B30-01 | 2 | 0 | mV |
| SC-5B30-02 | 10 | 0 | mV |
| SC-5B30-03 | 20 | 0 | mV |
| SC-5B30-04 | 4 | -10 | mV |
| SC-5B30-05 | 20 | -50 | mV |
| SC-5B30-06 | 40 | -100 | mV |
| Isolated Wideband Millivolt (5 V Current Requirement, 30 mA) | | | |
| SC-5B40-01 | 2 | 0 | mV |
| SC-5B40-02 | 10 | 0 | mV |
| SC-5B40-03 | 20 | 0 | mV |
| SC-5B40-04 | 4 | -10 | mV |
| SC-5B40-05 | 20 | -50 | mV |
| SC-5B40-06 | 40 | -100 | mV |
| Isolated Linearized T/C Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B47-J-01 | 152 | 0 | °C |
| SC-5B47-J-02 | 80 | -100 | °C |
| SC-5B47-J-03 | 100 | 0 | °C |
| SC-5B47-K-04 | 200 | 0 | °C |
| SC-5B47-K-05 | 100 | 0 | °C |
| SC-5B47-T-06 | 100 | -100 | °C |
| SC-5B47-T-07 | 40 | 0 | °C |
| SC-5B47-E-08 | 200 | 0 | °C |
| SC-5B47-R-09 | 250 | +500 | °C |
| SC-5B47-S-10 | 250 | +500 | °C |
| SC-5B47-S-11 | 260 | +500 | °C |
| Isolated RTD Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B34-01 | 40 | -100 | °C |
| SC-5B34-02 | 20 | 0 | °C |
| SC-5B34-03 | 40 | 0 | °C |
| SC-5B34-04 | 120 | 0 | °C |
| SC-5B34-C-01 | 24 | 0 | °C |
| SC-5B34-C-02 | 24 | 0 | °C |
| SC-5B34-N-01 | 24 | 0 | °C |
| Isolated Current Input (5 V Current Requirement, 30 mA) | | | |
| SC-5B32-01 | 3.2 | 4 | mA |
| SC-5B32-02 | 4 | 0 | mA |
| Voltage Switch Input | | | |
| SC-AC-1367 | 1 | 0 | V |

DBK44 – Specifications

Name/Function: 2-Channel 5B Signal Conditioning Card

Module Capacity: 2 “input only” 5B modules

Weight: 0.25 kg (8 oz.) with no modules installed

Cable (optional): CA-37-x

DC Input Fuse: 4 A

Connections:

Male DB37 mates via CA-37-1 cable with P1 on the LogBook, DaqBook, ISA-type DaqBoard*, or Daq PC-Card.

User connections include 8 screw-terminals (4 per channel).
Screw terminations, per channel, are: +EXC, +Vin, -Vin, -EXC

Isolation to Primary Acquisition Device (LogBook or Daq Device):

Input Power: 0 VDC

Signal Inputs: 1500 VDC

Input Channel-to-Channel: 500 VDC

Environmental:

Operating Temperature: 0 to 50°C

Humidity: 0 to 80% RH @ 30°C; de-rate 3%/°C

Altitude: 0 to 2000 m

***Note:** For DaqBoard/2000 Series and /2000c Series boards, the use of a DBK200 Series P4-to-P1 adapter is required.



Overview 1**Hardware Setup 2**

Card Connection 2

Card Configuration 2

Configuring DBK45 Filter Sections 3

DaqBook and DaqBoard [ISA type] Configuration 5

Software Setup 5**DBK45 – Specifications 6****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK45 combines the features of the DBK17 (SSH) and the DBK18 (low-pass filter) cards. Each DBK45 provides 4 input channels to a LogBook or Daq device system. Each of the main 16 analog input channels can accept 4 DBK45s, for a maximum of 64 DBK45s and 256 analog input channels. The simultaneous sample-hold function is activated at the beginning of each channel scan and freezes all signals present on DBK45 inputs for the duration of the scan, allowing for non-skewed readings of all channels.

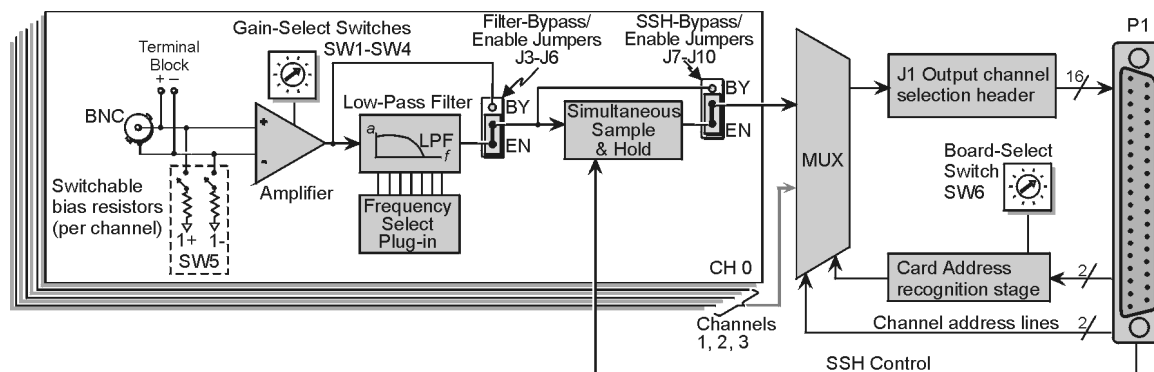


You should never set a DBK45 channel as the 1st channel in a scan due to timing of the SSH line.

For each of the 4 channels, a separate filter and a sample-hold stage follow the input stage. The outputs are connected to a 4-channel multiplexer stage. The enabled-output MUX allows 4 DBK45s to share a common analog input channel.

The DBK45 has an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a gain resistor for custom gain-selection instead of the 5 factory-default gains. Gain for any channel can be be set to any value between unity and $\times 500$ by installing an appropriate resistor. Four separate filter stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled output MUX allows 4 DBK45s to share a common analog base channel.


The input connectors are BNC type connectors. The differential inputs are provided with switchable 100 k Ω bias resistors to analog common.



DBK45 Block Diagram

Hardware Setup

Card Connection



CAUTION
Input voltage levels must not exceed ±5 V bipolar or 10 V unipolar.

DBK45 is equipped with BNC connectors for easy access to all of the analog inputs. Connections are provided for four differential inputs. The card also includes a terminal block as a connection-option to the BNC connectors.

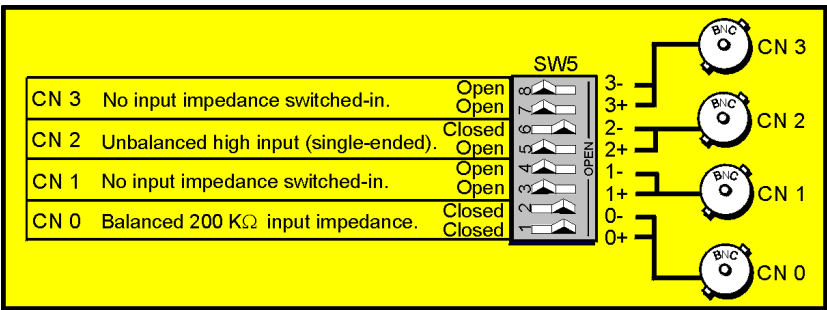
Card Configuration

Factory Defaults:

- 100K bias resistors – Enabled
- Low pass filter – Disabled (bypassed)
- Gain – x1
- SSH - Enabled

Input Termination

DBK45 provides two 100 KΩ bias resistors for each analog input. For balanced 200 KΩ input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required. Examples of SW5 switch positions and the resulting impedance selection follows.



Examples of Bias Resistor Selection Options

Gain Settings

On the printed circuit board, each channel has a gain-set switch labeled GAIN 1 to GAIN 4 (see figure) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows the 5 gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the board. The gain resistor’s value is determined by the formula: $R_{GAIN} = [40,000 / (Gain - 1)] - 50 \Omega$

Gain Values

0 x1

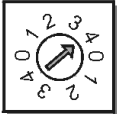
1 x10

2 x100

3 x200

4 x500

Gain Switch



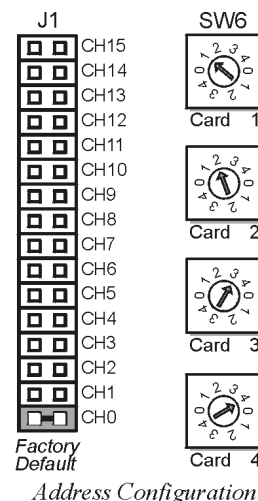
Setting Channel Gains

Address Configuration

Up to four DBK45s can be connected to each LogBook analog channel. With 16 main channels and 4 inputs per DBK45, 256 inputs are possible. Since this is a daisy-chain interface, each DBK45 must have a unique address (channel and card number). Note that the default setting of SW6 is Card 1.

To configure the module, locate the 16 × 2-pin header (labeled J1) near the front of the board by P1. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used. Two DBK45s in the daisy-chain can have the same channel number as long as their card number is unique.

Set switch SW6 for each DBK45 on a single channel. Verify that only one card in the system is set to a particular channel *and* card number.



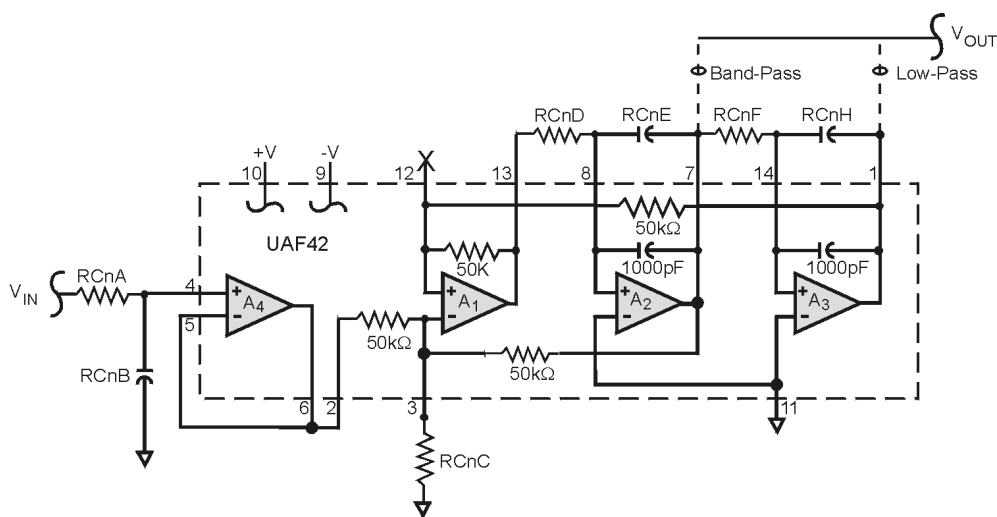
SSH Configuration

Each channel's Simultaneous-Sample-and-Hold circuit can be enabled (EN) or bypassed (BY) by placement of the jumper on J7 for channel 0, J8 for channel 1, J9 for channel 2, or J10 for channel 3. The factory-default setting is **enabled (EN)** for each channel.

Configuring DBK45 Filter Sections

There are 4 low-pass, 3-pole active filters on the DBK45. Each filter can be enabled (EN) or bypassed (BY) by placement of the jumper on J3 for channel 0, J4 for channel 1, J5 for channel 2, J6 for channel 3. The factory-default setting is **enabled (EN)** for each channel. Each filter can be configured as a Butterworth, Bessel, or Chebyshev filter with corner frequencies up to 50 kHz. Filter properties depend on the values of resistors and capacitors installed in several circuit locations. Above 10 Hz, installing capacitors is unnecessary because capacitors in the ICs are sufficient. In all cases, three resistors are required to complete the active filter circuits contained mostly within the UAF42 ICs.

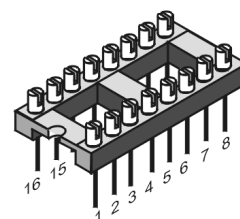
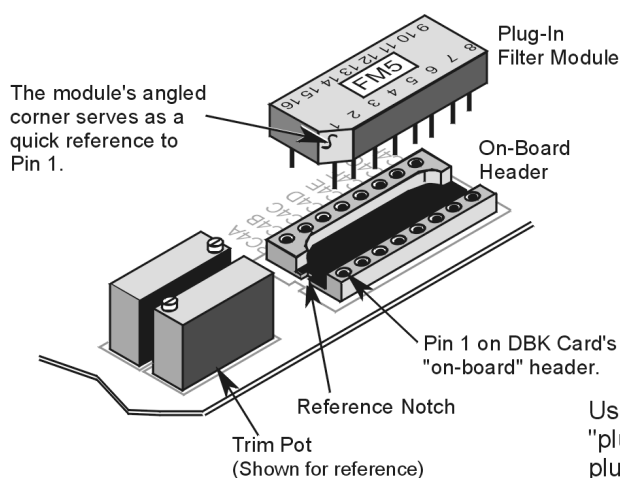
The following circuit diagram shows the active filter IC in a typical section of the DBK45. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is the channel number; and the 4th character corresponds to the socket position (A-H).



Filter Circuit Diagram

A machined-pin IC socket in each filter RC location can accept resistors and capacitors that plug directly into the socket; however, this is not recommended. Two much better approaches exist. The first is to use pre-configured plug-in filter modules; the second is to configure your own plug-in module using a blank CN-115. Both of these options are illustrated on the following page.

The use of plug-in modules provides excellent “gold-to-gold” contact between the components of the plug-in module and the on-board header.



CN-115, Blank Plug-In Module.
Components are soldered in place.

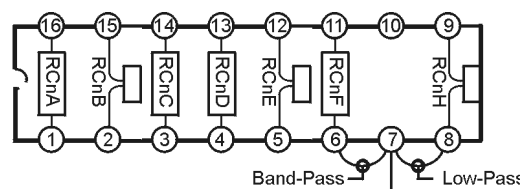
Users have a choice of using pre-configured "plug-in" filter modules; or using their own plug-in module (CN-115), that they can configure themselves by soldering components in place.

The right-hand figure shows the DIP-16 component pattern typical of the 4 filter sections.

Note: "n" corresponds to "channel number."

Pin 7 of the DIP-16 socket:

- connects to pin 8 for low-pass filtering
- connects to pin 6 for band-pass filtering



DIP-16 Component Pattern

The following table lists values of components for common corner frequencies in Butterworth filters. If designing your own filter, software from Burr-Brown provides the component values to create the desired filter. Note that the design math is beyond the scope of this manual.

| 3-Pole Butterworth Filter Components | | | | | | | | |
|--------------------------------------|---------|----------|------|---------|---------|---------|------|---------|
| 3dB (Hz) | RCnA | RCnB | RCnC | RCnD | RCnE | RCnF | RCnG | RCnH |
| 0.05 | 3.16 MΩ | 1 μF | none | 3.16 MΩ | 1 μF | 3.16 MΩ | none | 1 μF |
| 0.10 | 1.58 MΩ | 1 μF | none | 1.58 MΩ | 1 μF | 1.58 MΩ | none | 1 μF |
| 0.20 | 787 kΩ | 1 μF | none | 787 kΩ | 1 μF | 787 kΩ | none | 1 μF |
| 0.50 | 3.16 MΩ | 0.1 μF | none | 3.16 MΩ | 0.1 μF | 3.16 MΩ | none | 0.1 μF |
| 1 | 1.58 MΩ | 0.1 μF | none | 1.58 MΩ | 0.1 μF | 1.58 MΩ | none | 0.1 μF |
| 2 | 787 kΩ | 0.1 μF | none | 787 kΩ | 0.1 μF | 787 kΩ | none | 0.1 μF |
| 5* | 3.16 MΩ | 0.01 μF | none | 3.16 MΩ | 0.01 μF | 3.16 MΩ | none | 0.01 μF |
| 10* | 1.58 MΩ | 0.01 μF | none | 1.58 MΩ | 0.01 μF | 1.58 MΩ | none | 0.01 μF |
| 20 | 787 kΩ | 0.01 μF | none | 787 kΩ | 0.01 μF | 787 kΩ | none | 0.01 μF |
| 50 | 3.16 MΩ | 0.001 μF | none | 3.16 MΩ | none | 3.16 MΩ | none | none |
| 100* | 1.58 MΩ | 0.001 μF | none | 1.58 MΩ | none | 1.58 MΩ | none | none |
| 200 | 787 kΩ | 0.001 μF | none | 787 kΩ | none | 787 kΩ | none | none |
| 500* | 316 kΩ | 0.001 μF | none | 316 kΩ | none | 316 kΩ | none | none |
| 1000* | 158 kΩ | 0.001 μF | none | 158 kΩ | none | 158 kΩ | none | none |
| 2000 | 78.7 kΩ | 0.001 μF | none | 78.7 kΩ | none | 78.7 kΩ | none | none |
| 5000 | 31.6 kΩ | 0.001 μF | none | 31.6 kΩ | none | 31.6 kΩ | none | none |
| 10000 | 15.8 kΩ | 0.001 μF | none | 15.8 kΩ | none | 15.8 kΩ | none | none |

*These pre-configured Butterworth frequency modules are available from the manufacturer.

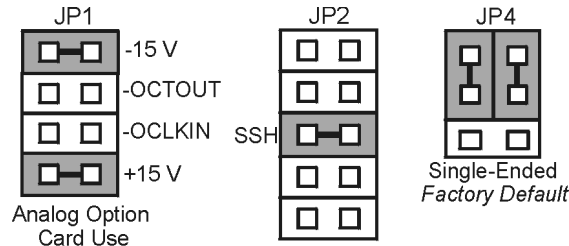
You have the option to configure the filter sections as band-pass filters rather than low-pass filters. The component selection program provides band-pass component values. The program also computes and displays phase and gain characteristics of the filter sections as a function of frequency.



