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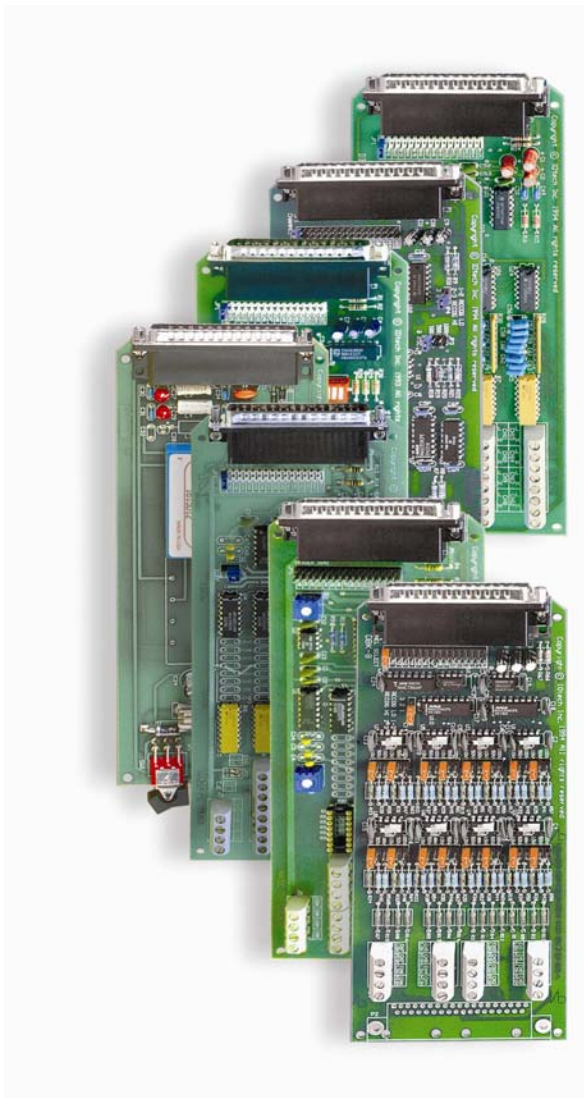
OMEGA CARE SM Extended Warranty Program

User's Guide



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OMB-DBK Option Cards and Modules

Part 2 of 2, OMB-DBK-41 and Higher

OMB-457-0912 rev 8.1

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Warnings, Cautions, Notes, and Tips

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

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 ESD caution symbol urges proper handling of equipment or components sensitive to damage from electrostatic discharge. Proper handling guidelines include the use of grounded anti-static mats and wrist straps, ESD-protective bags and cartons, and related procedures.

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

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

Tips provide advice that may save time during a procedure, or help to clarify an issue. Tips may include additional reference.

Specifications and Calibration

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

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

CAUTION

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

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

Start [Desktop “Start” pull-down menu]
⇒ **Programs**
⇒ **Omega DaqX Software**

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

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

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

DBKs Covered in Part 2 of 2

DBK41, 10-Slot Expansion Module
DBK42, 16-Slot 5B Signal Conditioning Module
DBK43A, 8-Channel Strain-Gage Module
DBK44, 2-Ch. 5B Signal-Conditioning Card
DBK45, 4-Ch. SSH and Low-Pass Filter Card
DBK46, 4-Channel Analog Output Card
DBK48, Multipurpose Isolated Signal-Conditioning Module (supports up to 16 8B Modules)
DBK50 and DBK51, Voltage Input Modules
DBK55, 8-Channel Frequency-to-Voltage Input Module
DBK60, 3-Slot Expansion Chassis
DBK65, 8-Channel Transducer Interface Module

DBK80, 16-Ch. Differential Voltage Input Card with Excitation Output
DBK81, 7-Ch. T/C Card
DBK82, 14-Ch. T/C Card
DBK83, 14-Ch. T/C Card, uses external connection pod
DBK84, 14-Ch. T/C Module
DBK85, 16-Ch. Differential Voltage Module
DBK90, 56-Ch. T/C Module
DBK100 Series, (DBK100/D, 100/T,101)
In-Vehicle Thermocouple Measurement System
DBK200 Series Matrix
DBK200, P4-to-P1 Adapter Board
DBK202, DBK203, DBK204 Series
P4-to-P1/P2/P3 Adapters
DBK206, P4-to-P1/P2/P3 Adapter Board with Screw Terminals
DBK207 and DBK207/CJC, 16-Channel,
5B Carrier Boards
DBK208, Relay Carrier Board,
Opto-22 Compatible
DBK209, P4 to P1/P2/P3 Mini-Adapter Board
DBK210, 32-Ch. Digital I/O Carrier Board
DBK213, Screw-Terminal & Expansion Module
3-Card Slot, P1/P2/P3/P4 Compatibility
DBK214, 16-Connector BNC Interface Module
P1/P2/P3/P4 Compatibility
DBK215, 16-Connector BNC Connection Module
with 68-Pin SCSI Adaptability
DBK601 thru DBK609, Termination Panels

Discontinued DBKs

The following DBKs have been discontinued. However, documentation for them may be obtained from the factory.

DBK12 and DBK13, A/I Multiplexer Cards
DBK19, 14-Channel Thermocouple Card
DBK33, Triple-Output Power Supply Card
DBK34, Vehicle UPS Module
DBK40, 18-Connector BNC Analog Interface
DBK52, 14-Ch. Thermocouple Input Module
DBK53 and DBK54, Analog Multiplexing Modules
DBK201, P4-to-P1/P2/P3 Adapter Board
DBK603, Termination Panel, Safety Jacks, SE
DBK605-B, Termination Panel, T/C, B Type, DE
DBK605-R, Termination Panel, T/C, R Type, DE
DBK605-S, Termination Panel, T/C, S Type, DE
DBK605-U, Termination Panel, T/C, U Type, DE
DBK609, Termination Panel, 5-Pin DIN

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

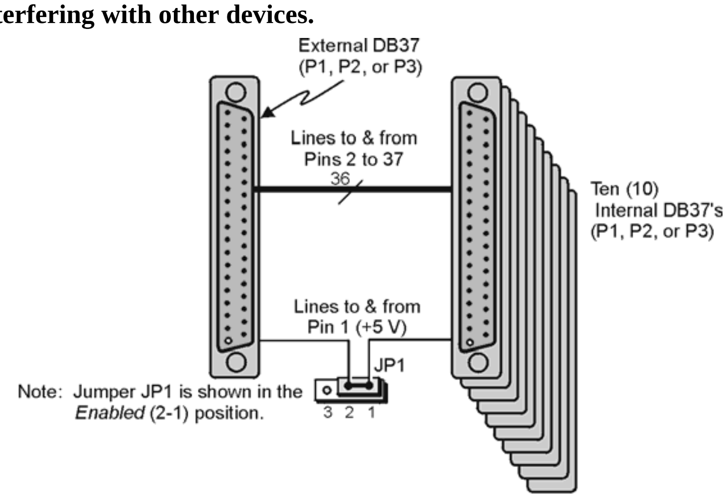
Overview

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. Refer to *Power Requirements* in the *DBK Basics* section, as well as the sections for the DBK32A and/or DBK33, as applicable.

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

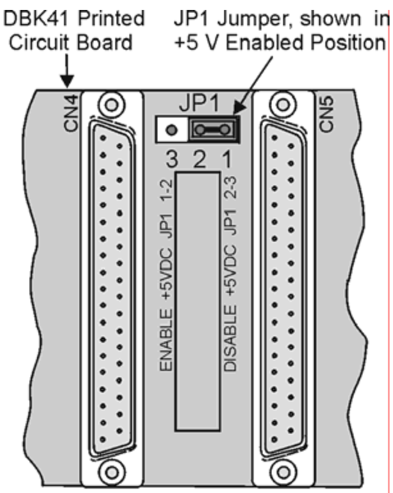
Each DBK card should be checked for proper configuration, and re-configured if needed, before being inserted into the DBK41. Refer to the individual DBK Document Modules that are applicable to your system.

Power Configuration

Power must be configured to prevent multiple power supplies from interfering with each other via the P1 interface. DBK41, LogBook/360, DaqBook/100 Series & /200 Series, and ISA-type DaqBoard 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:



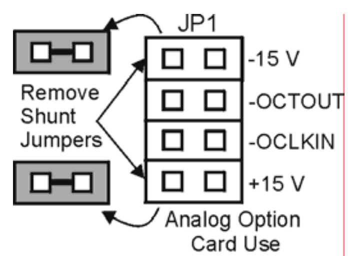
DBK41 Power Configuration

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/100 Series & /200 Series and DaqBoard [ISA type]

CAUTION
DBK power cards must not be connected until JP1 jumpers have been removed. Otherwise, equipment damage could result.



Auxiliary Power Configuration

If a DBK32A or DBK33 is used, you must remove the shunt jumpers from the JP1 header located inside the DaqBook/100 Series & /200 Series device or DaqBoard [ISA type]. DaqBook/100 Series & /200 Series devices 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.

DaqBook/2000 Series & DaqBoard/2000 Series Configuration

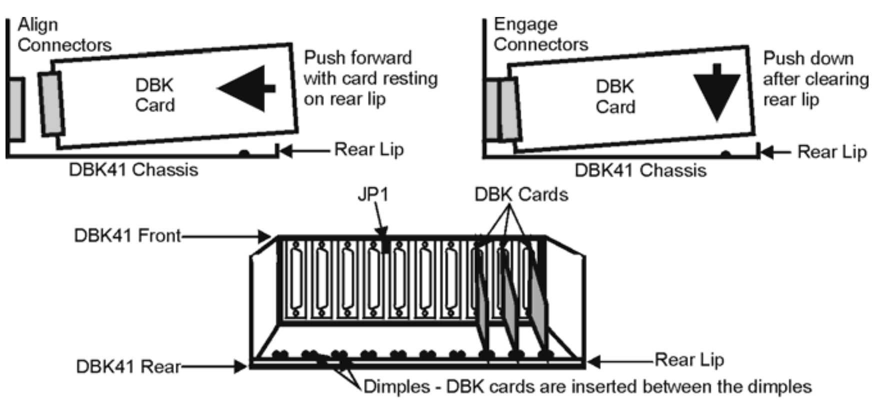
No jumper configurations are required for these /2000 series devices.

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.



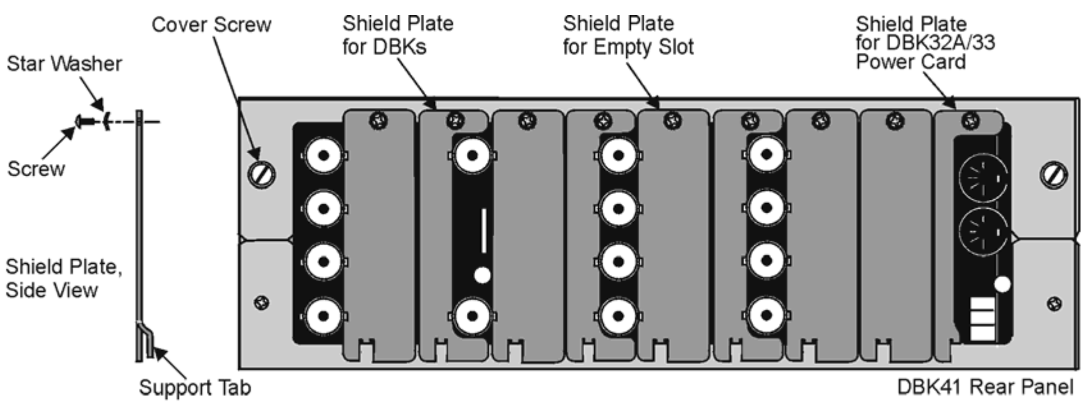
Inserting Cards into a DBK41

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.



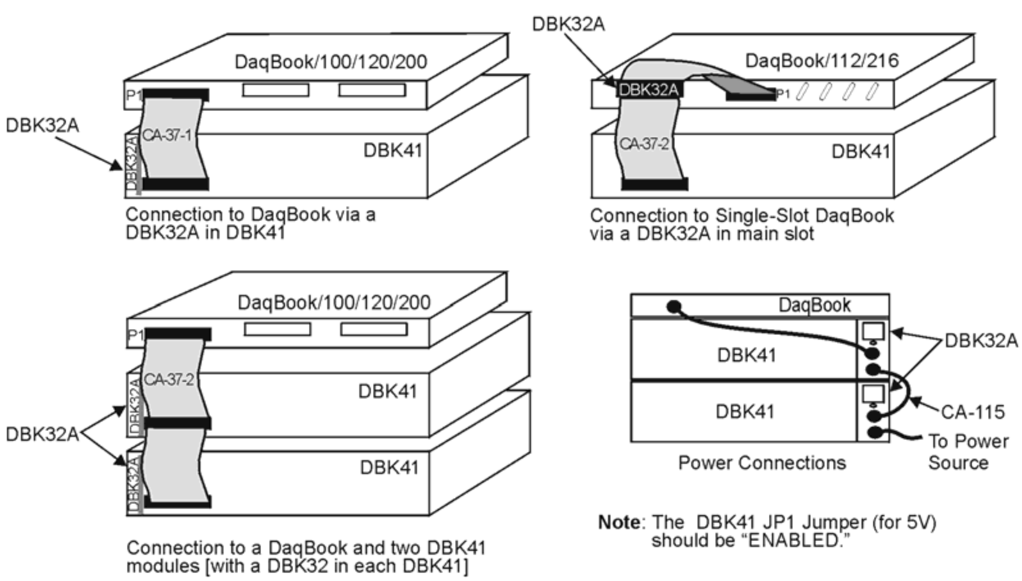
EMI Shield Plates on DBK41 Rear Panel

Reference Note:
The *Signal Management* chapter 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

Notes

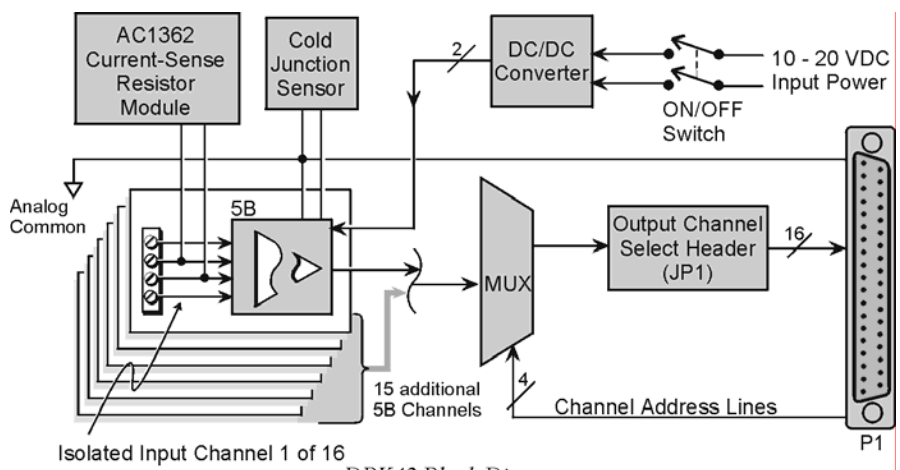
Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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



DBK42 Block Diagram

LogBook or Daq device scans the DBK42 channels at the same 10 µs/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.

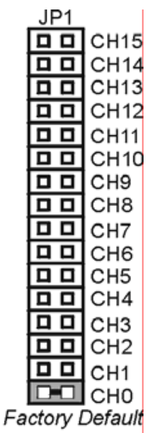
Hardware Setup

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



Channel 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.

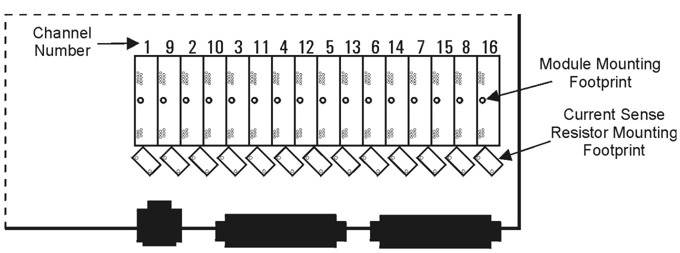
5B Module Connection

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.

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.



Module Installation

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	Input Amperes	
	With Strain-Gage Modules	With Thermocouple Modules
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.

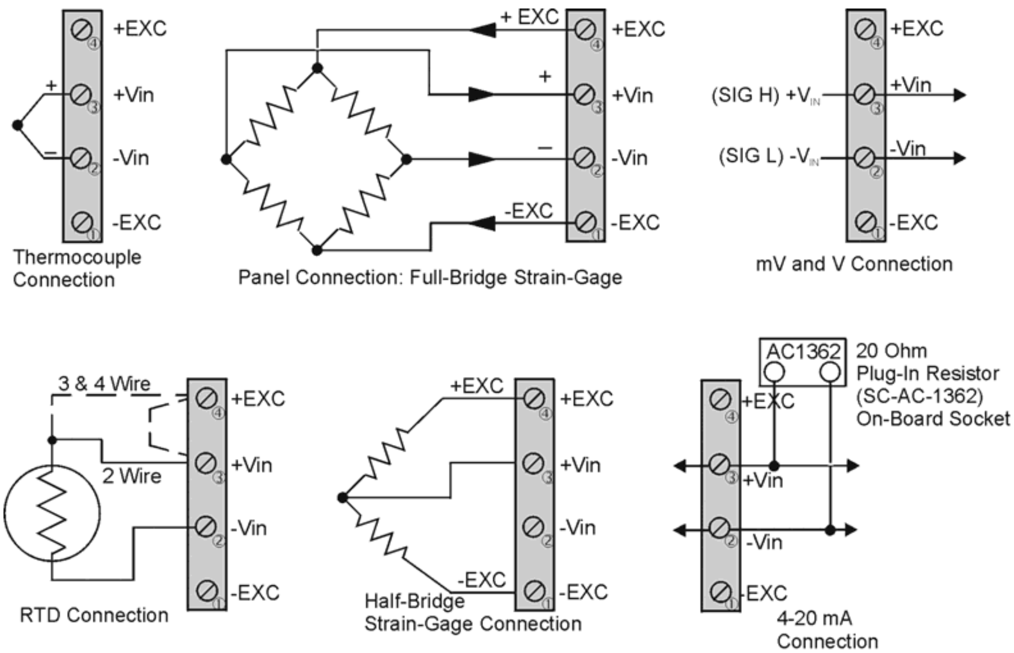
Terminal Block Connection

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.

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

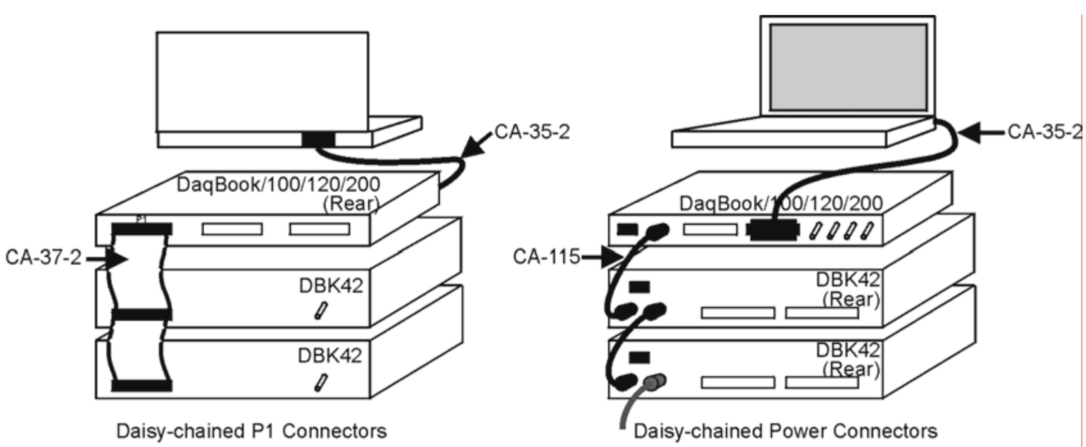
Shock Hazard! The DBK42 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK42 before changing the wiring or configuration.



DBK42 Terminal Connections

P1 Connection. The DBK42 attaches to the P1 analog I/O connector or to a DBK200 series P4-Adapter 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, Daq device, or adapter 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

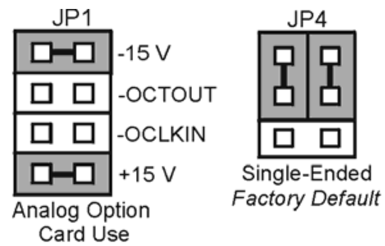
DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Connections

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/100 Series & /200 Series and ISA-Type DaqBoard Configuration



DaqBook/DaqBoard Jumpers for DBK42

The DBK42 requires two setup steps in DaqBook/100 Series & /200 Series devices 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 *Power Requirements* in the *DBK Basics* section of the manual. Also, refer to the DBK32A and DBK33 sections as applicable.

2. For DaqBook/100, /112, and /120 *only*, place the JP4 jumper in the DaqBook/100 & /200 or ISA-type DaqBoard in *single-ended* mode. Analog expansion cards convert all input signals to single-ended voltages referenced to analog common.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No Jumper configurations are required for these /2000 series devices.

Software Setup

You will need to set several parameters so *DaqView* can best meet your application requirements. After the 5B module type is identified, *DaqView* figures out the *m* and *b* (of the *mx+b* equation) for proper engineering units scaling. An example of the *mx + b* equation follows shortly.

The *mx + b* calculations for most 5B modules are included within *LogView* software.

Reference Note:

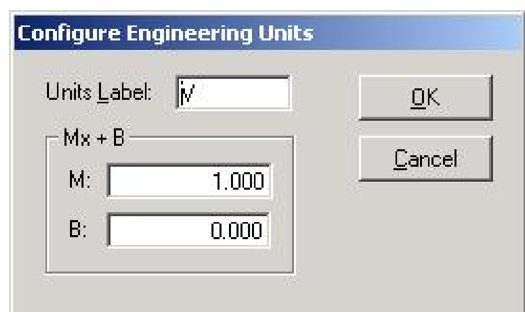
- For *DaqView* information refer to chapter 3, *DBK Setup in DaqView* and to the *DaqView* PDF included on your data acquisition CD.
- For *LogView* information refer to chapter 4, *DBK Setup in LogView* and to the *LogView* section of the LogBook PDF included on your data acquisition CD.
- The API includes functions applicable to the DBK42. Refer to related material in the *Programmer's Manual* (p/n 1008-0901) as needed.

PDF Note: During software installation, Adobe® PDF versions of user manuals automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation for details regarding both hardware and software. Note that you can also access PDF documents directly from the data acquisition CD via the <View PDFs> button on the CD's opening screen.

mX +b, an Example

The *Customize Engineering Units* dialog box can be accessed via the *DaqView Configuration main window* by activating the **Units** cell [for the desired channel], then clicking to select **mX+b**.

From the *Customize Engineering Units* dialog box (see figure at right), you can enter values for *m* and *b* components of the equation that will be applied to the data. There is also an entry field that allows you to enter a label for the new units that may result from the **mX+b** calculation.



An example of mX + b equation use follows.

Engineering Units Conversion Using mx + b

Most of our data acquisition products allow the user to convert a raw signal input (for example, one that is in volts) to a value that is in engineering units (for example, pressure in psi). The products accomplish this by allowing the user to enter *scale* and *offset* numbers for each input channel, using the software associated with the product. Then the software uses these numbers to convert the raw signals into engineering units using the following "**mx + b**" equation:

(1) Engineering Units = m(Raw Signal) + b

The user must, however, determine the proper values of *scale* (**m**) and *offset* (**b**) for the application in question. To do the calculation, the user needs to identify two known values: (1) the raw signal values, and (2) the engineering units that correspond to the raw signal values. After this, the scale and offset parameters can be calculated by solving two equations for the two unknowns. This method is made clear by the following example.

Example

An engineer has a pressure transducer that produces a voltage output of 10.5 volts when the measured pressure is 3200 psi. The same transducer produces an output of 0.5 volt when the pressure is 0 psi. Knowing these facts, m and b are calculated as follows.

A - Write a pair of equations, representing the two *known* points:

(2) 3200 = m(10.5) + b

(3) 0 = m(0.5) + b

B - Solve for m by first subtracting each element in equation (3) from equation (2):

(4) 3200 - 0 = m(10.5 – 0.5) + (b - b)

(5) Simplifying gives you: **3200 = m(10)**

(6) This means: **m = 320**

C - Substitute the value for m into equation (3) to determine the value for b:

(7) 0 = 320 (0.5) + b

(8) Therefore: **b = - 160**

Now it is possible to rewrite the general equation (1) using the specific values for m and b that we just determined:

(9) Engineering Units = 320(Raw Signal) - 160

The user can then enter the values of m and b into the appropriate location using the facilities provided by compatible data acquisition software, for example: *WaveView, DaqView, Personal DaqView, LogView*, and *TempView*. The software uses equation (9) to calculate signal values in engineering units from that point on.

DBK42 – Specifications

Name/Function: 16-Slot 5B Signal Conditioning Module

Module Capacity: 16 (input only) 5B modules

Size: 8.5" × 11" × 3.5" (11" × 11" × 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 ×2 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

DBK43A — 8-Channel Strain Gage Module

Reference Notes:

- In regard to calculating system power requirements, refer to the section *Power Requirements* in the *DBK Basics* section located at the beginning of the manual.
- Chapter 2, *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.

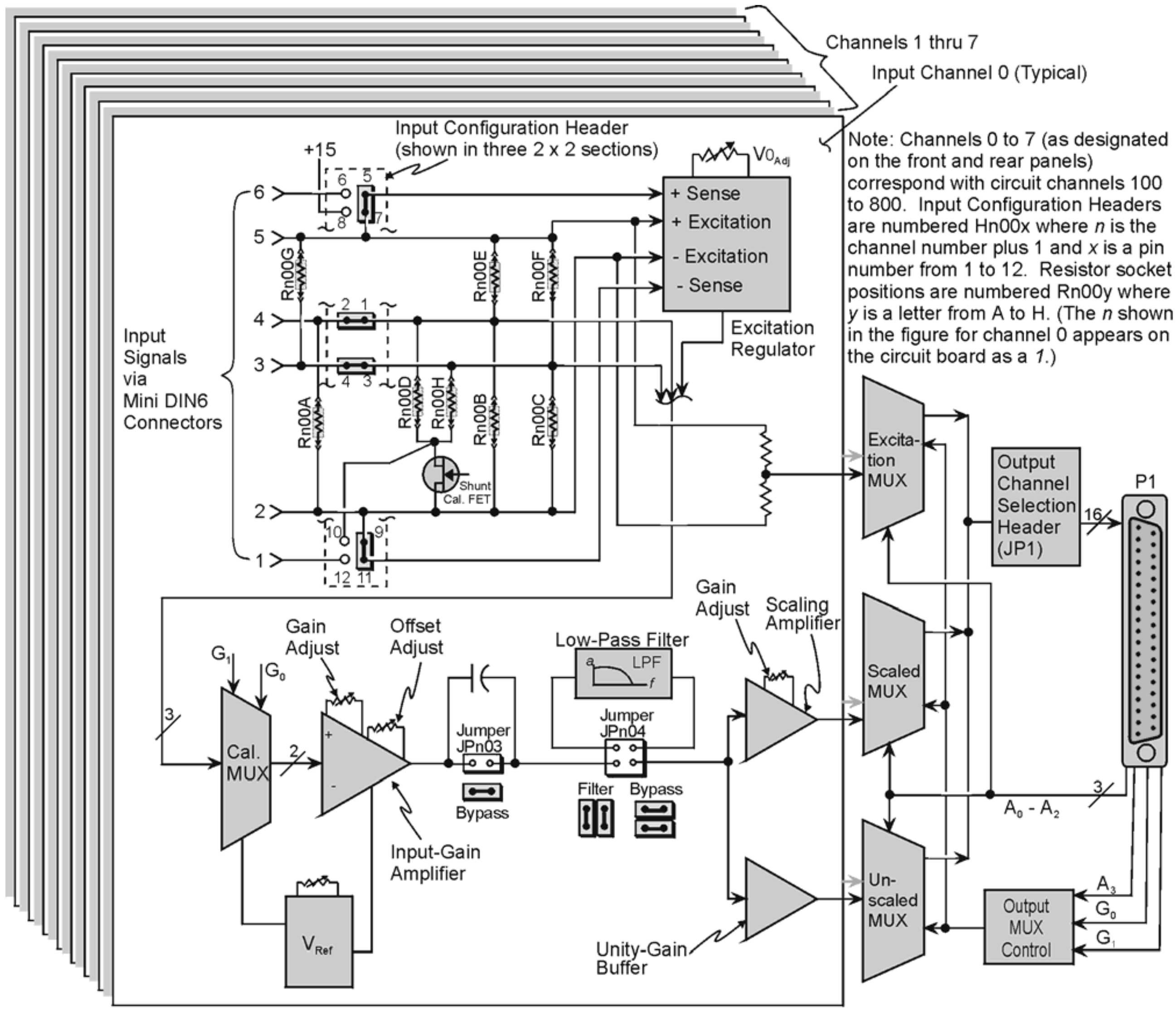
Overview

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 ×100 to ×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.



DBK43A Block Diagram

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.

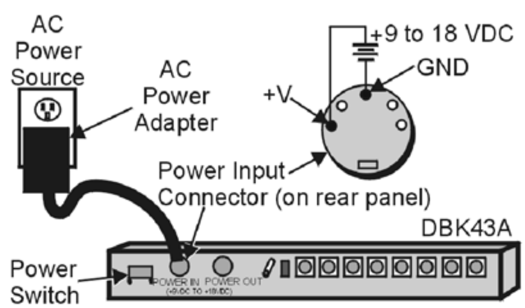
Hardware Connection

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.



DBK43A Power Connections

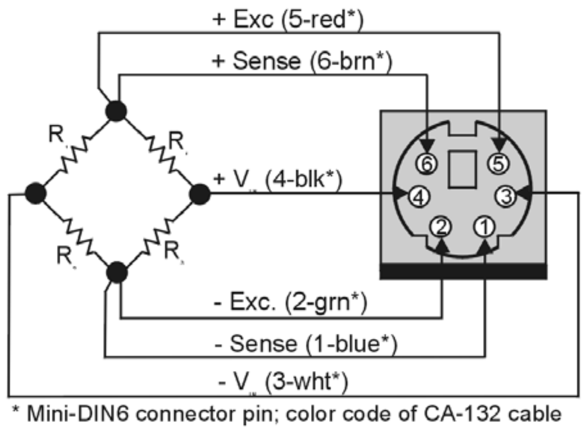
CAUTION
POWER IN : The power connectors are rated at 5 amps maximum DC current. The power supply provided with the DBK43A can power the unit but not any auxiliary devices. If using the DBK43A's power supply, do not use the POWER OUT terminal. If using another power supply to power auxiliary devices from 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.



DBK43A Signal Input Connection

Hardware Configuration

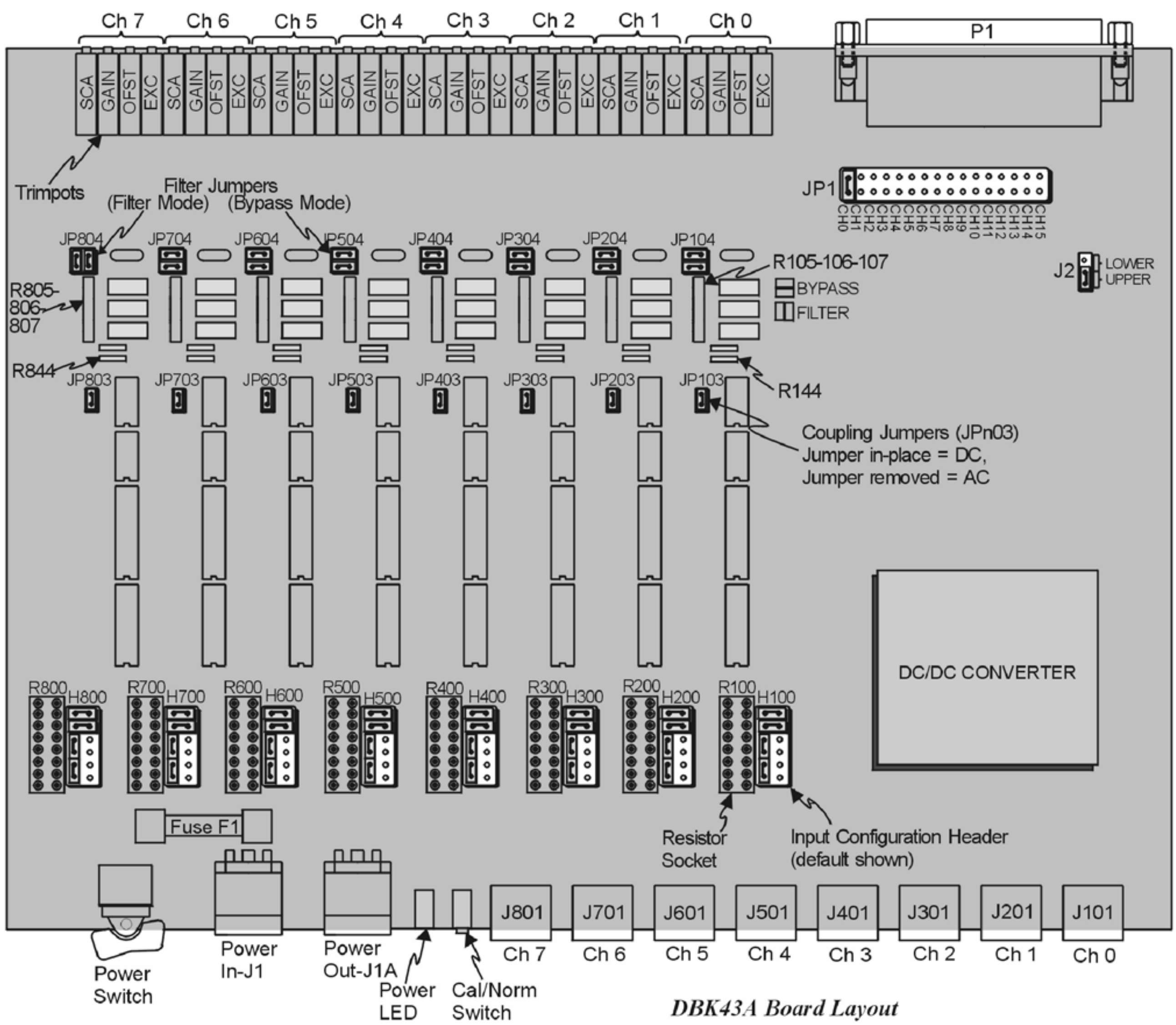
Factory Defaults:

- **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.

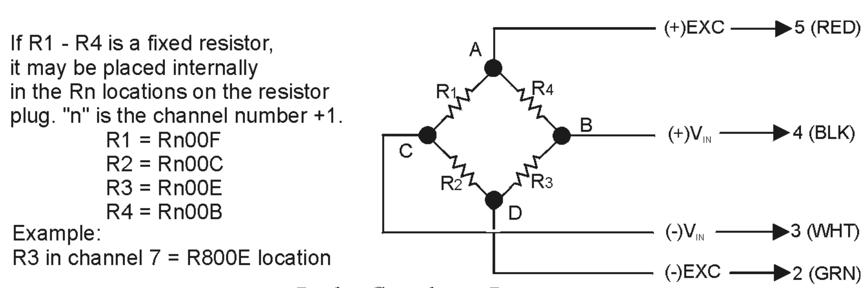


DBK43A Board Layout

Bridge Applications

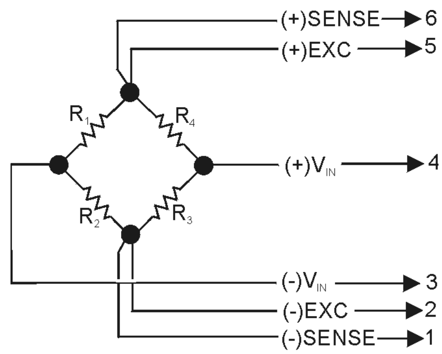
There are several ways to hook-up strain gages—all are configured into a 4-element bridge (the 4 legs in a bridge circuit). The *quarter-*, *half-* or *full-* designation for a strain gage refers to how many elements in the bridge are strain-variable. A quarter bridge has 1 strain-variable element; a 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.



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.)



Kelvin-type Excitation Leads

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 × R (where R = the resistance in ohms of 1 element in the bridge circuit).