DaqBook and DaqBoard [ISA type] Configuration

Use of the DBK45 requires setting jumpers in DaqBooks and DaqBoards [ISA type].

1. If not using auxiliary power, set the JP1 jumper for Analog Option Card Use (also referred to as Analog Expansion Mode).



DaqBook/DaqBoard Jumpers for the DBK45



The JP1 default position (Analog Option Card Use) is necessary to power the interface circuitry of the DBK45 via the internal ± 15 VDC power supply. If using auxiliary power, e.g., DBK32A or DBK33, you must remove both JP1 jumpers. Chapter 2, *Power Management* and the DBK32A and DBK33 *document modules* contain more detailed information.

2. Place the JP2 jumper in the SSH position.

CAUTION



When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

3. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP4 jumper in *single-ended* mode.

Software Setup



Reference Notes:

- *DaqView* users - Refer to [Chapter 4, DBK Setup in DaqView](#).
- *LogView* users - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK45 – Specifications

Name/Function: Simultaneous Sample and Hold and Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors

Output Connector: DB37 male,
mates with P1 using CA-37-x cable

Number of Cards Addressable: 64

Dimensions: 8.25" x 3.25"

Input Type: Differential

Voltage Input Ranges:

0 to ± 5000 mVDC

0 to ± 500 mVDC

0 to ± 50 mVDC

0 to ± 25 mVDC

0 to ± 10 mVDC

For Custom Gains: $R_{\text{GAIN}} = [40,000/(\text{Gain}-1)] - 80 \Omega$

Input Amplifier Slew Rate: 12 V/ μ s minimum

Acquisition Time:

0.6 μ s (10 V excursion to 0.1%)

0.7 μ s (10 V excursion to 0.01%)

Channel-to-Channel Aperture Uncertainty: 50 ns

Output Droop Rate: 0.1 μ V/ μ s

Input Gains: $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$, and
user-set up to $\times 500$

Input Offset Voltage: 500 μ V + 5000/G maximum (nullable)

Input Offset Drift: $\pm 5 + 100/G$ μ V/ $^{\circ}$ C maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

Input Impedance: $5 \times 10^{12} \Omega$ parallel with 6 pF

Switchable Bias Resistors: 100 K Ω each to analog
common

Gain Errors:

0.04% @ $\times 1$

0.1% @ $\times 10$

0.2% @ $\times 100$

0.4% @ $\times 200$

1.0% @ $\times 500$

Temperature vs Gain:

± 20 ppm/ $^{\circ}$ C @ $\times 1$

± 20 ppm/ $^{\circ}$ C @ $\times 10$

± 40 ppm/ $^{\circ}$ C @ $\times 100$

± 60 ppm/ $^{\circ}$ C @ $\times 200$

± 100 ppm/ $^{\circ}$ C @ $\times 500$

Non-Linearity:

± 0.015 % full-scale @ $\times 1$

± 0.015 % full-scale @ $\times 10$

± 0.025 % full-scale @ $\times 100$

± 0.025 % full-scale @ $\times 200$

± 0.045 % full-scale @ $\times 500$

Common-Mode Rejection:

70 dB minimum @ $\times 1$

87 dB minimum @ $\times 10$

100 dB minimum @ $\times 100$

100 dB minimum @ $\times 200$

100 dB minimum @ $\times 500$

Active Filter Device: UAF42 (Burr-Brown)

Number of Poles/Filter: 3

Types of Filters: Bessel, Butterworth,
Chebyshev

Frequency Range: 0.1 Hz to 50 kHz

The frequency is set by installation of
4-6 resistors and/or capacitors in
provided socket locations.

Frequency Modules: Optional frequency
module kits are available that consist of
4 plug-in resistor/capacitor (RC) headers.
These RC headers are pre-configured for
any of the following frequencies: 5 Hz,
10 Hz, 100 Hz, 500 Hz, or 1 kHz—all are
Butterworth-type filters.

Overview 1

Input Attenuation/Gain Factors 2

Hardware Setup 2

Signal-to-Module Connection 2

Module Configuration 2

DaqBook and DaqBoard [ISA type] Configuration 3

Software Setup 4

DBK50 and DBK51 – Specifications 4



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

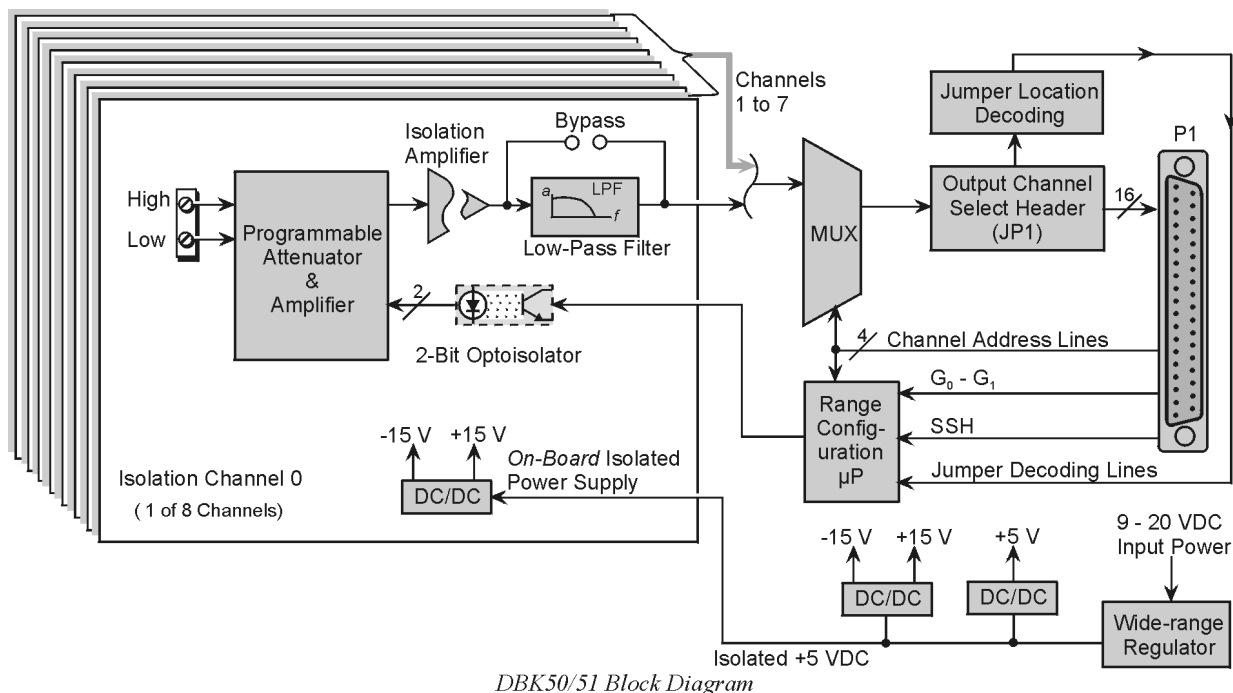
Overview

Except for their ranges, the DBK50 (high-voltage) and the DBK51 (low-voltage) are identical. Both have eight channels isolated from themselves (750 V) and from the LogBook or Daq Device analog common (1250 V). Each channel's input impedance is over 10 M Ω to minimize loading of the circuit being measured. Voltages can be read from DC to more than 20 kHz. One of three voltage ranges can be chosen via software:

- for **DBK50**: ± 10 V, ± 100 V, or ± 300 V.
- for **DBK51**: ± 100 mV, ± 1 V, or ± 10 V.

With standard plug-in attenuator assemblies, the voltage ranges are interchangeable. The gain or attenuation factor depends on the range, but the full-scale output for any range is +5 V.

Note: A fourth “range” delivers a shorted input voltage reading to allow offset compensation in some applications.



DBK50/51 Block Diagram

Input Attenuation/Gain Factors

Gain and attenuation may be calculated using the formula:

$K = V_{in} / V_{out}$

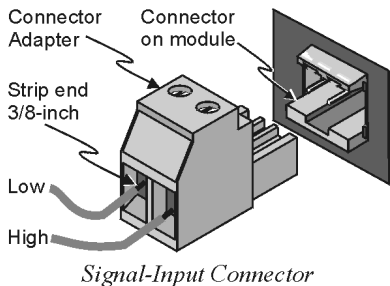
where: **K** is the attenuation or gain factor (the values of **K** for available voltage ranges are given in the table).
V_{in} is the voltage applied to the module input channel.
V_{out} is the amplified or attenuated voltage from the module output back to the main unit.

| Input Range | Function | K |
|--|------------|------|
| 300 V Range | Attenuates | 60 |
| 100 V Range | Attenuates | 20 |
| 10 V Range | Attenuates | 2 |
| 1 V Range | Amplifies | 0.2 |
| 100 mV Range | Amplifies | 0.02 |
| Note: not all input ranges are available on a single unit. | | |

Hardware Setup

Signal-to-Module Connection

The DBK50/51 rear panel has 8 plug-in screw terminals for easy access to the 8 analog input channels. There is a high (right side) and a low (left side) terminal in each pair to maintain consistent polarity (see figure). For AC signals, the polarity is arbitrary unless multiple signals must maintain their phase relationship.



Module Configuration

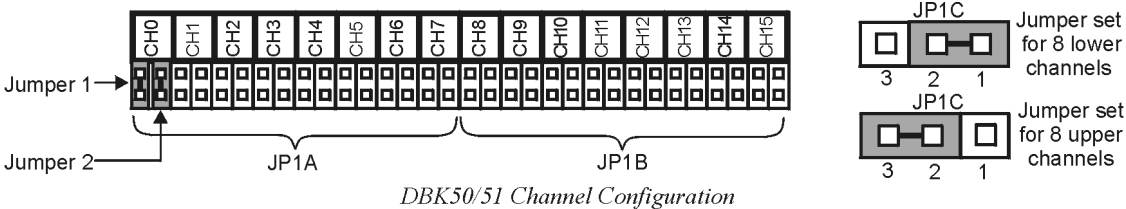
Factory Default: Low-pass filter – Enabled

Several jumpers must be set on the DBK50 and DBK51 to match your application:

- 2 jumpers on JP1A or JP1B to select the main channel to use (see following figure).
- 1 jumper on JP1C for upper or lower sub channels
- 1 jumper on JPN02 to use or bypass the low-pass filter—one for each channel number (n)

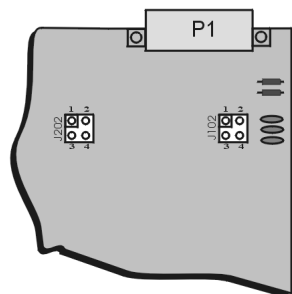
The main output channel is one of the 16 primary data acquisition device [LogBook or Daq device] channels. Each DBK50 [and DBK51] has 8 input channels and can be set to an upper or lower sub-channel that allows 2 modules to share a single LogBook or Daq device channel. Thus, a fully-populated system can have 256 input channels.

After determining a main channel number for the module, set two jumpers on JP1A or JP1B for the desired channel. The two jumpers must be used side-by-side on the selected channel. This is illustrated for channel 0 in the following figure. Next, set the JP1C jumper for the eight upper or eight lower sub-channels. Note that two modules may share the same main channel if one is set to the upper sub channel and the other set to the lower sub channel.



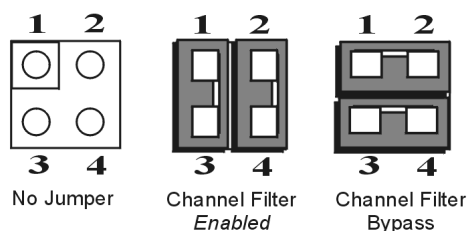
Each of the 8 input channels has a 3-pole low-pass filter that may be manually selected or bypassed by positioning 2 shunt jumpers on 2x2 headers for each channel. Orient the jumpers parallel/horizontal (enable) or perpendicular/vertical (bypass) to the header label (JP102 to JP802 for each of 8 channels). The following figure can be used for orientation.

Not to Scale



DBK50/51 partial board, referencing two of eight filter jumpers.

This reference applies to Channel Filter Jumpers J102 through J802 (for channels 1 through 8, respectively).



Jumpers Set to 1-3 & 2-4 = Filter Enabled
Jumpers Set to 1-2 & 3-4 = Filter Bypass

Channel Filter Jumper Settings for DBK50 and DBK51

The low-pass filters have a default corner frequency of 3.5 Hz when the jumpers are in the LPF-selected positions. This frequency may be readily changed by installing a different value of SIP resistor network in the 6-pin SIP socket of each filter section. Each channel has its own SIP located next to the channel filter bypass jumper and labeled RN(1-8)01A. The table lists values of common networks and their corner frequencies.

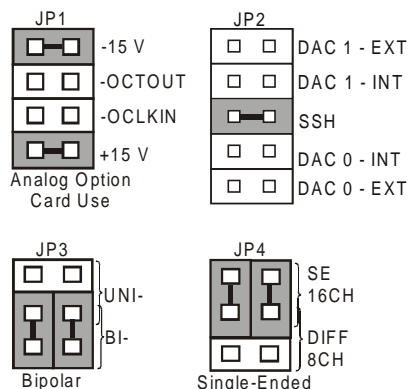
| Corner Frequency | R-SIP | Bournes Part # |
|------------------|----------------|----------------|
| 7500 Hz | 47 Ω | 4606M-102-470 |
| 3500 Hz | 100 Ω | 4606M-102-101 |
| 1750 Hz | 200 Ω | 4606M-102-201 |
| 750 Hz | 470 Ω | 4606M-102-471 |
| 350 Hz | 1 k Ω | 4606M-102-102 |
| 175 Hz | 2 k Ω | 4606M-102-208 |
| 75 Hz | 4.7 k Ω | 4606M-102-208 |
| 35 Hz | 10 k Ω | 4606M-102-103 |
| 17.5 Hz | 20 k Ω | 4606M-102-203 |
| 7.5 Hz | 47 k Ω | 4606M-102-473 |
| 3.5 Hz | 100k Ω | 4606M-102-104 |



DaqBook and DaqBoard [ISA type] Configuration

Several setup steps in DaqBooks and DaqBoards [ISA type] are required to use a DBK50 or DBK51 module in a system.

1. If not using auxiliary power, set the JP1 jumper [in the DaqBook or ISA-Type DaqBoard] to the Analog Option Card Use, also referred to as the expanded analog mode.



DaqBook/DaqBoard Jumpers for DBK50/51



To power the interface circuitry of the DBK50 [or DBK51] via the internal ± 15 VDC power supply, JP1 must be set to “Analog Option Card Use.” However, if using auxiliary power, e.g. the DBK32A or the DBK33, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 document modules for additional information, if needed.

CAUTION



When using the SSH output, do not use an external voltage reference for DAC1. Applying an external voltage reference for DAC1, when using the SSH output, will result in equipment damage due to a conflict on P1, pin #26.

2. Place the JP2 jumper in the SSH position.
3. For DaqBook/100, DaqBook /112 and DaqBook /120 *only*, place the JP3 jumpers in *bipolar mode*.
4. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP4 jumpers in *single-ended mode*.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).



DaqBooks and DaqBoards [ISA type] must have the Simultaneous Sample and Hold (SSH) jumper in place when using a DBK50 or DBK51. DaqView will remind you of this when you exit Hardware Setup with a DBK50 or DBK51 selected.

DBK50 and DBK51 – Specifications

Name/Function: 8-Ch. Isolated Voltage Input Module

Connectors: Male DB37, mates with P1

Inputs: Removable screw terminals

Number of Channels: 8, individually isolated

Isolation:

Channel-to-Channel: 500 V

Channel-to-System: 500 V

Input Impedance:

DBK50: 1 M Ω

DBK51: >10 M Ω

Bipolar Input Ranges:

DBK50: ± 10 V, ± 100 V, ± 300 V

DBK51: ± 100 mV, ± 1 V, ± 10 V

Output Voltage Range: ± 5 VDC

Accuracy:

Without Offset Correction: 1% of range

With Offset Correction: 0.2% of range

Offset: ± 50 mV max

Noise:

With Low-Pass Filter: <5 mV peak to peak

Without Low-Pass Filter: <50 mV peak to peak

Temperature Coefficient: 0.2 mV/ $^{\circ}$ C

Attenuation Ratios: $V_{out} = V_{in} / K$

DBK50:

10 V K = 2.0 gain = 0.5

100 V K = 20.0 gain = 0.05

300 V K = 60.0 gain = 0.0166

DBK51:

0.1 V K = 0.02 gain = 50

1 V K = 0.2 gain = 5

10 V K = 2.0 gain = 0.5

Bandwidth: 20 kHz (LPF bypassed)

Low-Pass Filter: Factory installed 3-pole, 3.5Hz (bypass or user-set)

Operating Power Voltage Range: +9 to +20 VDC

Module Power Requirements: 7.5 W

AC Adapter Rating: 15 VDC @ 0.9 A

Dimensions: 285 mm W x 221 mm D x 36 mm H (11" x 8.5" x 1.375")

Weight: 1.7 kg (4 lbs)

[Overview 1](#)

[Hardware Setup 2](#)

[Module Connection 2](#)

[Module Configuration 3](#)

[DaqBook and DaqBoard \[ISA type\] Configuration 3](#)

[Software Setup 4](#)

[DBK52 – Specifications 4](#)



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview



DaqView Users: When DBK52 is used with DaqBoard/2000 Series or /2000c Series Boards, the Internal Clock Speed should be set to 100 kHz as described in Chapter 4, *DBK Setup in DaqView*.