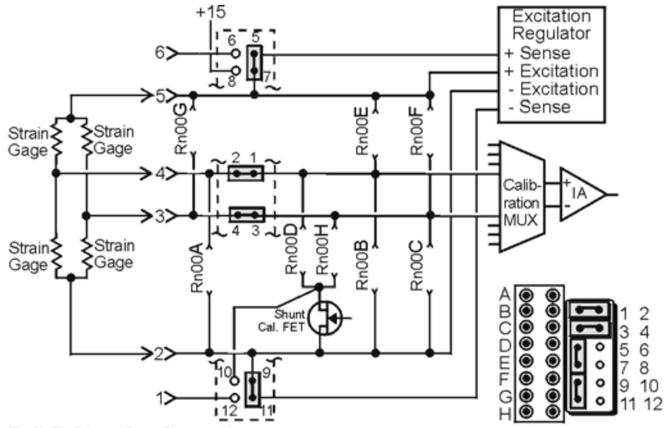
CAUTION

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.

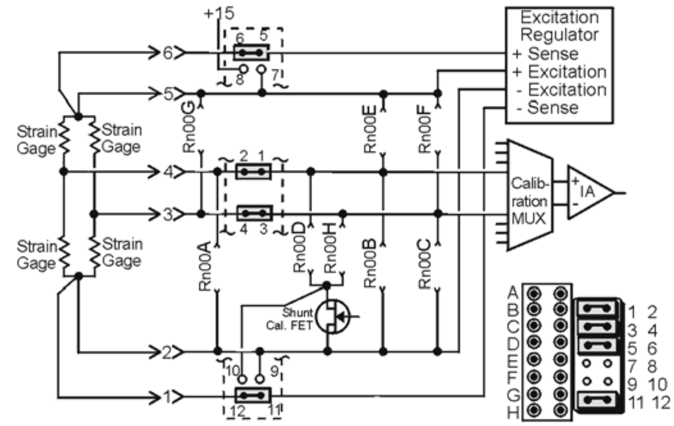
$$V_{MAX[EXC]} = 0.05 \times R$$

R is the resistance in ohms of 1 element in the bridge circuit.

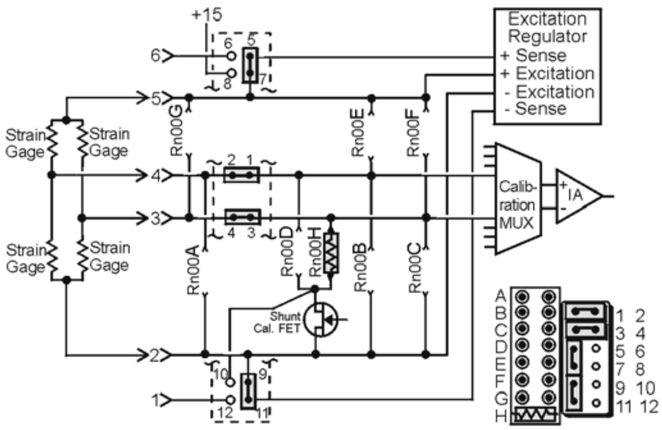
The following full-page figure shows various strain-gage configurations.



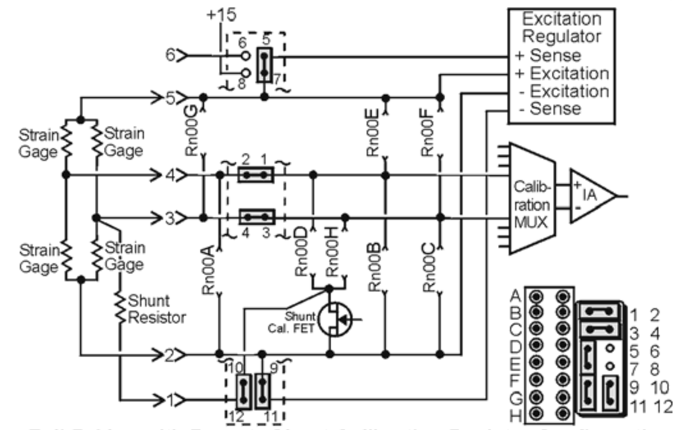
Full-Bridge Configuration



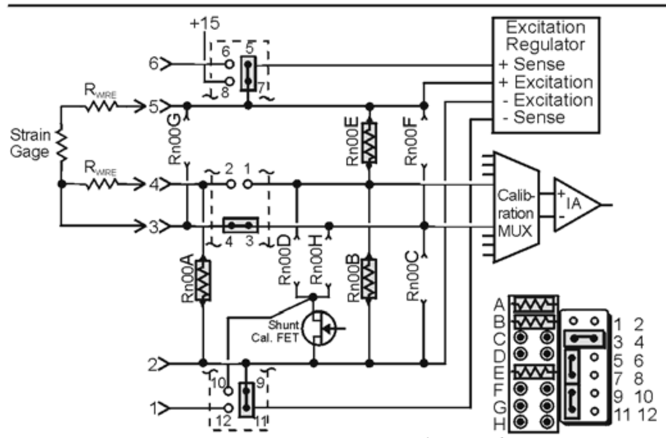
Full-Bridge with Remote Excitation Sensing Configuration



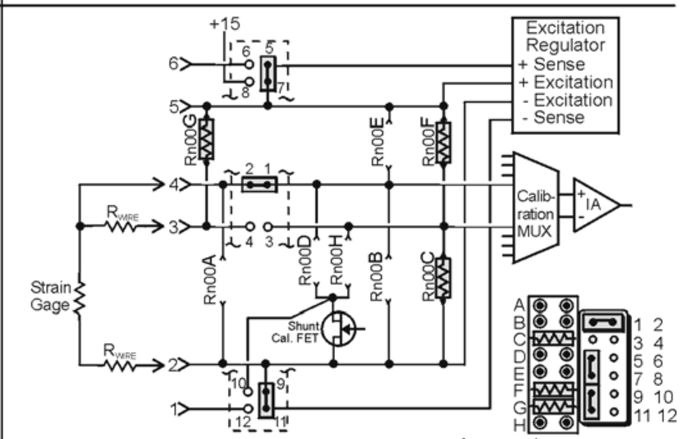
Full-Bridge with Internal Shunt Calibration Resistor Configuration



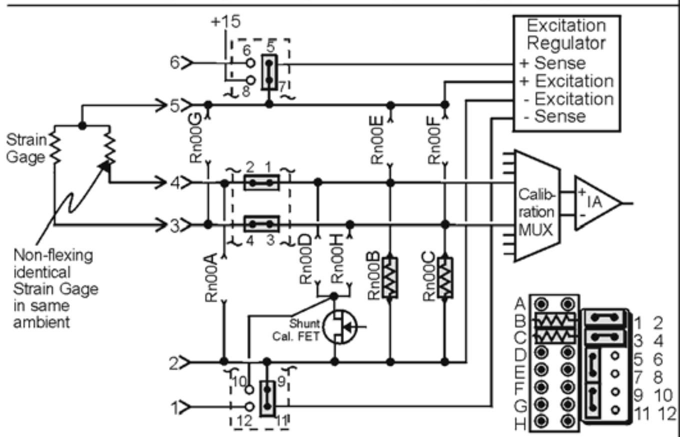
Full-Bridge with Remote Shunt Calibration Resistor Configuration



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±0.1% ohm or 120±0.1% ohm. Use the resistor value to match the particular strain gage in use.

DBK43A Bridge-Configuration Settings

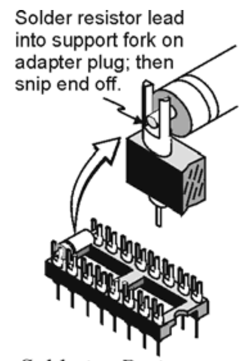
Input Configuration Headers

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



Soldering Resistors to Adaptor Plug

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:

$$R_{Shunt} = [R_{Gage} / F_G(\varepsilon)] - R_{Gage}$$

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:

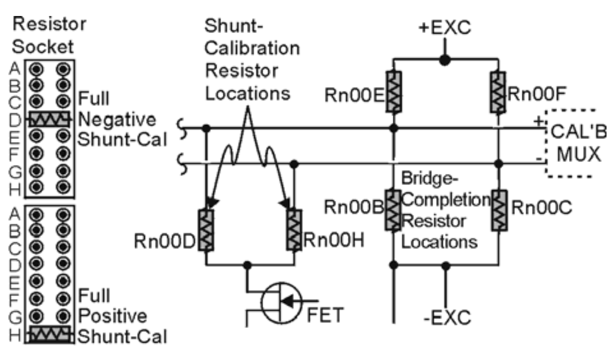
An engineer wants to know the shunt calibration resistor value for a strain gage with the following parameters.

resistance: 120 Ω
gage factor: 2.0
strain: 5000 micro-strain, i.e., 5000 x 10^{-6}

Plugging the values into the equation, we get:

$$\begin{aligned} R_{Shunt} &= [R_{Gage} / F_G(\varepsilon)] - R_{Gage} \\ &= [120 / 2.0(5000 \times 10^{-6})] - 120 \\ &= [120 / .01] - 120 \\ &= 12000 - 120 \\ &= 11{,}880\ \Omega \end{aligned}$$

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 accommodates 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 ×2 can be changed to ×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 2×2 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
133kHz	10	4606X-102-100
66.7kHz	20	4606X-102-200
26.6kHz	50	4606X-102-500
13.3kHz	100	4606X-102-101
6.67kHz	200	4606X-102-201
2.66kHz	500	4606X-102-501
1.33kHz	1K	4606X-102-102
667Hz	2K	4606X-102-202
266Hz	5K	4606X-102-502
133Hz	10K	4606X-102-103
66.7Hz	20K	4606X-102-203
26.6Hz	50K	4606X-102-503
13.3Hz	100K	4606X-102-104

The active low-pass filters on the DBK43A have a gain of ×2. This gain can be factored into the setup calculations, or the filter gain can be changed to ×1. To change the gain to ×1 (unity) for the corresponding channels, de-solder (or snip leads) and remove the resistors shown in the table.

Note: The default ×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 16×2 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.

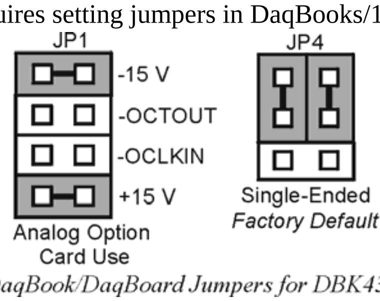
Daq Device Base Channel	First Expansion Channel Number (N)
0	16
1	32
2	48
3	64
4	80
5	96
6	112
7	128
8	144
9	160
10	176
11	192
12	208
13	224
14	240
15	256

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 Chapter 1, *Signal Management*.

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of the DBK43A requires setting jumpers in DaqBooks/100 Series & /200 Series devices



DaqBook/DaqBoard Jumpers for DBK43A

and ISA-type DaqBoards.

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 DBK43A via the internal ±15 VDC power supply. If using auxiliary power (DBK32A or DBK33), you must remove both JP1 jumpers. Refer to *Power Management* in the *DBK Basics* section [at the front of the manual] 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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No Jumper configurations are required for these /2000 series devices.

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.

Trimpots

The DBK43A's front panel has a slot to allow access to 4 potentiometers to trim (adjust) the accuracy for each channel circuit. The trimpots are labeled to represent the following adjustments:

EXC **for adjusting the excitation voltage to the transducer**

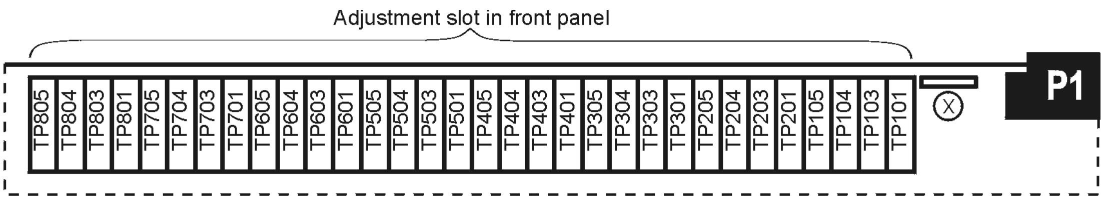
GAIN **for setting the gain of the input amplifier**

OFFSET **for adjusting the circuit offset for quiescent loads or bridge imbalance**

SCALE **for setting the gain of the scaling amplifier**

Trimpot	Channel Number							
	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.



DBK43A 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

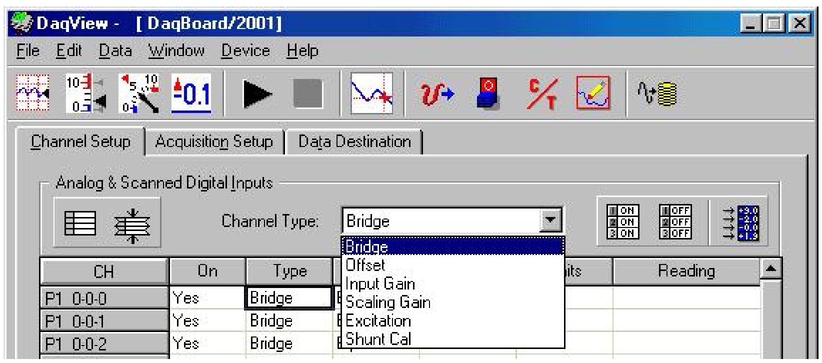
Proper setup includes the use of software to control the calibration multiplexer in each circuit. The calibration multiplexer is used to switch the bridge circuit out and apply internal reference voltages to the input for use in the DBK43A setup. The calibration multiplexer also allows the recording 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 DBK43A-14.
- Typical setup steps with embedded examples begin on page DBK43A-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. Vout = (Scaling Gain)(Filter Gain*)[(InputGain)(bridge circuit voltage) - 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. Vout = (Filter Gain*)(Input Gain)(-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]. Vout = (Filter Gain*)(Input Gain)(5 mV) - 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. Vout = Filter Gain*(Scaling Gain[(Input Gain)(5 mV) - offset voltage])
Excitation	CAL	Sets excitation. Vout = (Excitation Voltage)
Shunt Cal	CAL	Activates shunt-cal resistors. Vout = (Scaling Gain)(Filter Gain*)[(Input Gain)(bridge circuit voltage with shunt) - offset voltage]

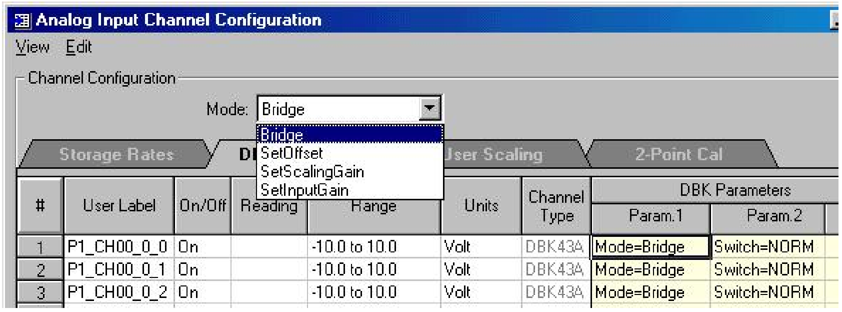
[1]The physical CAL/NORM Switch [on the DBK43A Module] is located next to the Power LED.

* In the equations, the asterisk indicates the conditional clause, "if the filter is enabled."

Selecting Channel Modes in LogView

Reference Notes:

- DaqView users refer to *Selecting Channel Types in DaqView* on page DBK43A-13.
- Typical setup steps with embedded examples begin on page DBK43A-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. Vout = (Scaling Gain)(Filter Gain*)[(InputGain)(bridge circuit voltage) - 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. Vout = (Filter Gain*)(Input Gain) - 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]. Vout = (Filter Gain*)(Input Gain)(5 mV) - 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. Vout = Filter Gain*(Scaling Gain[(Input Gain)(5 mV) - offset voltage])
Excitation	CAL	Sets excitation. Vout = (Excitation Voltage)
Shunt Cal	CAL	Activates shunt-cal resistors. Vout = (Scaling Gain)(Filter Gain*)[(Input Gain)(bridge circuit voltage with shunt) - 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.”

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 3, *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 4, *DBK Setup in LogView*.
- The board layout on page DBK43A-5 can be referred to for jumper locations, jumper setting orientations, and trimpot locations.
- For **Calibration of DBK43A** – DaqView users should refer to the *GageCal* segment beginning on page DBK43A-19 . LogView users should refer to the section titled *Calibrating DBK16 and DBK43A for LogBook Applications*, beginning on page DBK43A-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:

   <u>Strain Gage Example</u>

   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:

$$\frac{\text{(Excitation Voltage)(Gage Factor)(Strain in strain units)}}{4} = \text{*Bridge circuit output voltage}$$

   In this strain gage example, lets 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:

Load Cell Output Voltage = $(\text{Load}_{\text{Applied}}/\text{Load}_{\text{Rated}})$(Excitation Voltage)(Load Cell Rating)

For this example, lets 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.

Load Cell Output Voltage = $(3000/3000)(10)(2.05\times10^{-3}) = 20.5$ 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 mV/3 = 6.833 mV. If we used the entire equation we would see:

Load Cell Output Voltage = $(1000/3000)(10)(2.05\times10^{-3}) = 6.833$ 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.

   $\text{Gain}_{\text{TOTAL}}$ = (Sensor Output $\text{Voltage}_{\text{FULL-SCALE}}$ – $\text{Voltage}_{\text{OFFSET}}$) / Strain or Load $\text{Voltage}_{\text{OUTPUT}}$

   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 ×420, 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	×420	×100	×240	×300
Filter Gain x1 or x2	Disabled	×2	×1	Disabled
Scaling Gain x1 to x10	×1	×2.1	×1.75	×1.4
Total Gain	×420	×420	×420	×420

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) Select "Excitation" for the Channel Type.
   (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 x 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 x G_I x 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:

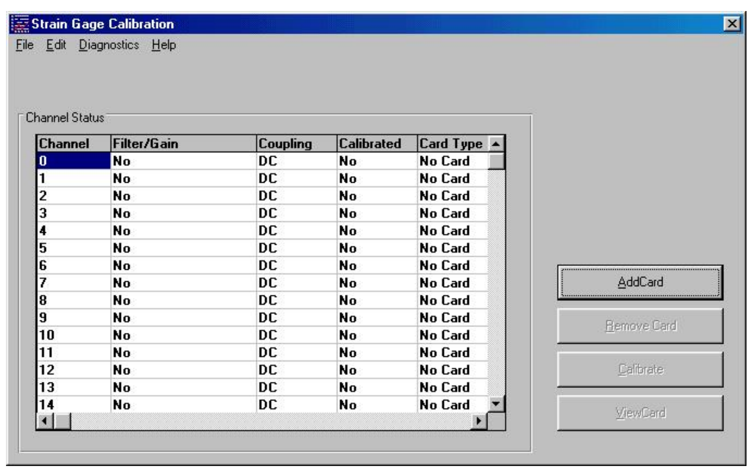
- Use a graphic representation of a strain-gage board as a guide to configure switches, jumpers, and other hardware settings.
- Enter all the parameters pertaining to your strain gage application.
- Follow step by step prompting to adjust trimpots for scale gain, input gain, and offset to ensure the 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 ⇒ Omega DaqXSoftware ⇒ GageCal
   A Select Device window will appear, similar to that shown in the following figure.

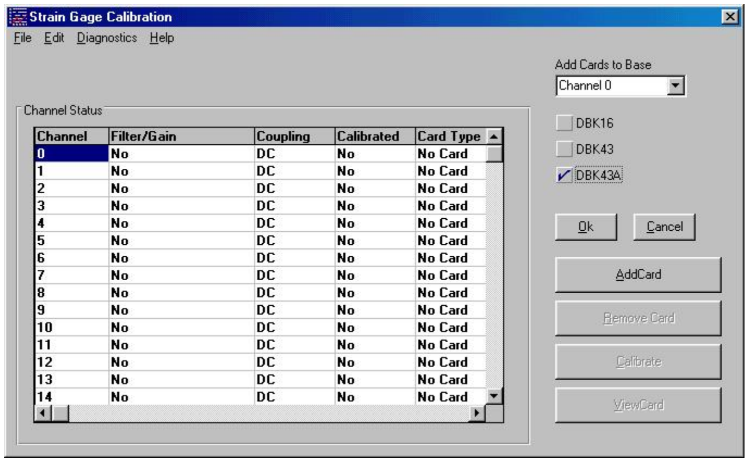
GageCal – Select Device

2. From the Select Device window, highlight the applicable DaqBook or DaqBoard, thin click the <OK> button. The Strain Gage Calibration window will appear.



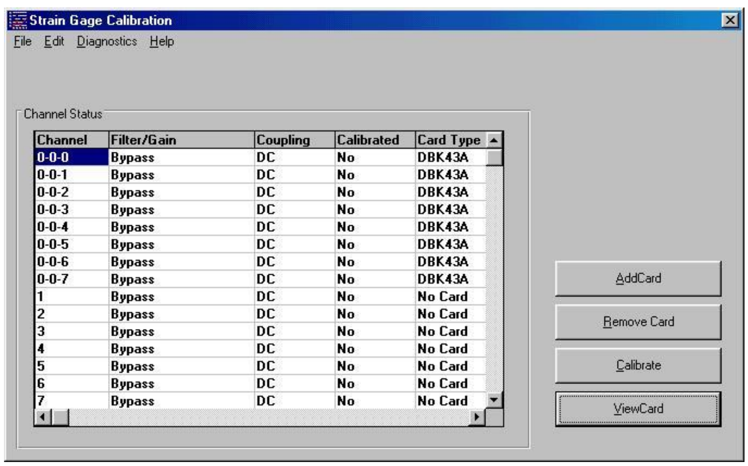
GageCal's Strain Gage Calibration Window

3. Click the <AddCard> button. Then select one of the following, as applicable: DBK16, DBK43, or DBK43A. See following figure.



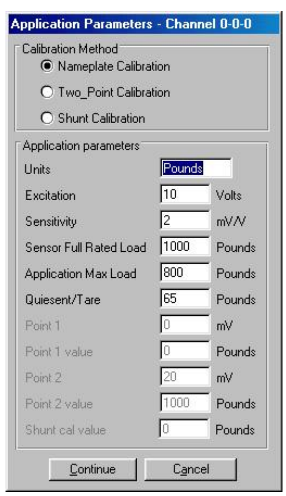
Selecting DBK43A

4. Click the <OK> button. The Strain Gage Calibration window will provide 3 digit channel numbers in the form of "n_1-n_2-n_3;" where n_1 is the card number, n_2- is the bank number on the card, and n_3 is the channel number. See following figure.



Strain Gage Calibration Window after Adding a Card

5. Click the <Calibrate> button. An Applications Parameter box appears. See following figure.

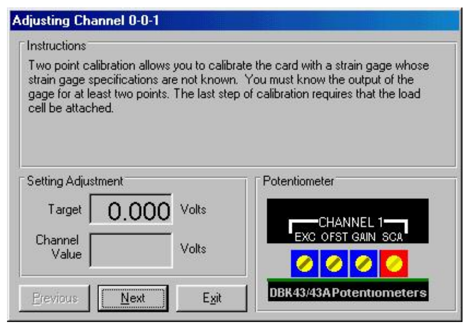


Application Parameters for Channel 0-0-0

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.

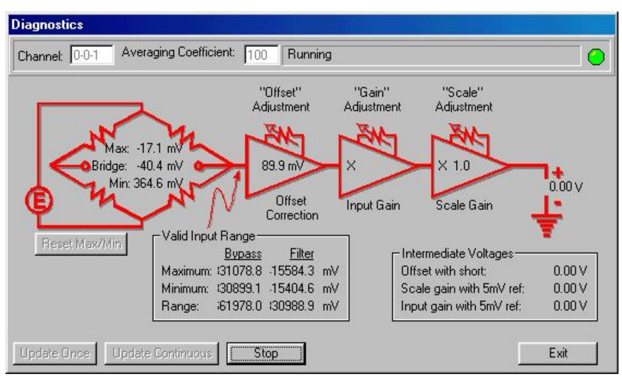
   - **Nameplate calibration** provides a way to enter parameters for your strain gage and its application. The final step of the procedure includes attaching the strain gage (load cell).
   - **Two-Point calibration** provides a way to calibrate a DBK16, DBK43, or DBK43A that is using a strain gage with 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.

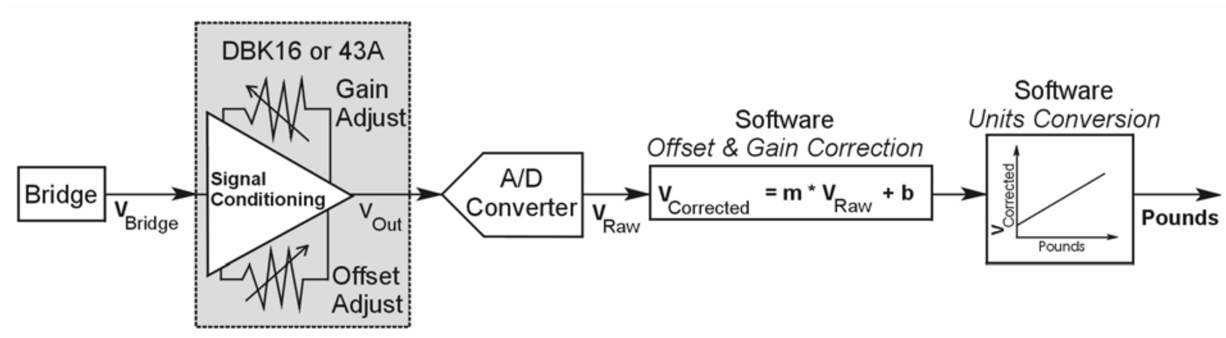
Notes

Calibrating DBK16 and DBK43A for LogBook Applications

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

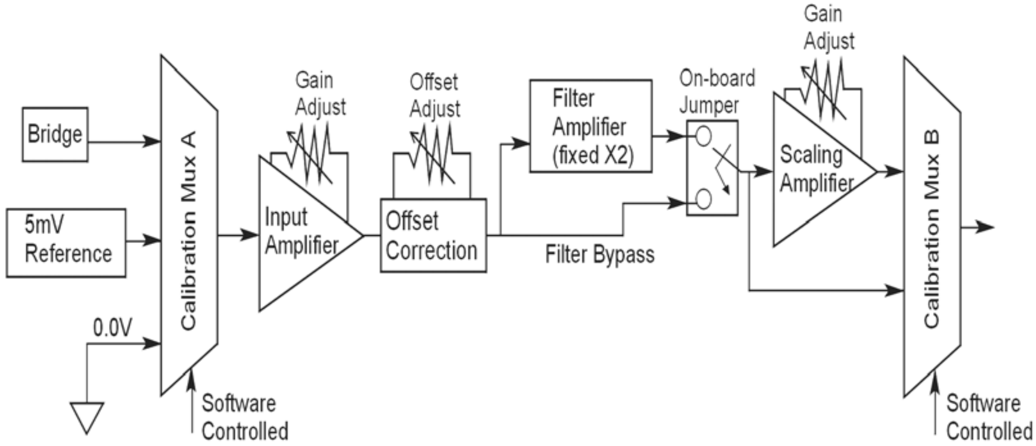
The trimpots provide course tuning so large quiescent offsets can be nulled and the bridge signal can be amplified to match the A/D input range. Once these adjustments are made, the operator can periodically fine-tune the calibration via software using LogView's 2-Point calibration feature. LogView's 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-FlowRelationship 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.

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

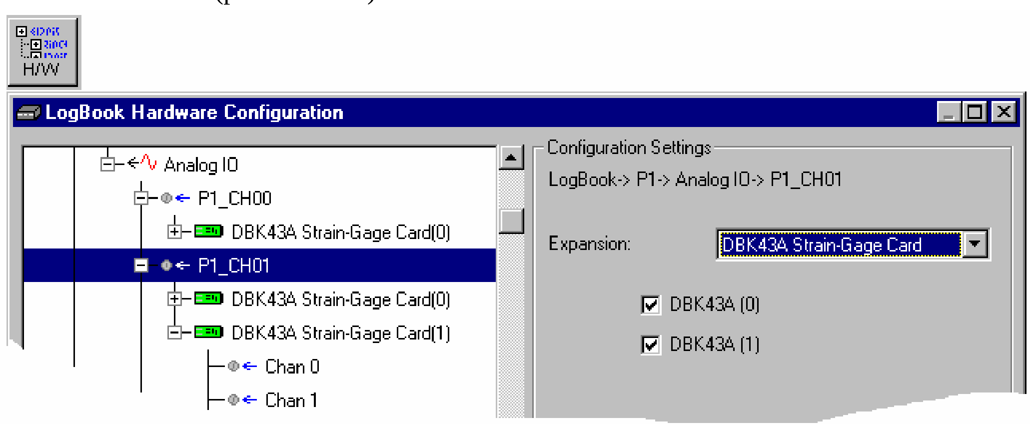
Since the applied calibration-signals are DC, set DC coupling for all the channels that are being adjusted. ***If your application requires AC coupling***, don't forget to remove the jumpers when the adjustment procedure has been completed.

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.

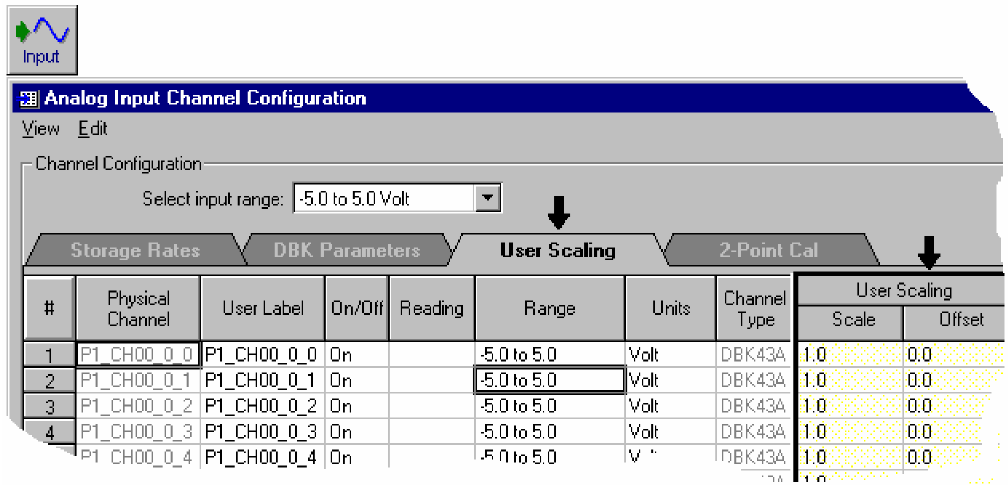
Initialize LogView

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 +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.

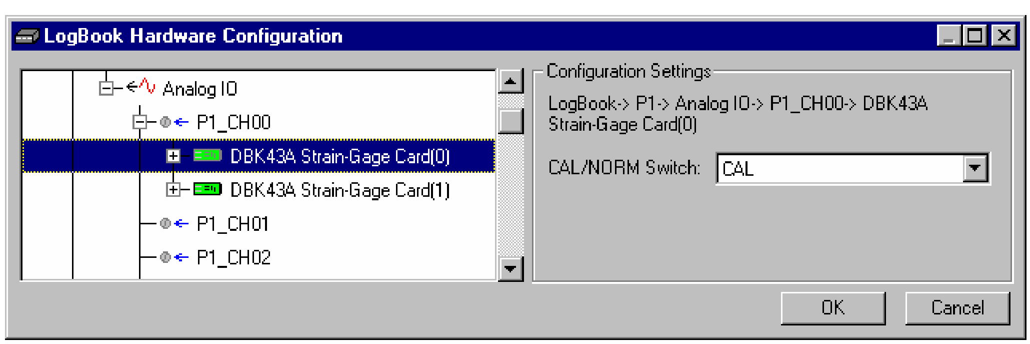
Adjust the Excitation - *DBK16*

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*

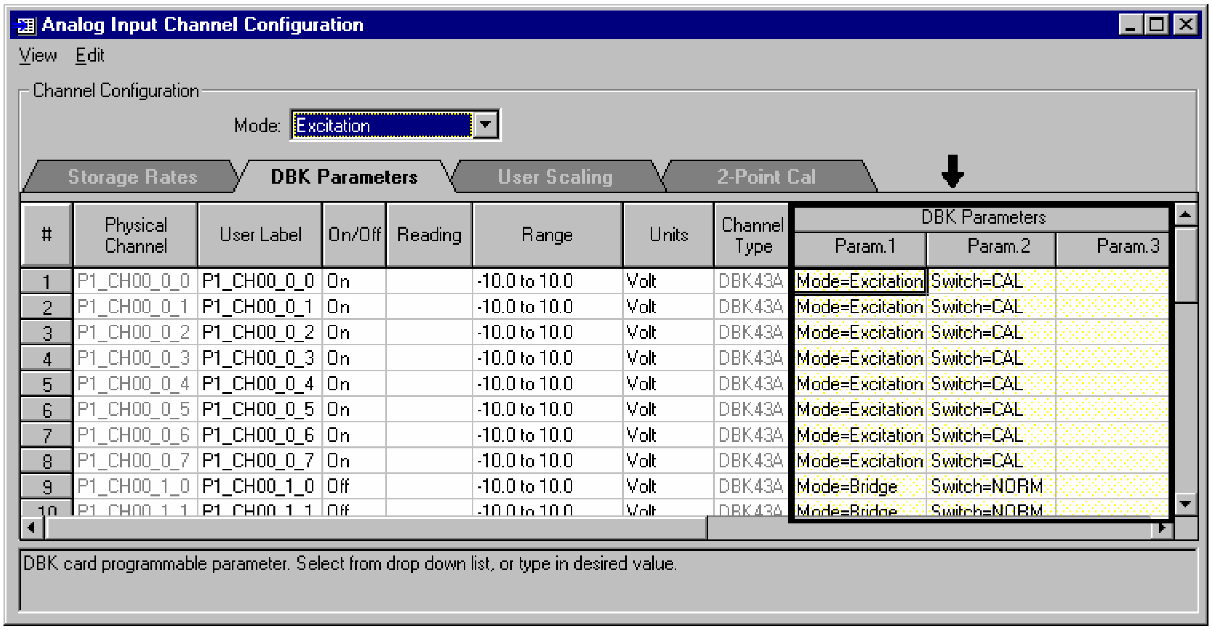
DBK43A is equipped with a switch that allows the excitation voltage to be read by the LogBook and displayed in LogView. For all DBK43A units to be adjusted, you must:

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"

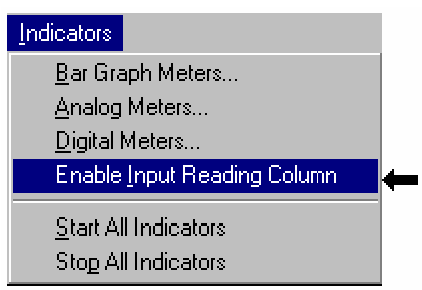
3. In the Param1 column (see next figure for location), select all of the DBK43A channels that are to be adjusted.
4. Set Mode equal to Excitation from the drop down list (located above the DBK Parameters tab).
5. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.



Selecting "Mode = Excitation" for DBK Parameter 1

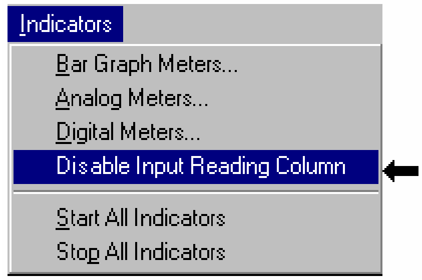
6. Click the Download button to send the current configuration to the LogBook.

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 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 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:

$\mathbf{V_{BR} = (V_{EXC} * G * S * B) / 4}$ [See following important notice.]

Where: $\mathbf{V_{BR}}$ = Bridge output voltage

$\mathbf{V_{EXC}}$ = 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, $\mathbf{V_{BR} = (V_{EXC} * G * S * B) / 4}$ 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.

$\mathbf{V_{BR} = (5 * 2.1 * 4000x10^{-6}) / 4 = 10.5\ mV}$

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.

$$\mathbf{V_{LC} = R * V_{EXC}}$$

Where: $\mathbf{V_{LC}}$ = Load cell output voltage

$\mathbf{R}$ = Load cell spec (mv/V)

$\mathbf{V_{EXC}}$ = 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.

$$\mathbf{V_{LC} = (10 * 2.05\times10^{-3}) = 20.5\ mV}$$

If 1000 pounds were applied, we would see 6.833 mV. This is arrived at as follows:

$$(1000/3000) * 10 * 2.05\times10^{-3} = 6.833\text{ mV}$$

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 $\underline{+}$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.

$$\mathbf{G = V_{LB} / (V_{GO} + V_{GO} * 5\%)}$$

Where: $\mathbf{G}$ = Gain

$\mathbf{V_{LB}}$ = LogBook input range

$\mathbf{V_{GO}}$ = Maximum gage output

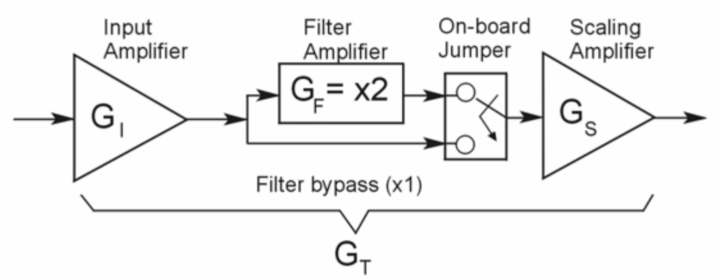
For the strain gage in the previous example with a maximum output of 10.5mV, the required gain is:

$$G = 5.0V / (0.0105V + 0.0105V * 0.05) = 453.5$$

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:

$$\mathbf{G_T = G_I * G_F * G_S}$$

Where: $\mathbf{G_T}$ = Total gain

$\mathbf{G_I}$ = Input amplifier gain

$\mathbf{G_F}$ = Filter gain

$\mathbf{G_S}$ = Scaling amplifier gain

Note: Maximum gain calibration is x1000 for $\underline{+}$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 ×100 to ×1250; the filter gain ×1 or ×2; and the scaling amplifier has a range of ×1 to ×10. For the strain gage example, if we round off our gain to ×420, any of these possible settings will work.