The DBK52 provides the ability to scan and input thermocouple data for various computer-based temperature-monitoring systems. Features include:

- Each DBK52 can connect up to 14 thermocouples. Up to 16 DBK52s may attach to a single LogBook or Daq Device to measure a maximum of 224 (16 × 14) temperatures.
- Standard, miniature jacks can connect to all T/C types.
- Onboard cold junction sensor (CJS) circuitry is accessible via a built-in channel to the system.
- A built-in short-to-ground channel back to the system eliminates offset errors via software.
- RC low-pass input filters reject high frequency noise for thermocouple shields.
- An external analog-common access jack provides a bias-current return path for differential signal inputs.
- An onboard programmable gain amplifier supports most thermocouple types and temperature ranges.
- Software-based linearization (in LogView and DaqView) converts analog signals into temperature values.



Reference Note:

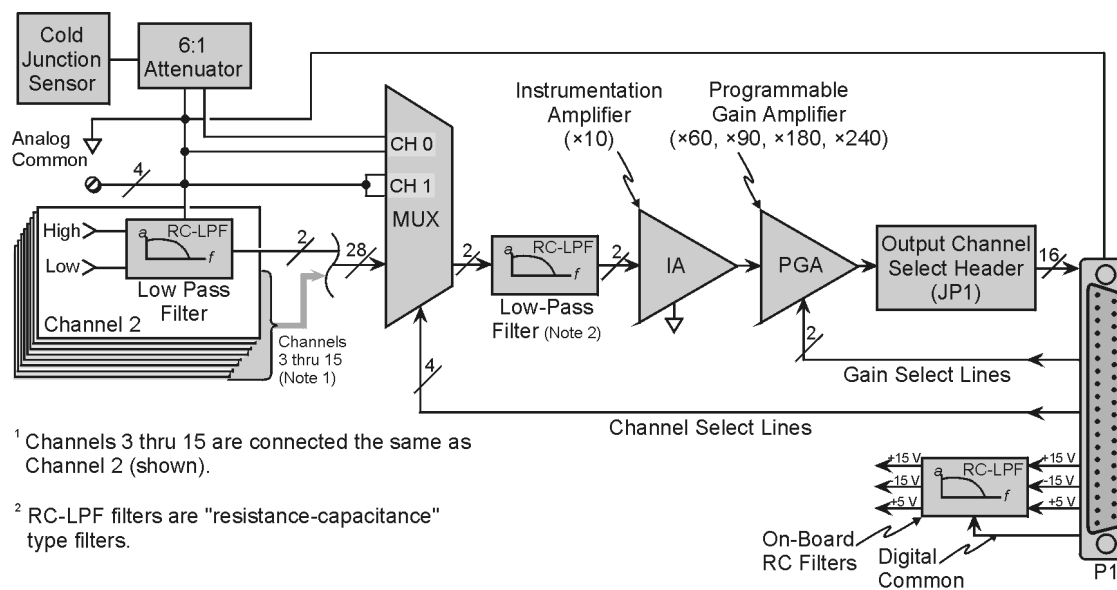
In regard to Daq devices, related material for programmers is included in the separate *Programmer's Manual* (p/n 1008-0901).

The following table shows the temperature range for each thermocouple type.

| T/C Type | J | K | T | E | N28 | N14 | S | R | B |
|----------------------|--------------|--------------|-------------|--------------|-------------|------------|------------|------------|------------|
| Temperature Range °C | -200 to 760 | -200 to 1260 | -200 to 400 | -270 to 1000 | -270 to 400 | 0 to 1300 | 0 to 1780 | 0 to 1780 | 0 to 1820 |
| Temperature Range °F | -328 to 1400 | -328 to 2300 | -328 to 752 | -454 to 1832 | -454 to 752 | 32 to 2372 | 32 to 3236 | 32 to 3236 | 32 to 3308 |

Thermocouple accuracy depends on the thermocouple itself, the cold-junction sensor, A/D conversion, and linearization. The DBK52, LogBook, and Daq device systems use quality components and software compensation to minimize error from these sources. Systems achieve a $\pm 1^\circ\text{C}$ CJS accuracy that contributes to the overall accuracy. When the software is calibrated, gain and offset errors are virtually eliminated. The DBK52's built-in auto-zero channel dynamically eliminates any other system offset-errors.

True differential measurements of T/Cs require bias-current referenced to the analog common. Resistors from each input T/C are connected to the analog common. Filter capacitors across each input operate with input protection resistors to form a single-pole RC low-pass filter.



DBK52 Block Diagram

Hardware Setup

Module Connection

The DBK52 has miniature T/C jacks to connect different types of thermocouples and an analog-ground access point. Connections are provided for 14 thermocouples. **Thermocouple polarities must be observed.** Thermocouple types J, K, T, E, N28, N14, S, R and B are supported by the LogView or DaqView software and may be connected to DBK52 board channels CH2 through CH15.

| T/C Type | (+) Lead to Channel-Hi | (-) Lead to Channel-Lo |
|----------|------------------------|------------------------|
| J | White | Red |
| K | Yellow | Red |
| T | Blue | Red |
| E | Violet | Red |
| N28 | Orange | Red |
| N14 | Orange | Red |
| S | Black | Red |
| R | Black | Red |
| B | Gray | Red |

Note: CH0 is reserved for the cold-junction compensation sensor (factory installed).
CH1 is permanently shorted to allow software-driven auto-zero to compensate for temperature drift.

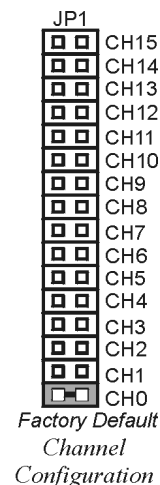
Thermocouple wire is standardized and color-coded as shown in the table. T/Cs have a very small output. Long T/C leads can pickup lots of noise. Use shielding as needed, and average several readings in software to minimize noise effects.

After all connections are in place, secure wires to captive areas (pre-drilled holes) at the rear edge of the board. Nylon tie wraps (not included) work well for this purpose.

Module Configuration

Up to 16 DBK52s may be connected to a LogBook or a Daq Device. As a daisy-chain interface, each module must appear unique. Each module uses a different analog input channel. To configure the module:

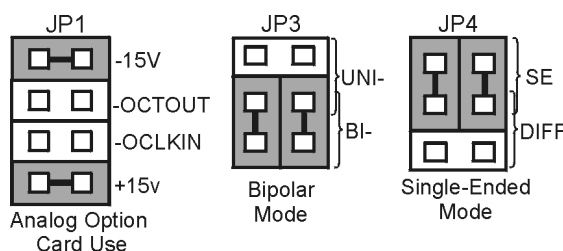
1. Assign a channel number to the module. **The assigned number must not be used by any other DBK card or module.**
2. Locate the 16×2-pin header near the front of the board labeled JP1, and place the jumper on the LogBook or Daq Device channel you wish to use. There are 16 jumper locations on this header labeled CH0 through CH15. Only one jumper setting is used on a single module; no other module in a common daisy-chain can use the same jumper setting.



DaqBook and DaqBoard [ISA type] Configuration

Three setup steps are needed to configure DaqBooks and DaqBoards [ISA type] for a DBK52.

1. If not using auxiliary power, place the JP1 jumper in the Analog Option Card Use (expanded analog) mode.



DaqBook/DaqBoard Jumpers for the DBK52



To power the interface circuitry of the DBK52 via the internal ± 15 VDC power supply, JP1 must be set to “Analog Option Card Use.” However, if using auxiliary power, e.g., the DBK32A or the DBK33, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the DBK32A and DBK33 document modules for additional information, if needed.

2. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP3 jumper in *bipolar mode*.
3. For DaqBook/100, DaqBook/112 and DaqBook/120 *only*, place the JP4 jumper in *single-ended mode*.

Note: The 200-series DaqBooks and DaqBoards do not have a JP4. The single-ended or differential choice is made via software configuration commands.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).
- **DBK52 Calibration Disk** – Each DBK52 card is shipped with a calibration disk with constants used to correct gain and offset errors inherent in the hardware. This calibration is done automatically by DaqView and LogView. Refer to the **readme.txt** file on the disk.



DaqView Users: When DBK52 is used with DaqBoard/2000 Series or /2000c Series Boards, the Internal Clock Speed should be set to 100 kHz as described in Chapter 4, *DBK Setup in DaqView*.

The DBK52 selection allows the user to define the thermocouple types by using the Type column of the analog input spreadsheet.

Each DBK52 card is shipped with a calibration disk with constants used **to correct gain and offset errors** inherent in the hardware. This gain and offset calibration is done automatically by DaqView and LogView. See the DBK52 readme.txt file on the disk shipped with the board for details on creating this file.

DBK52 - Specifications

Name/Function: Thermocouple Input Module

Connectors:

DB37 male, mates with P1.

Thermocouples attach directly to on-board jacks.

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: x60, x90, x180, x240

Inputs:

14 differential thermocouples

1 cold-junction compensation

1 auto zero

Cold Junction Sensor Output: 100 mV/°C

Voltage Ranges/Gains:

0 to 80 mV x60

0 to 50 mV x90

0 to 25 mV x180

0 to 20 mV x240

0 to ±10 mVDC

Input Impedance: 20 kΩ

Input RC Filter -3 dB Frequency: 15.9 kHz

Gain Accuracy:

Uncalibrated: 0.15%

Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Type/Range/Accuracy/Resolution: refer to the following table

Thermocouple Reference

| Type | Range | | Accuracy | | Resolution | | | |
|------|--------|--------|----------|--------|----------------|----------------|----------------|----------------|
| | Min | Max | (<0°C) | (>0°C) | 12-bit <0°C | 12-bit >0°C | 16-bit <0°C | 16-bit >0°C |
| J | -200°C | 760°C | 0.6°C | 0.6°C | 1.2°C | 0.5°C | 0.1°C | 0.1°C |
| K | -200°C | 1260°C | 1.6°C | 1.0°C | 1.1°C | 0.8°C | 0.1°C | 0.1°C |
| T | -200°C | 400°C | 1.4°C | 0.8°C | 0.8°C | 0.3°C | 0.1°C | 0.1°C |
| E | -270°C | 1000°C | 1.4°C | 0.9°C | 1.6°C | 0.7°C | 0.1°C | 0.1°C |
| N28 | -270°C | 400°C | 0.8°C | 0.8°C | 1.0°C | 1.0°C | 0.1°C | 0.1°C |
| N14 | 0°C | 1300°C | — | 1.0°C | — | 5.0°C | — | 5.0°C |
| S | 0°C | 1780°C | — | 1.6°C | — | 1.3°C | — | 0.1°C |
| R | 0°C | 1780°C | — | 1.6°C | — | 1.7°C | — | 0.1°C |
| B | 0°C | 1820°C | — | 1.8°C | — | 1.5°C | — | 0.1°C |

DBK53 – Low Gain Programmable Module
DBK54 – High Gain Programmable Module

Overview 1

Hardware Setup 2

Differential Mode 2

Single-Ended Mode 3

Module Connection 3

Module Configuration 3

DaqBook and DaqBoard [ISA type] Configuration 4

Software Setup 4

DBK53 and DBK54 – Specifications 5



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview



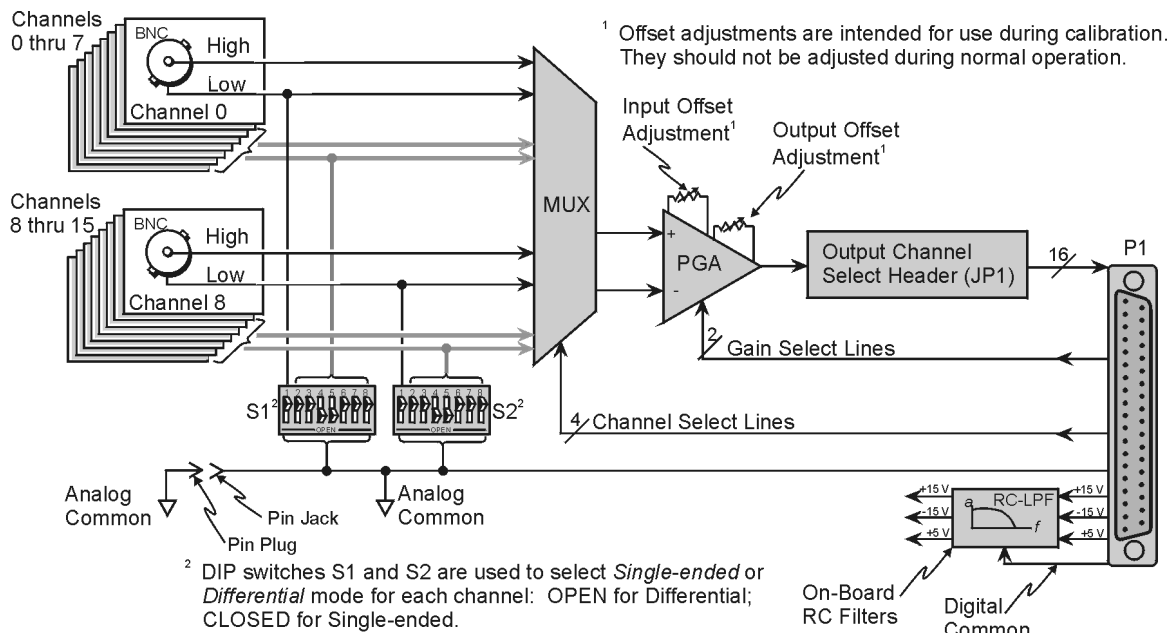
DaqView Users: When a DBK53 or DBK54 is used with a DaqBoard/2000 Series or a cPCI DaqBoard/2000c Series Board, the Internal Clock Speed should be set to 100 kHz as described in Chapter 4, [DBK Setup in DaqView](#).

Except for their gain ranges, the DBK53 (low gain) and DBK54 (high gain) are similar. Both:

- Have 16 channels of differential or single-ended analog inputs. Up to 16 modules can attach to one LogBook or Daq Device for a maximum of 256 single-ended or differential inputs.
- Are based on the DBK12 and DBK13 multiplexer cards.
- Are fully enclosed modules with easy user connection using BNC-type connectors and an analog common pin jack.
- Use power via the P1 connection from the LogBook or Daq Device or expansion module/power supply.
- Use one of the LogBook's or Daq Device's 16 analog input channels via the P1 connection to measure the multiplexed output. Both modules receive channel-selection and gain-selection programming via digital signals via P1. The LogBook's/Daq Device's 512 location scan sequencer can directly program the expansion modules to scan external signals at the same 10 μ s/channel rate as on-board channels. (The time skew between channels is constant.)

The amplification gains for each module are:

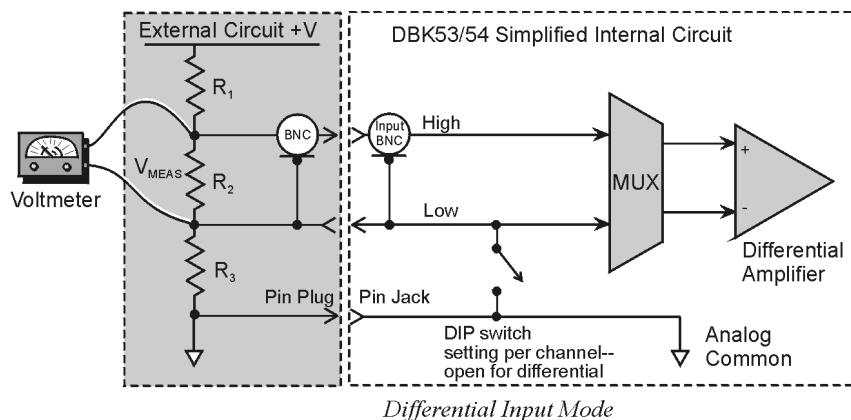
- The DBK53 has 4 gain ranges of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ that are scan-programmable per channel. These gains can be combined with the standard gains of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ for net gains of $\times 1$, $\times 2$, $\times 4$, $\times 8$, $\times 16$, $\times 32$, and $\times 64$.
- The DBK54 has 4 gain ranges of $\times 1$, $\times 10$, $\times 100$ and $\times 1000$ that are scan-programmable per channel. These gains can be combined with the standard gains of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ for net gains of $\times 1$, $\times 2$, $\times 4$, $\times 10$, $\times 20$, $\times 40$, $\times 80$, $\times 100$, $\times 200$, $\times 400$, $\times 800$, $\times 1000$, $\times 2000$, $\times 4000$, and $\times 8000$.



Hardware Setup

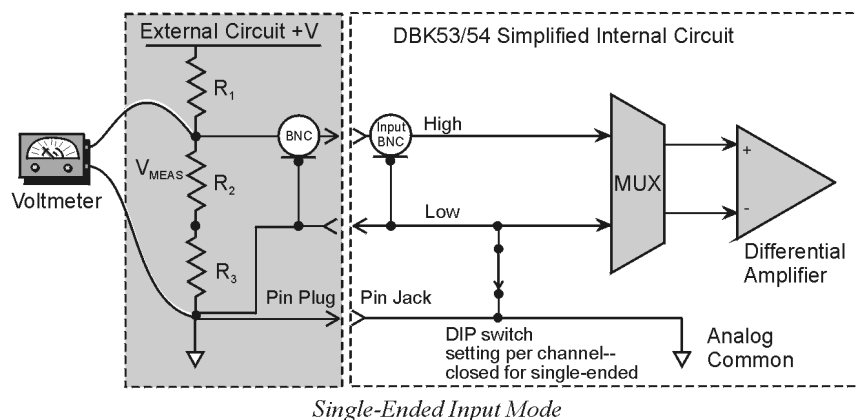
Differential Mode

The DBK53 and DBK54 are designed for floating-type differential measurements. Neither the high nor the low of the analog input has an inherent bias current return path to the analog common on the module. An external common pin jack is provided on the outside panel for this bias-current return path. The following figure shows a typical differential connection.



Single-Ended Mode

Ground referencing must also be observed with single-ended measurements. The following figure shows a typical single-ended hookup.



Module Connection

When connecting analog inputs, carefully consider the requirements for signal connection and ground referencing. Use BNC-terminated cables (test leads) to interface with the channel inputs. Be sure to provide the necessary analog common connection.

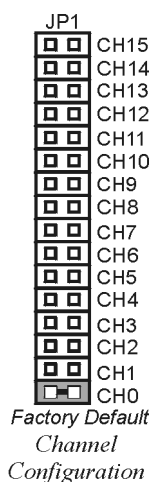
Module Configuration

Factory Default: Input mode – Single-ended

Up to 16 DBK53s [or DBK54s] may be connected to a primary data acquisition device such as LogBook, DaqBook, and DaqBoard. As a daisy-chain interface, each module must appear unique; and therefore uses a different analog input channel identification.

To configure the module:

1. Assign a channel number to the module. This number must not be used by any other DBK card or module.
2. On the DBK53 [or DBK54], locate the 16x2-pin header (JP1).
3. Place the jumper on the channel you wish to use. The 16 jumper locations on the JP1 header are labeled CH0 through CH15. Only 1 jumper setting is used on a single module; no other module in the system can use the same setting.

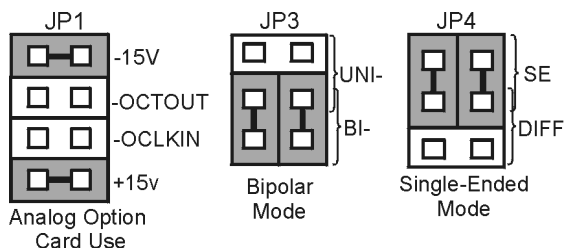




DaqBook and DaqBoard [ISA type] Configuration

Three setup steps are needed to configure DaqBooks and ISA-type DaqBoards for a DBK53 [or DBK54].

1. If not using auxiliary power, set JP1 for **Analog Option Card Use**, also referred to as the *expanded analog mode*.



DaqBook/DaqBoard Jumpers for the DBK53/54



To power the interface circuitry of the DBK53 or DBK54 via the internal ± 15 VDC power supply, JP1 must be set to “Analog Option Card Use.” However, if using auxiliary power, e.g., the DBK32A or the DBK33, you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the [DBK32A](#) and [DBK33](#) document modules for additional information, if needed.

2. For DaqBook/100, DaqBook/112, and DaqBook/120 *only*, place the JP3 jumper in *bipolar mode*.
3. For DaqBook/100, DaqBook/112, and DaqBook/120 *only*, place the JP4 jumper in *single-ended mode*.

Note: The 200-series DaqBooks and DaqBoards [ISA type] do not have a JP4; the single-ended or differential choice is made via software configuration commands.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).



DaqView Users: When a DBK53 or DBK54 is used with a DaqBoard/2000 Series or a cPCI DaqBoard/2000c Series Board, the Internal Clock Speed should be set to 100 kHz as described in Chapter 4, [DBK Setup in DaqView](#).

DBK53 and DBK54 – Specifications

Name/Function:

DBK53 16-Channel Low-Gain Analog Multiplexing Module

DBK54 16-Channel High-Gain Analog Multiplexing Module

Output Connector: DB37 male, mates with P1

Input Connector: BNC - DIFF. Inputs; Pin Jack - Analog Common

Gain Ranges:

DBK53: x1, x2, x4, x8

DBK54: x1, x10, x100, x1000

Inputs: 16 differential or single-ended jumper selectable as a group)

Voltage Range: 0 to ± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: 0.05% typ, 0.25% max

Maximum Input Voltage: 35 VDC

Slew Rate: 20 V/s typ, 10 V/s min

Settling Time: 2 s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typ, 0.015% max

Bias Current: 150 pA, 0.2 A max

Offset Voltage:

$\pm(0.5 + 5/G)$ V/ $^{\circ}$ C typ

$\pm(2.0 + 24/G)$ mV max

Offset Drift:

$\pm(3 + 50/G)$ V/ $^{\circ}$ C typ

$\pm(2.0 + 24/G)$ V/ $^{\circ}$ C max



Overview 1**Hardware Setup 2**

- 1 – Turn off system power and disconnect DBK60 3
- 2 – Remove the top cover (optional) 3
- 3 – Remove the card drawer 3
- 4 – Remove termination panels 3
- 5 – Determine power requirements 3
- 6 – Configure the chassis for power source 4
- 7 – Install a power card, if needed 5
- 8 – Configure the DBK cards 5
- 9 – Install the DBK cards 5
- 10 – Connect the internal signals 5
- 11 – Install the termination panels 5
- 12 – Install the card drawer 6
- 13 – Connect external signals 6
- 14 – Install the top cover 6
- 15 – Connect the DBK60 to the rest of your acquisition system 6
- 16 – Turn on system power and check operation 6

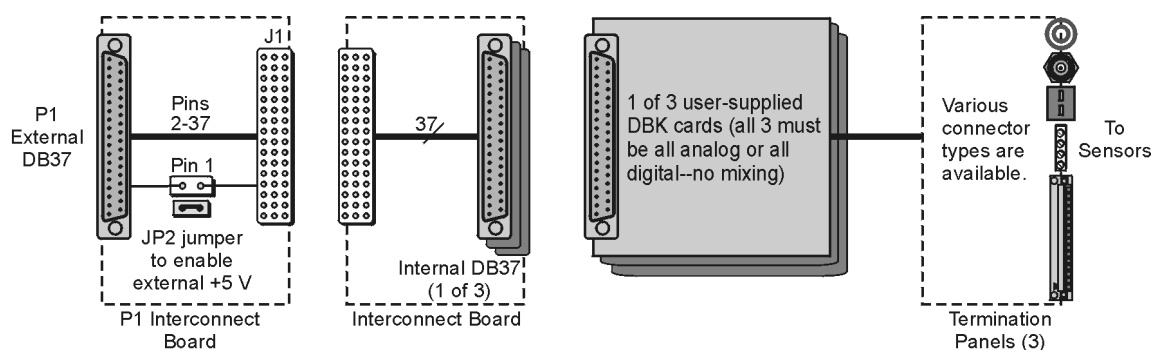
DBK60 – Specifications 6**Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK60 expansion chassis holds up to three analog DBK cards, or up to three digital DBK cards, and provides termination panels with connectors for various sensors. Several DBK60 units can be linked together and then to the primary acquisition device, e.g., a DaqBook, DaqBoard, or LogBook.

Splice plate kits can be used to stack multiple DBK60 units to the primary device.

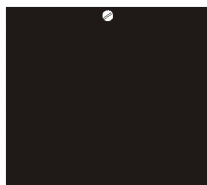


DBK60 Block Diagram

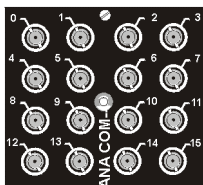
The **front panel** has a male DB37 connector that leads to the acquisition processor via a CA-37-x, CA-37-xT, or equivalent cable.



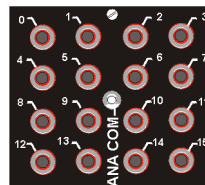
The **rear panel** is made of three termination panels with connectors for the various sensors.



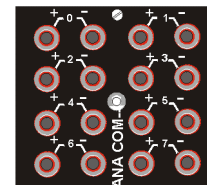
Blank Panel
DBK601



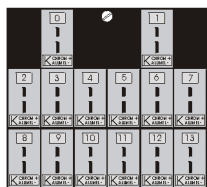
BNC Connectors
plus Analog Common
DBK602



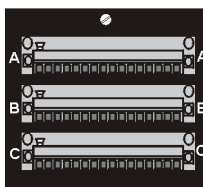
Safety Jacks, single-ended
plus Analog Common
DBK603



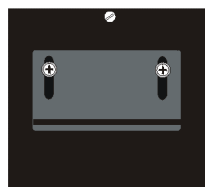
Safety Jacks, Differential
plus Analog Common
DBK604



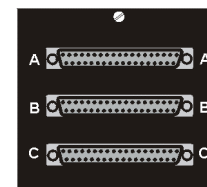
T/C Connectors, Differential
DBK605-B DBK605-R
DBK605-J DBK605-S
DBK605-K DBK605-T



Terminal Blocks,
16 connections per block
(48 connections per panel)
DBK606



Strain Relief Clamp
DBK607



DB37 Connectors, Female
DBK608

Hardware Setup

Hardware setup involves configuring the DBK60, configuring up to three DBK cards that will be used with the module, installing the DBK cards, then connecting signal lines to the DBK60's termination panels.

Read over the following WARNING and CAUTION, then complete the steps to successfully setup your hardware.

WARNING



Electrical Shock Hazard! To avoid injury or equipment damage, turn off power to all connected equipment during setup.

CAUTION



Use ESD tools, containers, and procedures during setup of DBK cards. Electrostatic discharge can damage some of the components.



To prevent pin damage, align DBK cards with the backplane DB37 connectors before gently pressing them together.

1 – Turn off system power and disconnect the DBK60

If the DBK60 is presently connected in a system, turn off all system devices and disconnect the DBK60 from the system.

2 – Remove the top cover (optional)

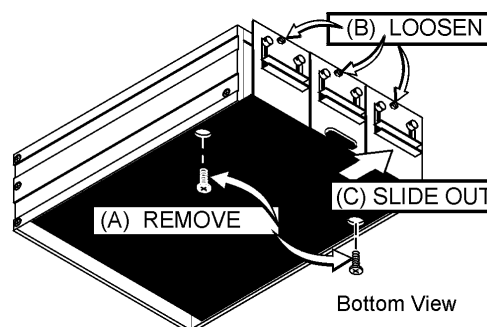
Removing the top cover is not necessary, but it does make it easier to set the JP2 jumper in step 6. A removed cover also allows for configuration and signal connection changes to be made to cards later on in the procedure, after the card drawer is returned to the DBK60.

To remove the top cover, simply remove the top cover screws and slide the cover towards the termination panels.

3 – Remove the card drawer

To remove the card drawer, refer to the A, B, and C call-outs in the figure at the right, then complete the corresponding steps below.

- A. Remove the two screws that hold the card drawer to the chassis.
- B. Loosen the three captive thumbscrews that hold the termination panels to the chassis.
- C. Using the handle, carefully slide out the card drawer.



Three Steps for Removing the Card Drawer

4 – Remove the termination panels

Remove the two screws [two per panel] that secure each termination panel to the card drawer (see figure).

5 – Determine the power requirements

Depending on the power needs of your system's DBK cards, you may need to add a power card. Refer to the Power Management chapter 2's, [Calculating Your System's Power Needs](#).

- A. Use the *DBK Power Requirements Work Table* to calculate the power requirements of your system's DBK cards.
- B. Use the *Available Power Chart* to determine your system's power availability.
- C. If the required power in step 5A is more than the available power in step 5B, or very close to it, you will need to use auxiliary power. There are two DBK auxiliary power supply cards for use in LogBook, DaqBook, and DaqBoard applications. These are the DBK32A and the DBK33.
 - DBK32A – provides power at ± 15 V.
 - DBK33 – provides power at +5 V and ± 15 V.

6 – Configure the chassis for the power source



Use one power source, and only one power source, for cards on the P1 bus!

+5 V is selected with the **DBK60's JP2** jumper, located inside the expansion chassis on the P1 interconnect board (see the following figure for location).

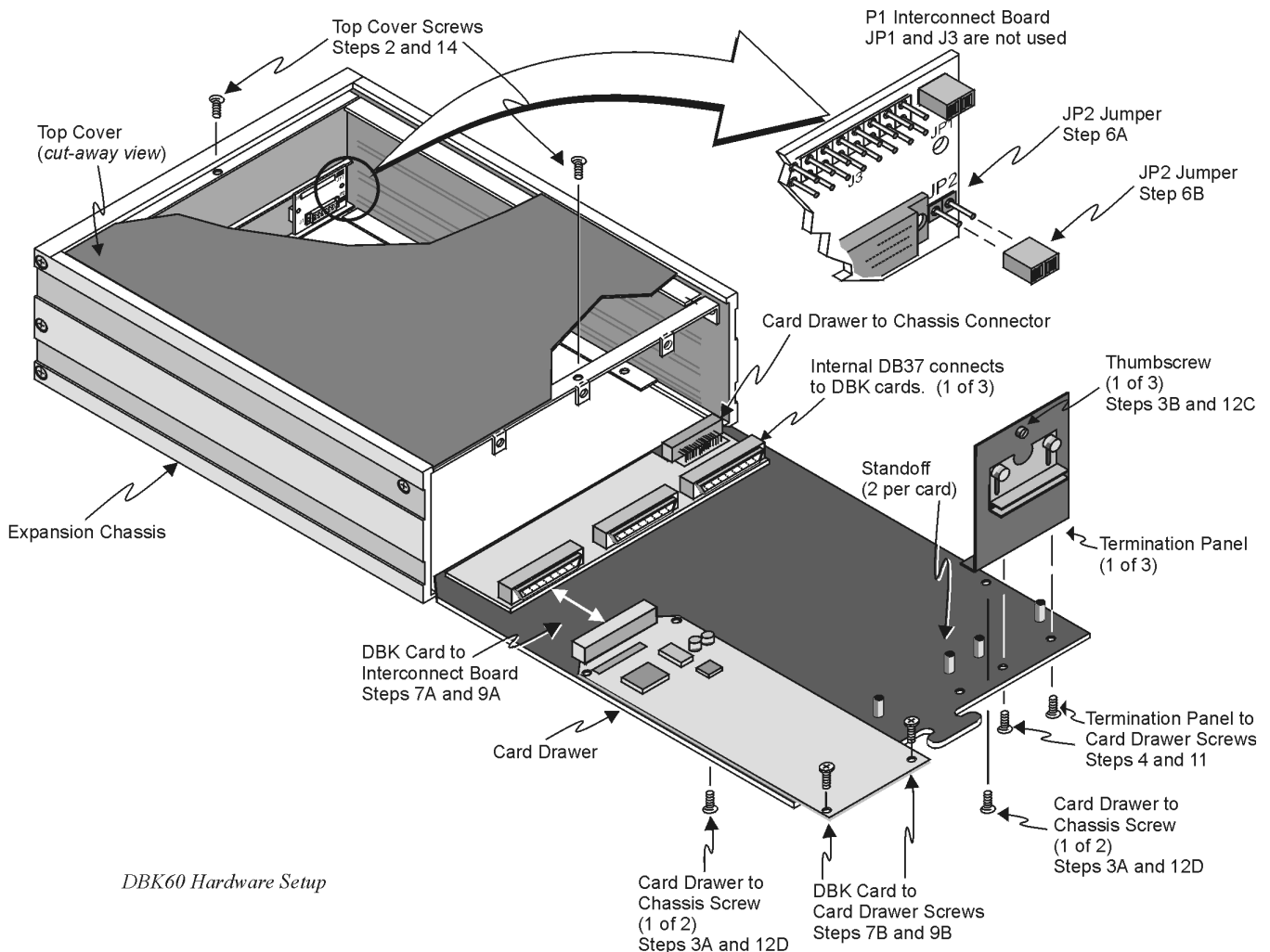
±15 V is selected with two **JP1** jumpers, located on the board of the **primary data acquisition device**, such as a DaqBook or ISA-type DaqBoard. **DO NOT CONFUSE THESE JP1 JUMPERS WITH THE JP1 JUMPER IN THE DBK60.**

- A. If **+5 V** will be supplied from a source *outside the expansion chassis*, place a jumper on DBK60's JP2 header. JP2 is located on the P1 interconnect board (see figure).
- B. If **+5 V** will be supplied from a DBK33 power card *inside the expansion chassis*, remove the jumper from the JP2 header (located on the P1 interconnect board).
- C. If using a DBK32A or DBK33 power card *anywhere in the system*, remove the +15 V and -15 V jumpers from **JP1** on the **primary data acquisition device**, such as a DaqBook or ISA-type DaqBoard. **DO NOT CONFUSE THESE JP1 JUMPERS WITH THE JP1 JUMPER IN THE DBK60.**



Reference Notes:

Refer to the [DBK32A](#) or [DBK33](#) document modules, if applicable.



7 – Install a power card, if needed

If you determined [in step 5] that additional power is needed, add a DBK32A or DBK33 power card to the acquisition processor chassis, or to the DBK60 expansion chassis.

To install a power card in a DBK60 complete steps 7A and 7B. Refer to the previous figure as needed.

- A. Carefully align the power card's DB37 connector with a DB37 connector on DBK60's P1 interconnect board and gently press the power card to establish a complete and solid connection.
- B. Use two screws to secure the power card to DBK60's card drawer standoffs.

8 – Configure the DBK cards

Configure channel addresses that are unique to each card; i.e., do not duplicate addresses. Some cards make use of jumpers for address configuration, while others make use of DIP switches.