	Option A	**Option B**	**Option C**	**Option D**
Input Gain	×420	×100	×240	×300
Filter Gain (enabled)	No	Yes (×2)	Yes (×2) *See Note	No
Scaling Gain	×1	×2.1	×1.75	×1.4
Total Gain	×420	×420	×420	×420

For Option C, the LPF gain is typically x2.
For gains of x1 (if the filter is enabled), the following apply:

<u>DBK16</u> - For a gain of x1 (if the filter is enabled),10KΩ resistors R44 and R46 must have been previously removed (for the low and high channels, respectively).

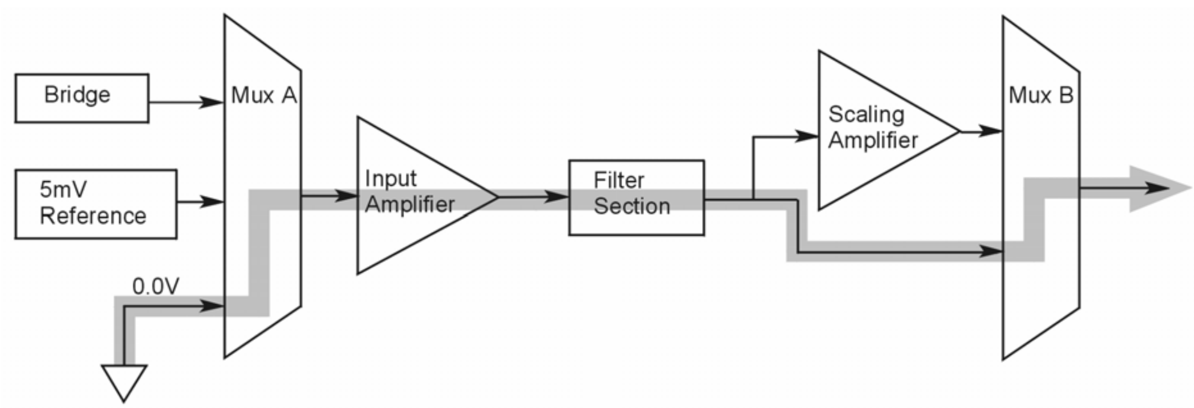
<u>DBK43A</u> - For a gain of x1 (if the channel filters are enabled), removal of the following 10 KΩ resistors applies: Ch0 – R144, Ch1 – R244, Ch3 – R444, Ch4 – R544,
Ch5 – R644, Ch6 – R744, Ch7 – R844.

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

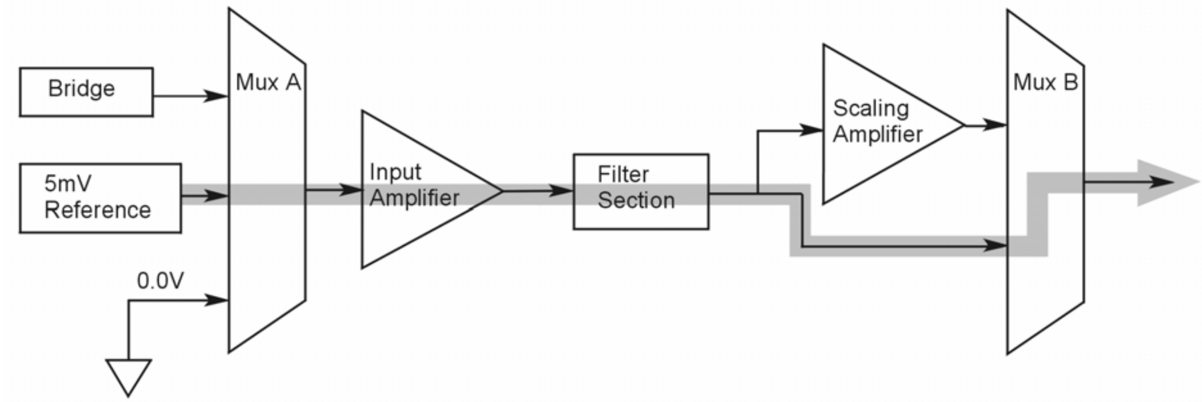
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button. This sends the current configuration to the LogBook.
5. Select Indictors \ Enable Input Reading Column from the menu bar. This displays the offset values for the enabled channels.
6. Set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET for the associated channel.
7. Select Indictors \ 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 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_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.

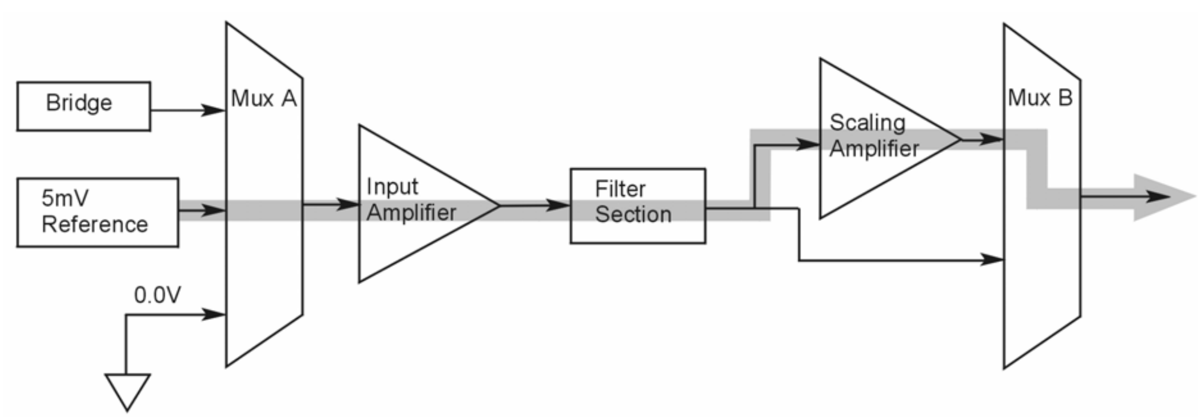
Example 1: If G_I = 250 and the filter is *disabled;* the GAIN trimpot would be adjusted to obtain 1.25V.
Example 2: If G_I = 250 and the filter is *enable;* the GAIN trimpot would be adjusted to obtain 2.50V.

7. Select Indictors \ 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.

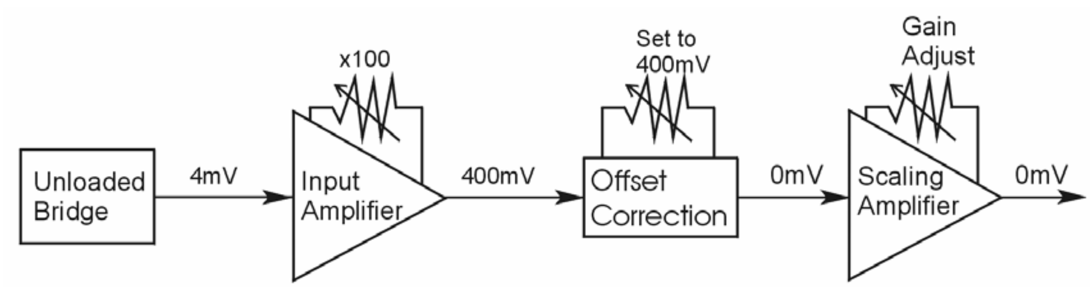
   Example: If G_T = 435.5, the SCALE trimpot would be adjusted to obtain 2.17 V.
7. Select Indictors \ Disable Input Reading Column from the menu bar.

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.

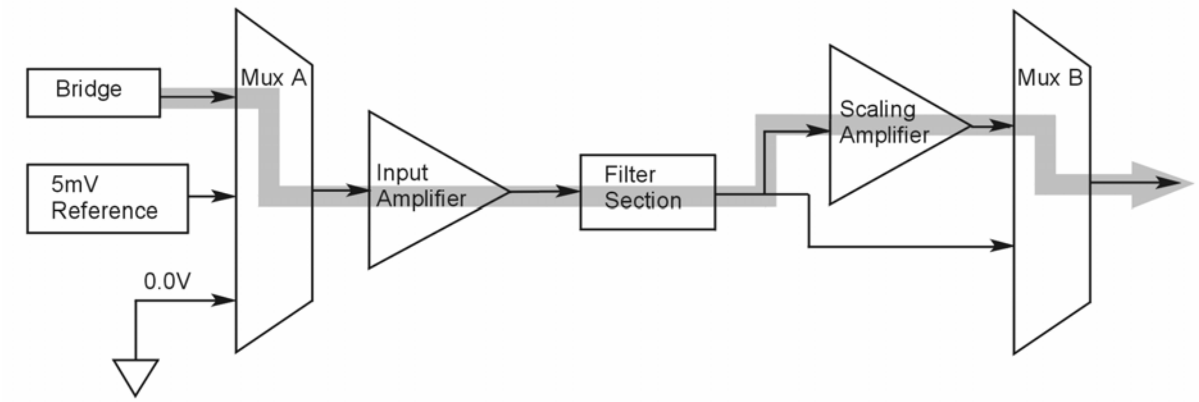


Trimming Bridge Quiescent Load

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:

$$\mathbf{V_D = (L_A/L_M) * V_I * 90\%}$$

Where: $\mathbf{V_D}$ = Desired voltage for 2nd point of calibration

$\mathbf{L_A}$ = Applied load used in calibrating the 2nd point

$\mathbf{L_M}$ = Maximum load expected during usage

$\mathbf{V_I}$ = 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 ±5V. The desired output voltage of the strain gage signal conditioning electronics is:

$$\mathbf{V_D = (100/150) * 5 * 0.90 = 3V}$$

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.

$$\mathbf{V_D = (150/150) * 5 * 0.90 = 4.5V}$$

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).

$$\mathbf{V_D = (L_s/L_M) * V_I * 90\%}$$

Where: $\mathbf{V_D}$ = Desired voltage from the after amplification when the shunt is applied

$\mathbf{L_s}$ = Simulated load produced by shunt

$\mathbf{L_M}$ = Maximum load expected during usage

$\mathbf{V_I}$ = 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:

$$\mathbf{V_D = (100/150) * 5 * 0.90 = 3V}$$

In this example, we would adjust the GAIN and SCALE trimpots until a value of 3V is measured.

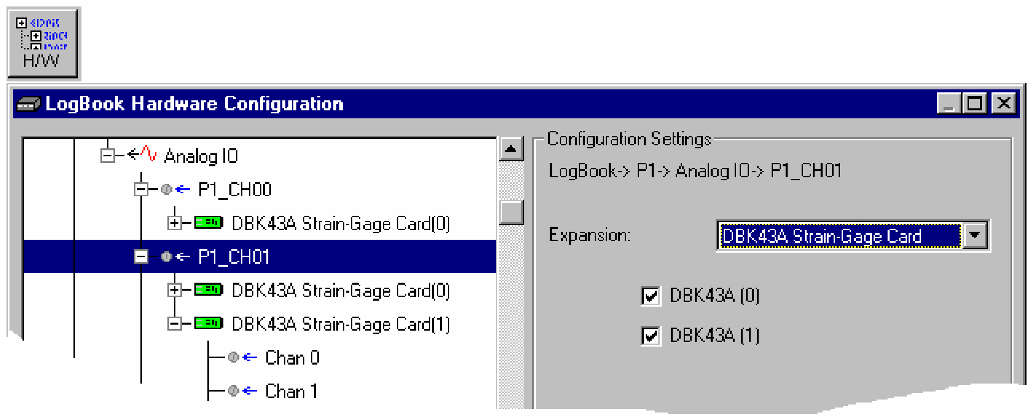
If 150lbs is applied to the gage, a voltage of 4.5V will be measured.

$$V_D = (150/150) * 5 * 0.90 = 4.5V$$

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.

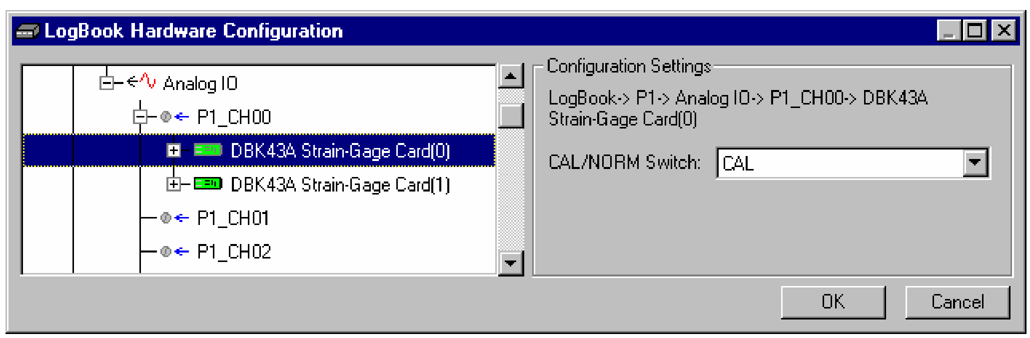
2. In LogView, open the *LogBook Hardware Configuration window* and select the DBK43A.



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 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.

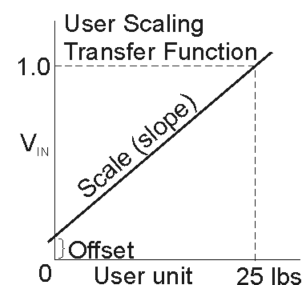
Storage | DBK Parameters | User Scaling | 2-Point Cal

#	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.

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: ×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 MΩ

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/°C

Gain Calibration Reference: 5 mVDC

Gain Calibration Reference Accuracy: 0.2%

Gain Calibration Reference Drift: 20 ppm/°C

Gain Accuracy: 0.5%

Gain Drift: 50 ppm/°C

Input Offset: 100 µV max

Offset Drift: 4 µV/°C

Output Offset: 20 µV

Offset Drift: 200 µV/°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: ×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 ×2

Power: 9 to 18 VDC, external supply provided, 16 Watts maximum

Notes

DBK44 — 2-Channel 5B Signal-Conditioning Card

Reference Notes:

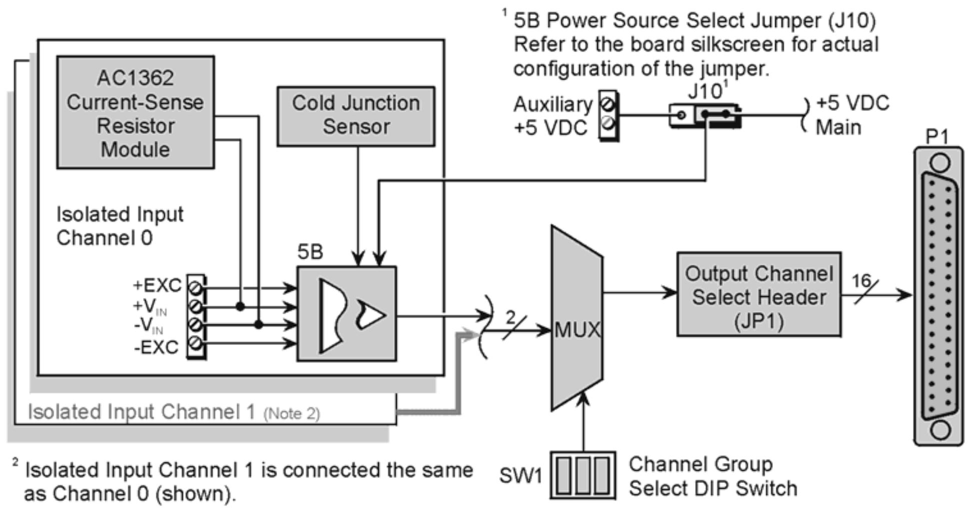
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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 µs/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).

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

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.

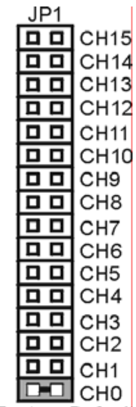
External power can be obtained from any regulated 5 V source or from a TR-4 power supply. External power attaches to the DBK44 via onboard screw-terminal connections (the Auxiliary Power Input J9 Combicon terminal at the rear of the board).

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).

CAUTION

Auxiliary power input must not exceed +5 VDC. DBK44 does not regulate auxiliary power input.

Card Configuration



Factory Default Channel 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.

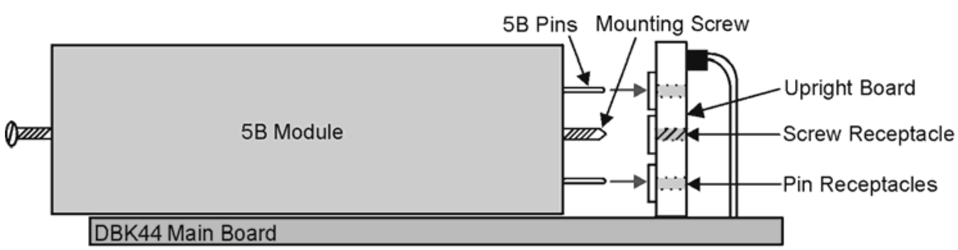
1. Locate the 16×2-pin header (labeled JP1) near the front of the card. Note the 16 jumper locations labeled CH0 through CH15 to match the main channel.
2. Place the JP1 jumper on the channel you wish to use. Only one jumper is used per card, but up to 8 DBK44s can occupy one main channel and use the 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 0 0 0	CBA 0 0 1	CBA 0 1 0	CBA 0 1 1	CBA 1 0 0	CBA 1 0 1	CBA 1 1 0	CBA 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.



5B Module Installation

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).

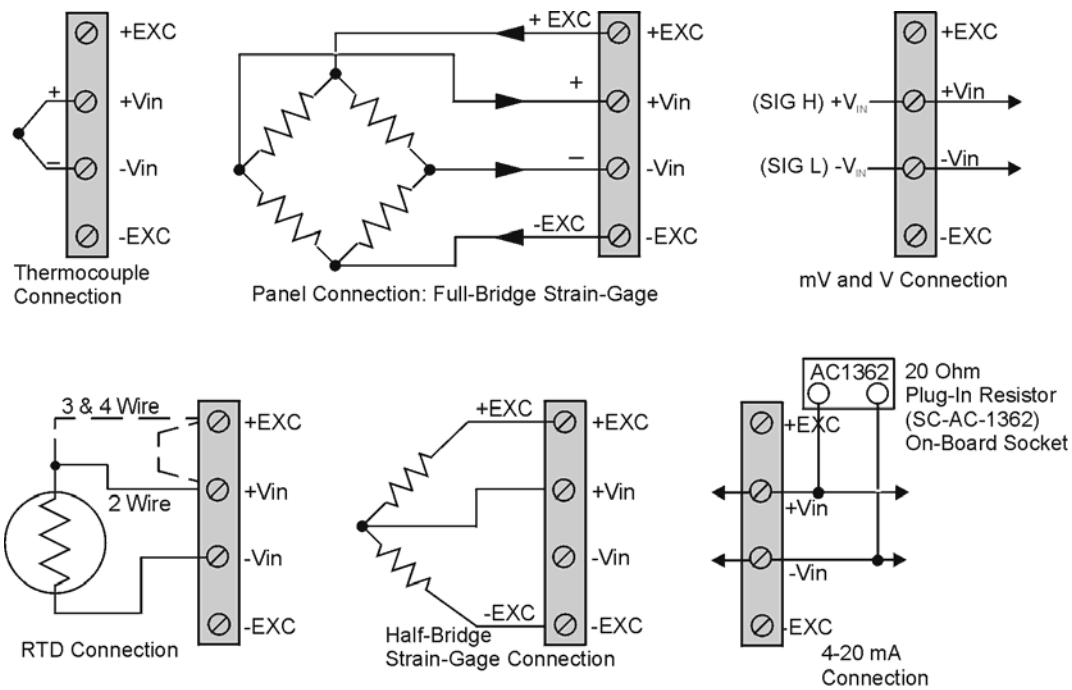
Install Current-Sense Resistor

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.



DBK44 Terminal Connections

P1 Connection

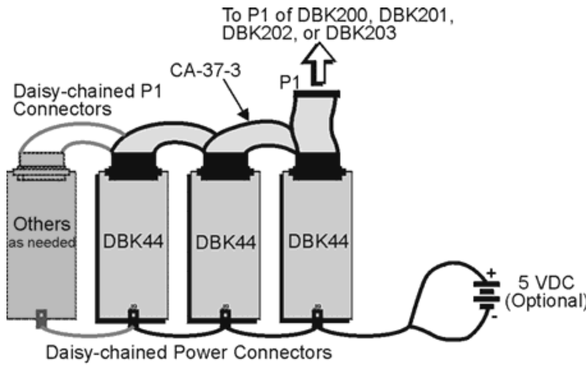
Reference Notes:
Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.

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.

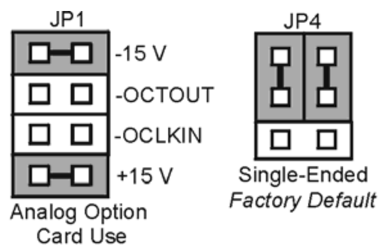
Note: Interface cables are available to connect up to 128 DBK44s.



Daisy-Chaining DBK44 Cards

CE Compliance

Reference Notes:
Should your data acquisition system need to comply with CE standards, refer to the *CE Compliance* section of the chapter *Signal Management*.



DaqBook/DaqBoard Jumpers for DBK44

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

The DBK44 requires two setup steps in DaqBooks/100 Series & /200 Series devices 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).

   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 *Power Requirements* in the *DBK Basics* section. Also refer to the DBK32A and DBK33 sections 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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for these 2000 series devices.

Software Setup

Reference Notes:

- ***DaqView* users** - Refer to chapter 3, *DBK Setup in DaqView*.
- ***LogView* users** - Refer to chapter 4, *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

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.

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

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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 four 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.

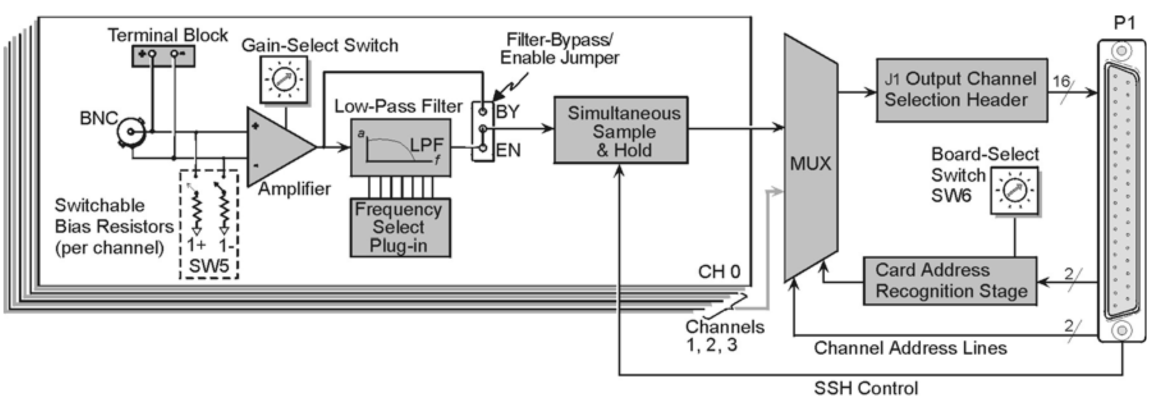
You should never set a DBK45 channel as the 1st channel in a scan due to timing of the SSH line.

For each of the four 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 four DBK45s to share a common analog input channel.

The DBK45 has an instrumentation amplifier for each channel, with switch-selected gains of ×1, ×10, ×100, ×200 and ×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 set to any value between unity and ×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 four DBK45s to share a common analog base channel.

Input can be connected to a channel's BNC or terminal block connector. The differential inputs are provided with switchable 100 kΩ 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 a BNC connector for each of the four differential analog inputs. The card includes terminal block connections, which can be used instead of the BNC connectors if desired.

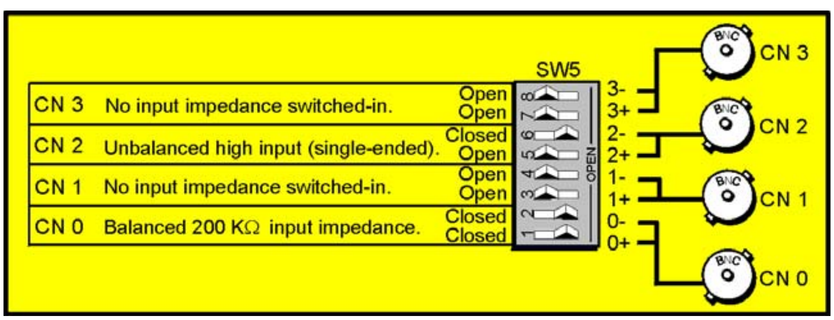
Card Configuration

Factory Defaults:

- **100K bias resistors – Enabled**
- **Low pass filter – Disabled (bypassed)**
- **Gain – x1**
- **SSH - Enabled**

Input Termination

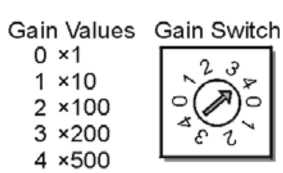
DBK45 provides two 100 KΩ bias resistors for each analog input. For balanced 200 KΩ input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The switches must be in the closed position to engage the termination resistors. For unbalanced 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 one gain-set switch. The switches are labeled GAIN 1, GAIN 2, GAIN3, and GAIN 4. Each channel also has holes in the board for gain resistors labeled RG1 to RG4. The 5 gain values for switch settings 0 to 4 are provided in the following figure. 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: $\mathbf{R_{GAIN} = [40{,}000 / (Gain - 1)] - 50\ \Omega}$



Setting Channel Gains

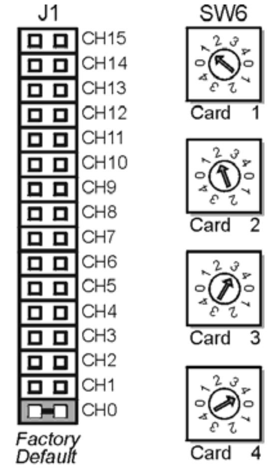
Address Configuration

Up to four DBK45s can be connected to each 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 (near 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.

Note: 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.

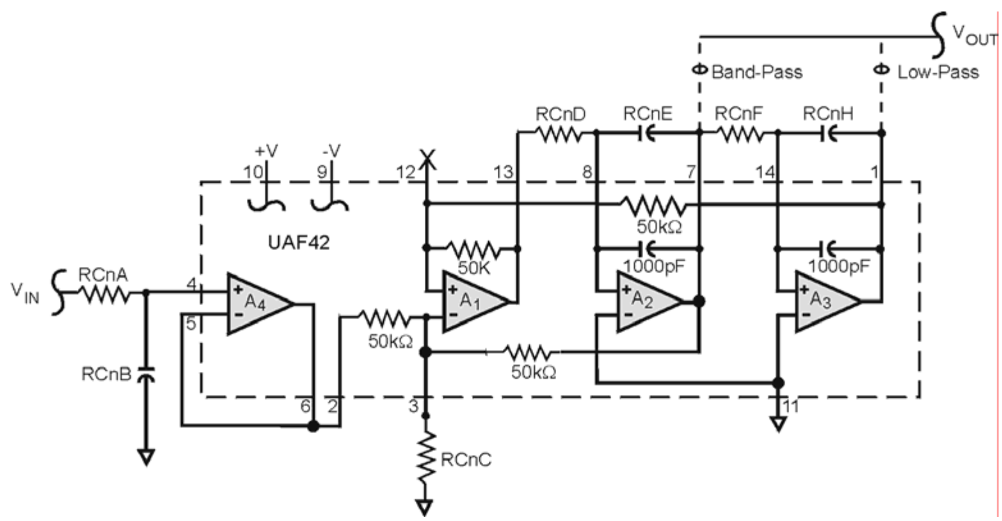


Address Configuration

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.

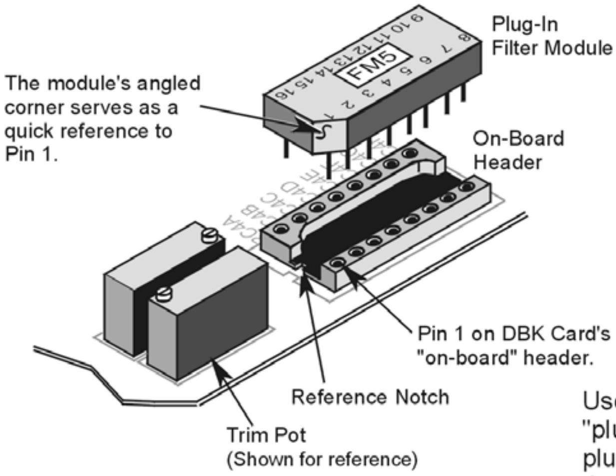
The following circuit diagram shows the active filter IC in a typical section of the DBK45. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is the channel number; and the 4th character corresponds to the socket position (A-H).

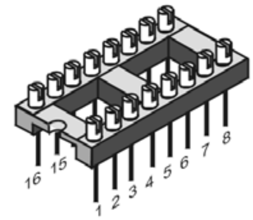


Filter Circuit Diagram

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.

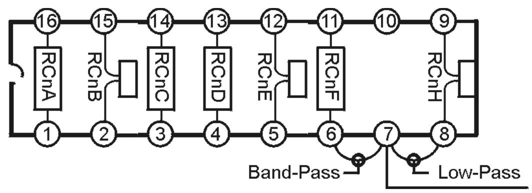
Users have a choice of using pre-configured "plug-in" filter modules; or using their own plug-in module (CN-115), that they can configure themselves by soldering components in place.

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

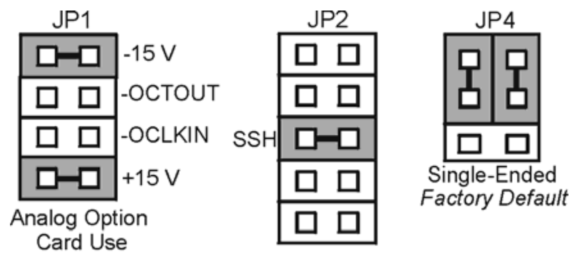
*These pre-configured Butterworth frequency modules are available from the manufacturer.

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/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of the DBK45 requires setting jumpers in **DaqBooks/100 Series & /200 Series devices** and **ISA-type DaqBoards.**

1. If not using auxiliary power, set the JP1 jumper for Analog Option Card Use (also referred to as Analog Expansion Mode).



Note:
These jumpers do not apply to /2000 Series devices.

Jumpers on DaqBook/100 Series, DaqBook/200 Series, and ISA-type DaqBoards

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. Refer to *Power Requirements* in the *DBK Basics* section and the DBK32A and DBK33 sections for more information, as applicable.

2. Place the JP2 jumper in the SSH position.

CAUTION

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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No hardware configuration is required for DaqBook/2000 Series or DaqBoard/2000 Series devices.

Software Setup

Reference Notes:
- ***DaqView* users -** Refer to chapter 3, *DBK Setup in DaqView*.
- ***LogView* users -** Refer to chapter 4, *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; 4 screw-terminal sets

Output Connector: DB37 male, mates with P1 using CA-37-x cable

Number of Cards Addressable: 64

Dimensions: 8.25” × 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_{GAIN} = [40,000/(Gain-1)] - 80 Ω

Input Amplifier Slew Rate: 12 V/µs minimum

Acquisition Time:
- 0.6 µs (10 V excursion to 0.1%)
- 0.7 µs (10 V excursion to 0.01%)

Channel-to-Channel Aperture Uncertainty: 50 ns

Output Droop Rate: 0.1 µV/µs

Input Gains: ×1, ×10, ×100, ×200, x500, and user-set up to ×500

Input Offset Voltage: 500 µV + 5000/G maximum (nullable)

Input Offset Drift: ±5 + 100/G µV/°C maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

Input Impedance: 5×10^{12} Ω parallel with 6 pF

Switchable Bias Resistors: 100 KΩ each to analog common

Gain Errors:
- 0.04% @ ×1
- 0.1% @ ×10
- 0.2% @ ×100
- 0.4% @ ×200
- 1.0% @ ×500

Temperature vs Gain:
- ±20 ppm/°C @ ×1
- ±20 ppm/°C @ ×10
- ±40 ppm/°C @ ×100
- ±60 ppm/°C @ ×200
- ±100 ppm/°C @ ×500

Non-Linearity:
- ±0.015 % full-scale @ ×1
- ±0.015 % full-scale @ ×10
- ±0.025 % full-scale @ ×100
- ±0.025 % full-scale @ ×200
- ±0.045 % full-scale @ ×500

Common-Mode Rejection:
- 70 dB minimum @ ×1
- 87 dB minimum @ ×10
- 100 dB minimum @ ×100
- 100 dB minimum @ ×200
- 100 dB minimum @ ×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.

For use with: **DaqBook/2000A**
DaqBook/2000E
DaqBook/2000X
WBK41

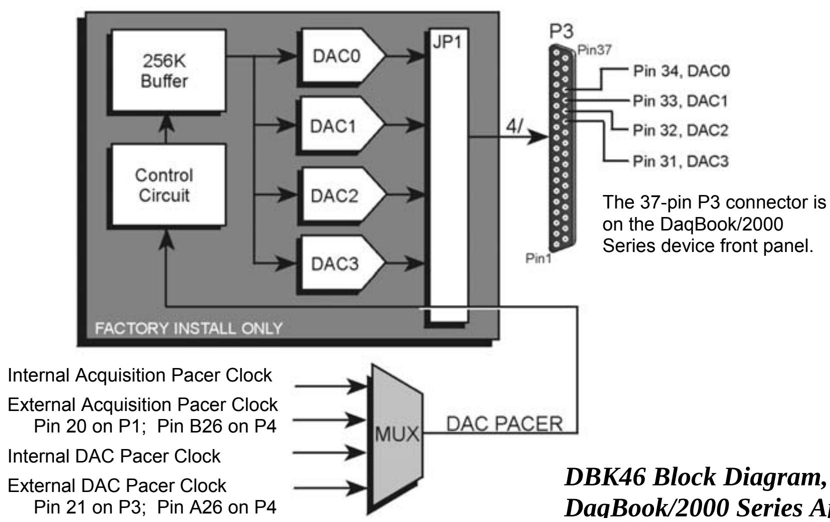
Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- The P3 connector's DAC related pins [31, 32, 33, and 34] apply to the DaqBook/2000 Series Device only when a DBK46 is installed. For WBK41, DAC related connections are made via a front panel screw terminal block.

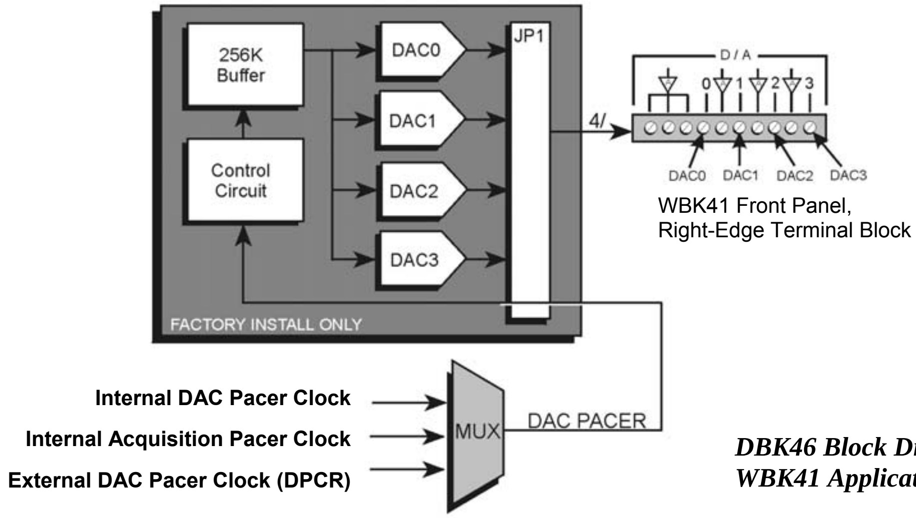
Overview

The DBK46 is a factory-installed option currently available for DaqBook/2000A, DaqBook/2000E, DaqBook/2000X, and WBK41. JP1 plugs into a 40-pin header on the primary acquisition device. Analog DAC Output is then available, as follows:

- For DaqBook/2000 Series devices, from the device's P3 connector.
- For WBK41, from a front panel terminal block.