Reference Note:

Refer to the appropriate *DBK document modules* in regard to specific DBK configuration.

9 – Install the DBK cards



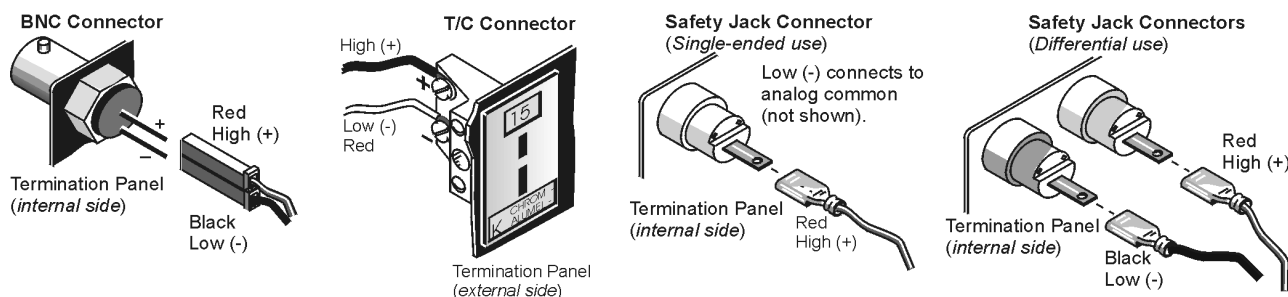
You cannot mix analog and digital DBK cards in the DBK60; in other words, use all analog or all digital, but not both.

- A. Carefully align the DBK card's DB37 connector with a DB37 connector on the interconnect board and gently press the DBK card to establish a complete and solid connection (see previous figure).
- B. Use two screws to secure the DBK card to the standoffs on the DBK60 card drawer (see previous figure).
- C. Repeat installation steps 9A and 9B for additional DBK cards, as applicable. Be sure that all cards to be installed are analog, or all digital. Analog and digital can not be mixed within a DBK60.

10 – Connect the internal signals

Connect signal inputs from DBK cards to the termination panels. DBK cards connect to the termination panels in various ways. Refer to the following figure and to the specific *DBK document modules* as needed.

- Single-ended connections use analog common.
- Differential connections require the proper polarity, typically red-to-red for high (+) and black-to-black for low (-).
- For thermocouples, red is generally the low side. The T/C connector and wire type must match the T/C type used.



11 – Install the termination panels

Mount the termination panels to the card drawer. Use two screws to secure each panel. Refer to the *DBK60 Hardware Setup* figure.

12 – Install the card drawer

- A. Hold the card drawer by its handle and tilt it up slightly. Place it on the bottom track of the DBK60.
- B. Carefully slide the card drawer into the chassis. When it engages the bottom track, level the card drawer and continue inserting it until it engages with the P1 interconnect board.
- C. Tighten the three captive thumbscrews [on the termination panels] into the chassis (see *DBK60 Hardware Setup* figure).
- D. Install the two bottom screws that hold the card drawer to the chassis.

13 – Connect external signals

Connect signal inputs from the sensors to termination panels.

14 – Install the top cover

If the top cover had been removed, slide it back into position and secure the cover with the two top cover screws.

15 – Connect the DBK60 to the rest of your acquisition system

- A. **If using analog DBK cards**, connect the DBK60 to P1 of the system.
- B. **If using digital DBK cards**, connect the DBK60's P1 to a P2 port of the system. Then Re-label the DBK60 front panel connector "P2."

16 – Turn on system power and check operation

DBK60 - Specifications

Description: DBK Card Expansion chassis accommodating 3 DBK cards, configurable power capability. Selection of 7 termination panels to allow custom user input connection.

Capacity: Accommodates any 3 DBK expansion cards.
Analog and Digital DBK cards cannot be mixed within a single DBK60 enclosure.

Material: Aluminum and Steel

Finish: Black, powder-coated

Dimensions: 280 mm x 330 mm x 89 mm (11" x 13" x 3.5")

Weight: 3.08 kg empty (7 lbs.); cards .25 to .75 kg each (8 to 12 oz)

Overview 1**Hardware Setup 2**

Card Connection 2

Card Configuration 4

DaqBook and DaqBoard [ISA type] Configuration 5

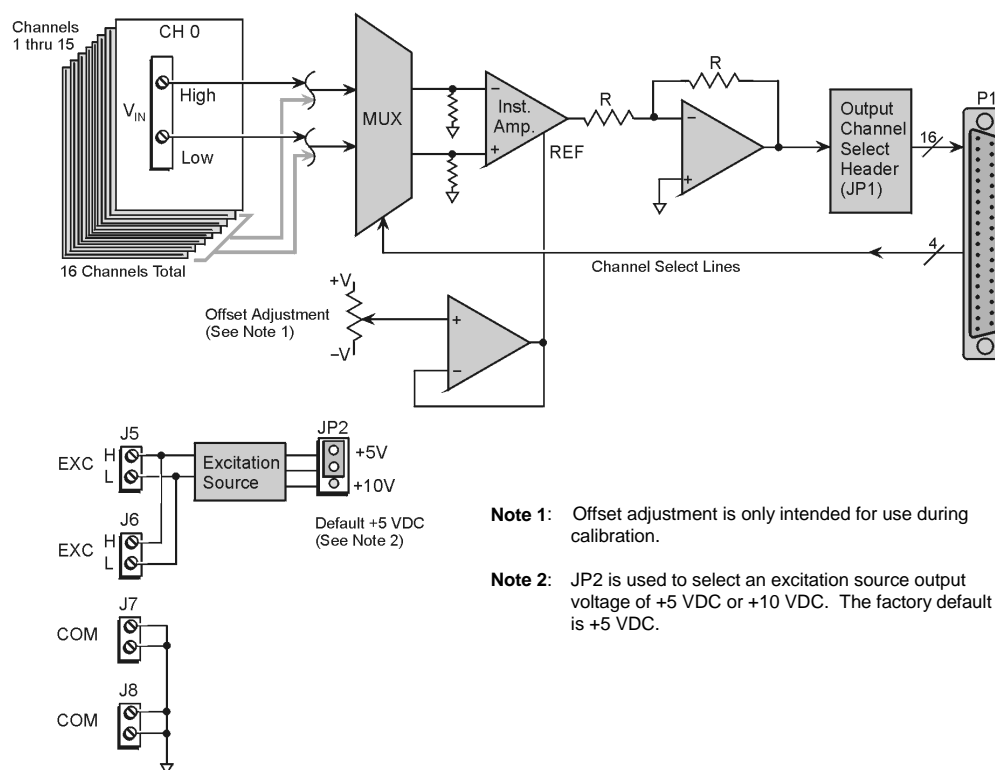
Software Setup 5**DBK80 – Specifications 6****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

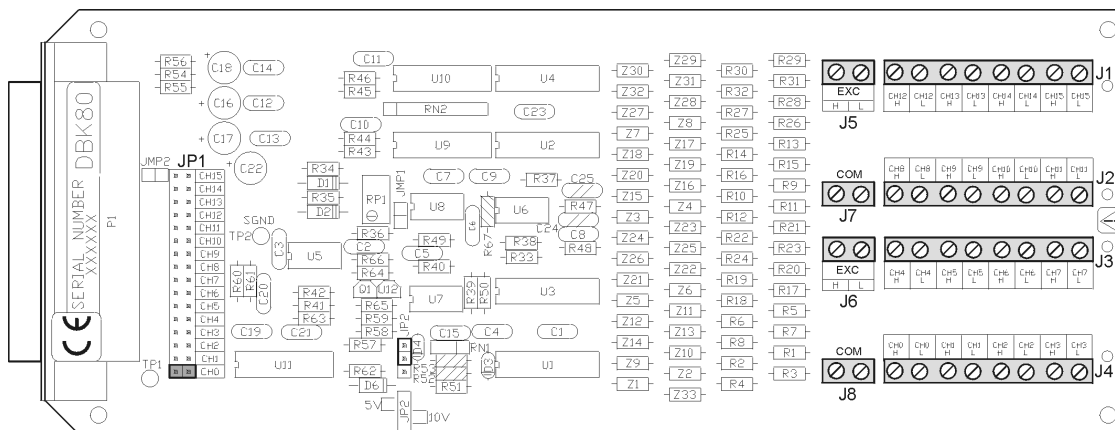
The DBK80 is a low-noise, high-speed, unity-gain multiplexer card that provides 16 channels of differential voltage input. Up to 16 such cards can be attached to a single Daq device, providing a possible 256 differential input channels. The card's unity gain combines with DaqBook, DaqBoard, and LogBook gains to accept full scale inputs from ± 156 mV to ± 10 V. The DBK80's expansion channels can be scanned at the maximum 200 kHz rate while maintaining measurement integrity.

The DBK80 includes an on-board excitation voltage source that is jumper-selectable to be +5 or +10 VDC. This source can be used to bias transducers or to measure resistors and thermistors without additional instrumentation.

**DBK80 Block Diagram**

Hardware Setup

Card Connection



DBK80 Board Layout

Referring to the figure above, voltage input signals are connected to the screw terminal blocks labeled J1, J2, J3, and J4. Each channel is labeled with “H” and “L” to denote its polarity. These inputs accept voltages up to ± 10 VDC.

Excitation Source

J5 and J6 provide the excitation source output, again labeled with “H” and “L” to denote polarity. Note that J5 and J6 are connected in parallel. There is only one voltage source; two connectors are simply provided for wiring convenience.

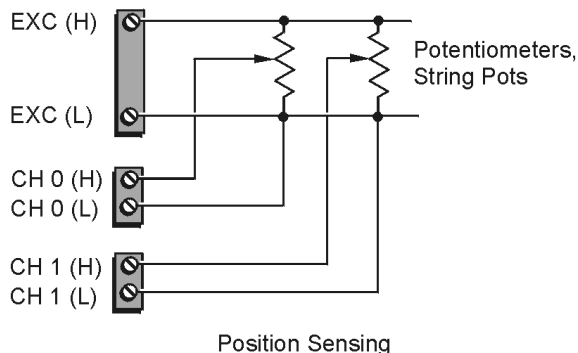
The excitation source is ground-referenced, not floating. That is, its low terminal is connected to the ground of the Daq device. It is designed to interface to circuits where it is the only power source, or where its connection is electrically isolated from other power sources. An example of the latter is an optocoupler.

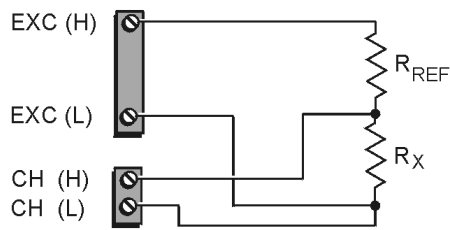
CAUTION

Do not connect the excitation source to a non-isolated, powered circuit. Making such a connection can cause damage to both the DBK80 and to the circuit under test.

The excitation source outputs should also be used together, with the “L” of the source providing the ground reference to the connecting circuit. This provides two benefits. It maintains the accuracy of the source, since the regulation of the “H” terminal is referenced to the “L” terminal. It also returns the load current directly to its source, where its path is designed to not influence any other part of the measurement system.

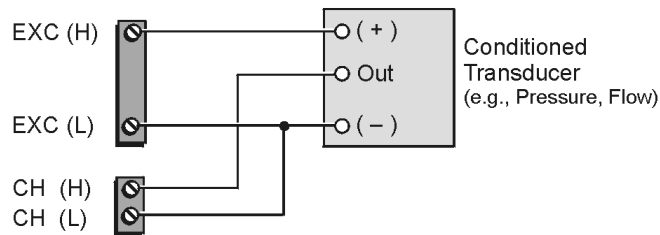
Three examples of using the excitation source follow. They are *Position Sensing*, *Resistance/Thermistor Measurement*, and *Reading a Transducer*.





$$R_X = R_{REF} \left[\frac{V_{CH}}{V_{EXC} - V_{CH}} \right]$$

Resistance/Thermistor Measurement

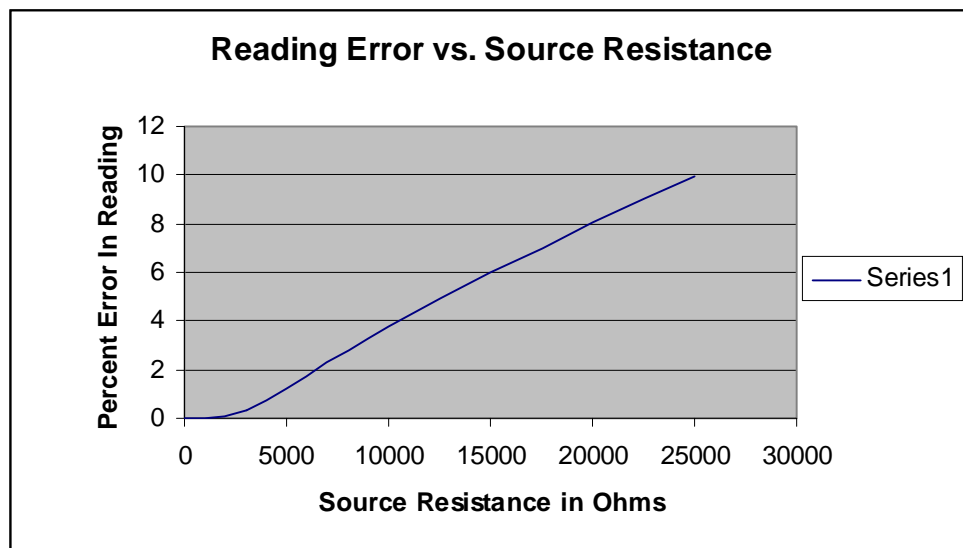


Reading a Transducer

Source Impedance and Settling Time

High speed multiplexing of signal sources with non-zero impedance will result in reading errors caused by settling time. In the simplest form, a multiplexing system consists of a group of switches, with internal resistance, and an output capacitance at the input of an amplifier feeding an A/D converter with a sample-hold circuit on the input. During the short time a channel signal is connected to the A/D amplifier, the signal must charge the output capacitance to the true value of the signal so that the sample-hold captures an accurate value for the A/D converter to digitize. If the source has significant internal impedance the voltage reading will be reduced.

Source impedance below 1000 ohms will create negligible error. Above 1000 ohms, the effects are increasingly noticeable. An accurate source in series with a variable resistance will readily demonstrate this. Although the effect is exponential, an easy reference point to remember is that 25K of source impedance will result in approximately a 10% error.



Analog Ground

J7 and J8 provide access to analog ground. The most common use for them is to provide a ground reference point for differential measurements. This is discussed in the [Signal Management](#) section of Chapter 1.



Although J7 and J8 are electrically equivalent to the "L" signal of the excitation source, they should never be used as the return point for the excitation source.

Card Configuration

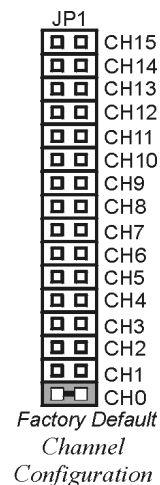
Configuration of the DBK80 involves setting the channel address and selecting the excitation output voltage.

Up to sixteen DBK80 cards can be attached to a single LogBook or Daq device, providing up to 256 differential input channels.

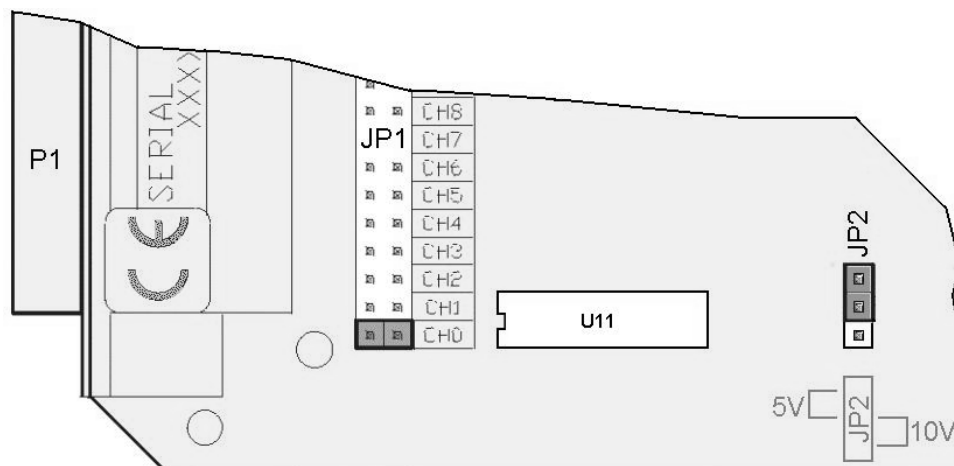
Since multiple cards are connected via a parallel interface, each card must have a unique channel address. To assign a channel number to the card, locate the 16x2-pin header (labeled JP1). JP1's jumper locations are labeled CH0 through CH15. Place the jumper on the two pins that correspond with the intended channel.



Only one channel configuration jumper is to be used per card. Each card in the system must have a unique jumper setting.



The excitation output voltage is set via JP2.



JP2 Location Reference

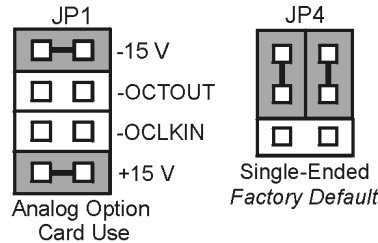
The above figure is of a partial DBK80. JP2 is shown selected to +5VDC. Note that the card's overlay for JP2's voltage selection, also depicted in the figure, indicates the jumper positions that are required to select the +5 or +10 VDC excitation output.



DaqBook and DaqBoard [ISA type] Configuration

Use of a DBK80 with a DaqBook, or with an ISA-type DaqBoard, requires the configuration of jumpers JP1 and JP4 located on the DaqBook, or DaqBoard, as applicable.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



Required Jumper Settings in DaqBooks and ISA-Type DaqBoards



The JP1 default position (above) is necessary to power the interface circuitry of the DBK80 via the internal ± 15 VDC power supply. If using auxiliary power (e.g., a DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the [DBK32A](#) or [DBK33](#) sections as applicable.

2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in the *single-ended* mode.

Note: Analog expansion cards convert all input signals to single-ended voltages that are referenced to analog common.

Software Setup

The DBK80 has no special software settings. The software controls are equivalent to those for a direct connection; e.g., for a DaqBoard/2000 Series board there are *Type* selections of x1 to x64, representing the internal gain of that board. When using the DBK80 with that board you will have the same *Type* options, since the DBK80 is always a constant gain of x1.

Note that there is no software control related to the excitation source. The selection of a +5 VDC or +10 VDC source is determined by JP2.

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).

DBK80 - Specifications

Connector: DBK37 male, mates with P1 pinout on a DaqBook, DaqBoard, or LogBook. The board includes screw-terminals for signal connection.

Gain Ranges: 1, x1

Inputs: 16 differential voltage inputs

Maximum Voltage Range: ± 10 V

Input Impedance: 20M Ohm

Accuracy: $\pm[0.025\% + 150 \mu\text{V}]$ (typ),
 $\pm[0.1\% + 250 \mu\text{V}]$ (max)

Noise: 60 μVrms (typ)

Maximum Input Voltage (without damage): ± 35 V

3 dB Bandwidth: 2.6 MHz

CMRR: 80 dB typ

Excitation Voltage: 1 channel, jumper-selectable to +5 V or +10 V

Excitation Voltage Accuracy: $\pm 0.5\%$

Excitation Voltage Current Limit: 20 mA Src, 1 mA Sink

Power: 25 mA max from ± 15 V (with no load on excitation voltage)

[Overview 1](#)

[Hardware Setup 2](#)

[Card Connection 2](#)

[Open Thermocouple Detection 3](#)

[Installing the DBK82 in the DBK41 Enclosure 3](#)

[Using the Connection Pod, DBK83 Only 3](#)

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[DBK81, DBK82, DBK83 – Specifications 8](#)

DBK81 – 7 Channel Card

DBK82 – 14 Channel Card

**DBK83 – 14 Channel Card with
External Connection Pod**



Reference Notes:

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK81, DBK82, and DBK83 are used in temperature measurement applications that make use of thermocouples. The DBK81 provides connections for 7 thermocouples. Both the DBK82 and the DBK83 provide connections for 14 thermocouples. The two 14 channel cards differ from each other in that the input connectors of the DBK82 are on the board, but connectors of the DBK83 are located in an external connection pod.

All three cards feature on-board cold junction compensation (CJC) for direct measurement of type J, K, T, E, N28, N14, S, R, and B thermocouples. The following table provides the temperature range for each of these thermocouple types.

| Thermocouple Temperature Ranges | | | | | | | | | |
|---------------------------------|--------------|--------------|-------------|--------------|-------------|------------|-------------|-------------|-------------|
| T/C Type | J | K | T | E | N28 | N14 | S | R | B |
| Temperature Range °C | -200 to 760 | -200 to 1200 | -200 to 400 | -270 to 650 | -270 to 400 | 0 to 1300 | -50 to 1768 | -50 to 1768 | 50 to 1780 |
| Temperature Range °F | -328 to 1400 | -328 to 2192 | -328 to 752 | -454 to 1202 | -454 to 752 | 32 to 2372 | -58 to 3214 | -58 to 3214 | 122 to 3236 |

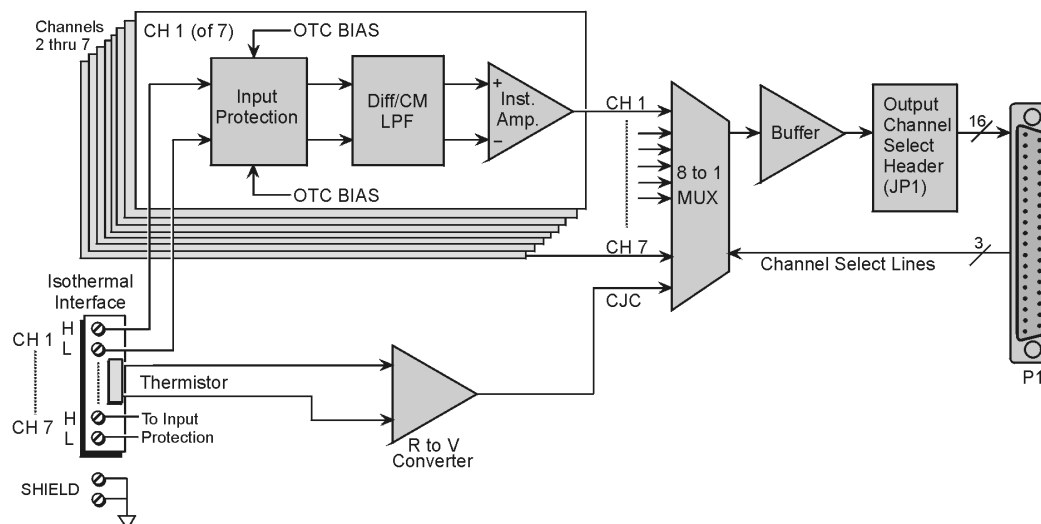
The three DBK cards connect to external thermocouples via channels, as follows:

- **DBK81** – up to seven thermocouples can be connected, using channels 1 through 7, inclusive
- **DBK82 and DBK83** - up to fourteen thermocouples can be connected, using channels 1 through 7 for the first seven and channels 9 through 15 for the second set of seven.

Note: On the DBK81, there is one CJC. It is measured on channel 0. On the DBK82 and DBK83 there are two CJC's, measured on channels 0 and 8.

In addition to thermocouple measurements, each input channel can be configured for a fixed voltage gain of 100. When in this mode, voltage can be measured in the range of ± 100 mV, or ± 50 mV, depending on the type of Daq device being used.

Up to sixteen DBK81, DBK82, or DBK83 cards can be attached to a single LogBook or Daq device, providing up to 224 temperature channels. The cards need not be the same. For example, you could have ten DBK81 cards, three DBK82 cards, and three DBK83 cards in one system.



DBK81 Block Diagram*

*The DBK81 block diagram can be applied to the DBK82 and DBK83, as their diagrams only differ to the one above in regard to the number of input channels provided.



In comparison to other DBK cards, the DBK81, DBK82, and DBK83 demand significant power from the system's $\pm 15V$ power supplies. It is important that you calculate your system's power demand, as you may need to add auxiliary power supplies. Refer to Chapter 2, [Power Management](#), in regard to calculating system power requirements.

Hardware Setup

Card Connection

Connect the thermocouple wires to the intended input terminals on the card. The DBK81 provides input connections for channels 1 through 7, while the DBK82 and DBK83 offer input connections for channels 1 through 7 and 9 through 15. All channels have the same level of functionality.

Thermocouple wire is standardized, color-coded, and polarized, as noted in the following table.

| Thermocouple Standards | | | | |
|------------------------|---------------------------|--|--------------------------|--|
| T/C Type | (+) Lead to Channel High | | (-) Lead to Channel Low | |
| J | White | | Red | |
| K | Yellow | | Red | |
| T | Blue | | Red | |
| E | Violet | | Red | |
| N28 | Orange | | Red | |
| N14 | Orange | | Red | |
| S | Black | | Red | |
| R | Black | | Red | |
| B | Gray | | Red | |

Input connections for the three cards are labeled "H" and "L" to denote polarity.



For isothermal performance, an exposed, grounded copper plane surrounds the input connectors. It is important that non-insulated input wires do not contact the grounded plane – since such contact can degrade measurement integrity.

It should be noted that thermocouples output very small voltages and that long thermocouple leads can pickup a large amount of noise. However, the DBK81, DBK82, and DBK83 inherently provide a high level of noise immunity via their 4 Hz signal bandwidth and input filtering. If desired, further noise reduction can be achieved through the use of shielded thermocouples and/or averaging.



You can minimize the effect of noise by (1) using shielded thermocouples, (2) averaging readings, or (3) employing both of these practices.

To accommodate shielding, grounded connections, labeled “SHIELD,” are provided. A typical use of the connection would be the attachment of the shield to a shielded thermocouple.



If a thermocouple shield is connected on the DBK card, leave the shield unconnected at the other end of the thermocouple.

Open Thermocouple Detection

The DBK81, DBK82, and DBK83 are equipped with open thermocouple detection for each channel. This means that a broken thermocouple wire [or otherwise unconnected input] that is measured will result in an off-scale reading. This is accomplished by applying a small bias current to each of the channel inputs. Whenever a valid input is absent, the bias current saturates the input amplifier, resulting in the off-scale reading. When in this “off-scale” state, however, the input amplifier draws more current from the power supply. Specifically, the power draw of a card from ± 15 V will increase by 0.75 mA for each open channel.



If available power is limited, short unused channels by connecting a short length of wire between the H and L terminals. This will minimize power consumption. Note that it is not enough to simply avoid scanning unused channels; to minimize power consumption the channels must be physically shorted in the hardware.

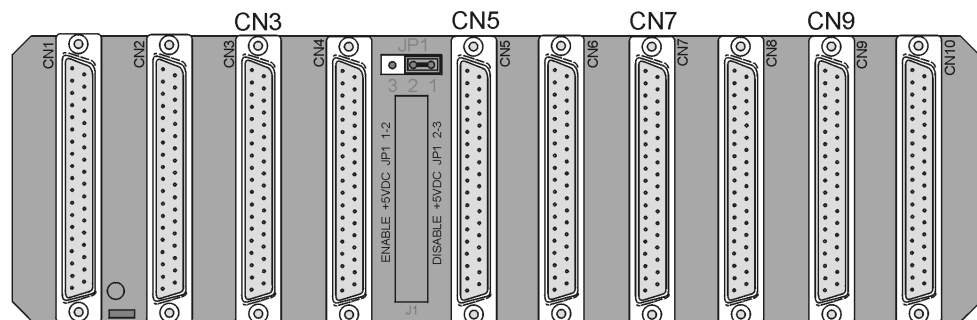


The power requirements, detailed in the product specification, assume worst case connection conditions.

Installing the DBK82 in the DBK41 Enclosure

Because of its physical size, the DBK82 will not fit into 1-slot enclosures such as the DBK10 or DaqBook/216. It does fit, however, in the DBK41 enclosure, and in “drawer-type” products, such as the DaqBook/260.

Installation of the DBK82 is possible in DBK41 connectors CN3, CN5, CN7, and CN9. The connector labels are visible near the upper edge of the DBK41’s printed circuit board, as indicated in the following figure.

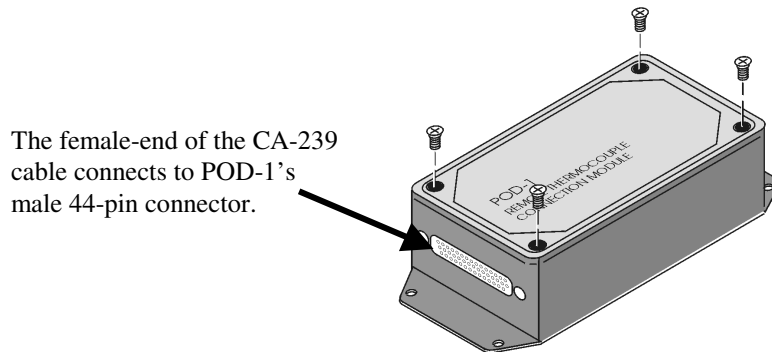


DBK41's Printed Circuit Board

DBK82 cards can be connected to CN3, CN5, CN7, and CN9.

Using the Connection Pod, DBK83 Only

Unlike other DBK units, the input connections for the DBK83 do not exist on the card itself. Instead, they exist in an external connection pod, POD-1. POD-1 simply represents a physical relocation of the input screw terminals and cold junction sensors that reside on the card in the case of the DBK81 and DBK82. POD-1 connects to the DBK83 unit via the CA-239 cable.

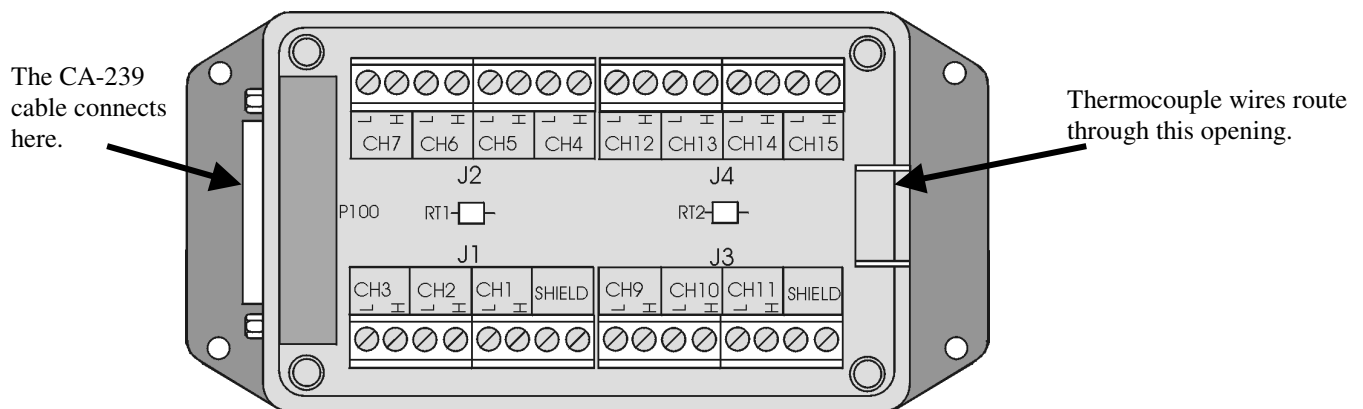


You must remove the four cover screws and the cover plate to access the pod's terminal blocks. The terminal block layout is provided in the following figure.

POD-1

To install thermocouple wires in POD-1:

1. Remove the four screws of the POD-1 cover.
2. Route the thermocouple wires through the input hole of the POD-1 and connect them to the intended channels. Note the "H" and "L" polarity designations on the channels for proper connection. (See the following figure).
3. Replace the POD-1 cover and secure it with the four screws that were removed in step 1.



POD-1 Connection Terminals



For isothermal performance, an exposed, grounded copper plane surrounds the input connectors. It is important that non-insulated input wires do not contact the grounded plane – since such contact can degrade measurement integrity.

To connect the POD-1 to the DBK83:

1. Connect the male end of the CA-239 cable to the female 44-pin connector on the DBK83.
2. Connect the female end of the CA-239 cable to the male 44-pin connector on the POD-1.



The system design of the DBK83 allows for the quick connection/disconnection of up to 14 thermocouples at one time. You may find it advantageous to have several POD-1 modules permanently wired to different sets of thermocouples and to simply swap the CA-239 cable between them and one DBK83 card, as desired.



Because of the opposing gender on the CA-239 cable ends, it is possible to mate multiple CA-239 cables together to increase the distance from the POD-1 to the DBK83. Because of characteristics of the cable design and the signals on it, measurement integrity is not affected by doing so, and there are no practical limits on how many cables can be used.

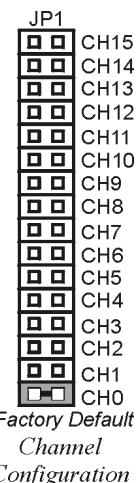
Card Configuration

Up to sixteen DBK81, DBK82, or DBK83 cards can be attached to a single LogBook or Daq device, providing up to 224 temperature channels. The cards need not be the same. For example, you could have ten DBK81 cards, three DBK82 cards, and three DBK83 cards in one system.

Since multiple cards are connected via a parallel interface, each card must have a unique channel address. To assign a channel number to the card, locate the 16×2-pin header (labeled JP1). JP1's jumper locations are labeled CH0 through CH15. Place the jumper on the two pins that correspond with the intended channel.



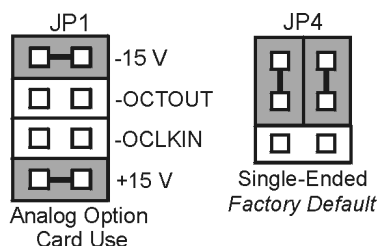
Only one channel configuration jumper is to be used per card. Each card in the system must have a unique jumper setting.



DaqBook and DaqBoard [ISA type] Configuration

Use of a DBK81, DBK82, or DBK83 with a DaqBook, or with an ISA-type DaqBoard, requires the configuration of jumpers JP1 and JP4 located on the DaqBook, or DaqBoard, as applicable.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



The JP1 default position (above) is necessary to power the interface circuitry of the DBK81, DBK82, and DBK83 cards via the internal ± 15 VDC power supply. If using auxiliary power (e.g., a DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, *Power Management* and to the [DBK32A](#) or [DBK33](#) sections as applicable.

2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in the *single-ended* mode.

Note: Analog expansion cards convert all input signals to single-ended voltages that are referenced to analog common.

Software Setup



Reference Notes:

- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).
- Programmers using Daq devices should refer to related sections in the *Programmer's Manual*.