DBK46 Block Diagram, DaqBook/2000 Series Applications



DBK46 Block Diagram, WBK41 Application

The DBK46 has a 256K sample buffer that can be used for one to four DACs. If only one DAC is enabled for waveform output, then the entire 256K sample memory can be used to store a waveform for that DAC. If two DACs are enabled for waveform output, then 128K of sample memory is available for each of the two DACs. Use of all four DACs drops the available memory down to 64K per DAC.

Software loads the waveform(s) into all, or a portion of, the 256K sample buffer. The waveform data drives the DACs at the rate of the specified DAC Pacer Clock. The waveforms will repeat until the DACs are disabled by software.

The DBK46 provides an output range of -10V to +10V. The card's 256 Kbyte of sample buffer memory can store waveforms from the PC.

When used to generate waveforms for a <u>DaqBook/2000 Series device</u>, each DAC can be independently clocked in one of four modes. These are:

- **Internal DAC Pacer Clock -** The on-board programmable clock can generate updates ranging from 1.5 Hz to 100 kHz, independent of any acquisition rate.
- **Internal Acquisition Pacer Clock -** Using the on-board programmable clock, the analog output *rate of update* can be synchronized to the acquisition rate derived from 100 kHz to once every 5.96 hours.
- **External DAC Pacer Clock -** A user-supplied external input clock can be used to pace the DAC, entirely independent of other analog inputs.
- **External Acquisition Pacer Clock -** A user-supplied external input clock can simultaneously pace the DAC and the analog input.

When used to generate waveforms in a <u>WBK41</u>, the DACs can be clocked in one of three modes. These are:

- **Internal DAC Pacer Clock -** The WBK41 programmable clock can generate updates ranging from 1.5 Hz to 100 kHz, independent of any acquisition rate.
- **Internal Acquisition Pacer Clock –** By using the WBK41 programmable clock, the analog output *rate of update* can be synchronized to the acquisition rate derived from 100 kHz to once every 5.96 hours.
- **External DAC Pacer Clock (DPCR) -** A user-supplied external input clock can be used to pace the DAC, entirely independent of other analog inputs. This external clock input connects to the DPCR connector, located on the Counter/Timer Terminal Block.

Hardware Setup

DBK46 is installed at the factory. To verify that a DBK46 is installed, simply check the acquisition software's Analog Output Window for the presence of DAC0, DAC1, DAC2, and DAC3.

Software Setup

DBK46 does not require setup in software.

Reference Notes:

- **DaqView Users**: In regard to the *out-of-the-box* software and analog output channels, refer to the *DaqView and DaqViewXL* Document Module, especially the following two sections: *Analog Output Window*, and *Waveform and Digital Pattern Output Window.*
- **WaveView Users**: In regard to the *out-of-the-box* software, refer to the *WaveView* Document Module.
- PDF versions of the documents are included on the data acquisition CD and can be accessed via the **<View PDFs>** button, which is located on the CD's intro-screen.

DBK46 – Specifications

The four analog output channels are updated synchronously relative to scanned inputs, and are clocked from either an internal clock on the primary acquisition device, such as a DaqBook/2000A; or from a user-supplied external clock source. Analog outputs can also be updated asynchronously, independent of any other scanning in the system.

Channels: 4

Resolution: 16 bits

Data Buffer: 256 K sample FIFO

Output Voltage Range: ±10V

Output Current: ±10 mA

Offset Error: ±0.0045V max

Gain Error: ±0.01%

Update Rate: 100 kHz max, 1.5 Hz min (no minimum with external clock)

Settling Time: 10 μsec max to 1 LSB for full-scale step

Digital Feed-thru: a spike of up to 50 mV may occur on the DAC output each time the DAC output is updated

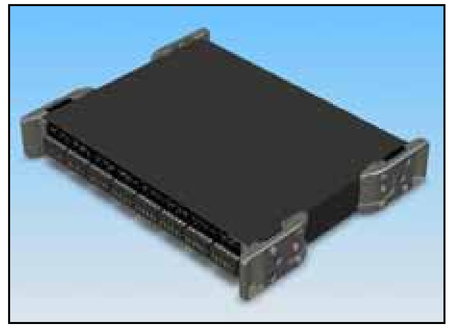
Clock Sources: 4 programmable clock sources:

- The primary acquisition device's *onboard* **D/A input clock**, independent of the scanning input clock
- The primary acquisition device's *onboard* **scanning input clock**
- An *external* **D/A input clock**, independent of an external scanning input clock
- An *external* **scanning input clock**

Note: Specifications are subject to change without notice.

DBK48 Multipurpose Isolated Signal-Conditioning Module

Supports up to Sixteen 8B Modules

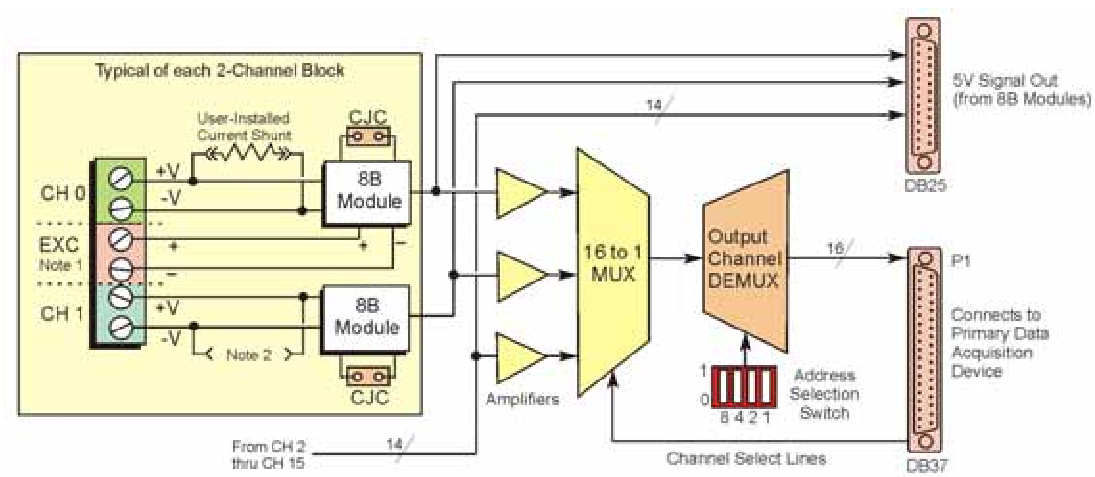


Description

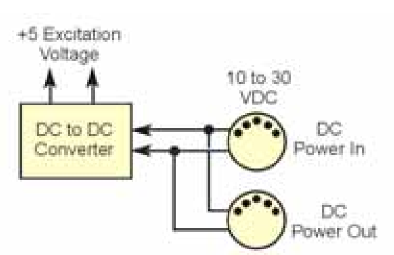
The DBK48 module can accommodate up to sixteen 8B isolated-input signal-conditioning modules for use with Daq systems. A single cable connects the DBK48 output to the P1 analog input connector on the primary device. One Daq system can support up to 16 DBK48 modules, providing a total of 256 isolated analog input channels. The A/D converter scans the DBK48 channels at the same 5 µs/channel rate that it scans all other channels from DBK series analog expansion and signal conditioning cards.

Other features of DBK48 include:

- Built-in power supply that operates from 10 to 30 VDC and can power a full complement of 8B modules (even with bridge excitation).
- Removable, plug-in screw-terminal blocks for convenient connection of 8B modules.
- On-board cold-junction sensing for thermocouple 8B modules.
- For each 8B module, 250 V isolation from the system and from other channels.



Note 1: Only channels 0, 2, 4, 6, 8, 10, 12, and 14 can be connected to excitation. For example, in the above block diagram Channel 0 could be connected to Excitation; Channel 1 could not.



Note 2: Each channel can accept a plug-in resistor to serve as a current shunt. In the above diagram, Channel 0 has a current shunt installed, Channel 1 does not. Only current-input type modules require the plug-in resistors. The plug-in resistors must be removed for all other module types.

Safety Concerns

WARNING

Shock Hazard! Voltages above 50 Vrms AC and voltages above 100 VDC are considered hazardous. Safety precautions are required when 8B modules are used in situations that require high-voltage isolation from the rest of the system. Failure to practice electrical safety precautions could lead to injury or death.

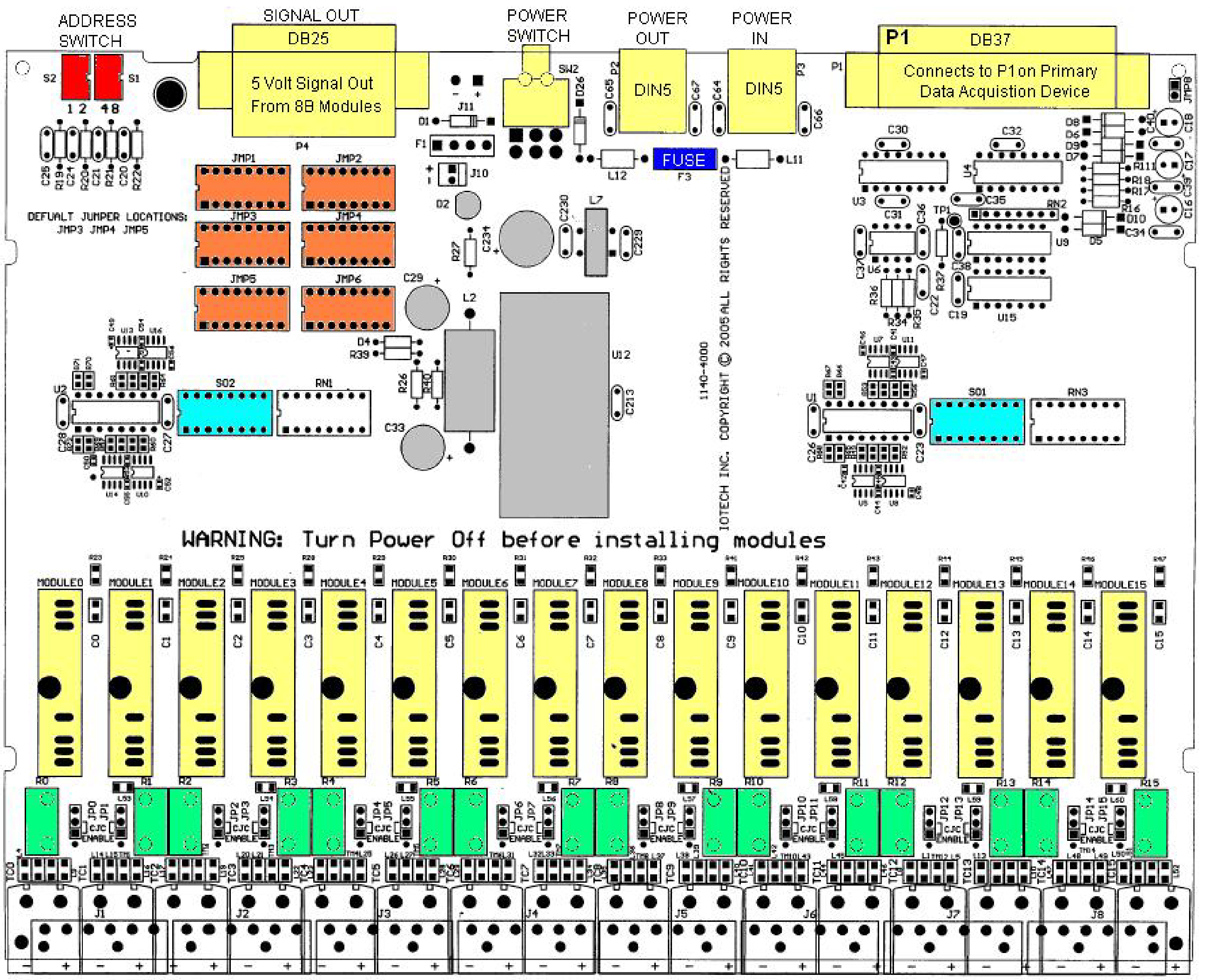
DBK48 has a 250 VDC isolation specification. This is in a normal environment free of conductive pollutants and condensation. The 250 VDC rating requires a proper earth ground connection to the chassis and treatment of adjacent inputs as potentially hazardous.

Input cables must be rated for the isolation potential in use. Line voltage ratings are much lower than the DC isolation values specified due to transients that occur on power lines. Never remove the cover unless all inputs with potentially hazardous voltages are removed. The cover must be securely screwed on during use.

Some things to remember:

- **Properly tighten all chassis screws before system use.**
- **Never plug in or unplug potentially hazardous connections with power applied to any connected equipment.**
- **Never attempt to change 8B modules or remove the cover plate while power is applied to the DBK48. You could short out internally exposed circuits and cause personal injury or equipment damage.**
- **Disconnect power, all equipment, and signal lines from the DBK48 prior to installing 8B modules.**

Reference Note:
Refer to user manual that is associated with your primary Daq device.



DBK48 Circuit Board Layout

Installing 8B Modules

WARNING

Electric shock hazard! Turn off power to the DBK48 and all connected modules and devices before inserting or removing modules. Failure to do so could lead to injury or death due to electric shock.

CAUTION

Handle the 8B module carefully while inserting pins into the circuit board. Do not over-tighten the mounting screw.

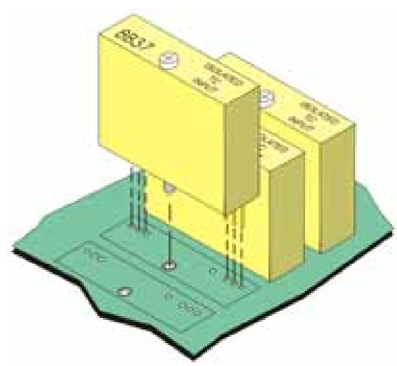
CAUTION

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.

If the DBK48 is not connected to a Daq device via the P1 connector, then remove the Rnets from S01 and S02. These resistor networks connect each 8B module's output to the multiplexer for P1.

Up to sixteen 8B modules can be installed onto the DBK48 circuit board. The preceding figure indicates module locations.

To install 8B modules:



1. **Turn off power to the DBK48 and all connected modules and devices**.
2. **Disconnect power, all equipment, and signal lines from the DBK48 prior to installing 8B modules. Be aware that isolated measurements can present lethal voltages!**
3. Remove the DBK48 top cover plate and set aside.
4. Align the 8B module's retaining screw and pins with the holes in the circuit board (see figure).
5. Gently press the module into place.
6. Tighten the retaining screw snug, but DO NOT OVERTIGHTEN.
7. Repeat steps 3, 4, and 5 for each additional module.
8. Return and secure the cover plate to the unit.

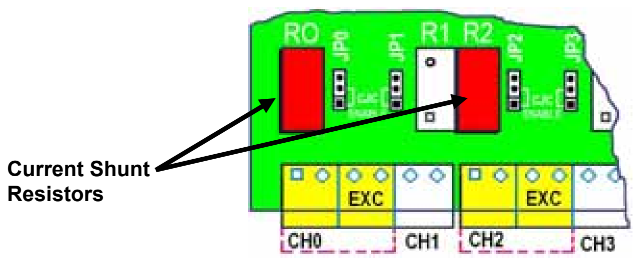
Installing Plug-in Resistors to Create 4 to 20 mA Loops

WARNING

Electric shock hazard! Turn off power to the DBK48 and all connected modules and devices before inserting or removing resistors. Failure to do so could lead to injury or death due to electric shock.

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.



Location of Current Shunt Resistor Plug-In
Shown with resistors plugged-in for Channel 0 (at R0) and Channel 2 (at R2)

Only current-input type modules require the plug-in resistors.
The plug-in resistors must be removed for all other module types.

Inputs to monitor the commonly used 4 to 20mA current loops most often employ a 250Ω precision resistor to develop a 1 to 5 VDC voltage drop.

Ideally, a resistor for such purpose should have a 0.1% tolerance (or better) with a minimum power rating of 0.25W and a temperature coefficient of at least 25ppm/°C.

Lower values of resistance, for example, 62.5Ω [for a lower voltage drop within the loop of 0.25 to 1.25 VDC] will require that the host data acquisition device use a gain of x4 to maximize the signal resolution.

To create a 4 to 20mA current loop:

1. **Turn off power to the DBK48 and all connected modules and devices.**
2. **Disconnect power, all equipment, and signal lines from the DBK48 prior to installing the resistors. Be aware that isolated measurements can present lethal voltages!**
3. Remove the DBK48 top cover plate and set aside.
4. Carefully plug the Current Shunt Resistor into the applicable plug-in location for the designated channel; for example, **R0** for Channel 0, **R1** for Channel 1, **R2** for Channel 2, etc. Repeat for each channel as applicable.

   DO NOT solder the Current Plug-In Resistors in place. Only current-input type modules require these resistors. The plug-in resistors must be removed for all other module types.

5. Reinstall the DBK48 top cover plate and secure in place.

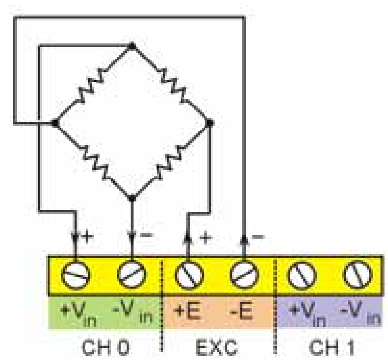
Making Terminal Block Connections

Input signals (and excitation when applicable) are wired to removable terminal blocks. Eight such blocks can accept 2 channel inputs each. However, only channels 0, 2, 4, 6, 8, 10, 12, and 14 can be connected to excitation. Thus the DBK48 is limited to 8 strain gages or 8 RTDs as only the even numbered channels can be connected to excitation.

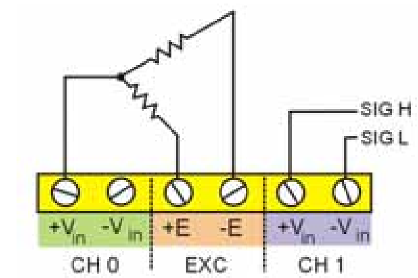
Each terminal block connects to a signal conditioning module within the DBK48. The blocks accept up to 14-gage wire into quick-connect screw terminals. Wiring schematics are provided below for RTDs, thermocouples, 20 mA circuits, voltage (mV and V), and for full-bridge and half-bridge strain gages.

WARNING

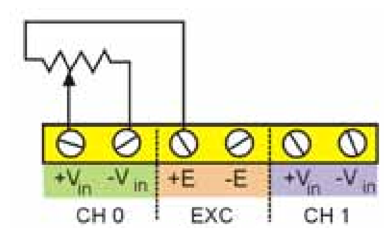
Shock Hazard! The DBK48 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK48 before changing the wiring or configuration.



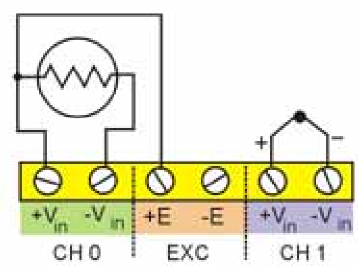
CH 0 is connected to a Full-Bridge Strain Gage.
CH 1 is shown not connected.



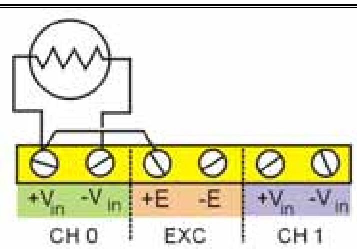
CH 0 is connected to a Half-Bridge Strain Gage.
CH 1 is connected for voltage input (mV or V).



CH 0 has a 3-wire connection to a potentiometer.
CH 1 is shown not connected.

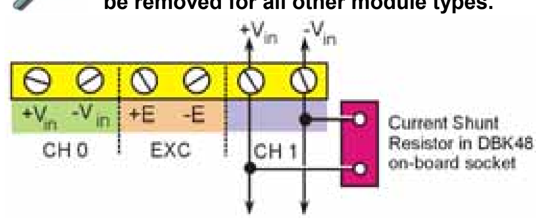


CH 0 has a 3-wire connection to an RTD.
CH 1 is connected to a Thermocouple.



CH 0 has a 2-wire connection to an RTD.
CH 1 is shown not connected.

Note: Only current-input type modules require the plug-in resistors. The plug-in resistors must be removed for all other module types.



CH 0 is shown not connected.
CH 1 is connected to a current shunt resistor resulting in a 4 to 20 mA current loop.

Setting DBK48 Module Addresses

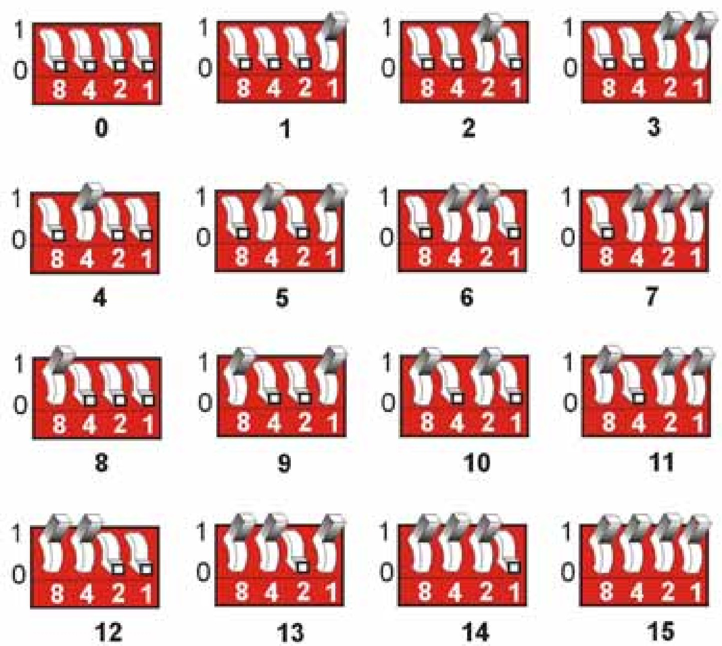
Up to sixteen DBK48 modules can be attached to a single LogBook or Daq device. Each DBK48 module must have a unique channel address because they connect to the primary data acquisition device via parallel interface.

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 DBK48 module, first locate the DIP switch on the right side of the rear panel. 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 16 possible addresses are illustrated in the following figure.

Each module in the system must have a unique primary device channel address.



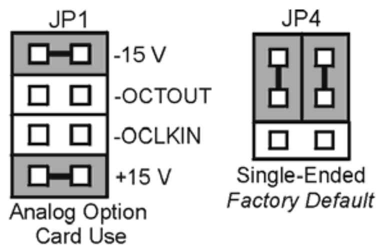
The 16 Possible Address Settings for DBK48 Modules

Configuring the Primary Data Acquisition Device

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK48 with a DaqBook/100 Series, /200 Series devices, or with an ISA-type DaqBoard requires the configuration of jumpers JP1 and JP4**. These jumpers are located on the DaqBook/100 Series, /200 Series devices, and DaqBoard [ISA type] board**.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



Note:
These jumpers do not apply to /2000 Series Devices.

Required Jumper Settings in DaqBook/100 Series & /200 Series and ISA-Type DaqBoards

The JP1 default position (above) is necessary to power the interface circuitry of the DBK48 via the internal ±15 VDC power supply. If using auxiliary power (e.g., DBK32A or DBK33) you must remove both JP1 jumpers.
For additional information refer to *Power Requirements* in the *DBK Basics* section and to the DBK32A and DBK33 sections, as applicable.

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

DaqBook/2000 Series, DaqBoard/2000 Series, DaqLab, and DaqScan

No jumper configurations are required on these Daq devices in regard to connecting a DBK48.

LogBooks

No jumper configurations are required on LogBook devices in regard to connecting a DBK48.

CE Compliance

If your data acquisition system needs to comply with CE standards, the DBK48 must be connected to the LogBook or Daq device by a CA-143-x cable. In addition, the CE compliant operating conditions must be met as specified on the DBK48 module's *Declaration of Conformity* card, which is shipped with the module.

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

- the DBK48 *Declaration of Conformity*
- the *CE Compliance* section of *Signal Management* chapter of this manual

Connecting the DBK48 to the Primary Data Acquisition Device

Connect the DBK48 module as follows. Note that if your system needs to be CE Compliant, be sure to read the preceding *CE Compliance* section prior to connecting the DBK48.

1. For a single DBK48 module, connect one end of the P1 cable to the module's male DB37 output connector.
    - For DaqBook applications - use a CA-37-x cable or a CA-255-xT cable.*
    - For DaqBoard/2000 Series or /2000c Series boards - use a CA-37-x with a DBK200 Series adapter.*
    - For DaqBoard [ISA type] boards - use a CA-131-x cable.*

    * CA-37-x and CA-131-x cables do not meet CE compliance requirements. Refer to the preceding CE section if CE compliance must be met.

2. Connect the free end of the cable to the P1 port of the LogBook or Daq device. For multiple DBK48 modules, use a CA-37-x (or CA-131-x) cable to daisy-chain several modules or an expansion module. For example, three DBK48 modules could be connected to a LogBook or a Daq device via a CA-37-3 cable.

Note: For longer cable runs you can use a CA-113 cable to add 6 ft of length.

Using the DB25 Signal Output Connector

Important Notes Regarding the Signal Output Connector

The signal output connector on the rear panel of the DBK48 can be used to directly measure the output voltage of each 8B module. This applies to *input-type* modules, i.e., volts, millivolts, thermocouple, potentiometer, frequency, strain gage, RTD, etc.

DBK48 Rear Panel

The signal output connector can also be used with *output-type* 8B modules, e.g., current output and voltage output. In this case a voltage is applied to the signal output connector. This voltage is converted to an isolated current or isolated voltage by the 8B module which is installed in that channel. The isolated current or voltage is available on the front panel terminal block.

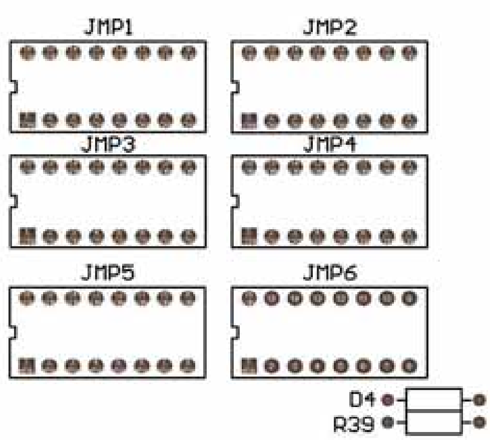
Be careful when mixing 8B input modules and 8B output modules.
If possible, do not mix 8B input modules and 8B output modules within the same DBK48.

When applying voltages to the rear panel signal output connector [for 8B output-modules] it can be easy to short to an adjacent pin on the 25 pin DSUB connector. If there is an 8B input-module on that channel, damage may occur to that 8B module.

If a voltage source is being applied to a front panel terminal block for an 8B input-type module and there is an 8B output-type module mistakenly installed in that channel, damage to the 8B output module may occur.

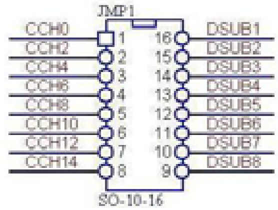
Configuring the SIGNAL OUTPUT

The signal output connector on the rear panel of the DBK48 can be configured in one of two ways via jumper networks that are placed in sockets JMP1, 2, 3, 4, 5, and 6.

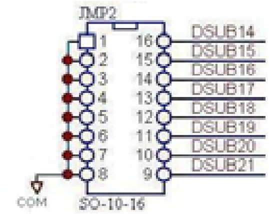


Signal Output Configuration Jumpers
as Oriented on PCB

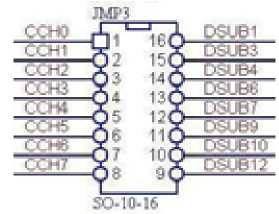
Jumper Assignments



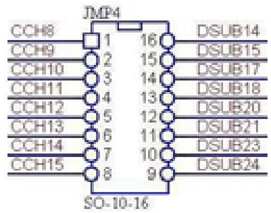
JMP1



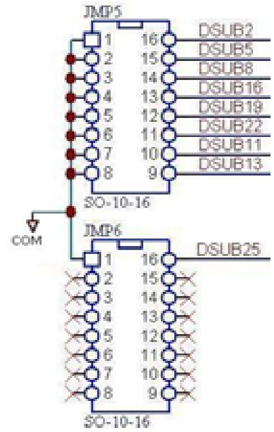
JMP2



JMP3



JMP4



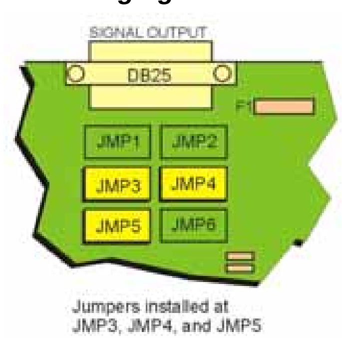
JMP5 and JMP6

For JMP1 through JMP6:

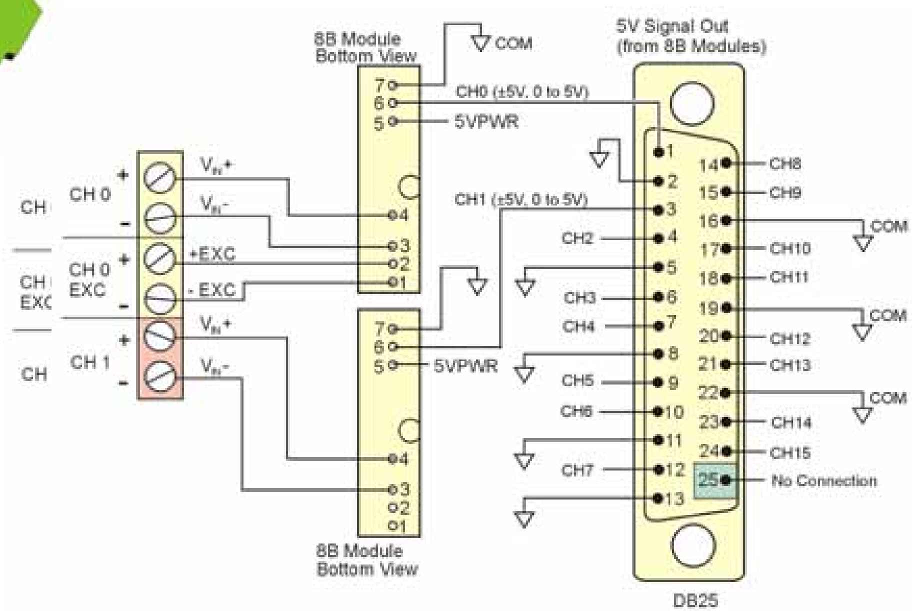
CCHx = Single-ended I/O channel of 8B Module.

DSUBx = Pin x of the DB25 Signal Output connector.

Bringing all Sixteen 8B Module Outputs to the DB25 Signal Output Connector



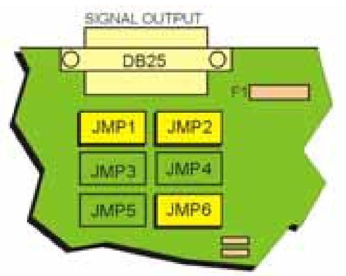
With three CA-19-8 jumper networks installed [one per socket] in **JMP3**, **JMP4**, and **JMP5** the signal output connector is pinned out as shown in the following figure. This brings the outputs of all sixteen 8B modules to the 25-pin DSUB Signal Output connector on the rear panel.



DB25 SIGNAL OUTPUT Pinout with JMP3, JMP4, JMP5 Installed

This configuration brings all 16 channel outputs to the DB25 Signal Output Connector.

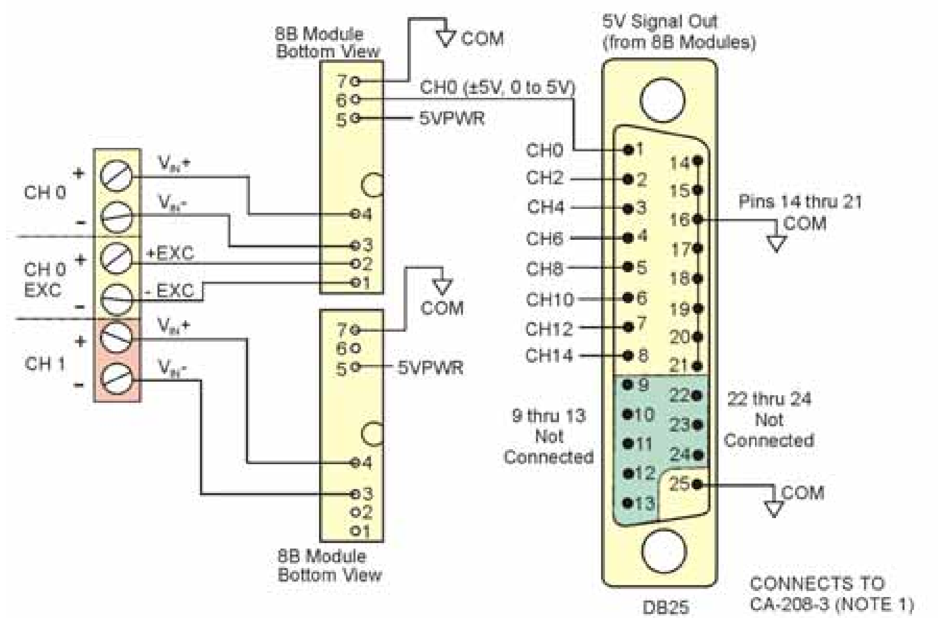
Bringing Eight 8B Module Outputs to the DB25 Signal Output Connector



Jumpers installed at JMP1, JMP2, and JMP6

With 3 jumper networks installed [one per socket] in **JMP1**, **JMP2**, and **JMP6** the signal output connector is pinned out as shown in the following figure. **This only brings the outputs of eight of the 8B modules, i.e., Ch 0, 2, 4, 6, 8, 10, 12, and 14**.

When the Signal Output connector is pinned-out in this manner it can be used with a CA-208-3 cable to bring the 8 channels out to the cable's BNC connectors for easy connection to other measuring equipment.

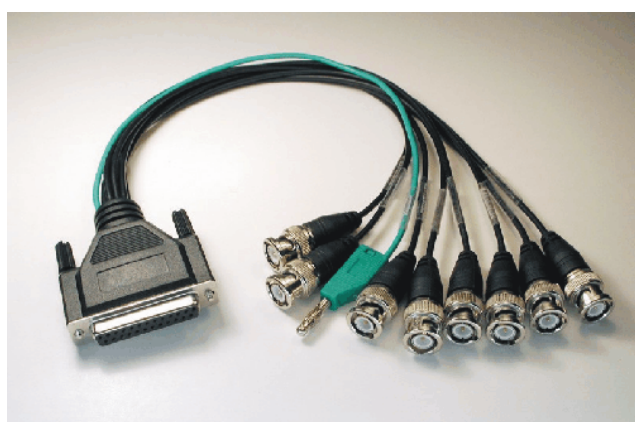


DB25 SIGNAL OUTPUT Pinout with JMP1, JMP2, JMP6 Installed
This configuration brings channel 0, 2, 4, 6, 8, 10, 12 and 14 outputs to the DB25 Signal Output Connector.

If the DBK48 is not connected to a Daq device via the P1 connector, then remove the Rnets from S01 and S02. These resistor networks connect each 8B module's output to the multiplexer for P1.

Use the CA-208-3 cable as follows:

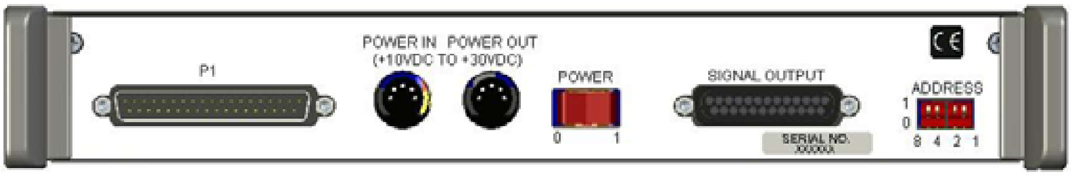
1. Connect the DB25-end of the CA-208-3 cable directly to DBK48's 25-pin Signal Output connector.
2. Connect the CA-208-3 analog common banana plug to the local ground of the measuring equipment.
3. Connect the CA-208-3 BNC connectors (for channels 1 through 8) to the measuring equipment.