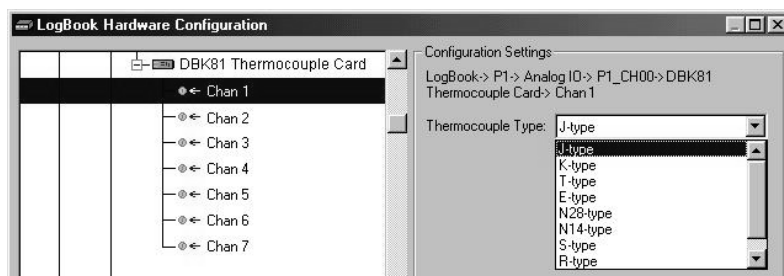
Note: LogView and DaqView software each include functions for the conversion and linearization of thermocouple readings into temperature data.

When a DBK81, DBK82, or DBK83 is selected in DaqView or LogView, thermocouple types must also be selected for the card's channels. The two programs each use a different method for selecting the thermocouple types.

In LogView ...

In LogView, the *LogBook Hardware Configuration Window* is used to select the thermocouple types. After selecting DBK81, DBK82, or DBK83, set each of the card's channels according to the actual thermocouple being used for the channel's input.

In the following screen-shot [from LogView], we see a J-type thermocouple being selected for Channel 1 of a DBK81.

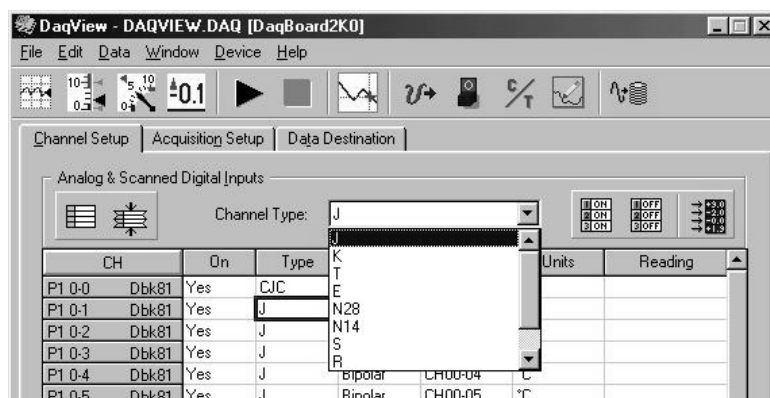


LogBook Hardware Configuration Window

In DaqView

In DaqView, after selecting the DBK81, DBK82, or DBK83 in the *Configure System Hardware Window*, the *Channel Setup Tab* (on the main window) is used to select the thermocouple types (see following figure). The channel types can be changed by double-clicking in the *Types* column, or by using the *Channel Type* pull-down list.

In the following screen-shot [from DaqView], we see a J-type thermocouple being selected for a DBK81 card's Channel 1. Note that the channel is designated "P1 0-1" in the Channel column.



DaqView, Channel Setup

Using a Temperature Calibrator

The DBK81, DBK82, and DBK83 thermocouple cards provide accurate and repeatable temperature measurements across a wide range of operating conditions. However, all instrumentation is subject to drift with time and with ambient temperature change. If the ambient temperature of the operating environment is below 18°C or above 28°C, or if the product is near or outside its one-year calibration interval, then the absolute accuracy may be improved through the use of an external temperature calibrator.

A temperature calibrator is a temperature simulation instrument that allows selection of thermocouple type and temperature. For proper operation, it must be connected to the DBK81, DBK82, or DBK83 with the same type thermocouple wire and connector that is used in normal testing. The calibrator then generates and supplies a voltage to the card. The supplied voltage corresponds to that which would be generated by the chosen thermocouple type at the selected temperature.

The temperature selected on the calibrator will be dictated by the nature of normal testing. 0°C is usually the best choice. Calibrators are the most accurate at this setting, and the connecting thermocouple wire will contribute very little error at this temperature. However, if the dynamic range of the normal testing is, for example, 100°C to 300°C, a selection of 200°C may give better results. In either case, the level of adjustment is determined by comparing the unit reading to the selected calibrator temperature. For example, if the calibrator is set to 0°C output, and the DBK unit reads 0.3°C, then an adjustment of -0.3°C is required. That is, the adjustment value is determined by subtracting the DBK reading from the calibrator setting.

To implement the adjustment in DaqView:

1. Ensure that the acquisition process is turned off.
2. Click on the cell in the Units column for the channel that is connected to the calibrator. The engineering units pull-down menu above the grid becomes active.
3. Click on the down arrow and select the “mx+b” option. This option allows post-acquisition mathematical manipulation.
4. For the example adjustment, enter -0.3 for “b.” The channel under calibration will now read 0°C.

Note that this adjustment is a mathematical operation only, and in no way alters the hardware calibration of the product. Moreover, it operates on a per channel basis, with the settings for a given channel having no influence on any other channels.

To implement the adjustment in LogView:

1. Ensure that the acquisition process is turned off.
2. In the Analog Input Channel Configuration window, select the “User Scaling” tab.
3. Click on the “Offset” cell for the channel that is connected to the calibrator.
4. For the example adjustment, enter -0.3 for “Offset.” The channel under calibration will now read 0°C.

Note that this adjustment is a mathematical operation only, and in no way alters the hardware calibration of the product. Moreover, it operates on a per channel basis, with the settings for a given channel having no influence on any other channels.

DBK81, DBK82, DBK83 - Specifications

Name/Function:

DBK81 – 7 Channel High-Accuracy Thermocouple Card

DBK82 – 14 Channel High-Accuracy Thermocouple Card

DBK83 – 14 Channel High-Accuracy Thermocouple Card with external TC/mV screw-terminal connection pod

System Connector: All DBK options have a DB37 male, which mates with P1 on the DaqBoard, DaqBook, LogBook, or other DBK options

TC/mV Connector

DBK81: Board-mounted screw terminals

DBK82: Board-mounted screw terminals

DBK83: External pod-mounted screw terminals

Functions: TC types J, K, S, T, E, B, R, N; x100 (voltage)

Inputs

DBK81: 7 differential TC/mV inputs

DBK82: 14 differential TC/mV inputs

DBK83: 14 differential TC/mV inputs

Input Voltage Range: ± 100 mV with a DaqBoard/2000 or LogBook
 ± 50 mV with a DaqBook or DaqBoard

Input Impedance: 40M Ohm (differential); 20M Ohm (single-ended)

Input Bandwidth: 4 Hz

Input Bias Current: 10 nA typ

CMRR: 100dB typ

Maximum Working Voltage (signal + common mode): ± 10 V

Over-Voltage Protection: ± 40 V

Power Requirements

DBK81: 35 mA max from ± 15 V; 2 mA max from +5 V

DBK82 and DBK83: 60 mA max from ± 15 V; 2 mA max from +5 V

Operating Temperature: 0°C to 50°C

Voltage Accuracy: $\pm(0.2\%$ of reading +50 μ V)

TC Accuracy: See table. Valid for one year, 18 to 28°C

Minimum Resolution: 0.1°C for all TC types

| TC Accuracy at Measurement Temperature in °C (\pm °C) | | | | | | | | | | | |
|--|------|------|------|-----|-----|-----|-----|-----|-----|------|------|
| Type | Min | Max | -100 | 0 | 100 | 300 | 500 | 700 | 900 | 1100 | 1400 |
| J | -200 | 760 | 0.6 | 0.5 | 0.5 | 0.6 | 0.7 | 0.7 | — | — | — |
| K | -200 | 1200 | 0.7 | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 1.0 | — |
| T | -200 | 400 | 0.7 | 0.6 | 0.6 | 0.6 | — | — | — | — | — |
| E | -270 | 650 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 | — | — | — | — |
| S | -50 | 1768 | — | 2.3 | 1.8 | 1.5 | 1.5 | 1.4 | 1.5 | 1.6 | 1.6 |
| R | -50 | 1768 | — | 2.3 | 1.6 | 1.5 | 1.4 | 1.4 | 1.3 | 1.4 | 1.5 |
| B | 50 | 1780 | — | — | — | 3.7 | 2.4 | 2.1 | 1.8 | 1.7 | 1.5 |
| N28 | -270 | 400 | 0.9 | 0.7 | 0.7 | 0.7 | — | — | — | — | — |
| N14 | 0 | 1300 | — | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 1.0 | — |

Accuracy conditions:

- Data is based on the use of a calibrated DaqBoard/2000
- The table reflects total system absolute accuracy, including accuracy of the CJC and DaqBoard/2000
- Excludes possible error from thermocouples
- Excludes noise
- $V_{CM} = 0$

Overview 1**Hardware Setup 3**

Module Connection 3

Open Thermocouple Detection 4

Module Configuration 4

DaqBook and DaqBoard [ISA type] Configuration 6

Software Setup 7**Using a Temperature Calibrator 8****DBK84 – Specifications 9****Reference Notes:**

- Refer to [Chapter 2, Power Management](#), in regard to calculating system power requirements.
- [Chapter 3, System Connections and Pinouts](#), includes pinouts for P1, P2, P3, and P4. Refer to the pinouts that are applicable to your system, as needed.

Overview

The DBK84 is used in temperature measurement applications and provides connections for 14 thermocouples through convenient mini-TC connectors.

The DBK84 features on-board cold junction compensation (CJC) for direct measurement of type J, K, T, E, N28, N14, S, R, and B thermocouples. The following table provides the temperature range for each of these thermocouple types.

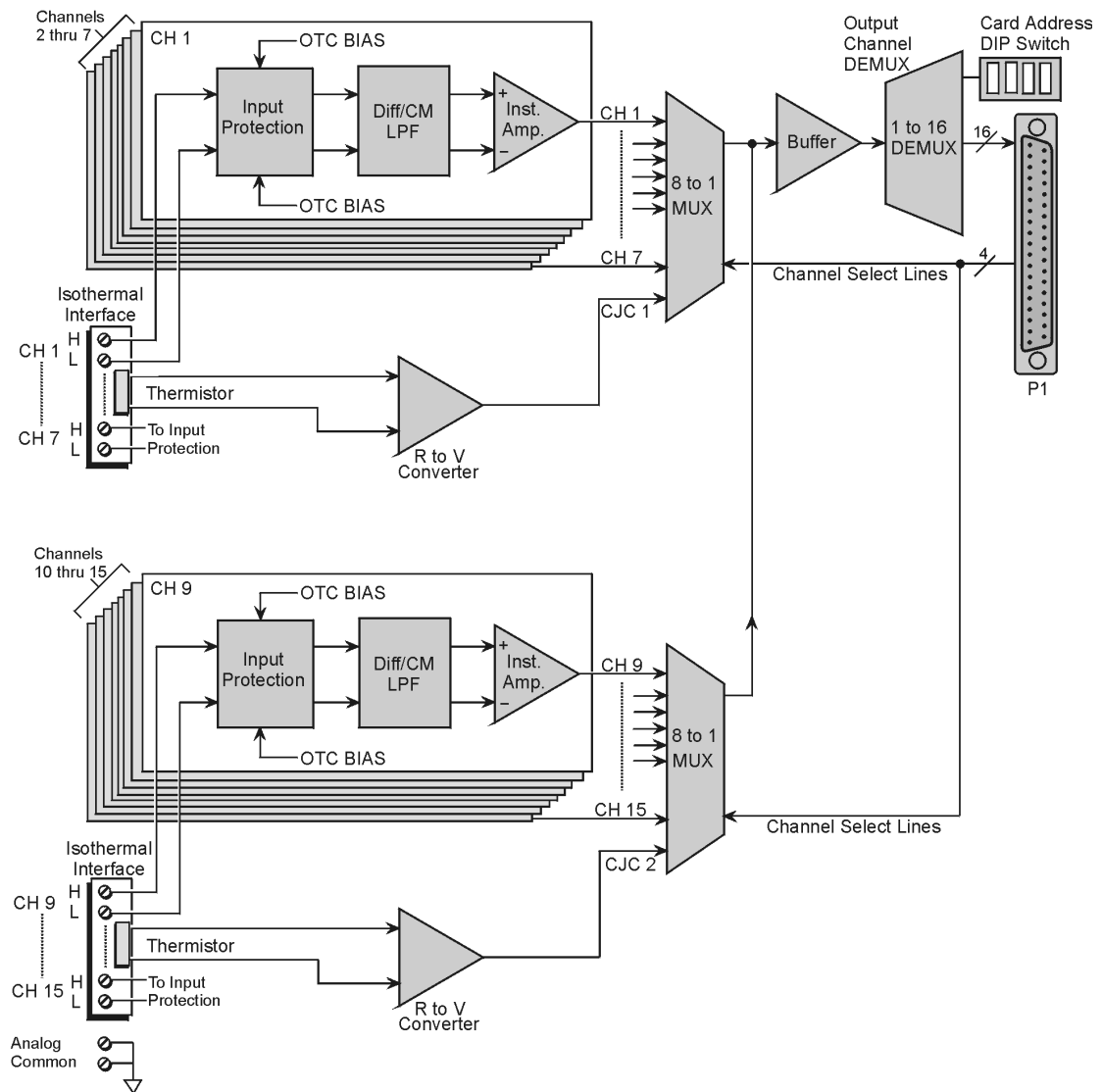
| Thermocouple Temperature Ranges | | | | | | | | | |
|---------------------------------|--------------|--------------|-------------|--------------|-------------|------------|-------------|-------------|-------------|
| T/C Type | J | K | T | E | N28 | N14 | S | R | B |
| Temperature Range °C | -200 to 760 | -200 to 1200 | -200 to 400 | -270 to 650 | -270 to 400 | 0 to 1300 | -50 to 1768 | -50 to 1768 | 50 to 1780 |
| Temperature Range °F | -328 to 1400 | -328 to 2192 | -328 to 752 | -454 to 1202 | -454 to 752 | 32 to 2372 | -58 to 3214 | -58 to 3214 | 122 to 3236 |

Up to fourteen external thermocouples can be connected to the DBK84 module. Channels 1 through 7 are used for the first seven thermocouples, and channels 9 through 15 are used for the second set of seven.

Note: On the DBK84, there are two CJC's. They are measured on channels 0 and 8.

In addition to thermocouple measurements, each input channel can be configured for a fixed voltage gain of 100. When in this mode, voltage can be measured in the range of ± 100 mV, or ± 50 mV, depending on the type of Daq device being used.

Up to sixteen DBK84 modules can be attached to a single LogBook or Daq device, providing up to 224 temperature channels.



DBK84 Block Diagram



In comparison to typical DBK options, the DBK84 demands significant power from the system's ± 15 V power supplies. It is important that you calculate your system's power demand, as you may need to add auxiliary power supplies. Refer to Chapter 2, [Power Management](#), in regard to calculating system power requirements.

Hardware Setup

Module Connection

The DBK84 accepts up to 14 mini-TC plugs in its channels 1 through 7 and 9 through 15. All channels have the same level of functionality.

Thermocouple wire is standardized, color-coded, and polarized, as noted in the following table.

| Thermocouple Standards | | | | |
|------------------------|---------------------------|--|--------------------------|--|
| T/C Type | (+) Lead to Channel High | | (-) Lead to Channel Low | |
| J | White | | Red | |
| K | Yellow | | Red | |
| T | Blue | | Red | |
| E | Violet | | Red | |
| N28 | Orange | | Red | |
| N14 | Orange | | Red | |
| S | Black | | Red | |
| R | Black | | Red | |
| B | Gray | | Red | |

Mini-TC plugs are type-specific, and for best measurement operation the plug TC type should match the wire TC type. If necessary, copper/copper (Type U) plugs may be used, but measurement stability will be slightly degraded. Mini-TC plugs are polarized as well, and it is critical for proper measurement operation that this polarity be followed when connecting the thermocouple wire. Once wired, the TC plugs will only mate into the DBK84's connectors in one orientation, ensuring a correct connection.

It should be noted that thermocouples output very small voltages and that long thermocouple leads can pickup a large amount of noise. However, the DBK84 inherently provides a high level of noise immunity via its 4 Hz signal bandwidth and input filtering. If desired, further noise reduction can be achieved through the use of shielded thermocouples and/or averaging.



You can minimize the effect of noise by (1) using shielded thermocouples, (2) averaging readings, or (3) employing both of these practices.

To accommodate shielding, grounded connections, labeled “Analog Common,” are provided. A typical use of the connection would be to attach the shield of a shielded thermocouple. Note that the Analog Common connector is removable to facilitate wiring.



If a thermocouple shield is connected to the DBK84 module, leave the shield unconnected at the other end of the thermocouple.

Open Thermocouple Detection

The DBK84 is equipped with open thermocouple detection for each channel. This means that a broken thermocouple wire [or otherwise unconnected input] that is measured will result in an off-scale reading. This is accomplished by applying a small bias current to each of the channel inputs. Whenever a valid input is absent, the bias current saturates the input amplifier, resulting in the off-scale reading. When in this “off-scale” state, however, the input amplifier draws more current from the power supply. Specifically, the power draw of the module from ± 15 V will increase by 0.75 mA for each open channel.



If available power is limited, insert shorted TC plugs into unused channels. This will minimize power consumption. Note that it is not enough to simply avoid scanning unused channels; to minimize power consumption the channels must be physically shorted in the hardware.



The power requirements, detailed in the product specification, assume worst case connection conditions.

Module Configuration

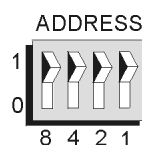
Up to sixteen DBK84 modules can be attached to a single LogBook or Daq device. Since multiple modules are connected via a parallel interface, each must have a unique channel address.