Note 1: CA-208-3 connects directly to the signal output connector. However, another cable, which looks virtually the same, is the CA-208 (with no"-3" extension). If you are using a CA-208 you must first connect a CA-35-18 cable to the DB25 connector on the DBK48; then connect the CA-208 to the CA-35-18 cable. For CA-208 users, a wiring diagram is provided immediately following the DBK48 specifications section.

Powering the System

The DBK48 contains an internal power supply. The unit can be powered by an AC power adapter or any 10 to 30 VDC source, such as a 12 V car battery. For portable or field applications, DBK48 and the primary Daq device can be powered by a DBK30A rechargeable battery module or DBK34 vehicle UPS module. The supply input is fully isolated from the measurement system. If the fuse requires replacement, use a
2 Amp Mini ATO Fuse, factory part number FU-8-2 (Littelfuse # 297-002).



DBK48 Rear Panel

DBK48's internal power supply supplies power to the 8B modules only. The DIN5 Power Out connector is a pass-through to allow for a power daisy-chain.

Prior to daisy-chaining from one module's power connector to another, be sure to compute the power consumption for the entire system. Some modules may need independent power adapters. See chapter 2 for information regarding power supply issues.

Software Setup

You will need to set several parameters so *DaqView* can best meet your application requirements. After the 8B module type is identified, *DaqView* figures out the *m* and *b* (of the *mx+b* equation) for proper engineering units scaling. An example of the *mx + b* equation follows shortly.

LogView does not include the means to directly select the DBK48. To use a DBK48 and its 8B modules with LogBook: Select DBK42 in LogView. This will recognize the DBK48, but will identify it as a DBK42. For each 8B module, select the 5B module that exhibits the same measurement ranges; three examples follow:

For **SC-8B30-01** select **SC-5B30-01** as both have an Input Range of ±10 mV; and an Output Range of ±5V.

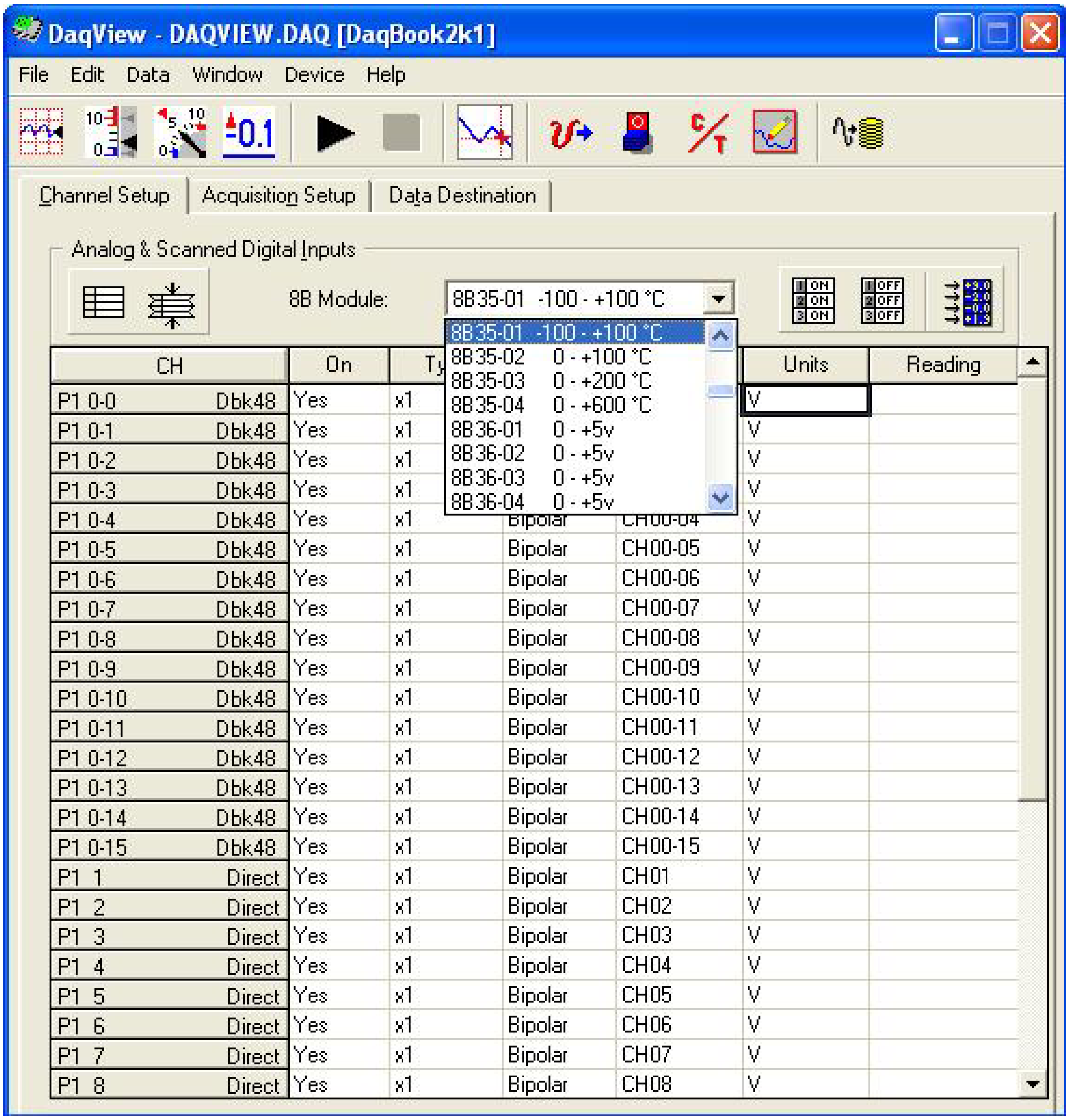
For **SC-8B34-02** select **SC-5B34-02** as both are Type 100 Ohm Pt; with an Input Range of 0°C to +100°C.

For **SC-8B47-T-07** select **SC-5B47-T-07** as both are a Type T Thermocouple, with an Input Range of 0°C to +200°C.

Reference Note:

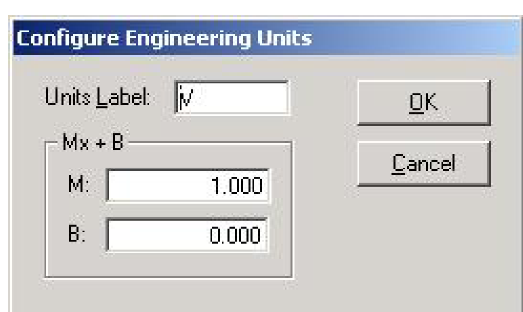
- For *DaqView* information refer to chapter 3, *DBK Setup in DaqView* and to the *DaqView* PDF included on your data acquisition CD.
- For *LogView* information refer to chapter 4, *DBK Setup in LogView* and to the *LogView* section of the LogBook PDF included on your data acquisition CD. Also, see above note.
- The API includes functions applicable to the DBK48. Refer to related material in the *Programmer's Manual* (p/n 1008-0901) as needed.

PDF Note: During software installation, Adobe® PDF versions of user manuals automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation for details regarding both hardware and software. Note that you can also access PDF documents directly from the data acquisition CD via the <View PDFs> button on the CD's opening screen.



DaqView Configuration Main Window

mX +b, an Example



The *Customize Engineering Units* dialog box can be accessed via the *DaqView Configuration main window* by activating the **Units** cell [for the desired channel], then clicking to select **mX+b**.

From the *Customize Engineering Units* dialog box (see figure at right), you can enter values for *m* and *b* components of the equation that will be applied to the data. There is also an entry field that allows you to enter a label for the new units that may result from the **mX+b** calculation.

An example of mX + b equation use follows.

Engineering Units Conversion Using mx + b

Most of our data acquisition products allow the user to convert a raw signal input (for example, one that is in volts) to a value that is in engineering units (for example, pressure in psi). The products accomplish this by allowing the user to enter *scale* and *offset* numbers for each input channel, using the software associated with the product. Then the software uses these numbers to convert the raw signals into engineering units using the following "**mx + b**" equation:

(1) Engineering Units = m(Raw Signal) + b

The user must, however, determine the proper values of *scale* (**m**) and *offset* (**b**) for the application in question. To do the calculation, the user needs to identify two known values: (1) the raw signal values, and (2) the engineering units that correspond to the raw signal values. After this, the scale and offset parameters can be calculated by solving two equations for the two unknowns. This method is made clear by the following example.

Example

An engineer has a pressure transducer that produces a voltage output of 10.5 volts when the measured pressure is 3200 psi. The same transducer produces an output of 0.5 volt when the pressure is 0 psi. Knowing these facts, m and b are calculated as follows.

A - Write a pair of equations, representing the two *known* points:

(2) 3200 = m(10.5) + b

(3) 0 = m(0.5) + b

B - Solve for m by first subtracting each element in equation (3) from equation (2):

(4) 3200 - 0 = m(10.5 – 0.5) + (b - b)

(5) Simplifying gives you: **3200 = m(10)**

(6) This means: **m = 320**

C - Substitute the value for m into equation (3) to determine the value for b:

(7) 0 = 320 (0.5) + b

(8) Therefore: **b = - 160**

Now it is possible to rewrite the general equation (1) using the specific values for m and b that we just determined:

(9) Engineering Units = 320(Raw Signal) - 160

The user can then enter the values of m and b into the appropriate location using the facilities provided by compatible data acquisition software, for example: *WaveView, DaqView, Personal DaqView, LogView*, and *TempView*. The software uses equation (9) to calculate signal values in engineering units from that point on.

Specifications – DBK48

Name/Function: DBK48, 16-slot Multi-Purpose Isolated Signal Conditioning Module

Operating Environment:

Temperature: -30°C to 70°C
Relative Humidity: 95% RH, non-condensing

Connectors:

System Connector: DB37 male, mates with P1 connector on primary acquisition device (**Note 1**)
Signal Connector: DB25, 5V output signals from the 8B modules
Power Connectors: Two DIN5 connectors; "Power In" and "Power Out" for daisy-chaining
Input Connections:

8 sets of removable screw terminal blocks, each with 6 connection points as follows:

1st channel voltage in (+V in, -V in)
1st channel excitation (+E, -E) (**Note 2)**
2nd channel voltage in (+V in, -V in)

Shunt-Resistor Socket: R0 through R15, plug-in resistor sockets.
One socket per channel for current loop inputs.

Cold-Junction Sensor: Enabled or disabled per channel via jumpers JP0 through JP15.

8B Module Capacity:

- Up to 16 voltage input
- Up to 16 thermocouple
- Up to 8 modules which require excitation; i.e.
  strain gauge, potentiometer, RTD

See latest catalog or contact your sales representative in regard to the types of 8B Modules available for your application.

Power Requirements: 10 to 30 VDC; or 120 VAC with AC-to-DC adapter

With 16 thermocouple-type modules (0.03 amps each):
10 VDC @ 0.30 A
15 VDC @ 0.20 A
25 VDC @ 0.12 A

With 8 strain-gage-type modules (0.2 amps each):
10 VDC @ 1.000 A
15 VDC @ 0.667 A
25 VDC @ 0.400 A

Power Consumption: 750 mW from P1, typical
(±15V @ 25mA)

Channel-to-Channel Settling: ±0.05%, typical at 200kHz; ±0.025%, typical at 100kHz

DC Input Fuse: 2 Amp, Mini ATO Fuse, FU-8-2 (Littelfuse #297-002); at board location F3

Isolation

Input Power to System: 250 VDC
Signal Inputs to System: 250 VDC
Input Channel-to-Channel: 250 VDC

Dimensions: 285 mm W × 220 mm D × 45 mm H (11" x 8.5" × 1.75")

Weight: 1.13 kg (2.5 lb) with no modules installed

Note 1: If attachment to the primary device is through a 100-pin P4 connector, a DBK200 series adapter must be used to obtain the mating P1 connector.

Note 2: Input devices that require excitation can only be connected to the following channels: 0, 2, 4, 6, 8, 10, 12, 14. The odd-numbered channels do not connect to excitation.

8B Module Ranges

Voltage Input Modules (3 Hz BW)		
Part No.	**Input Range**	**Output Range**
SC-8B30-01	±10 mV	±5V
SC-8B30-02	±50 mV	±5V
SC-8B30-03	±100 mV	±5V
SC-8B31-01	±1 V	±5V
SC-8B31-02	±5 V	±5V
SC-8B31-03	±10 V	±5V
SC-8B31-04	±1 V	0 to +5V
SC-8B31-05	±5 V	0 to +5V
SC-8B31-06	±10 V	0 to +5V
SC-8B31-07	±20 V	±5V
SC-8B31-08	±20 V	0 to +5V
SC-8B31-09	±40 V	±5V
SC-8B31-10	±40 V	0 to +5V
SC-8B31-12	±60 V	±5V
SC-8B31-13	±60 V	0 to +5V

Current Input Modules (3 Hz)		
Part No.	**Input Range**	**Output Range**
SC-8B32-01	4 to 20 mA	0 to +5V
SC-8B32-02	0 to 20 mA	0 to +5V

Linearized 2-wire or 3-wire RTD Modules (0 to +5V Output, 3 Hz BW) Type: 100Ω Pt RTD [Available June 2005]		
Part No.	**Input Range in ˚C**	**˚F**
SC-8B34-01	-100˚C to +100˚C	-148˚F to +212˚F
SC-8B34-02	0˚C to +100˚C	+32˚F to +212˚F
SC-8B34-03	0˚C to +200˚C	+32˚F to +392˚F
SC-8B34-04	0˚C to +600˚C	+32˚F to +1112˚F

Potentiometer Input Modules (0 to +5V Output, 3 Hz BW) [Available June 2005]		
Part No.	**Input Range**	**Output Range**
SC-8B36-01	0 to 100Ω	0 to +5V
SC-8B36-02	0 to 500Ω	0 to +5V
SC-8B36-03	0 to 1 kΩ	0 to +5V
SC-8B36-04	0 to 10 kΩ	0 to +5V

Specifications are subject to change without notice.

Voltage Input Modules (1 kHz BW)		
Part No.	**Input Range**	**Output Range**
SC-8B40-01	±10 mV	±5V
SC-8B40-02	±50 mV	±5V
SC-8B40-03	±100 mV	±5V
SC-8B41-01	±1 V	±5V
SC-8B41-02	±5 V	±5V
SC-8B41-03	±10 V	±5V
SC-8B41-04	±1 V	0 to +5V
SC-8B41-05	±5 V	0 to +5V
SC-8B41-06	±10 V	0 to +5V
SC-8B41-07	±20 V	±5V
SC-8B41-08	±20 V	0 to +5V
SC-8B41-09	±40 V	±5V
SC-8B41-10	±40 V	0 to +5V
SC-8B41-12	±60 V	±5V
SC-8B41-13	±60 V	0 to +5V

Linearized Thermocouple Input Modules (0 to +5V Output, 3 Hz BW)			
Part No.	**Type**	**Input Range in ˚C**	**˚F**
SC-8B47-J-01	J	0˚C to +760˚C	32˚F to +1400˚F
SC-8B47-J-02	J	-100˚C to +300˚C	-148˚F to +572˚F
SC-8B47-J-03	J	0˚C to +500˚C	+32˚F to +932˚F
SC-8B47-J-12	J	-100˚C to +760˚C	-148˚F to +1400˚F
SC-8B47-K-04	K	0˚C to +1000˚C	+32˚F to +1832˚F
SC-8B47-K-05	K	0˚C to +500˚C	+32˚F to +932˚F
SC-8B47-K-13	K	-100˚C to +1350˚C	-148˚F to +2462˚F
SC-8B47-K-14	K	0˚C to +1200˚C	+32˚F to +2192˚F
SC-8B47-T-06	T	-100˚C to +400˚C	-148˚F to +752˚F
SC-8B47-T-07	T	0˚C to +200˚C	+32˚F to +392˚F

Specifications are subject to change without notice.

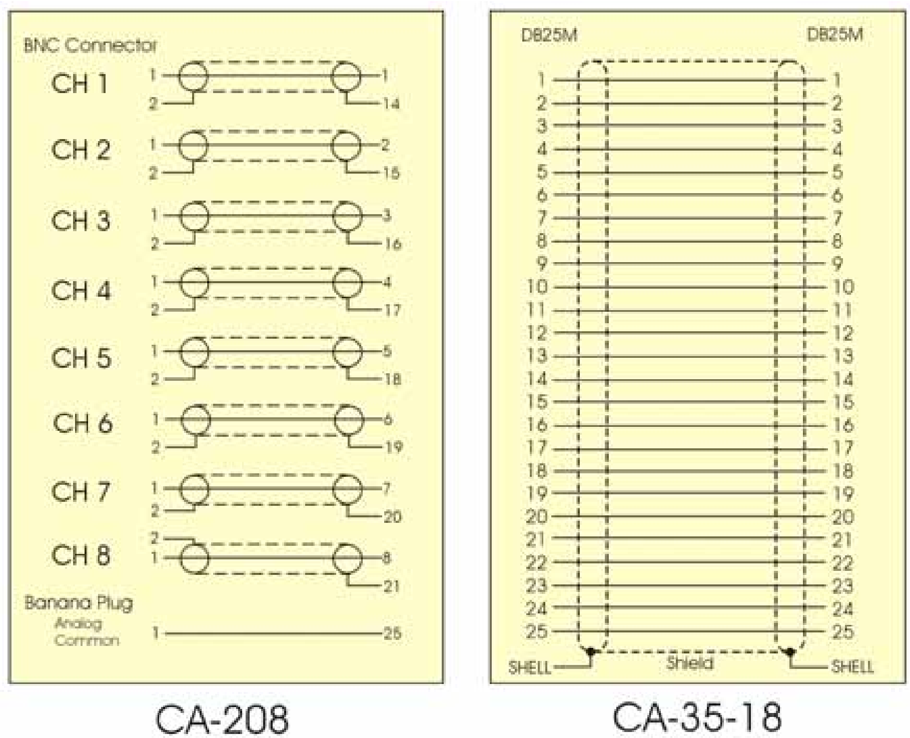
A NOTE FOR USERS OF CABLE CA-208

The following applies to customers using a CA-208 instead of a CA-208-3 cable.

<u>Users of CA-208-3 are to ignore this material</u>.

Note! **If the DBK48 is not connected to a Daq device via the P1 connector, then remove the Rnets from S01 and S02. These resistor networks connect each 8B module's output to the multiplexer for P1.**

Note! **DO NOT connect the CA-208 cable directly to the Signal Output connector. First connect a CA-35-18 cable to the DB25; then connect the CA-208 to the CA-35-18 cable. Both cables are required.**



Wiring Diagrams

Use the two cables (CA-208 and CA-35-18) as follows:

1. Connect the CA-35-18 expansion cable to DBK48's 25-pin Signal Output connector.
2. Connect DB25 end of the CA-208 cable to the CA-35-18 expansion cable.
3. Connect the CA-208 analog common banana plug to the local ground of the measuring equipment.
4. Connect the CA-208 BNC connectors (for channels 1 through 8) to the measuring equipment.

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Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

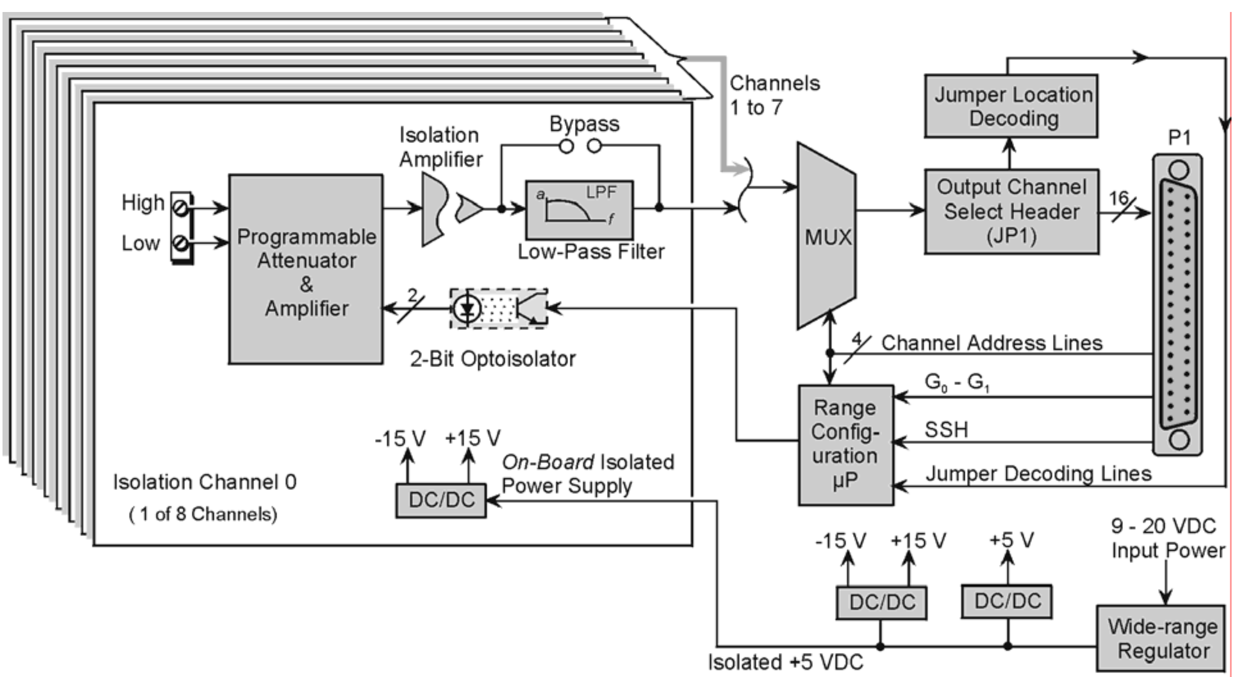
Overview

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 MΩ 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:

$$K = Vin / Vout$$

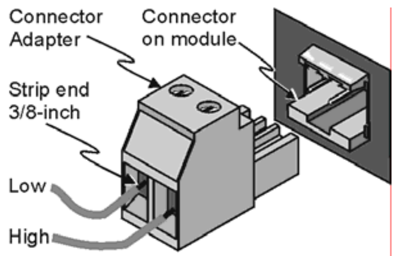
where: **K** is the attenuation or gain factor (the values of **K** for available voltage ranges are given in the table).
Vin is the voltage applied to the module input channel.
Vout is the amplified or attenuated voltage from the module output back to the main unit.

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.



Signal-Input Connector

Module Configuration

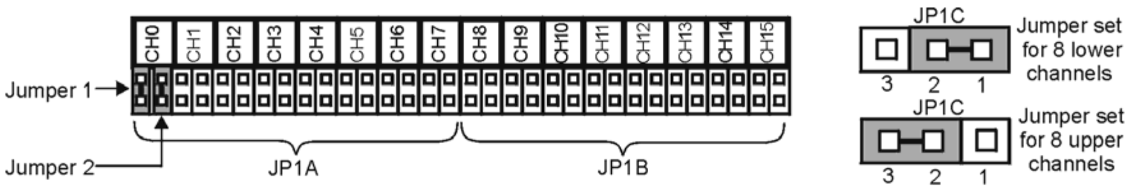
Factory Default: Low-pass filter – Enabled

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)

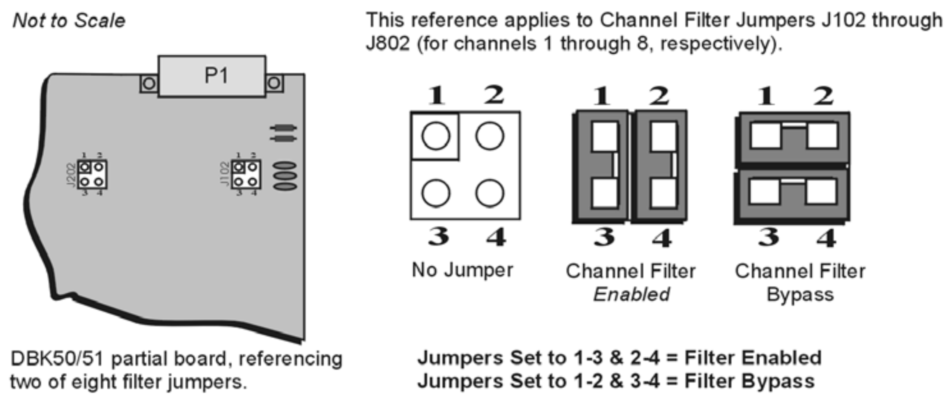
The main output channel is one of the 16 primary data acquisition device [LogBook or Daq device] channels. Each DBK50 [and DBK51] has 8 input channels and can be set to an upper or lower sub-channel that allows 2 modules to share a single LogBook or Daq device channel. Thus, a fully-populated system 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.



DBK50/51 Channel Configuration

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 2×2 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.



Channel Filter Jumper Settings for DBK50 and DBK51

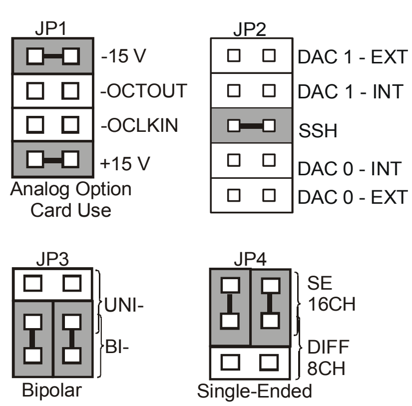
The low-pass filters have a default corner frequency of 3.5 Hz when the jumpers are in the LPF-selected positions. This frequency may be readily changed by installing a different value of SIP resistor network in the 6-pin SIP socket of each filter section. Each channel has its own SIP located next to 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 kΩ	4606M-102-102
175 Hz	2 kΩ	4606M-102-208
75 Hz	4.7 kΩ	4606M-102-208
35 Hz	10 kΩ	4606M-102-103
17.5 Hz	20 kΩ	4606M-102-203
7.5 Hz	47 kΩ	4606M-102-473
3.5 Hz	100k Ω	4606M-102-104

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Several setup steps in DaqBook/100 Series & /200 Series devices 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/100 Series & /200 Series devices 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 *Power Requirements* in the *DBK Basics* section and to the DBK32A and DBK33 sections as applicable.

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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for these /2000 series devices.

Software Setup

Reference Notes:

- **DaqView users** - Refer to chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to chapter 4, *DBK Setup in LogView*.

DaqBooks/100 Series & /200 Series devices 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 MΩ
DBK51: >10 MΩ

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/°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)

DBK53 and DBK54 16-Channel Analog Input Multiplexing Modules

DBK53 – Low Gain Programmable Module
DBK54 – High Gain Programmable Module

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

Overview

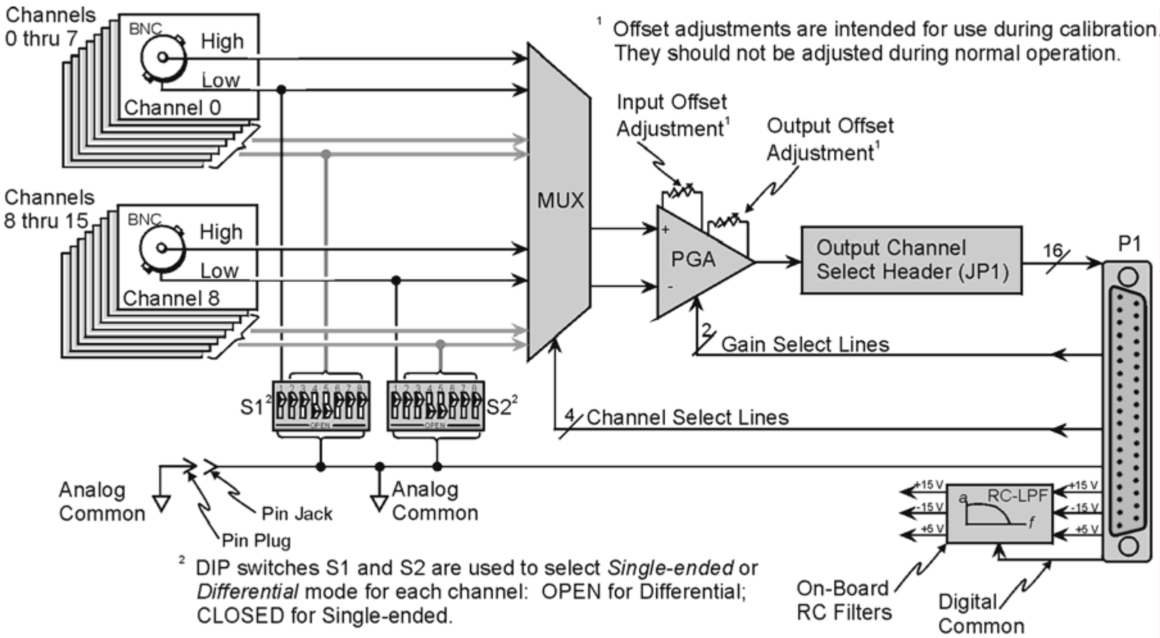
DaqView Users: When a DBK53 or DBK54 is used with a /2000 Series Device, the Internal Clock Speed should be set to 100 kHz as described in Chapter *DBK Setup in DaqView*.

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 µs/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 ×1, ×2, ×4, and ×8 that are scan-programmable per channel. These gains can be combined with the standard gains of ×1, ×2, ×4, and ×8 for net gains of ×1, ×2, ×4, ×8, ×16, ×32, and ×64.
- The DBK54 has 4 gain ranges of ×1, ×10, ×100 and ×1000 that are scan-programmable per channel. These gains can be combined with the standard gains of ×1, ×2, ×4, and ×8 for net gains of ×1, ×2, ×4, ×10, ×20, ×40, ×80, ×100, ×200, ×400, ×800, ×1000, ×2000, ×4000, and ×8000.

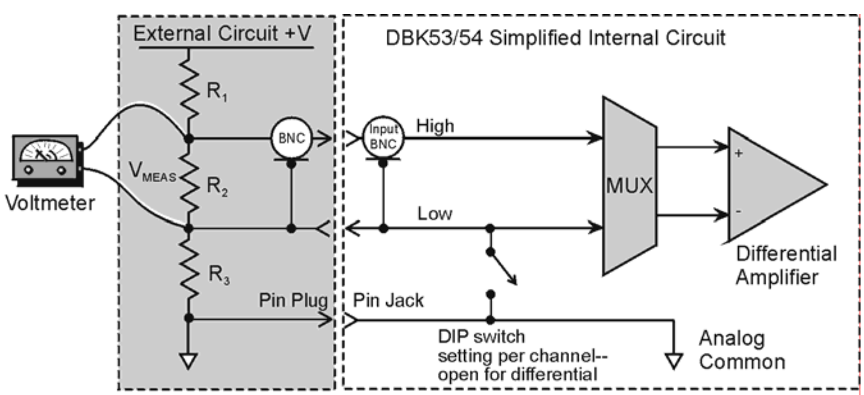


DBK53/54 Block Diagram

Hardware Setup

Differential Mode

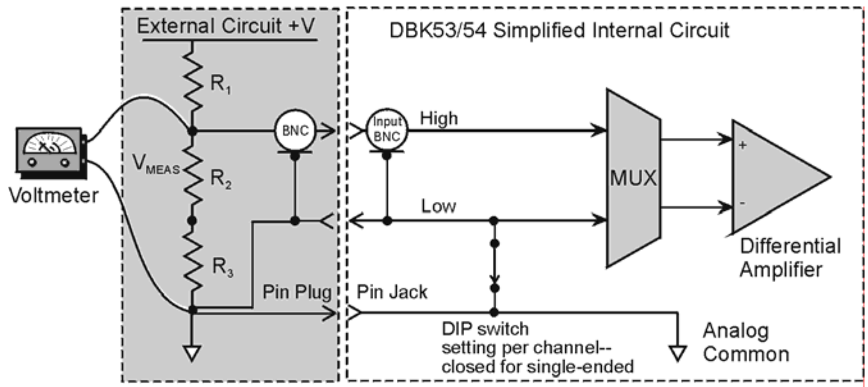
The DBK53 and DBK54 are designed for floating-type differential measurements. Neither the high nor the low of the analog input has an inherent bias current return path to the analog common on the module. An external common pin jack is provided on the outside panel for this bias-current return path. The following figure shows a typical differential connection.



Differential Input Mode

Single-Ended Mode

Ground referencing must also be observed with single-ended measurements. The following figure shows a typical single-ended hookup.



Single-Ended Input Mode

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.

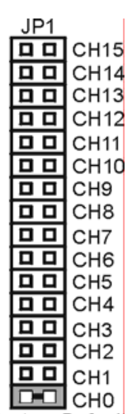
Module Configuration

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 16×2-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.

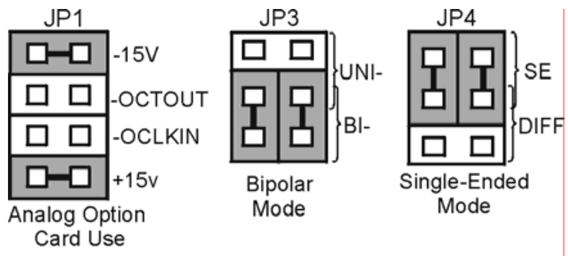


Factory Default Channel Configuration

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Three setup steps and needed to configure DaqBooks/100 Series & /200 Series devices 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

Note:
These jumpers do not apply to /2000 Series Devices.

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., DBK32A or DBK33, you must remove both JP1 jumpers. Refer to *Power Requirements* in the *DBK Basics* section and to the DBK32A and DBK33 sections for more detailed information, 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: The DaqBook/200 Series devices and DaqBoards do not have a JP4 jumper. The single-ended or differential choice is made via software configuration commands.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for the /2000 series devices.

Software Setup

Reference Notes:

- **DaqView users** - Refer to chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to chapter 4, *DBK Setup in LogView*.

DaqView Users: When a DBK53 or DBK54 is used with a /2000 Series Device, the Internal Clock Speed should be set to 100 kHz as described in Chapter 3, *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: ×1, ×2, ×4, ×8
DBK54: ×1, ×10, ×100, ×1000

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 MΩ (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:
±(0.5 + 5/G) V/°C typ
±(2.0 + 24/G) mV max

Offset Drift:
±(3 + 50/G) V/°C typ
±(2.0 + 24/G) V/°C max

Notes

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

DBK55 Module

Overview

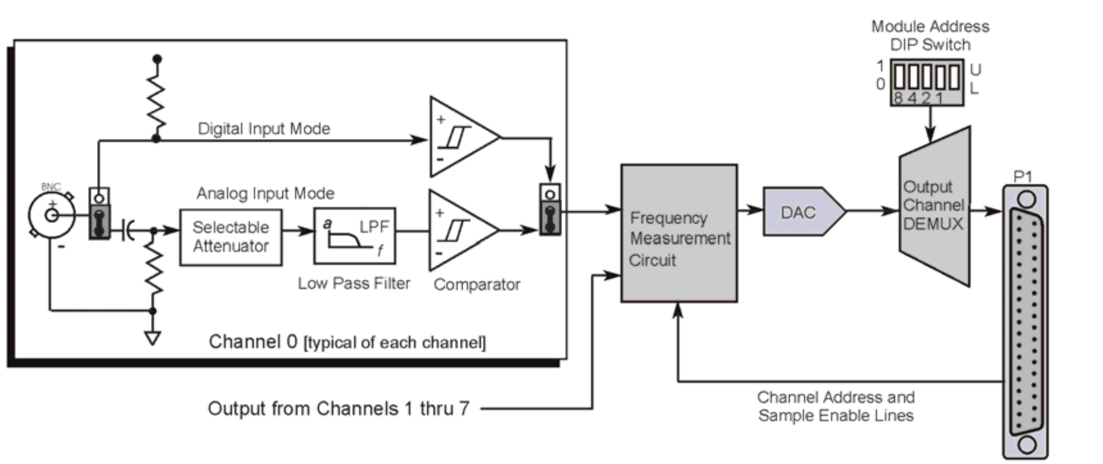
Features of the DBK55

The DBK55 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 DBK55 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 32 DBK55s can be used with a single LogBook or Daq device for a maximum of 256 channels.

The digital-to-analog converter (DAC) outputs a voltage from -5 V to +5 V to correspond with the selected frequency range. The DaqBook directs the DBK55 module's DAC to convert the data from the proper input channel.

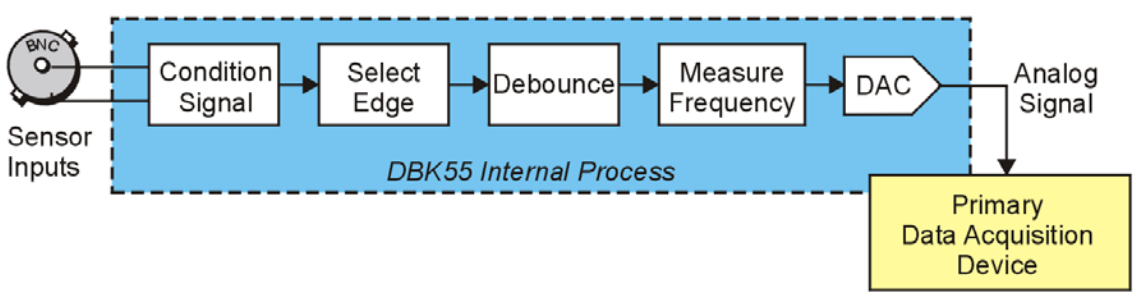


DBK55 Block Diagram

As indicated in the next figure, the DBK55 module completes the following functions for each channel:

- Conditions an input signal
- Selects the signal's rising or falling edge
- Debounces the edge
- Measures the signal's frequency.
- Sends a voltage (V_{out}) analog signal [which corresponds to the measured frequency] from the DAC to the primary data acquisition device.

These functions are discussed in the upcoming text.



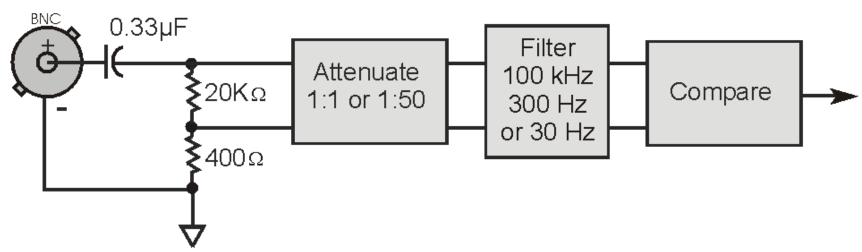
DBK55 System Functionality

Input Signal Conditioning

The DBK55 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. The debounce concept is discussed on page 4.

Analog Input Signal Conditioning

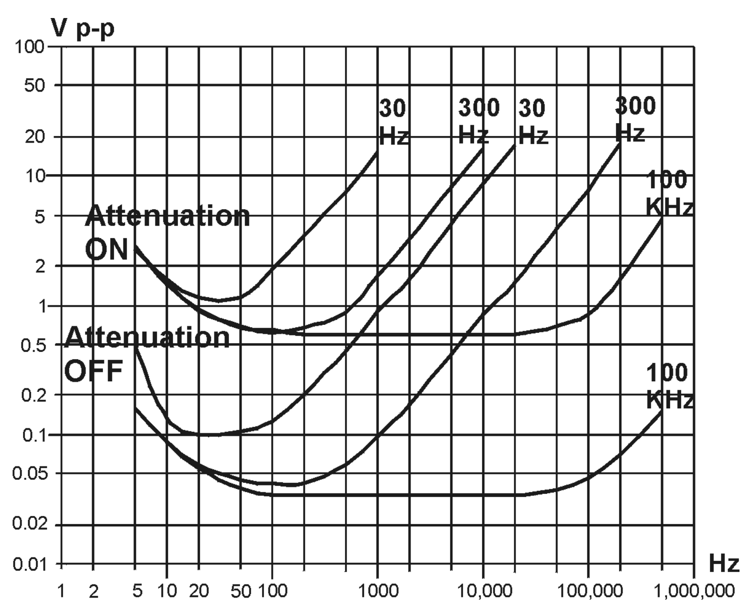
WARNING
Input voltages should be at least 50 mV peak-to-peak. The maximum analog input signal is 30 Vrms (42 Vpeak, 84 Vp-p). Stronger signals may damage the DBK55 or present an electrical shock hazard.



When a channel's two "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 to ground. With the attenuator disabled [full sensitivity] input-protection diodes limit the signal to about 1.5 Vp-p. Larger signals will see an impedance of 6.7 KΩ (rather than 20 KΩ) in series with 0.33 µF. With the attenuator enabled, the input impedance remains 20 KΩ 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 than the outside-conductor signal. 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.



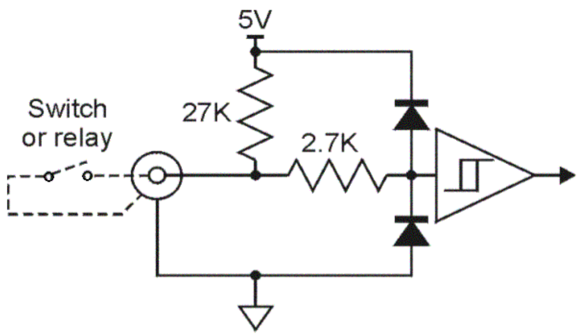
Digital Input Signal Conditioning

CAUTION

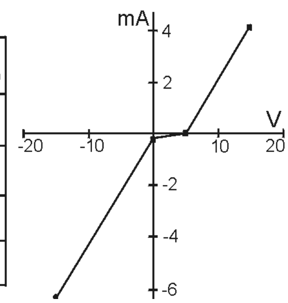
The input signal may range from -15 to +15 V. Higher voltages may damage the DBK55.

The digital input circuit is represented in the left-hand figure, below. When both of a channel's "input circuit jumpers" are set for digital, the outside (shield) conductor of the BNC connector connects to ground. The center conductor is pulled up with 27 KΩ to +5 V and then passes through a 2.7 KΩ protection resistor before being detected by a Schmitt-trigger buffer with input-protection diodes.

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 KΩ pull-up resistor allows the digital inputs to sense switches or relays connected directly to the DBK55 as shown in the figure. The debounce circuit can remove noise effects of switching. Debouncing is discussed later on this page.



V (volts)	I (mA)
-15	-6.3
0	-0.2
5	0
15	4.1



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 KΩ 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 KΩ. The figure (upper right) shows the approximate digital-input current/voltage relationship.

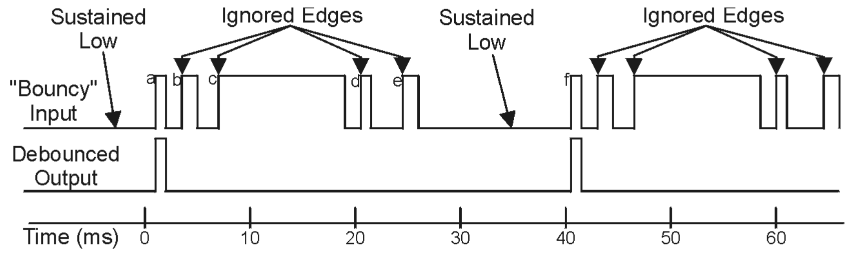
Edge Selection

The DBK55 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 before 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 DBK55 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 DBK55 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:

Minimum Measurement Period (sec) = (4096 x 0.5 µs) [F_{max}/(F_{max} - F_{min})]

In this equation: 4096 derives from 12-bit precision; 0.5 µs is the resolution of the DBK55's timing circuits; and F_{max} / (F_{max} - F_{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 x 0.5 µs x 61/2 = 62.5 ms**, or about 16 measurements per second.
- To measure frequencies from 1 to 61 Hz, the measurement period is at least **4096 x 0.5 µs x 61/60 = 2.1 ms**. Note that as the DBK55 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_{max}/(F_{max} - F_{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_{min}) / (F_{max} - F_{min})]; where: 0 < 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_{min} + 4095/4096 (F_{max} - F_{min}) which is the same as F_{max} - 1/4096 (F_{max} - F_{min}).

Digital-to-Analog Conversion

The 12-bit scaled result of the frequency measurement is stored in a DAC to be read by the data acquisition system. The DBK55 makes use of two DACs. The first DAC is shared by channels 0 through 3 and the second by channels 4 through 7. Each time the LogBook or Daq device addresses a different DBK55 channel, the associated DAC supplies the corresponding voltage (V_{out}) according to the formula:

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

Since DAC values (D) range from 0 to 4095, DBK55 output voltages range from -5.0000 to +4.9976 V.

Calibration for the DBK55 is automatic. When the DBK55 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 settings. The DBK55's software-adjustable gain and offset can correct for small errors in the DBK55 or the LogBook or Daq device. This automatic calibration eliminates the periodic need for manual calibration.

Hardware Setup

CAUTION

DBK55 modules must be configured before connecting them to inputs and outputs. Failure to do so could result in damage to equipment.

Hardware-related steps for setting up DBK55 include:

- Configuring the DBK55 for the application
- Configuring the Daq device to which the DBK55 is being connected to
- Connecting the input cables to sensors
- Connecting the module's output cable to a Daq device or LogBook.

Configuring the DBK55 Module

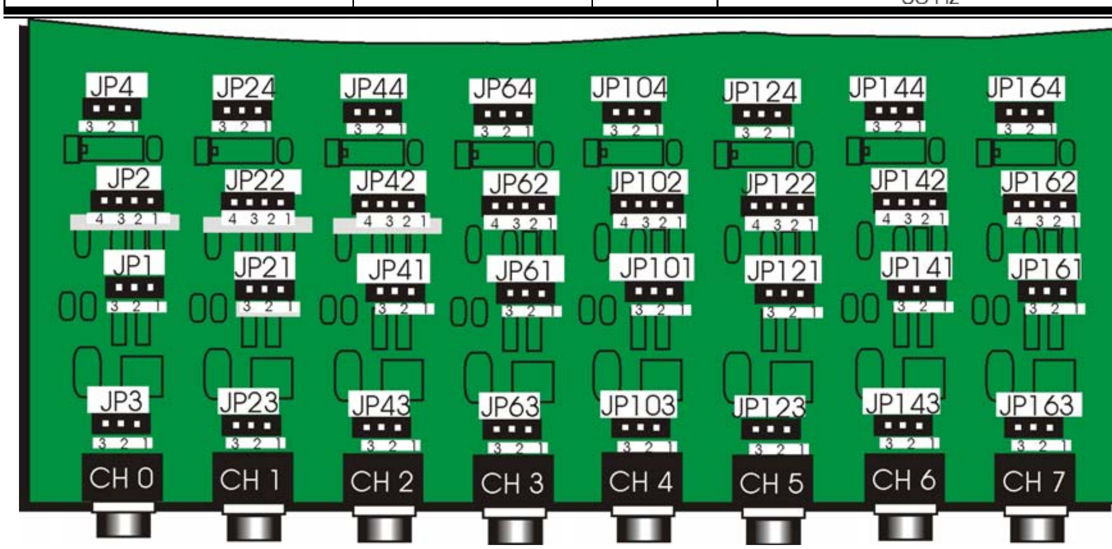
Unless the factory default settings are going to be used, several jumpers and one switch must be set on the DBK55 module to match both the system setup and the signal-conditioning requirements. Each channel can have its own individual hardware and software settings.

The default settings are:

- **Input Circuit – set to Analog**
- **Attenuation – set to Enabled (less sensitive)**
- **Low Pass Filter – set to 100 kHz**

The following table indicates the possible settings of each jumper and includes an illustration to facilitate the location of jumpers. More detailed information concerning jumper settings immediately follows the table.

DBK55 On-board Jumper Configurations			
Configuration	**Jumpers**	**Channel**	**Selected Functions**
Input Circuit Selection, pg. 8 • The default is Analog Input; Pins 1 and 2 connected for two associated jumpers. • For Digital Input mode; pins 2 and 3 are connected for the two associated jumpers.	JP3 and JP4	CH 0	  **Analog** (Default) **Digital** * Two jumpers are required to set Analog or Digital. For example, JP3 and JP4, which are at the input and output ends of the circuit, respectively.
	JP23 and JP24	CH 1	
	JP43 and JP44	CH 2	
	JP63 and JP64	CH 3	
	JP103 and JP104	CH 4	
	JP123 and JP124	CH 5	
	JP143 and JP144	CH 6	
	JP163 and JP164	CH 7	
Attenuation Selection, pg. 8 • The default is Attenuation Enabled (reduced sensitivity). Pins 1 and 2 are connected. • For Full Sensitivity (Attenuation Disabled) pins 2 and 3 are connected.	JP1	CH 0	  **Attenuation Enabled** (Default) **Full Sensitivity**
	JP21	CH 1	
	JP41	CH 2	
	JP61	CH 3	
	JP101	CH 4	
	JP121	CH 5	
	JP141	CH 6	
	JP161	CH 7	
Low Pass Filter Selection, pg. 8 • The default LPF is 100 kHz. Pins 1 and 2 are connected. • For an LPF of 300 Hz, pins 2 and 3 are connected. • For an LPF of 30 Hz, pins 3 and 4 are connected.	JP2	CH 0	 100 kHz (Default)  300 Hz  30 Hz
	JP22	CH 1	
	JP42	CH 2	
	JP62	CH 3	
	JP102	CH 4	
	JP122	CH 5	
	JP142	CH 6	
	JP162	CH 7	



Jumper Locations Partial Board, Not Drawn to Scale

Input Circuit Selection: Analog or Digital

Each input channel can be set for the analog (default) or digital circuit. Two jumpers must be set for each channel. These are listed in the preceding table, along with the associated channels.

Refer to the previous figure and table; then 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 each channel's circuit jumpers (2 jumpers per channel) for analog or digital.
3. Verify that both jumpers for a channel are set the same, i.e., both set to pins 1 and 2 for Analog, or both set to pins 2 and 3 for Digital.

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 50.

Refer to the previous figure and table; then set the attenuation for each channel as follows:

1. Decide whether or not you want attenuation for a given channel. Attenuation enabled, which reduces sensitivity, is the default setting.
   - Use attenuation (reduced sensitivity) if the input signal's peak level exceeds 1 V.
   - Disable attenuation (full sensitivity) if the input signal's peak level is less than 1 V.
2. For attenuation, position the associated jumper across pins 1 and 2. To disable attenuation (full sensitivity), position the jumper across pins 2 and 3.
3. Verify the jumper position for each input channel.

Low-Pass Filter Selection (Analog Input Circuit Only)

The low-pass filter removes high-frequency noise that would otherwise have the DBK55 detecting a higher frequency than desired. 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. Verify that the DBK55's sensitivity will accommodate the expected input signal strength. Page 3 includes a graph of typical sine-wave sensitivity (peak-to-peak voltage) verses frequency (Hz).
3. *Refer to the previous figure and table*; then set the associated jumpers for the desired low-pass filter selection.

Address Configuration via Rear Panel DIP Switch

You can connect 1 or 2 DBK55 modules to a single main channel on the primary data acquisition device. Thus, a 16-channel LogBook or Daq device can support up to 32 DBK55 modules. Since each module has 8 input channels, a fully populated system can use 256 input sensors (32 modules x 8 channels per module).

To keep the large number of inputs organized, each DBK55 module is given a unique address via its DIP switch, S1[located on the rear panel].

CAUTION

Each DBK55 must be configured before connecting the module to inputs and outputs. In addition, adjustment of the channel address must only be performed when the system's power is OFF. Failure to do so may result in equipment damage.

S1's four leftmost micro-switches are used to set the module's channel address in binary. Set the micro-switches to the desired address only after ensuring that the system power is OFF. Several example address settings are provided below. Other settings can be easily derived.

Note!

Each DBK55 module in the system must have a unique channel address for the primary data acquisition device. Valid addresses are 0 to 15. Note that two modules can have a setting for the same primary channel, for example, two modules could be set to channel 0; as long as one module is set to "L" to indicate the lower sub-channels 0-7 and the other is set to "U" to indicate the upper sub-channels of 8-15. Examples of various settings follow.

Channel 0 / Lower

Primary Acquisition Device Channel 0
DBK55 Lower Sub-Channels 0-7

The four leftmost micro-switches are set to "0" (Open). This sets the unit to **primary acquisition device Channel 0**. The rightmost switch is at "**L**," setting the module to the **"lower" DBK55 sub-channels (0 through 7)**.

Note: If connecting a second module to primary device Channel 0, the U/L switch for that module would be set to "U" for sub-channels 8 thru 15.

Channel 5 / Lower

Primary Acquisition Device Channel 5
DBK55 Lower Sub-Channels 0-7

The micro-switches for binary 4 and binary 1 are closed. This sets the unit to **primary acquisition device Channel5**. The rightmost switch is at "**L**," setting the module to the **"lower" DBK55 sub-channels (0 through 7)**.

Channel 15 / Lower

Primary Acquisition Device Channel 15
DBK55 Lower Sub-Channels 0-7

The micro-switches for binary 8, 4, 2, and 1 are closed, thus setting the **channel to "15"** (8 + 4 + 2 + 1) for the primary acquisition device. The rightmost switch is at "**L**," setting the module to the **"lower" DBK55 sub-channels**
(0 through 7).

Channel 2 / Upper

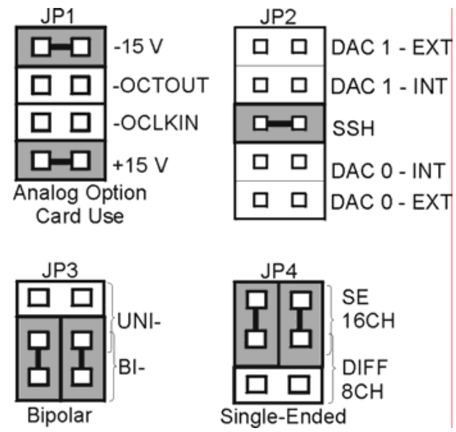
Primary Acquisition Device Channel 2
DBK55 Upper Sub-Channels 8-15

The micro-switch for binary 2 is closed, thus setting the **channel to "2"** for the primary acquisition device. The rightmost switch is at "**U**," setting the module to the **"upper" DBK55 sub-channels (8 through 15)**.

Configuring the Primary Data Acquisition Device

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Several setup steps of DaqBook/100 Series & /200 Series devices and DaqBoards [ISA type] are required to use DBK55 modules 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 the Section *Power Requirements* in the document module *DBK Basics*, in regard to calculating system power requirements).

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*.

DaqBook/2000 Series & DaqBoard/2000 Series

No jumper configurations are required on the DaqBook/2000 series and DaqBoard/2000 series devices in regard to connecting a DBK55.

LogBooks

No jumper configurations are required on LogBook devices in regard to connecting a DBK55.

CE Compliance

If your data acquisition system needs to comply with CE standards, the DBK55 must be 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 *CE Compliance* section of *Signal Management* chapter.

Connecting the DBK55 to Signals and to the Primary Data Acquisition Device

You can connect the DBK55 module to your primary data acquisition device and to its signal inputs after you have completed the following:

- set the DBK55 module's address
- configured the DBK55 on a channel-by-channel basis for the application
- configured the primary data acquisition device, if applicable

You can connect up to eight sensors to one DBK55, i.e., one per BNC. A CA-37-x (or CA-131-x) cable is used to connect the module to a LogBook or Daq device via the module's DB37 connector (P1).

WARNING

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 DBK55 damage.

Connect the DBK55 module as follows. If your system needs to be CE Compliant, be sure to read the preceding *CE Compliance* section prior to connecting the DBK55.

1. Connect each sensor's BNC connector to a mating connector on the DBK55 module

   Label each sensor with its associated channel/sub-channel information.

2. For a single DBK55 module, connect one end of the P1 cable to the module'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.

3. Connect the free end of the cable to the P1 port of the LogBook or Daq device. For multiple DBK55 modules, use a CA-37-x (or CA-131-x) cable to daisy-chain several modules or an expansion module. For example, three DBK55s could be connected to a LogBook or a Daq device with via a CA-37-3 cable.

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

Software Setup

LogView does not include the means to directly select DBK55. However, since a single DBK55 has the functionality of two DBK7 cards we can still use a DBK55 with LogBook. To do this, select DBK7 in LogView. This will recognize the DBK55, but will identify it as a DBK7. Next do one of the following, as applicable:

(a) If the DBK55 is set to the L sub-address, Select DBK7 (0) and DBK7 (1)
(b) If the DBK55 is set to the H sub-address, Select DBK7 (2) and DBK7 (3)

Reference Notes:

- **DaqView users** - Refer to Chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *DBK Setup in LogView*. See above note.

Specifications - DBK55

Name/Function: 8-Channel Frequency-to-Voltage Input Card

Input Channels per Module: 8

Maximum Modules per System: 32

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%

Power Required: 840 mW

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 μF), in series w/ 20 KΩ 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 μF), in series w/ 20 KΩ to ground.

250 mV hysteresis.

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

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

Digital Input

TTL-Level: 0.001 to 960 kHz.

Input Impedance: 27 KΩ 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.

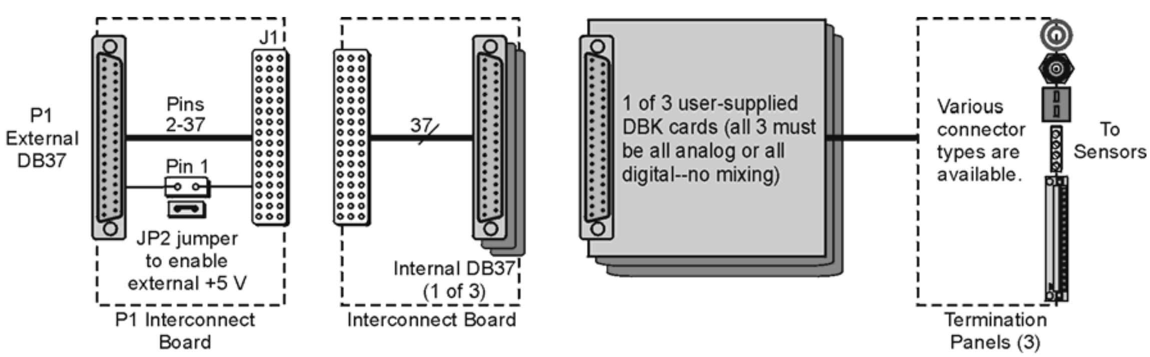
Maximum Input Voltage: -15 V to +15 V

Reference Notes:
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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.

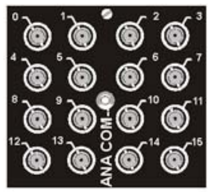


DBK60 Block Diagram

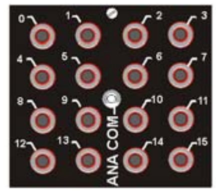
The **front panel** has a male DB37 connector that leads to the acquisition processor via a CA-37-x, CA-37-xT, or equivalent cable.

The **rear panel** is made of three termination panels with connectors for the various sensors.

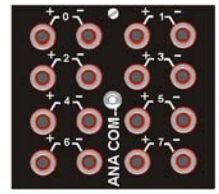
Blank Panel
DBK601



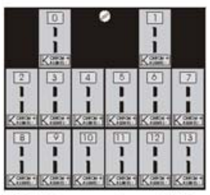
BNC Connectors
plus Analog Common
DBK602



Safety Jacks, single-ended
plus Analog Common
DBK603

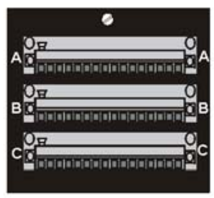


Safety Jacks, Differential
plus Analog Common
DBK604



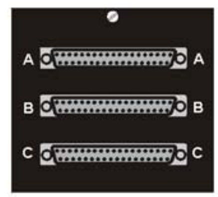
T/C Connectors, Differential

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.

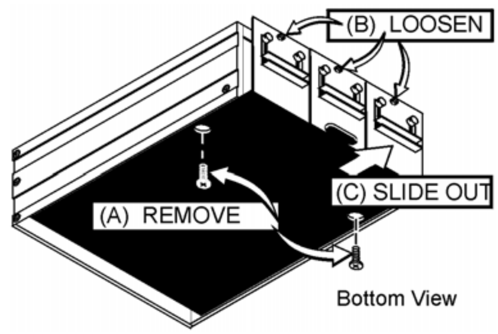
3 – Remove the card drawer

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 *Power Requirements* in the *DBK Basics* section in regard to 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).

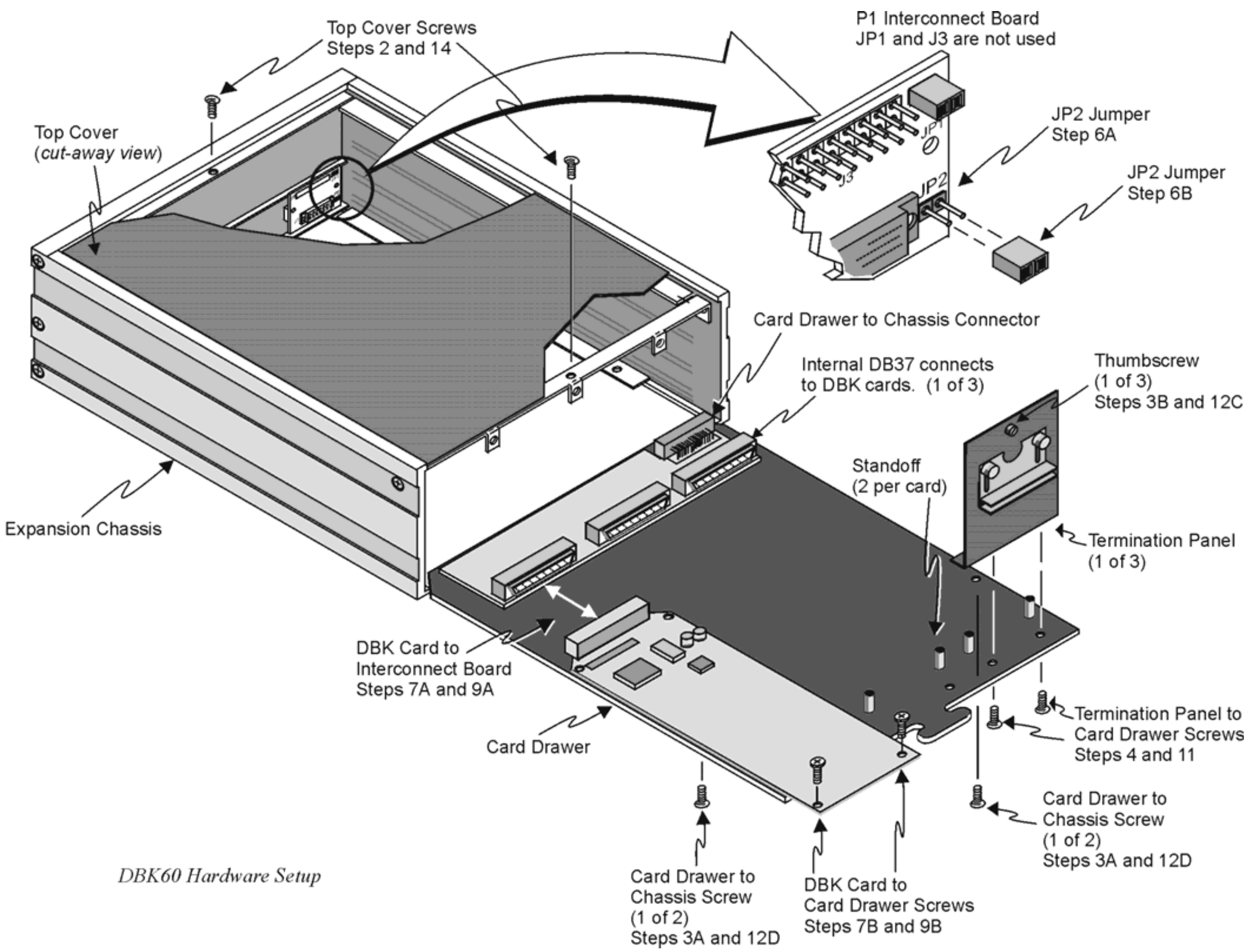
±15 V is selected with two **JP1 jumpers, located on the board of the primary data acquisition device**, such as a DaqBook or ISA-type DaqBoard.
DO NOT CONFUSE THESE JP1 JUMPERS WITH THE JP1 JUMPER IN THE DBK60.

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 sections, if applicable.



DBK60 Hardware Setup

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 gently press the DBK card to establish a complete and solid connection (see previous figure).

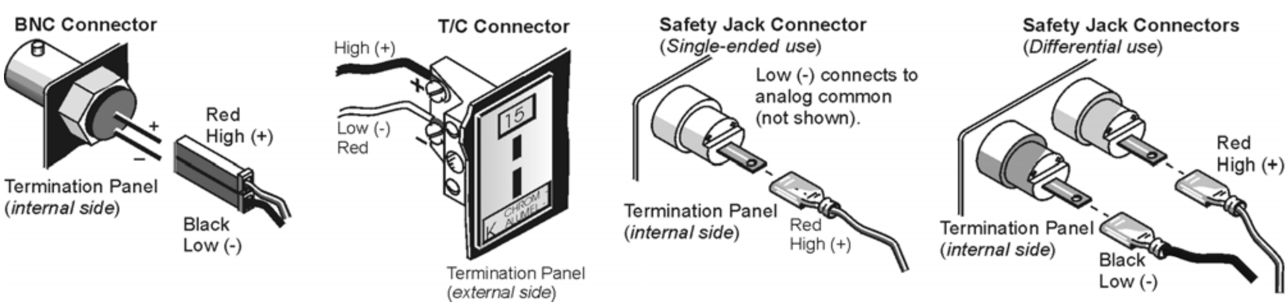
B. Use two screws to secure the DBK card to the standoffs on the DBK60 card drawer (see previous figure).

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)

The DBK65 is campatible with: WaveBook, ZonicBook, LogBook, DaqBook, DaqLab, DaqScan, and DaqBoard/2000 Series devices.

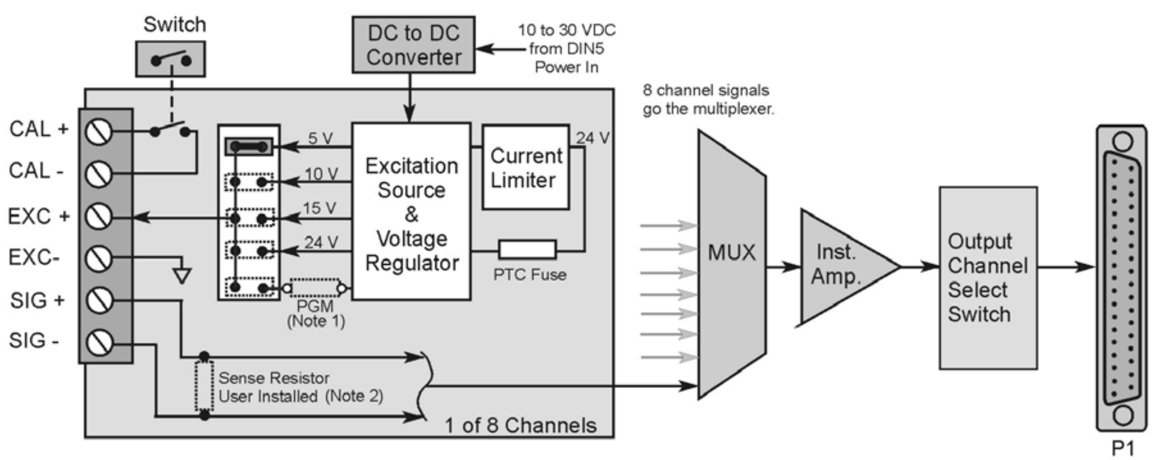
Overview

The DBK65 is an 8 channel transducer interface module. Transducers of 2, 3, 4, and 6 wire type can be easily connected to the device by means of removable screw terminal blocks, 1 per channel.

DBK65

The module is ideally suited for transducer outputs of the following types. Wiring schematics are provided on page 2 of this DBK65 section.

- 4 to 20 mA
- 3-wire string pots
- 4-wire bridge based transducers
- 6-wire bridge based transducers



DBK65 Block Diagram

Note 1: The user can install a resistor for use with the programmable regulator. The programmable voltage source can be within the range of 5 to 20 VDC.

Note 2: The user can install a 250Ω resistor across the positive and negative signal lines (+Signal and -Signal) for 4 to 20 mA transducer outputs.

Each of the 8 channels can be set for a different excitation voltage. 5, 10, 15, and 24 VDC are provided internally from the DBK65 and are selected via placement of a jumper. In addition, a fifth jumper position can be used to select a custom voltage between 5 and 20 VDC. The user must install a resistor if this option is desired. The following section, *Customizing a Voltage*, contains additional information.

Each channel includes 2 screw terminals that allow for a relay closure. Designated as CAL+ and CAL-, the terminals can be used to switch in a calibration resistor for 6-wire transducers. Note that the DBK65's rear panel CAL switch will open or close the internal calibration switches for all 8 channels simultaneously.

DBK65 Power Requirements

The amount of DC power required, which is supplied to the DBK65 through its Power-In DIN5 connector, is 15 V @ 833 mA, 20 V @ 625 mA, assuming max load. In addition, the amount of power drawn from the P1-based host acquisition device, such as a Daq device or a LogBook is 25 mA from ±15 V, 750 mW total. For purpose of our discussion here, a P1-based device is one which is connecting to the DBK65 via the DB37 (P1) connector.

Power Available for Transducers

At the excitation voltages available from the DBK65 (5 to 24 V) a single transducer will typically draw from 10 to 100mA. This fact and the per-channel and per-module current limits must be taken into account to avoid overloading the system.

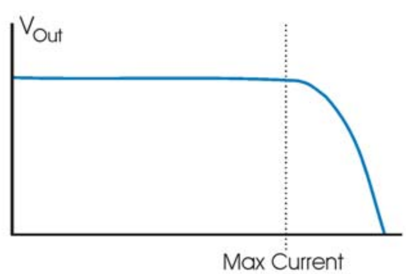
- Total current available, for all 8 channels: 240mA.
- Current available for a single channel: 100mA.
- Transducer, typical current draw: 10 to 100mA

DBK65 Voltage Regulation

Better voltage regulation results in a lower variance of the source output voltage [excitation voltage], as load is applied. Graphs depicting DBK65 voltage regulation for excitation set at 5, 10, 15, and 24 V are included with the product's specifications.

The following graph is intended to provide a better understanding of voltage regulation. In the graph, the output voltage (V_{Out}) exhibits less than ±5% variance from nominal voltage, i.e., 5, 10, 15, or 24 VDC. This also applies to the user settable 5 to 20 VDC.

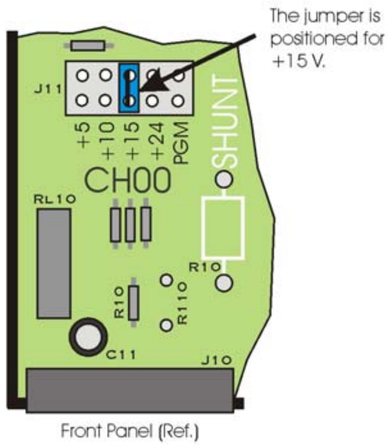
The ±5% variance factor holds true up to the limiting current (Max Current). Refer to the graphs at the end of *Specifications* for typical voltage and current values.



Typical Current Limiting Voltage Curve

Selecting an Excitation Voltage

Each channel has a voltage select header, which consists of 5 pairs of pins and a jumper. The jumper position determines the excitation voltage. Possible voltages are 5, 10, 15, and 24 VDC. A fifth possibility exists for a custom voltage that resides within the range of 5 to 20 V. To obtain a custom voltage you must install a resistor in the excitation line labeled “PGM.” The method is discussed shortly.



Reference for Selecting a Pre-Set Voltage Value

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.

WARNING

HOT COMPONENTS! Allow the DBK65 module to cool for at least 30 minutes before removing the top cover. Some internal components can become very hot and may cause burns.

To select a pre-set voltage (5, 10, 15, or 24V):

1. Remove the DBK65 from power and disconnect all signal lines.
2. Allow the unit to cool for at least 30 minutes.
3. Remove the 4 screws from the top cover plate. Then remove the plate.
4. Position the voltage select header’s jumper to the desired setting. See the preceding figure.
5. Re-install the top cover plate and secure it with the 4 screws that were removed in step 3.

Customizing a Voltage

To make use of the custom voltage feature you will need to acquire a resistor of the calculated value. The formula to use is:

$\mathbf{R_2 = (V_{out} - 1.2V) / 0.007645}$

<u>Example</u>:
Suppose you wanted an excitation source of 12V. Simply replace the V_{out} variable with 12V and solve for R_2. Thus, $R_2 = (12 - 1.2) / 0.007645 = 1412.688\Omega$ In practice, a 1400 ohm, 1% resistor would be used.

Of course, 1400Ω is a little off from the 1412.688Ω, which was calculated. To see the actual nominal voltage that would result from 1400Ω we can use a second equation.

$\mathbf{V_{out} = 1.2V (1 + R_2/158) + 0.00005*R_2}$

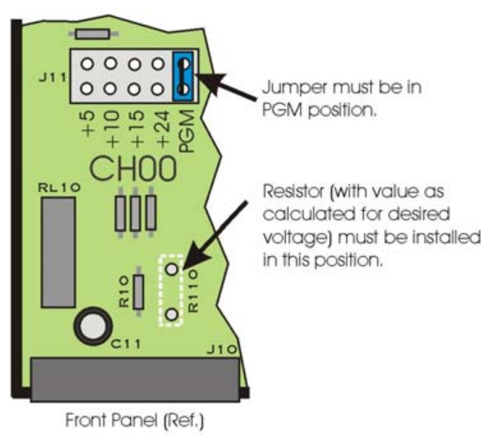
$V_{out} = 1.2 (1 + 1400/158) + 0.00005*1400 = 11.903$ volts

After the resistor value is known, it can be installed as follows.