CAUTION



Adjustment of the channel address must only be performed when the system power is OFF. Failure to do so may result in equipment damage.

To assign a channel address to the DBK84 module, first locate the DIP switch on the front panel (next to P1). Four micro-switches [on the DIP switch] are used to set the module’s channel address in binary. After ensuring that the system power is OFF, adjust the micro-switches to set the desired address. The following page shows DIP switch settings for the 16 possible addresses.

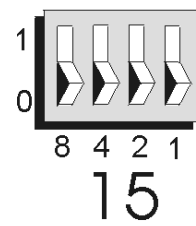
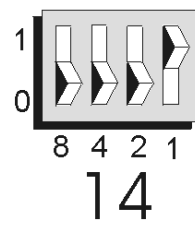
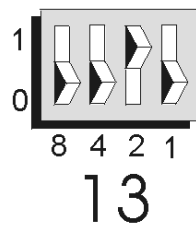
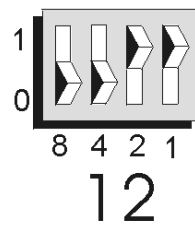
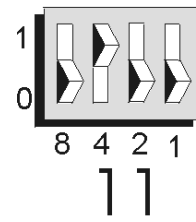
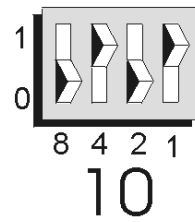
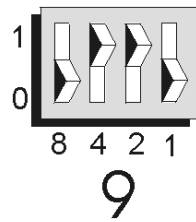
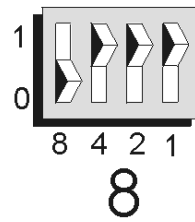
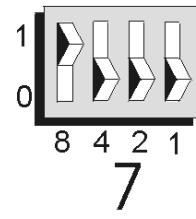
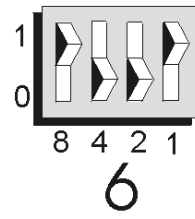
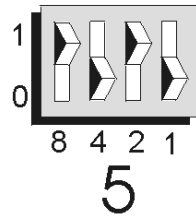
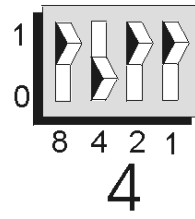
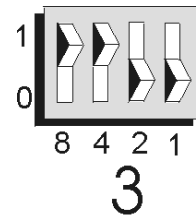
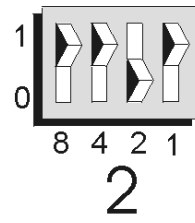
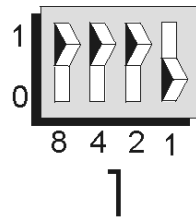
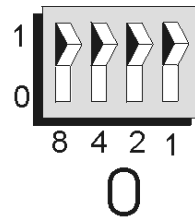


Address Selection DIP Switch

In this figure the address is set to “0.”



Each module in the system must have a unique address.



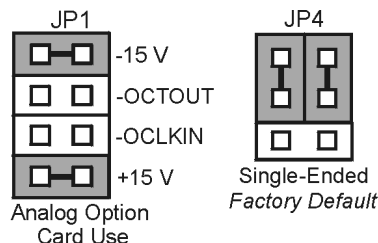
DBK84 Channel Address Settings



DaqBook and DaqBoard [ISA type] Configuration

Use of a DBK84 with a DaqBook, or with an ISA-type DaqBoard, requires the configuration of jumpers JP1 and JP4 located on the DaqBook, or DaqBoard, as applicable.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



*Required Jumper Settings in DaqBooks
and ISA-Type DaqBoards*



Note! The JP1 default position (above) is necessary to power the interface circuitry of the DBK84 module via the internal ± 15 VDC power supply. If using auxiliary power (e.g., a DBK32A or DBK33), you must remove both JP1 jumpers. Refer to chapter 2, [Power Management](#) and to the [DBK32A](#) or [DBK33](#) sections as applicable.

2. For DaqBook/100, DaqBook /112, and DaqBook /120 *only*, place the JP4 jumper in the *single-ended* mode.

Note: Analog expansion options convert all input signals to single-ended voltages that are referenced to analog common.

Software Setup

Reference Notes:



- **DaqView users** - Refer to [Chapter 4, DBK Setup in DaqView](#).
- **LogView users** - Refer to [Chapter 5, DBK Setup in LogView](#).
- Programmers using Daq devices should refer to related sections in the *Programmer's Manual*.

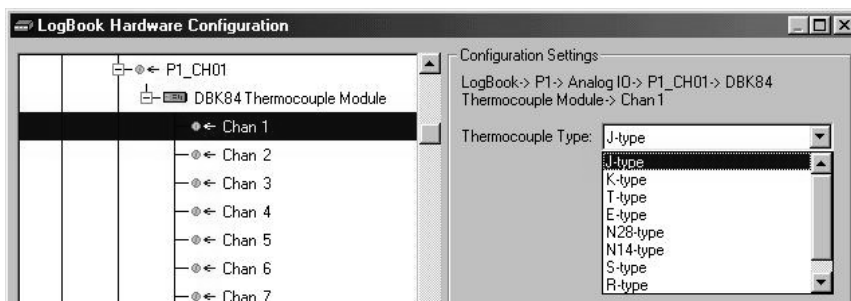
Note: LogView and DaqView software each include functions for the conversion and linearization of thermocouple readings into temperature data.

When a DBK84 is selected in DaqView or LogView, thermocouple types must also be selected for the module's channels. The two programs each use a different method for selecting the thermocouple types.

In LogView ...

In LogView, the *LogBook Hardware Configuration Window* is used to select the thermocouple types. After selecting DBK84, set each of the module's channels according to the actual thermocouple being used for the channel's input.

In the following screen-shot [from LogView], we see a J-type thermocouple being selected for Channel 1 of a DBK84.

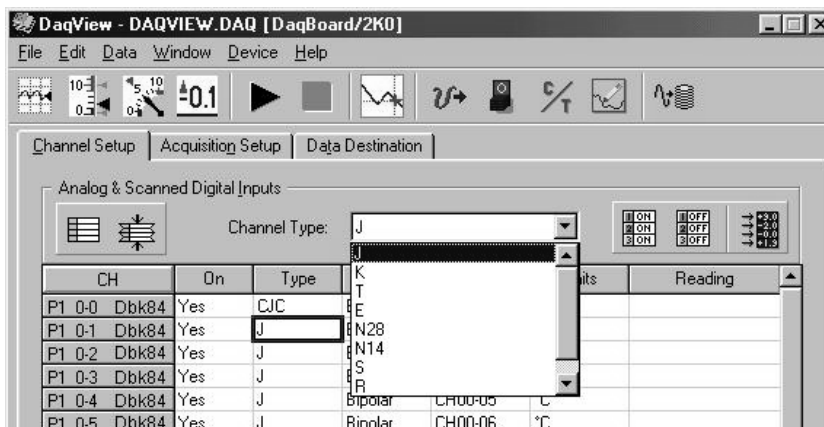


LogBook Hardware Configuration Window

In DaqView

In DaqView, after selecting the DBK84 in the *Configure System Hardware Window*, the *Channel Setup Tab* (on the main window) is used to select the thermocouple types (see following figure). The channel types can be changed by double-clicking in the *Types* column, or by using the *Channel Type* pull-down list.

In the following screen-shot [from DaqView], we see a J-type thermocouple being selected for a DBK84 module's Channel 1. Note that the channel is designated "P1 0-1" in the Channel column.



DaqView, Channel Setup

Using a Temperature Calibrator

The DBK84 thermocouple module provides accurate and repeatable temperature measurements across a wide range of operating conditions. However, all instrumentation is subject to drift with time and with ambient temperature change. If the ambient temperature of the operating environment is below 18°C or above 28°C, or if the product is near or outside its one-year calibration interval, then the absolute accuracy may be improved through the use of an external temperature calibrator.

A temperature calibrator is a temperature simulation instrument that allows selection of thermocouple type and temperature. For proper operation, it must be connected to the DBK84 with the same type thermocouple wire and connector that is used in normal testing. The calibrator then generates and supplies a voltage to the module. The supplied voltage corresponds to that which would be generated by the chosen thermocouple type at the selected temperature.

The temperature selected on the calibrator will be dictated by the nature of normal testing. 0°C is usually the best choice. Calibrators are the most accurate at this setting, and the connecting thermocouple wire will contribute very little error at this temperature. However, if the dynamic range of the normal testing is, for example, 100°C to 300°C, a selection of 200°C may give better results. In either case, the level of adjustment is determined by comparing the unit reading to the selected calibrator temperature. For example, if the calibrator is set to 0°C output, and the DBK unit reads 0.3°C, then an adjustment of -0.3°C is required. That is, the adjustment value is determined by subtracting the DBK reading from the calibrator setting.

To implement the adjustment in DaqView:

1. Ensure that the acquisition process is turned off.
2. Click on the cell in the Units column for the channel that is connected to the calibrator. The engineering units pull-down menu above the grid becomes active.
3. Click on the down arrow and select the “mx+b” option. This option allows post-acquisition mathematical manipulation.
4. For the example adjustment, enter -0.3 for “b.” The channel under calibration will now read 0°C.

Note that this adjustment is a mathematical operation only, and in no way alters the hardware calibration of the product. Moreover, it operates on a per channel basis, with the settings for a given channel having no influence on any other channels.

To implement the adjustment in LogView:

1. Ensure that the acquisition process is turned off.
2. In the Analog Input Channel Configuration window, select the “User Scaling” tab.
3. Click on the “Offset” cell for the channel that is connected to the calibrator.
4. For the example adjustment, enter -0.3 for “Offset.” The channel under calibration will now read 0°C.

Note that this adjustment is a mathematical operation only, and in no way alters the hardware calibration of the product. Moreover, it operates on a per channel basis, with the settings for a given channel having no influence on any other channels.

DBK84 - Specifications

Name/Function:

DBK84 – 14 Channel High-Accuracy Thermocouple Module

System Connector: All DBK options have a DB37 male, which mates with P1 on the DaqBoard, DaqBook, LogBook, or other DBK options

TC/mV Connector: Mini-TC connectors

Functions: TC types J, K, S, T, E, B, R, N; x100 (voltage)

Inputs: 14 differential TC/mV inputs

Input Voltage Range: ± 100 mV with a DaqBoard/2000 or LogBook
 ± 50 mV with a DaqBook or DaqBoard

Input Impedance: 40M Ohm (differential); 20M Ohm (single-ended)

Input Bandwidth: 4 Hz

Input Bias Current: 10 nA typ

CMRR: 100dB typ

Maximum Working Voltage (signal + common mode): ± 10 V

Over-Voltage Protection: ± 40 V

Power Requirements: 60 mA max from ± 15 V; 2 mA max from +5 V

Operating Temperature: 0°C to 50°C

Voltage Accuracy: $\pm(0.2\%$ of reading +50 μ V)

TC Accuracy: See table. Valid for one year, 18 to 28°C

Minimum Resolution: 0.1°C for all TC types

| TC Accuracy at Measurement Temperature in °C (\pm °C) | | | | | | | | | | | |
|--|------|------|------|-----|-----|-----|-----|-----|-----|------|------|
| Type | Min | Max | -100 | 0 | 100 | 300 | 500 | 700 | 900 | 1100 | 1400 |
| J | -200 | 760 | 0.6 | 0.5 | 0.5 | 0.6 | 0.7 | 0.7 | — | — | — |
| K | -200 | 1200 | 0.7 | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 1.0 | — |
| T | -200 | 400 | 0.7 | 0.6 | 0.6 | 0.6 | — | — | — | — | — |
| E | -270 | 650 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 | — | — | — | — |
| S | -50 | 1768 | — | 2.3 | 1.8 | 1.5 | 1.5 | 1.4 | 1.5 | 1.6 | 1.6 |
| R | -50 | 1768 | — | 2.3 | 1.6 | 1.5 | 1.4 | 1.4 | 1.3 | 1.4 | 1.5 |
| B | 50 | 1780 | — | — | — | 3.7 | 2.4 | 2.1 | 1.8 | 1.7 | 1.5 |
| N28 | -270 | 400 | 0.9 | 0.7 | 0.7 | 0.7 | — | — | — | — | — |
| N14 | 0 | 1300 | — | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 1.0 | — |

Accuracy conditions:

- Data is based on the use of a calibrated DaqBoard/2000
- The table reflects total system absolute accuracy, including accuracy of the CJC and DaqBoard/2000
- Excludes possible error from thermocouples
- Excludes noise
- $V_{CM} = 0$



For use with DaqBook/260, DBK60, and LogBook/360



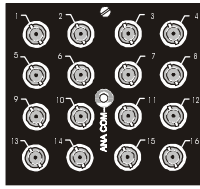
Reference Notes:

- **DaqBook/260 users** – refer to the *DaqBook, DaqBoard [ISA], Daq PC-Card User's Manual* (p/n 457-0901) for installation instructions.
- **DBK60 users** – refer the [DBK60 document module](#) that is included in the *DBK Option Cards & Modules User's Manual* (p/n 457-0905).
- **LogBook/360 users** – refer to the *LogBook User's Manual* (p/n 461-0901) for installation instructions.

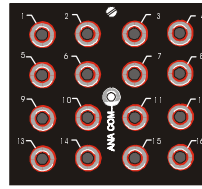
The rear panels of the **DaqBook/260**, **DBK60**, and the **LogBook/360** are each customized through the use of three termination panels. The three panels can be a combination of the following *600-series* DBKs.



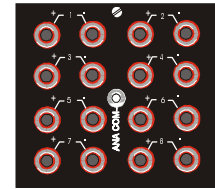
Blank Panel
DBK601



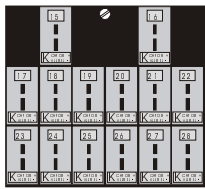
BNC Connectors
plus Analog Common
DBK602



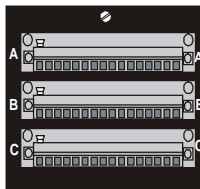
Safety Jacks, Single-ended
plus Analog Common
DBK603



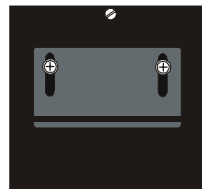
Safety Jacks, Differential
plus Analog Common
DBK604



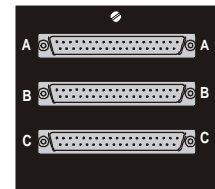
T/C Connectors, Differential
DBK605-B DBK605-R
DBK605-J DBK605-S
DBK605-K DBK605-T



Terminal Blocks,
16 connections each
DBK606



Strain Relief Clamp
DBK607



DB37 Connectors, Female
DBK608

DBK600 Series Termination Panels

WARNING



Electrical Shock Hazard! To avoid possible injury and equipment damage, turn off power to devices and connected equipment prior to setup.

The signal inputs, from DBK cards, connect directly to the *600-series* termination panels, with exception of the DBK601 (blank panel) and the DBK607 (strain relief clamp). In the case of the DBK601 (blank panel), there are no connections. In regard to DBK607, wires pass through a slot in the panel, and are clamped.

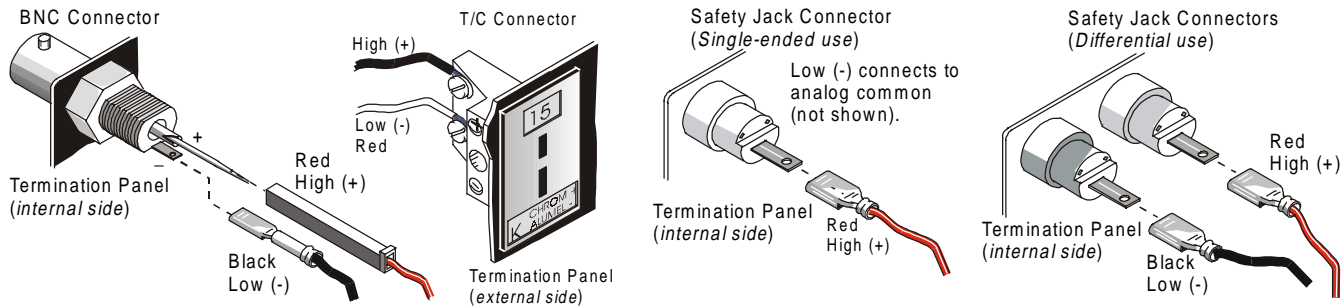
The remaining *600-series* DBKs have different ways in which DBK cards connect to the termination panels (see following figure). Some points to note:

- Single-ended connections use analog common.
- Differential connections require the proper polarity, typically red-to-red for high (+) and black-to-black for low (-).
- For thermocouples, red is generally the low side.
- The T/C connector and wire type must match the T/C type used.

WARNING



Electrical Shock Hazard! To avoid possible injury and equipment damage, turn off power to devices and connected equipment prior to setup.



DBK Cards Connect to the Termination Panels in Various Ways



Reference Notes:

- **DaqBook/260 users** – refer to the *DaqBook, DaqBoard [ISA], Daq PC-Card User's Manual* (p/n 457-0901) for installation instructions.
- **DBK60 users** – for installation instructions, refer the [DBK60 document module](#) that is included in the *DBK Option Cards & Modules User's Manual* (p/n 457-0905).
- **LogBook/360 users** – refer to the *LogBook User's Manual* (p/n 461-0901) for installation instructions.
- Refer to DBK document modules, as applicable, for information regarding the DBK cards that integrate with your LogBook or DaqBook system.



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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.

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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.

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