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.

WARNING

HOT COMPONENTS! Allow the DBK65 module to cool for at least 30 minutes before removing the top cover. Some internal components can become very hot and may cause burns.



1. Remove the DBK65 from power and disconnect all signal lines.
2. Allow the unit to cool for at least 30 minutes.
3. Remove the 4 screws from the top cover plate. Then remove the plate.
4. Remove solder from the 2 holes at the resistor mounting location.
5. Using rosin core solder and proper soldering technique, solder the resistor into position for the applicable channel. **Be sure that the resistor leads are short enough to avoid making contact with the metal chassis**.

   The figure to the right indicates the resistor location for use with channel 0 (CH00). The location scenario is similar for all 8 channels.

   Refer to the following table for a channel's PGM Resistor Location number. The location numbers appear on the circuit board.

Channel	PGM Resistor Location	Voltage Out Jumper Header	Voltage Set V_{out}	Resistor Value R_2
CH00	R110	J11		
CH01	R120	J21		
CH02	R130	J31		
CH03	R140	J41		
CH04	R150	J51		
CH05	R160	J61		
CH06	R170	J71		
CH07	R180	J81		

6. On the jumper header, reposition the channel’s voltage out jumper to the “PGM” position. Refer to the table for a channel’s applicable Jumper Header. The header numbers appear on the circuit board.
7. If applicable, install resistors for other channels, and set the applicable voltage out jumper headers to PGM.
8. Re-install the top cover plate and secure it with the 4 screws that were removed in step 3.

Creating a 4 to 20mA Current Loop

Inputs to monitor the commonly used 4 to 20mA current loops most often employ a 250Ω precision resistor to develop a 1 to 5 VDC voltage drop.

Ideally, a resistor for such purpose should have a 0.1% tolerance (or better) with a minimum power rating of 0.25W and a temperature coefficient of at least 25ppm/°C.

Lower values of resistance, for example, 62.5Ω [for a lower voltage drop within the loop of 0.25 to 1.25 VDC] will require that the host data acquisition device use a gain of x4 to maximize the signal resolution.

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.

WARNING

HOT COMPONENTS! Allow the DBK65 module to cool for at least 30 minutes before removing the top cover. Some internal components can become very hot and may cause burns.

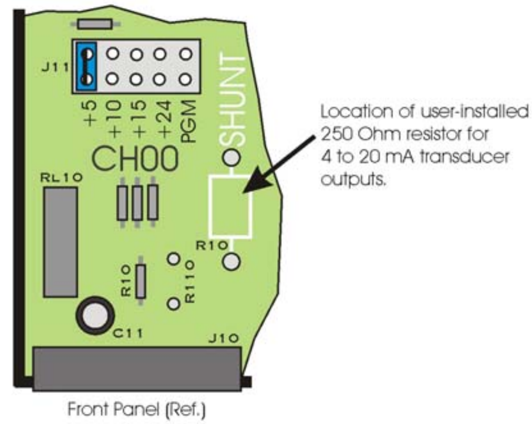
To create a 4 to 20mA current loop:

1. Remove the DBK65 from power and disconnect all signal lines.
2. Allow the unit to cool for at least 30 minutes.
3. Remove the 4 screws from the top cover plate. Then remove the plate.
4. Remove solder from the 2 holes at the resistor mounting location (see the following figure for location).

5. Using rosin core solder and proper soldering technique, solder the resistor into position for the applicable channel. **Be sure that the resistor leads are short enough to avoid making contact with the metal chassis**.

   The figure to the right indicates the resistor location for use with channel 0 (CH00). The location scenario is similar for all 8 channels.

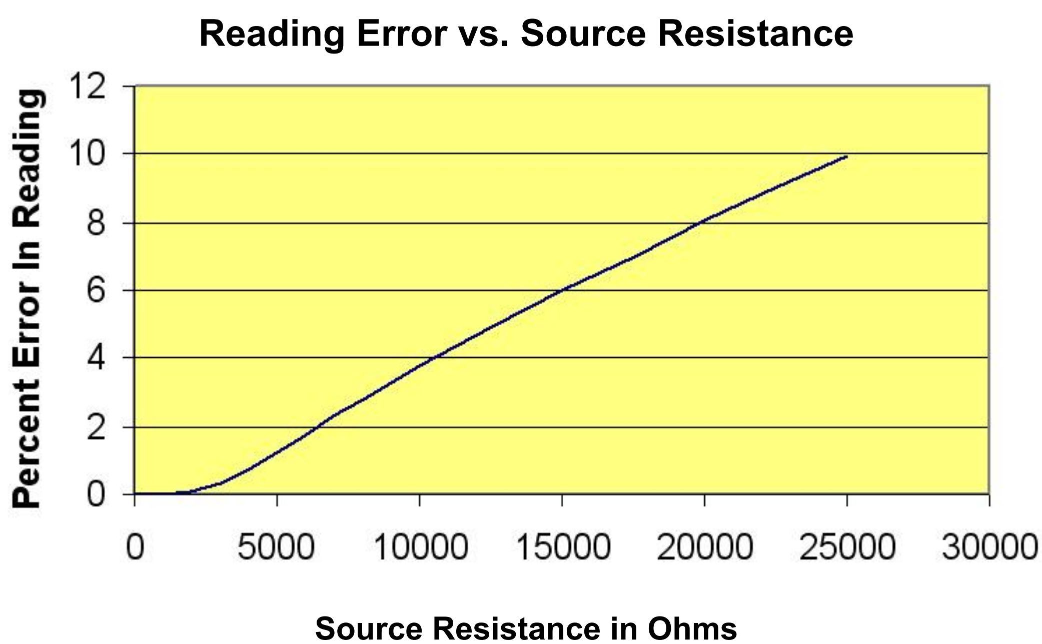
6. Re-install the top cover plate and secure it with the 4 screws that were removed in step 3.



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.



Configuring the DBK65 Address

You can connect 1 or 2 DBK65 modules to a single main channel on the primary data acquisition device. Thus, a 16-channel Daq device can support up to 32 DBK65 modules. Since each module has 8 input channels, a fully populated system can use 256 input sensors (32 modules x 8 channels per module).
To keep the large number of inputs organized, each DBK65 module is given a unique address via its DIP switch, S1 [located on the rear panel].

CAUTION

Each DBK65 must be configured before connecting the module to inputs and outputs. In addition, adjustment of the channel address must only be performed when the system's power is OFF. Failure to do so may result in equipment damage.

S1's four leftmost micro-switches are used to set the module's channel address in binary. Set the micro-switches to the desired address only after ensuring that the system power is OFF. Several example address settings are provided below. Other settings can be easily derived.

Each DBK65 module in the system must have a unique channel address for the primary data acquisition device. Valid addresses are 0 to 15. Note that two modules can have a setting for the same primary channel, for example, two modules could be set to channel 0; as long as one module is set to "L" to indicate the lower sub-channels 0-7 and the other is set to "U" to indicate the upper sub-channels of 8-15. Examples of various settings follow.

Channel 0 / Lower

Primary Acquisition Device Channel 0
DBK65 Lower Sub-Channels 0-7

The four leftmost micro-switches are set to "0" (Open). This sets the unit to **primary acquisition device Channel 0**. The rightmost switch is at "**L**," setting the module to the **"lower" DBK65 sub-channels (0 through 7)**.

Note: If connecting a second module to primary device Channel 0, the U/L switch for that module would be set to "U" for sub-channels 8 thru 15.

Channel 5 / Lower

Primary Acquisition Device Channel 5
DBK65 Lower Sub-Channels 0-7

The micro-switches for binary 4 and binary 1 are closed. This sets the unit to **primary acquisition device Channel 5**. The rightmost switch is at "**L**," setting the module to the **"lower" DBK65 sub-channels (0 through 7)**.

Channel 15 / Lower

Primary Acquisition Device Channel 15
DBK65 Lower Sub-Channels 0-7

The micro-switches for binary 8, 4, 2, and 1 are closed, thus setting the **channel to "15"** (8 + 4 + 2 + 1) for the primary acquisition device. The rightmost switch is at "**L**," setting the module to the **"lower" DBK65 sub-channels**
(0 through 7).

Channel 2 / Upper

Primary Acquisition Device Channel 2
DBK65 Upper Sub-Channels 8-15

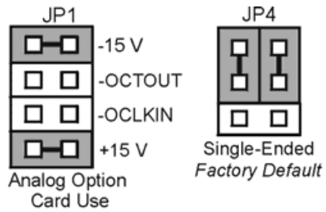
The micro-switch for binary 2 is closed, thus setting the **channel to "2"** for the primary acquisition device. The rightmost switch is at "**U**," setting the module to the **"upper" DBK65 sub-channels (8 through 15)**.

Configuring the Primary Data Acquisition Device

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK65 with a DaqBook/100 Series, DaqBook/200 Series, or with an ISA-type DaqBoard device requires the configuration of jumpers JP1 and JP4 located on that device, 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].



Note:
These jumpers do not apply to /2000 Series Devices.

Required Jumper Settings for DaqBook/100 Series, DaqBook /200 Series, and ISA-Type DaqBoards

The JP1 default position (above) is necessary to power the interface circuitry of the DBK65 via the internal ±15 VDC power supply. If using auxiliary power you must remove both JP1 jumpers.

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.

DaqBook/2000 Series & DaqBoard/2000 Series

No jumper configurations are required on the DaqBook/2000 series and DaqBoard/2000 series devices in regard to connecting a DBK65.

LogBooks

No jumper configurations are required on LogBook devices in regard to connecting a DBK65.

Connecting the DBK65 to Signals and to the Primary Data Acquisition Device

You can connect the DBK65 module to your primary data acquisition device and to its signal inputs after you have completed the following:

- set the DBK65 module's address
- configured the DBK65 on a channel-by-channel basis for the application
- configured the primary data acquisition device, if applicable

You can connect up to eight sensors to one DBK65. A CA-37-x, CA-131-x, or a CA-255-xT cable is used to connect the module to a LogBook or Daq device via DB37 connectors (P1).

To connect a DBK65 to a WaveBook or ZonicBook, refer to the final portion of this section, *Connecting to a BNC Connector*.

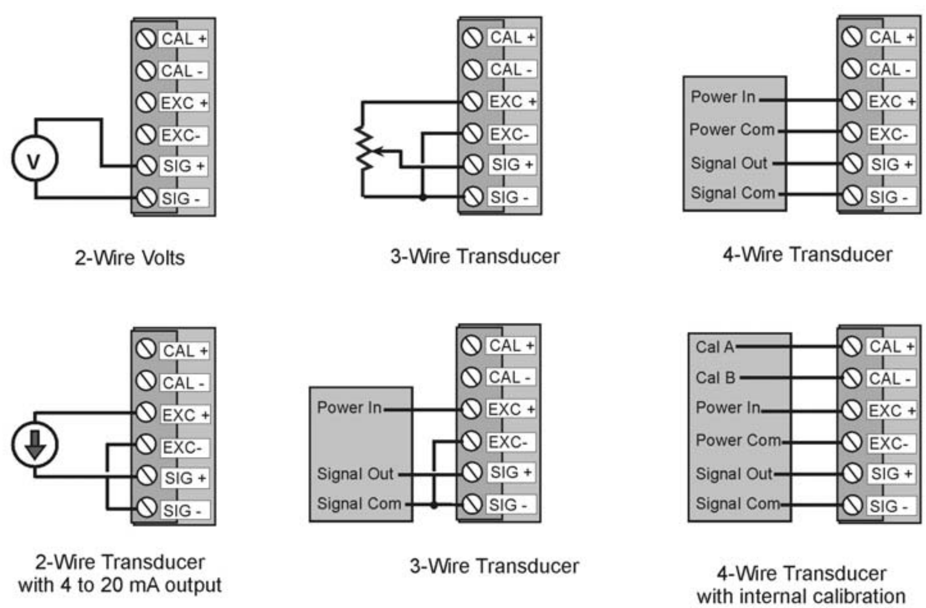
If your system needs to be CE Compliant, be sure to read the applicable *Declarations of Conformity* prior to connecting the DBK65.

Connect the DBK65 module as follows.

1. Connect each input to a screw terminal block on the DBK65. Example wiring diagrams are provided below. Note that the screw-terminal blocks can be removed from the DBK65 to allow for easier wiring.

CAUTION

Do not connect the excitation source to a non-isolated, powered transducer. Making such a connection can cause damage to both the DBK65 and to the transducer.



Wiring Scenarios

A Note Regarding the Excitation Source

The excitation source is ground-referenced, not floating, i.e., the -Excitation (EXC -) terminal is connected to the DBK65's ground. The Excitation Source is designed to interface with transducers such that it is the only power source, or its connection is electrically isolated from other power sources.

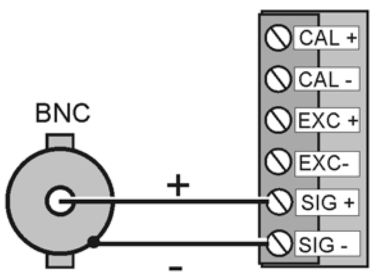
Tip: Label each transducer with its associated channel/sub-channel information.

2. For a single DBK65 module, connect one end of the P1 cable to the module's male DB37 output connector.
    - For DaqBook applications - use a CA-37-1, or a CA-255-xT cable.
    - For DaqBoard/2000 Series applications - use a CA-37-1 with a DBK200 Series adapter.
    - For DaqBoard [ISA type] boards - use a CA-131-1 cable.

3. Connect the free end of the cable to the P1 port of the LogBook or Daq device. For multiple DBK65 modules, use a CA-37-x, CA-131-x, or a CA-255-xT cable to daisy-chain several modules or an expansion module. For example, three DBK65s could be connected to a LogBook or a Daq device with via a CA-37-3 cable.

Connecting to a BNC Connector (Used with WaveBooks and ZonicBooks)

To connect a BNC connector to a DBK65 channel as signal input we make use of the two-wire scenario. The positive wire comes from the BNC central pin and connects to a DBK65 channel SIG+ terminal. The negative wire connects the negative of the pin hub to a DBK65 channel SIG- terminal. A "BNC to Male Binding Post" connector is convenient for making such two-wire connections.



Connecting a BNC to SIG+ and SIG-

BNC to Male Binding Post (for 2-wire connection)

Software Setup

The DBK65 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 DBK65 with that board you will have the same *Type* options, since the DBK65 is always a constant gain of x1.

LogView does not include the means to directly select a DBK65. To use a DBK65 with LogBook: First select DBK80 in LogView. This will recognize the DBK65, but will identify it as a DBK80 (which has eight additional channels). Next do one of the following as applicable:

(a) If the DBK65 is set to the L sub-address, use channels 0 through 7; *and ignore the displayed unused channels (8 through 15)*.

(b) If the DBK65 is set to the H sub-address, use channels 8 through 15; *and ignore the displayed unused channels (0 through 7)*.

Reference Notes:

- **DaqView users** - Refer to Chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *DBK Setup in LogView*. See above note.

Calibrating a Transducer using the “Shunt Calibration Technique”

The “shunt calibration” technique involves applying a known resistance across one leg of a transducer. When the resistance is applied, the transducer’s output changes as it would if an actual load was applied. Typically, transducers with internal amplifiers already have a built-in shunt calibration resistor. The shunt calibration resistor can be activated via the DBK65 by use of its rear panel CAL switch.

Prior to making use of the CAL switch, two transducer wires must be connected from the transducer to the applicable channel’s CAL+ and CAL- terminals on the DBK65. The wiring section of the transducer’s calibration data sheet will indicate which terminals (or wires) are to be connected.

To perform shunt calibration:

1. Verify that each transducer to be calibrated has been properly connected to a DBK65 channel’s CAL+ and CAL- terminals.
2. Ensure that the transducer has no initial load, i.e., that it is initially at “zero.”
3. Adjust the data instruments zero-control to obtain a value of 0.0 volts.
   In the case of 4 to 20 mA outputs, this value would be 4 mA.
4. Slide the CAL switch on the DBK65 rear panel to the “CLOSED” position. Each channel’s internal calibration switch will simultaneously close, activating the calibration shunts [if present].

   A step change in the channel output will occur.
5. If the amount of the step change does not agree with the expected change as indicated by the transducer’s calibration data sheet, adjust the transducer as needed. This is typically accomplished with SPAN and/or GAIN control. Refer to the documentation for your specific transducer.
6. Return the “CAL” switch to the “OPEN” position. This removes the shunt calibration resistance from each channel.
7. Recheck the “zero.” Note that there may be some interaction if the GAIN or SPAN control adjustments were large.

   In regard to 4 to 20 mA circuits, several full cycles of adjusting the ZERO and SPAN controls may be needed.

DBK65 Specifications

Dimensions: 285 mm W x 220 mm D x 45 mm H (11” x 8.5” x 1.75”)

Weight: 1.13 kg (2.5 lbs.)

Operating Temperature: -30°C to +70°C

System Connector: DBK37 male, mates with P1 connectors

Transducer Connectors: 8 removable screw-terminal blocks. Each block has 6 terminals.

Power Connectors: DIN5 Power In, DIN5 Power Out

DC Power Input: +10 to +30 VDC

DC Power Required (through DBK65 Power-In DIN5): 15 V @ 833 mA, 20 V @ 625 mA, assuming max load

DC Power Required (from P1-based host acquisition device): 25 mA from ±15 V, 755 mW total

Gain Ranges: x1

Inputs: 8 differential voltage inputs

Maximum Voltage Range: ±10 V

Input Impedance: 20M Ohm

Accuracy: ±[0.025% +150 μV] (typ), ±[0.1% +250 μV] (max)

Noise: 60 μV_{RMS} (typ)

Temperature Coefficient: 10ppm for every degree outside the range of 0° to 50°C

Maximum Signal Input Voltage (without damage): ±35 V

3 dB Bandwidth: 2.6 MHz

CMRR: 80 dB (typ)

Output Voltage: Each channel, jumper-selectable to +5 V, +10 V, +15 V, and +24 V
or to a custom voltage setting within the range of +5 to +20 V (user set via resistor)

Voltage Accuracy: ±2% (typical)

Current Limit: 100 mA per channel

Load Regulation: 5% (typ)

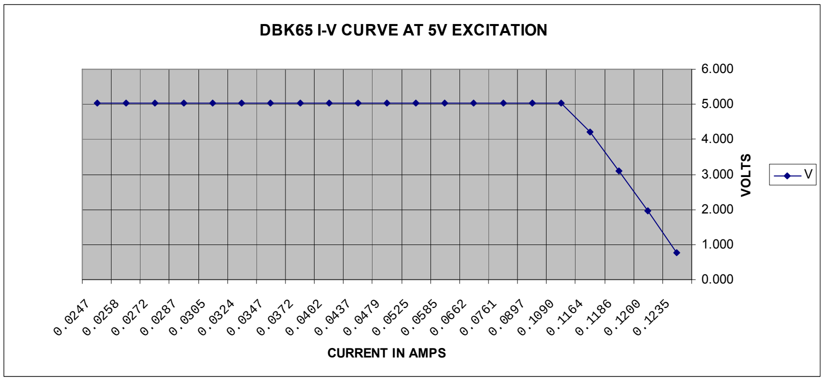
Total Output: 240 mA max, total of all 8 channels

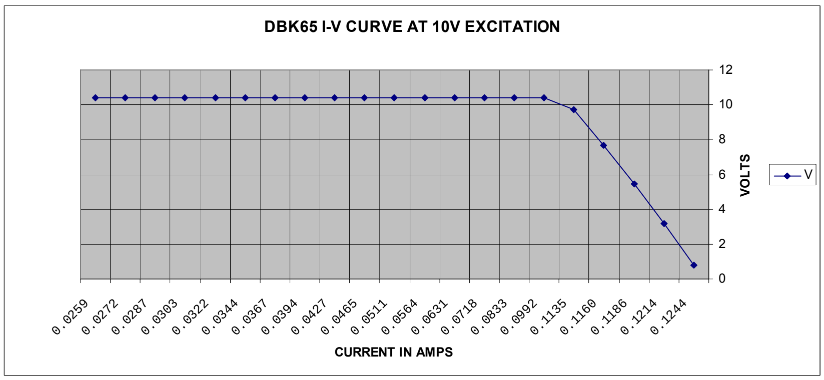
Accessories and Cables

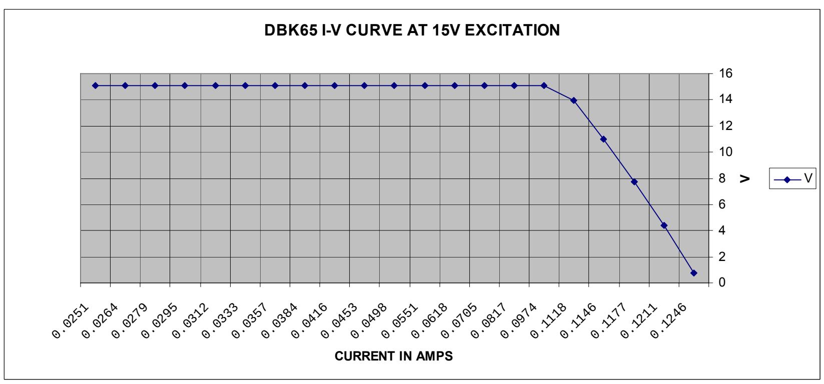
Rack mount kit	**RackDBK3**
Shielded P1 T cable for use with DaqBook/2020, LogBook/360, WBK40, WBK41	**CA-255-4T**
Shielded P1 T cable for use with DaqBook/2001, /2005, LogBook/300, DaqLab/2001, /2005	**CA-255-2T**
Ribbon cable for use with DaqScan	**CA-37-x** (see note)

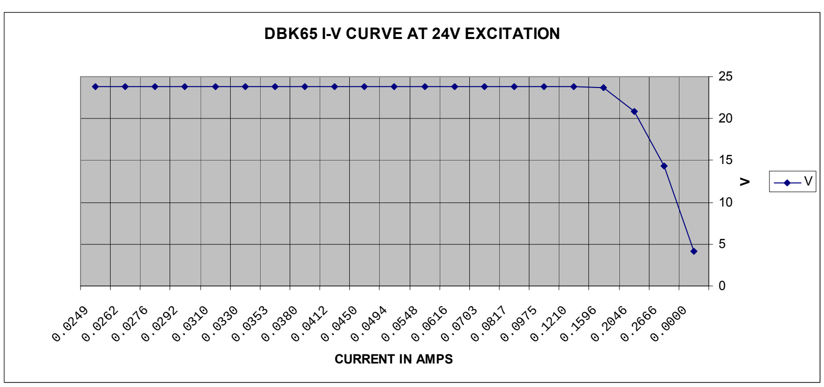
Note: The CA-37-x ribbon cable can also be used in lieu of the CA-255-x molded T cables.

The following 4 graphs illustrate the current limiting capabilities of the DBK65 for 5, 10, 15, and 24 VDC excitation values.


DBK65 I-V CURVE AT 5V EXCITATION
6.000
5.000
4.000
3.000
2.000
1.000
0.000
VOLTS
V
0.0247 0.0258 0.0272 0.0287 0.0305 0.0324 0.0347 0.0372 0.0402 0.0437 0.0479 0.0525 0.0585 0.0662 0.0761 0.0897 0.1090 0.1164 0.1186 0.1200 0.1235
CURRENT IN AMPS


DBK65 I-V CURVE AT 10V EXCITATION
12
10
8
6
4
2
0
VOLTS
V
0.0259 0.0272 0.0287 0.0303 0.0322 0.0344 0.0367 0.0394 0.0427 0.0465 0.0511 0.0564 0.0631 0.0718 0.0833 0.0992 0.1135 0.1160 0.1186 0.1214 0.1244
CURRENT IN AMPS


DBK65 I-V CURVE AT 15V EXCITATION
16
14
12
10
8
6
4
2
0
V
V
0.0251 0.0264 0.0279 0.0295 0.0312 0.0333 0.0357 0.0384 0.0416 0.0453 0.0498 0.0551 0.0618 0.0705 0.0817 0.0974 0.1118 0.1146 0.1177 0.1211 0.1246
CURRENT IN AMPS


DBK65 I-V CURVE AT 24V EXCITATION
25
20
15
10
5
0
V
V
0.0249 0.0262 0.0276 0.0292 0.0310 0.0330 0.0353 0.0380 0.0412 0.0450 0.0494 0.0548 0.0616 0.0703 0.0817 0.0975 0.1210 0.1596 0.2046 0.2666 0.0000
CURRENT IN AMPS

Notes

DBK80 16-Channel Differential Voltage Input Card

with Excitation Output

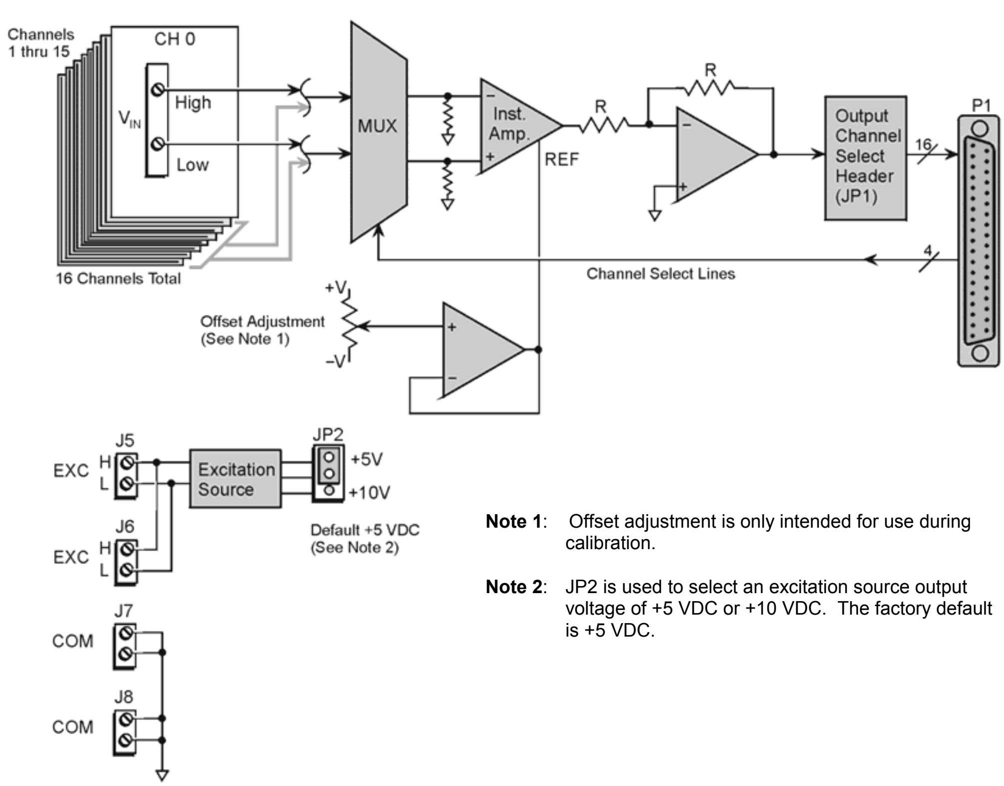
Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

Overview

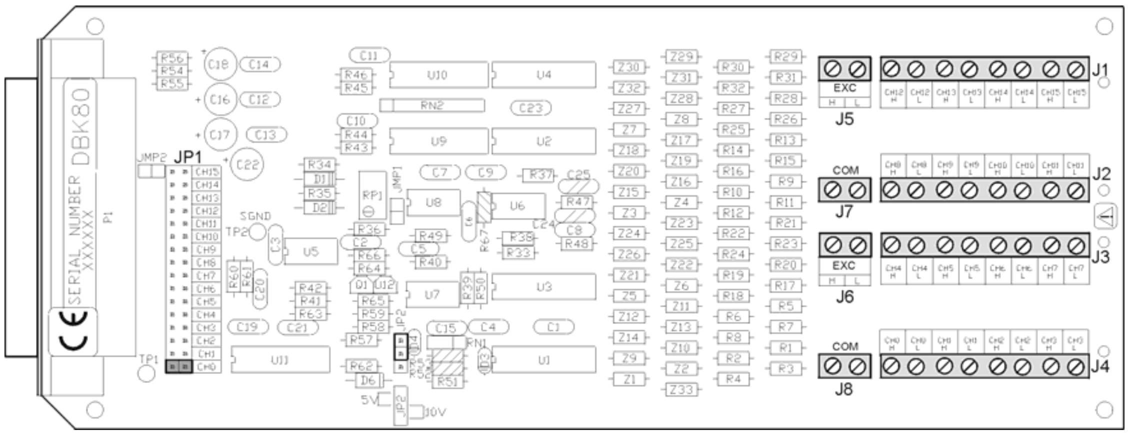
The DBK80 is a low-noise, high-speed, unity-gain multiplexer card that provides 16 channels of differential voltage input. Up to 16 such cards can be attached to a single Daq device, providing a possible 256 differential input channels. The card's unity gain combines with DaqBook, DaqBoard, and LogBook 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

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.

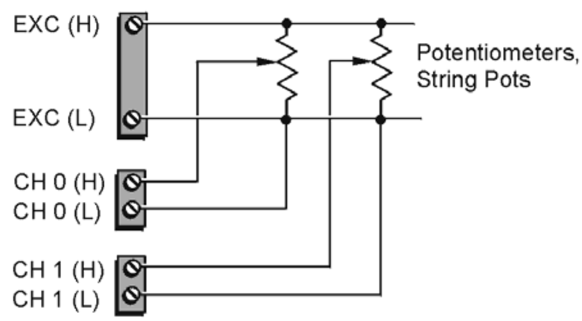
The excitation source is ground-referenced, not floating. That is, its low terminal is connected to the ground of the Daq device. It is designed to interface to circuits where it is the only power source, or where its connection is electrically isolated from other power sources. An example of the latter is an optocoupler.

CAUTION

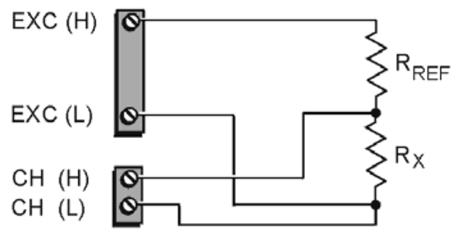
Do not connect the excitation source to a non-isolated, powered circuit. Making such a connection can cause damage to both the DBK80 and to the circuit under test.

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*.

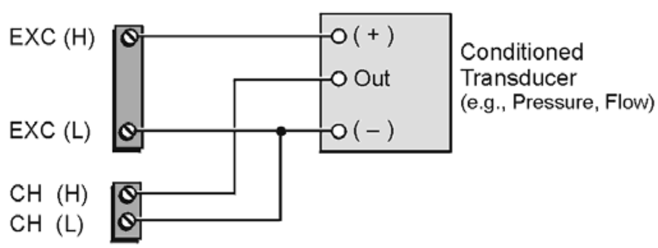


Position Sensing



$$R_X = R_{REF}\left[\frac{V_{CH}}{V_{EXC} - V_{CH}}\right]$$

Resistance/Thermistor Measurement

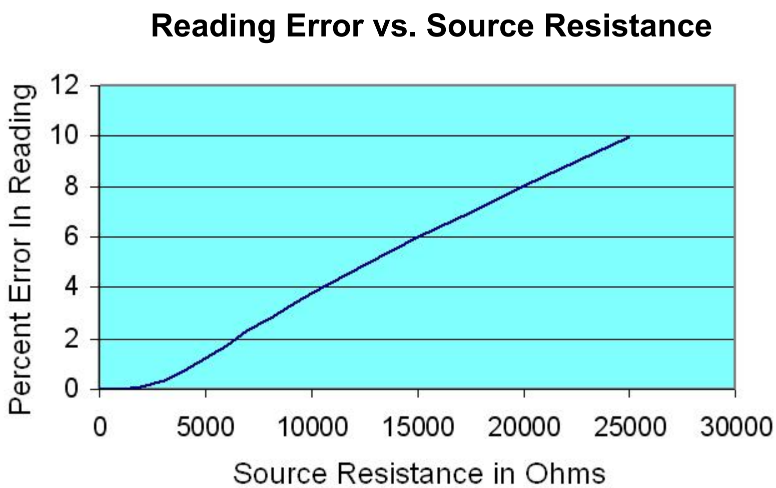


Reading a Transducer

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.

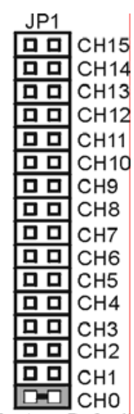
Although J7 and J8 are electrically equivalent to the "L" signal of the excitation source, they should never be used as the return point for the excitation source.

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.

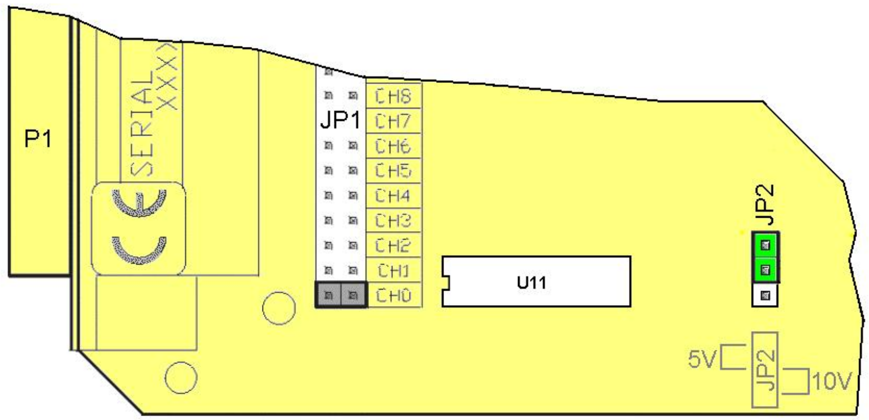
Since multiple cards are connected via a parallel interface, each card must have a unique channel address. To assign a channel number to the card, locate the 16×2-pin header (labeled JP1). JP1's jumper locations are labeled CH0 through CH15. Place the jumper on the two pins that correspond with the intended channel.



Factory Default Channel Configuration

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.



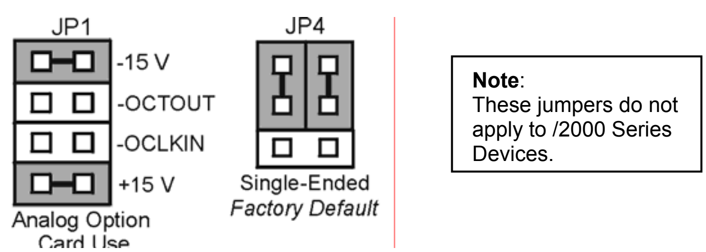
JP2 Location Reference

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/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK80 with a DaqBook/100 Series & /200 Series devices, or with an ISA-type DaqBoard, requires the configuration of jumpers JP1 and JP4 located on the DaqBook/100 Series & /200 Series devices, or DaqBoard [ISA type], 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 DaqBook/100 Series & /200 Series 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., DBK32A or DBK33) you must remove both JP1 jumpers.
Refer to *Power Requirements* in the *DBK Basics* section and to the DBK32A and DBK33 sections for more detailed information, 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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for the /2000 series devices.

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 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *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: ±[0.025% +150 µV] (typ), ±[0.1% +250 µV] (max)

Noise: 60 µVrms (typ)

Maximum Input Voltage (without damage): ±25 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: ±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)

DBK81, DBK82, and DBK83 Thermocouple Cards

DBK81 – 7 Channel Card
DBK82 – 14 Channel Card
DBK83 – 14 Channel Card with External Connection Pod

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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

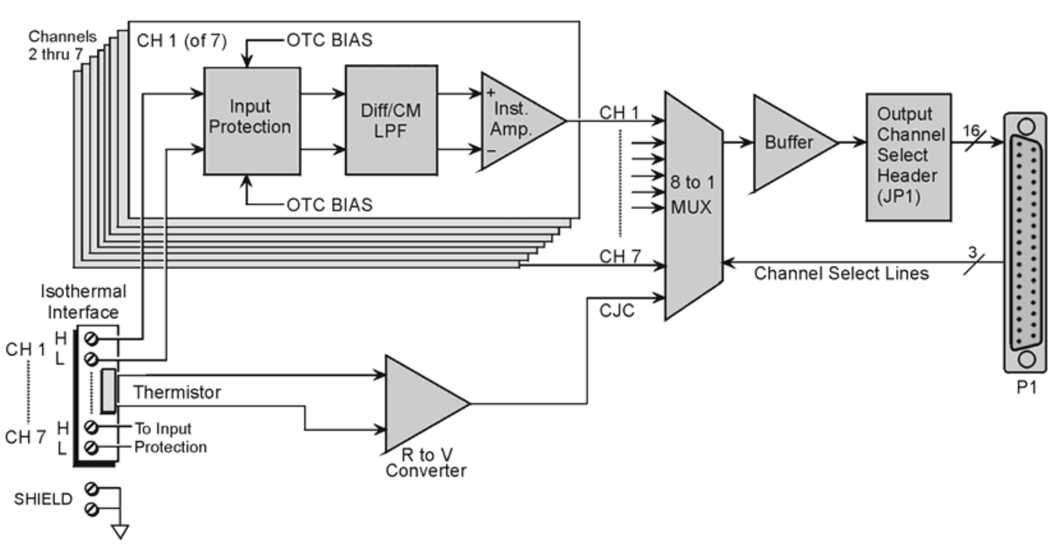
The three DBK cards connect to external thermocouples via channels, as follows:

- **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 CJCs, 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 ±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 *Power Requirements* in the DBK Basics section for additional information.

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.

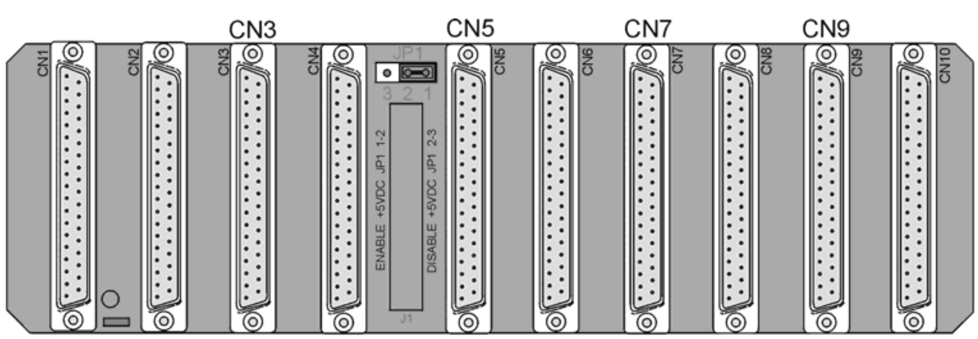
If available power is limited, short unused channels by connecting a short length of wire between the H and L terminals. This will minimize power consumption. Note that it is not enough to simply avoid scanning unused channels; to minimize power consumption the channels must be physically shorted in 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.

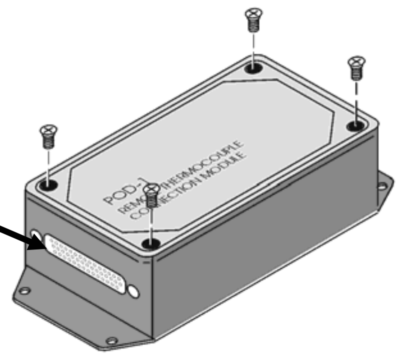


DBK41’s Printed Circuit Board
DBK82 cards can be connected to CN3, CN5, CN7, and CN9.

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. POD-1 dimensions are provided at the end of this section.

The female-end of the CA-239 cable connects to POD-1's male 44-pin connector.



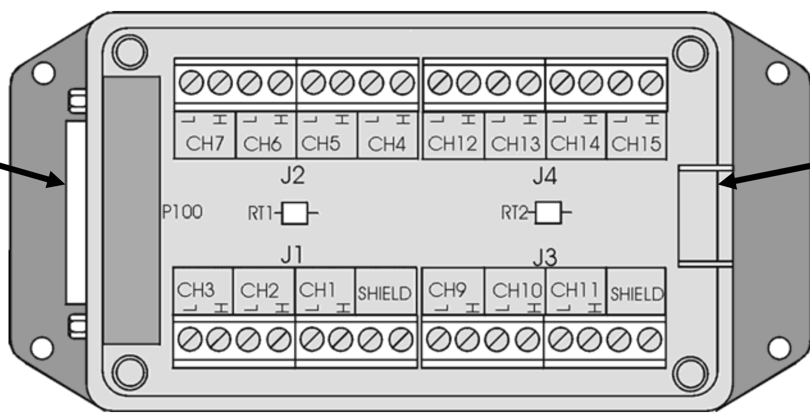
You must remove the four cover screws and the cover plate to access the pod's terminal blocks. The terminal block layout is provided in the following figure.

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.

The CA-239 cable connects here.



Thermocouple wires route through this opening.

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.

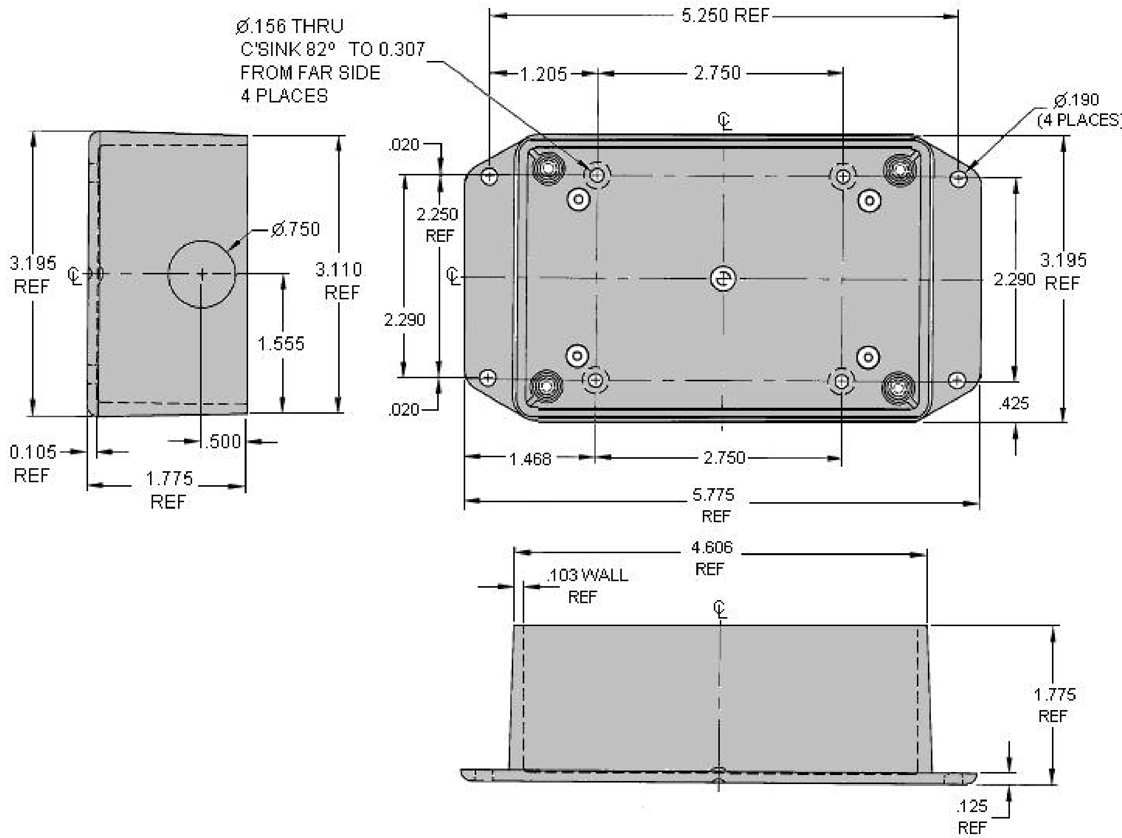
***To connect the POD-1 to the DBK83*:**

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.

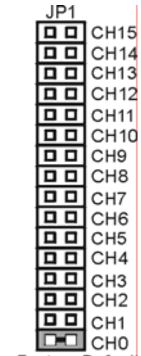
Because of the opposing gender on the CA-239 cable ends, it is possible to mate multiple CA-239 cables together to increase the distance from the POD-1 to the DBK83. Because of characteristics of the cable design and the signals on it, measurement integrity is not affected by doing so, and there are no practical limits on how many cables can be used.

POD-1 Dimensions



POD-1 Dimensions. POD-1 is for use with DBK43.

Card Configuration



Factory Default Channel 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.

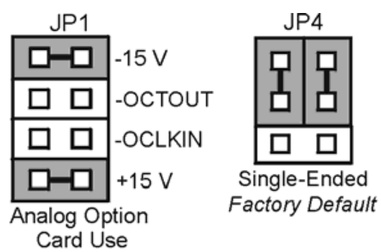
Since multiple cards are connected via a parallel interface, each card must have a unique channel address. To assign a channel number to the card, locate the 16×2-pin header (labeled JP1). JP1's jumper locations are labeled CH0 through CH15. Place the jumper on the two pins that correspond with the intended channel.

Only one channel configuration jumper is to be used per card. Each card in the system must have a unique jumper setting.

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK81, DBK82, or DBK83 with a DaqBook/100 Series device, /200 Series device, or 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.



Note:
These jumpers do not apply to /2000 Series devices.

Required Jumper Settings in DaqBook/100 Series & DaqBook/200 Series Devices and ISA-Type DaqBoards

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 *Power Requirements* in the *DBK Basics* section and to the DBK32A and 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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for the /2000 series devices.

Software Setup

Reference Notes:

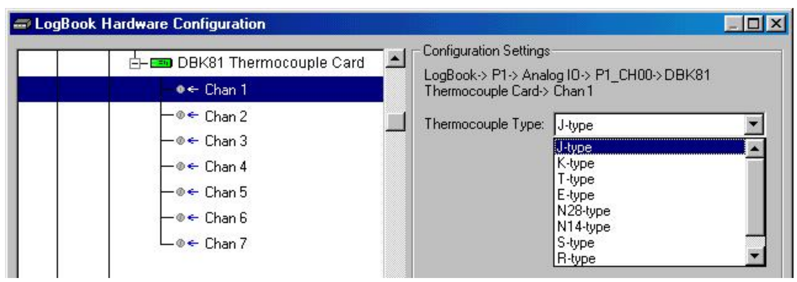
- **DaqView users** - Refer to Chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *DBK Setup in LogView*.
- Programmers using Daq devices should refer to related sections in the *Programmer's Manual*.

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.

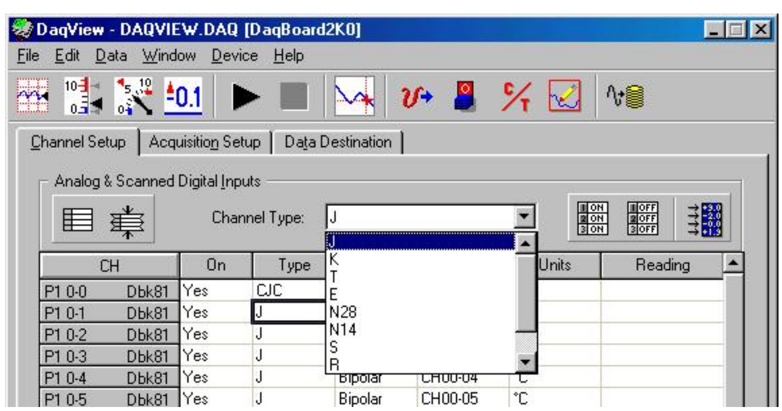
In the following screen-shot [from LogView], we see a J-type thermocouple being selected for Channel 1 of a DBK81.



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 ±15V; 2 mA max from +5 V
DBK82 and DBK83: 60 mA max from ±15V; 2 mA max from +5 V

Operating Temperature: 0°C to 50°C
Voltage Accuracy: ±(0.2% of reading +50 μV)

TC Accuracy: See table and accuracy conditions. Valid for one year, 18 to 28°C

Minimum Resolution: 0.1°C for all TC types

TC Accuracy at Measurement Temperature in °C (±°C)											
Type	**Min**	**Max**	**-100**	**0**	**100**	**300**	**500**	**700**	**900**	**1100**	**1400**
J	-200	760	0.8	0.7	0.7	0.8	0.9	0.9	—	—	—
K	-200	1200	0.9	0.8	0.8	0.9	1.1	1.1	1.2	1.3	—
T	-200	400	0.9	0.8	0.8	0.8	—	—	—	—	—
E	-270	650	0.8	0.7	0.7	0.7	0.8	—	—	—	—
S	-50	1768	—	3.1	2.4	2.0	2.0	1.9	2.0	2.1	2.1
R	-50	1768	—	3.1	2.1	2.0	1.9	1.9	1.7	1.9	2.0
B	50	1780	—	—	—	4.9	3.2	2.8	2.4	2.3	2.0
N28	-270	400	1.2	0.9	0.9	0.9	—	—	—	—	—
N14	0	1300	—	0.9	0.9	0.9	1.1	1.1	1.2	1.3	—

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
- $V_{CM} = 0$

Notes

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

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.

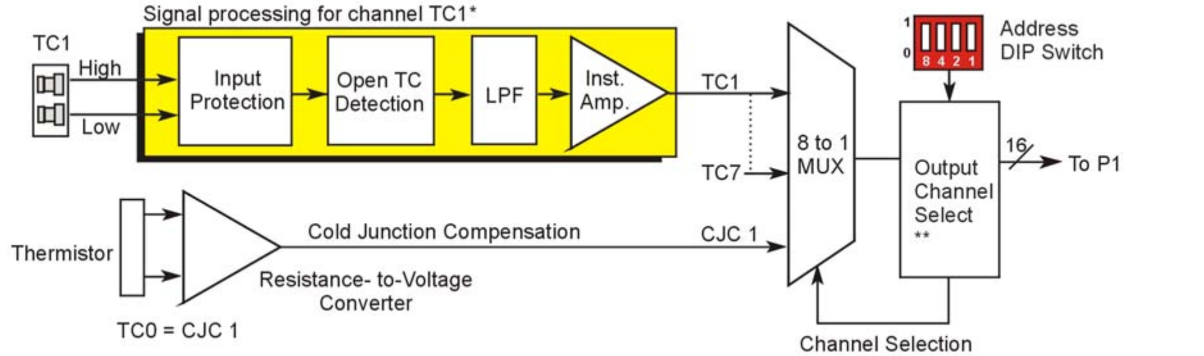
Thermocouple Temperature Ranges									
T/C Type	**J**	**K**	**T**	**E**	**N28**	**N14**	**S**	**R**	**B**
Temperature Range °C	-200 to 760	-200 to 1200	-200 to 400	-270 to 650	-270 to 400	0 to 1300	-50 to 1768	-50 to 1768	50 to 1780
Temperature Range °F	-328 to 1400	-328 to 2192	-328 to 752	-454 to 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: DBK84 has two on-board CJCs. 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.



* The 14 thermocouple circuitry channels TC1 through TC7 and TC9 through TC15 each have their own signal processing block, which consists of Input Protection, Open Thermocouple Detection, a Low Pass Filter, and an Instrument Amplifier. Channels TC0 and TC8 are used for Cold Junction Compensation (CJC).

** A second MUX [not shown] connects to the Output Channel Select. That MUX is for channels TC9 through TC15 and CJC2 (TC8).

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. For additional information refer to *Power Requirements* in the *DBK Basics* section.

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.

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

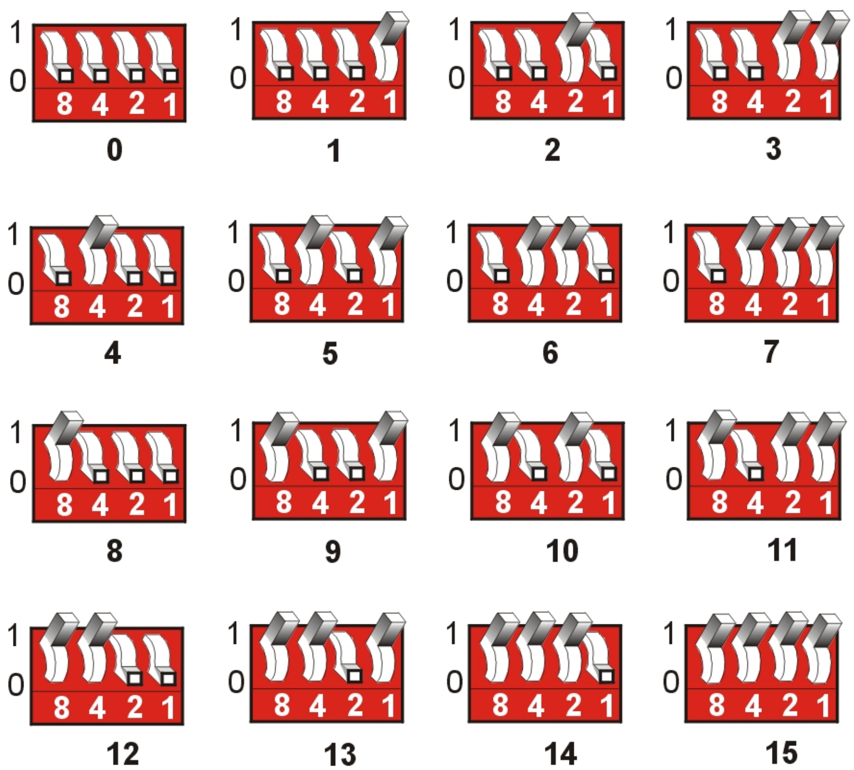
Up to sixteen DBK84 modules can be attached to a single LogBook or Daq device. Since multiple modules are connected via a parallel interface, each must have a unique channel address.

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.

Each module in the system must have a unique address.

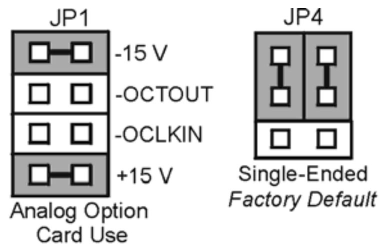


DBK84 Channel Address Settings

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK84 with a DaqBook/100 Series device, DaqBook/200 Series device, or with an ISA-type DaqBoard requires the configuration of jumpers JP1 and JP4 located on the DaqBook or DaqBoard device.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



Note:
These jumpers do not apply to /2000 Series devices.

Required Jumper Settings in DaqBook/100 Series Devices, DaqBook/200 Series Devices, and ISA-Type DaqBoards

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 *Power Requirements* in the *DBK Basics* section 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.

DaqBook/2000 Series and DaqBoard/2000 Series Configuration

No jumper configurations are required for the /2000 series devices.

Software Setup

Reference Notes:

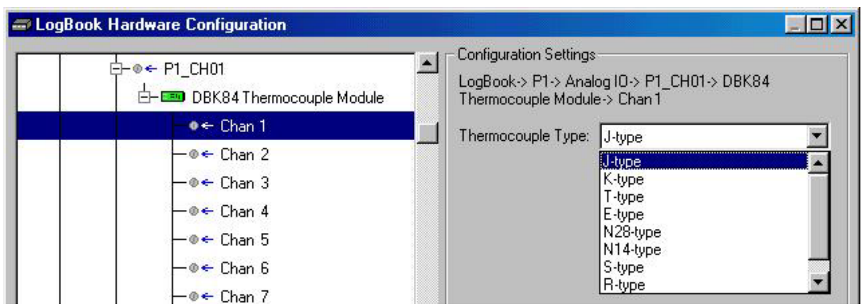
- **DaqView users** - Refer to Chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *DBK Setup in LogView*.
- Programmers using Daq devices should refer to related sections in the *Programmer's Manual*.

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.

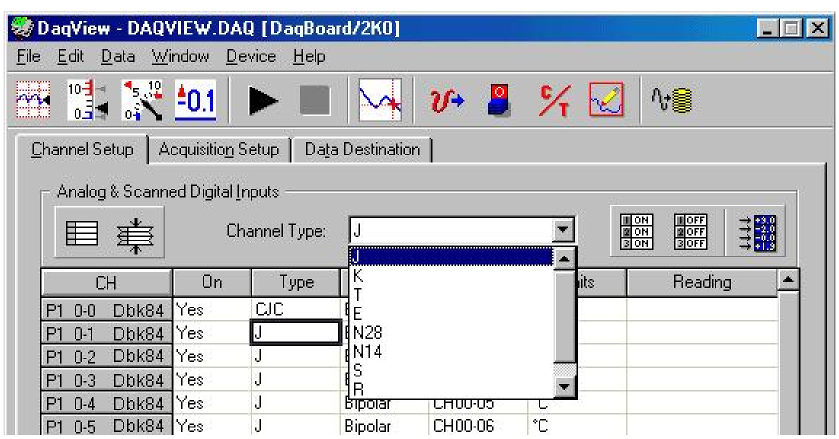
In the following screen-shot [from LogView], we see a J-type thermocouple being selected for Channel 1 of a DBK84.



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 ±15V; 2 mA max from +5 V
Operating Temperature: 0°C to 50°C
Voltage Accuracy: ±(0.2% of reading +50 µV)

TC Accuracy: See table and accuracy conditions. Valid for one year, 18 to 28°C

Minimum Resolution: 0.1°C for all TC types

TC Accuracy at Measurement Temperature in °C (±°C)											
Type	**Min**	**Max**	**-100**	**0**	**100**	**300**	**500**	**700**	**900**	**1100**	**1400**
J	-200	760	0.8	0.7	0.7	0.8	0.9	0.9	—	—	—
K	-200	1200	0.9	0.8	0.8	0.9	1.1	1.1	1.2	1.3	—
T	-200	400	0.9	0.8	0.8	0.8	—	—	—	—	—
E	-270	650	0.8	0.7	0.7	0.7	0.8	—	—	—	—
S	-50	1768	—	3.1	2.4	2.0	2.0	1.9	2.0	2.1	2.1
R	-50	1768	—	3.1	2.1	2.0	1.9	1.9	1.7	1.9	2.0
B	50	1780	—	—	—	4.9	3.2	2.8	2.4	2.3	2.0
N28	-270	400	1.2	0.9	0.9	0.9	—	—	—	—	—
N14	0	1300	—	0.9	0.9	0.9	1.1	1.1	1.2	1.3	—

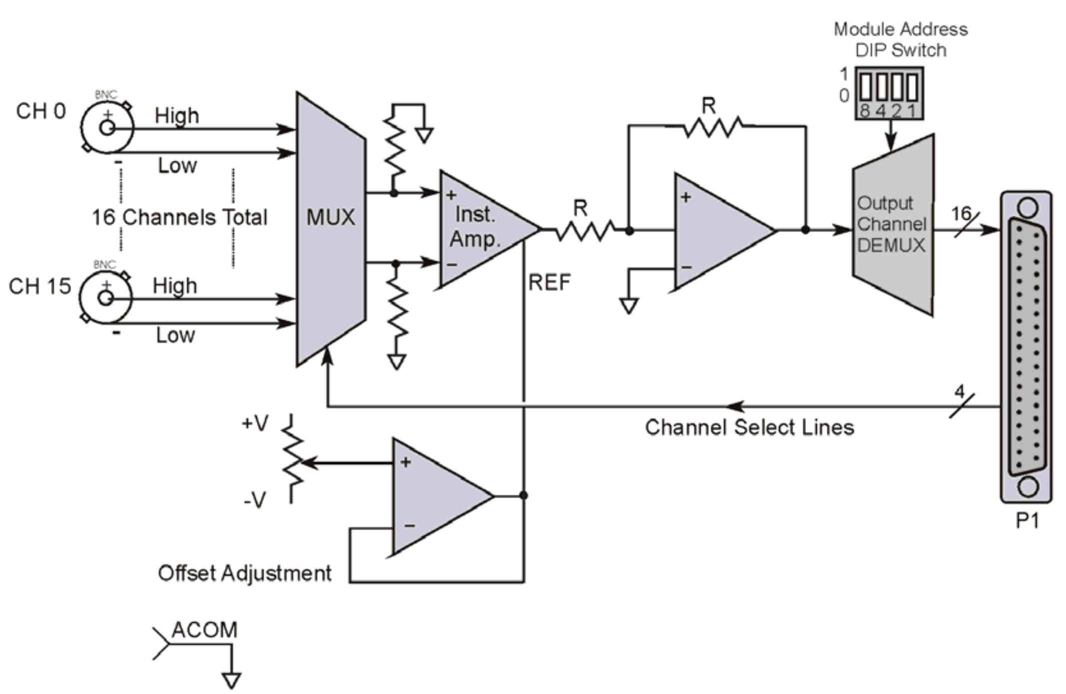
Accuracy conditions:

- Exclusive of thermocouple errors
- Exclusive of noise
- V_{CM} = 0

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

DBK85 Front Panel



DBK85 Block Diagram

Overview

The DBK85 is a low-noise, high-speed, unity-gain multiplexer module that provides 16 channels of differential voltage input. Up to 16 DBK85 modules can be attached to a single LogBook or Daq device, providing a possible 256 differential input channels. The module's unity gain of x1 combines with DaqBook, DaqBoard, and LogBook gains to accept full scale inputs from ±156 mV to ±10 V. The DBK85's channels can be scanned at the maximum 200 kHz rate while maintaining measurement integrity.

Hardware Setup

Configuring the DBK85 Module

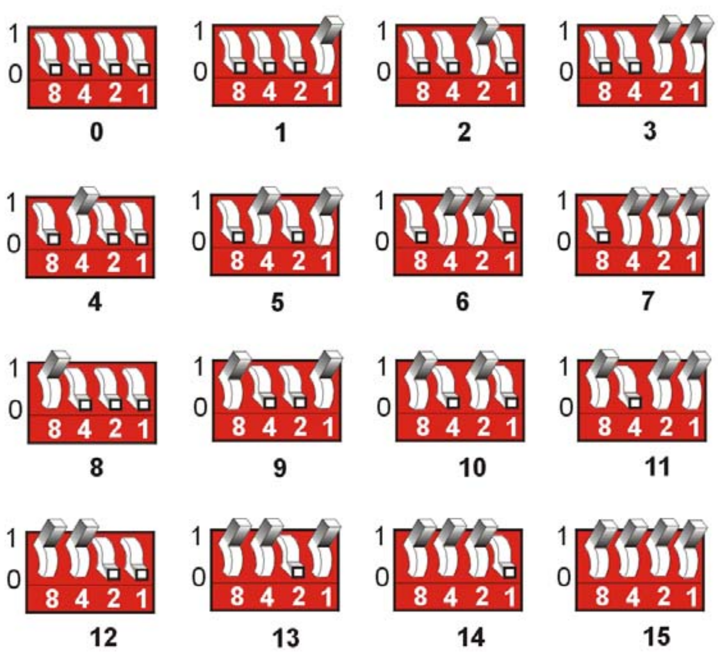
Up to sixteen DBK85 modules can be attached to a single LogBook or Daq device. Each module must have a unique channel address because they connect to the primary data acquisition device via parallel interface.

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 DBK85 module, first locate the DIP switch on the right side of the rear panel. 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 16 possible addresses are illustrated in the following figure.

Each module in the system must have a unique primary device channel address.



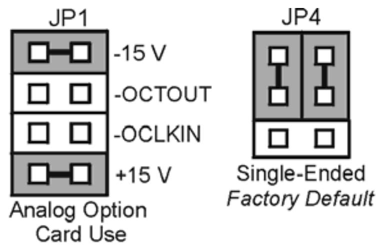
The 16 Possible Address Settings for DBK85 Modules

Configuring the Primary Data Acquisition Device

DaqBook/100 Series & /200 Series and DaqBoard [ISA type] Configuration

Use of a DBK85 with a DaqBook/100 Series, /200 Series devices, or with an ISA-type DaqBoard requires the configuration of jumpers JP1 and JP4. These jumpers are located on the DaqBook/100 Series, /200 Series devices, and DaqBoard [ISA type] board.

1. If not using auxiliary power, set the JP1 jumper for **Analog Option Card Use**, also referred to as the expanded analog mode.



Note:
These jumpers do not apply to /2000 Series Devices.

Required Jumper Settings in DaqBook/100 Series & /200 Series and ISA-Type DaqBoards

The JP1 default position (above) is necessary to power the interface circuitry of the DBK85 via the internal ±15 VDC power supply. If using auxiliary power (e.g., DBK32A or DBK33) you must remove both JP1 jumpers.
For additional information refer to *Power Requirements* in the *DBK Basics* section and to the DBK32A and DBK33 sections, as applicable.

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

Reference Note: Analog expansion cards convert all input signals to single-ended voltages that are referenced to analog common. The DBK85's analog common connector is located next to the channel 1 BNC. The connector is typically used to provide a ground reference point for differential measurements as discussed in Chapter 1, *Signal Management*.

DaqBook/2000 Series & DaqBoard/2000 Series

No jumper configurations are required on the DaqBook/2000 series and DaqBoard/2000 series devices in regard to connecting a DBK85.

LogBooks

No jumper configurations are required on LogBook devices in regard to connecting a DBK85.

CE Compliance

If your data acquisition system needs to comply with CE standards, the DBK85 must be connected to the LogBook or Daq device by a CA-143-x cable. In addition, the CE compliant operating conditions must be met as specified on the DBK85 module's *Declaration of Conformity* card, which is shipped with the module.

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

- the DBK85's *Declaration of Conformity*
- the *CE Compliance* section of *Signal Management* chapter of this manual

Connecting the DBK85 to Signals and to the Primary Data Acquisition Device

You can connect the DBK85 module to your primary data acquisition device and to its signal inputs after you have completed the following:

- set the DBK85 module's address
- configured the primary data acquisition device, if applicable

You can connect up to 16 signal lines to one DBK85, i.e., one per BNC. These inputs accept voltages up to ±10 VDC.

Connect the DBK85 module as follows. Note that if your system needs to be CE Compliant, be sure to read the preceding *CE Compliance* section prior to connecting the DBK85.

1. Connect each signal input line's BNC connector to a mating connector on the module. Overlays for CH0 to CH15 identify the associated BNC. Remember, signal input is limited to ±10 VDC.

   Tip: Label each signal input line with its associated channel information.

2. For a single DBK85 module, connect one end of the P1 cable to the module's male DB37 output connector.

   - For DaqBook applications - use a CA-37-x cable.*
   - For DaqBoard/2000 Series or /2000c Series boards - use a CA-37-x with a DBK200 Series adapter.*
   - For DaqBoard [ISA type] boards - use a CA-131-x cable.*

   * CA-37-x and CA-131-x cables do not meet CE compliance requirements. Refer to the preceding CE section if CE compliance must be met.

3. Connect the free end of the cable to the P1 port of the LogBook or Daq device. For multiple DBK85 modules, use a CA-37-x (or CA-131-x) cable to daisy-chain several modules or an expansion module. For example, three DBK85s could be connected to a LogBook or a Daq device via a CA-37-3 cable.

Note: For longer cable runs you can use a CA-113 cable to add 6 ft of length.

Analog Common

DBK85's analog common connector is located just left of the channel 1 BNC. The connector is typically used to provide a ground reference point for differential measurements as discussed in the *Signal Management* section of Chapter 1.

Software Setup

The DBK85 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 DBK85 with that board you will have the same *Type* options since the DBK85 has a fixed gain of x1.

LogView does not include the means to directly select a DBK85. To use a DBK85 with LogBook, select DBK80. This will recognize the DBK85, but will identify it as a DBK80.

Reference Notes:

- **DaqView users** - Refer to Chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Refer to Chapter 4, *DBK Setup in LogView*. See above note.

Specifications – DBK85

Connectors:

DBK37 male connector designated as P1. Connects to P1 on a DaqBook, DaqBoard, or LogBook via a CA-37-x or a CA-131-x cable.

BNC: 16 BNC connectors (CH0 through CH15) for signal connection.

Analog Common: Binding Post/Banana Jack. Provides a ground reference point for differential measurements.

Gain Ranges: fixed gain at x1

Inputs: 16 differential voltage inputs

Maximum Voltage Range: ±10 VDC

Input Impedance: 20M Ohm

Accuracy: ±[0.025% +150 μV] (typ), ±[0.1% +250 μV] (max)

Noise: 60 μVrms (typ)

Maximum Input Voltage (without damage): ±25 V

3 dB Bandwidth: 2.6 MHz

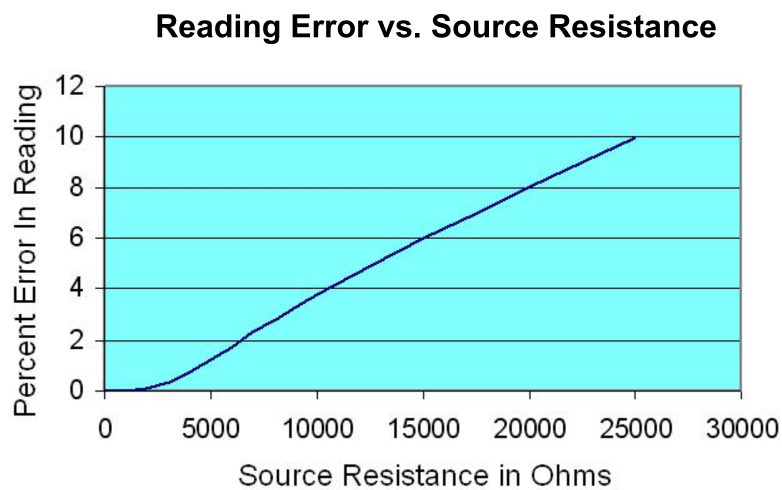
CMRR: 80 dB typ

Power: 25 mA max from ±15 VDC

A Note Regarding 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.



DBK90

56-Channel Thermocouple Module

For use with DaqBook/2000 Series Devices, WBK40, & WBK41

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

Overview

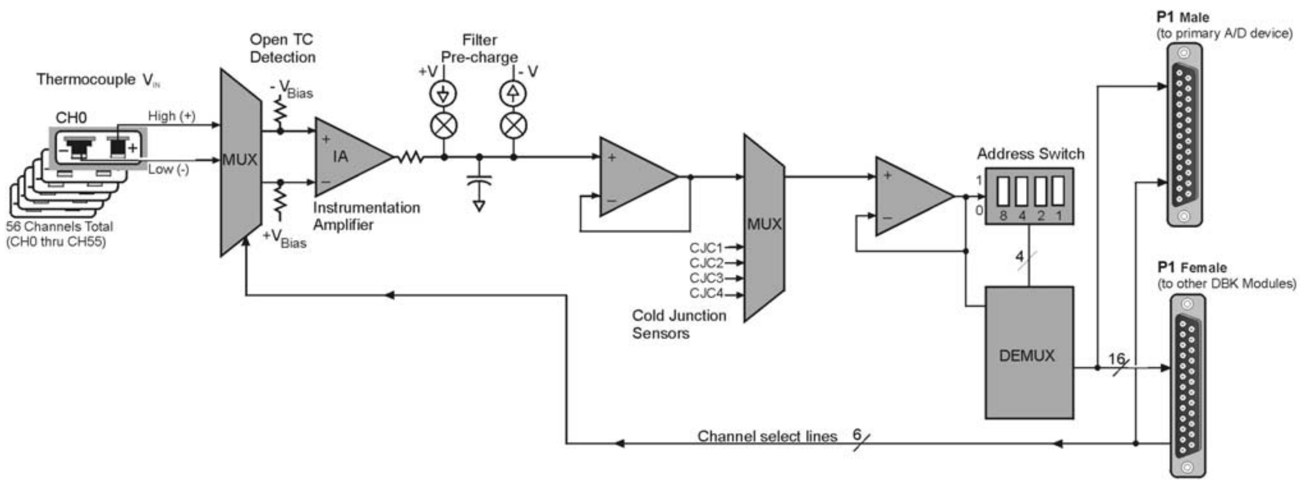
The DBK90 is used in temperature measurement applications and provides connections for 56 thermocouples through convenient mini-TC connectors.

The DBK90 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

Note: There are four CJCs on the DBK90, one per row of thermocouple connectors.

Up to sixteen DBK90 modules can be attached to a single DaqBook/2000 Series device, WBK40, or WBK41. Using Sixteen DBK90 modules provides up to 896 temperature channels.



DBK90 Block Diagram

In comparison to typical DBK options, the DBK90 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. For additional information refer to *Power Requirements* in the *DBK Basics* section.

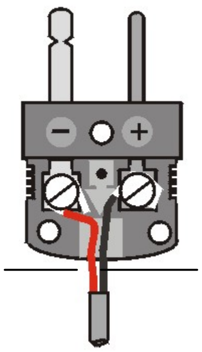
Hardware Setup

Connecting DBK90 Modules to Thermocouples

The DBK90 accepts up to 56 mini-TC plugs in its channels 0 through 55. 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 DBK90'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. If desired, 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.

Each DBK90 includes a jack labeled "ACOM." The jack is typically used for connecting the shield of a shielded thermocouple to the DBK90's analog common. When this connection is made the shield at the other end of the thermocouple is left unconnected.

If a thermocouple shield is connected to the DBK90 module, leave the shield unconnected at the other end of the thermocouple. Connecting the shield to common at both ends will result in a ground loop.

The jack accepts a removable 2mm banana plug for ease of making and breaking the analog common connection. The 2mm banana plug that is shipped with the product is part number 5936-0 from Pomona® Electronics.

The ACOM connector is a 2mm banana jack. To ensure a good connection that will not damage the jack, use a Pomona® Electronics 2mm banana plug (p/n 5936-0). The use of a different plug (including a 0.08 inch tip type) may damage the ACOM jack.

Reference Note:
In regard to automotive applications, refer to the upcoming section entitled, *Vehicle Testing*. The section begins on page 9.

Open Thermocouple Detection

The DBK90 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.

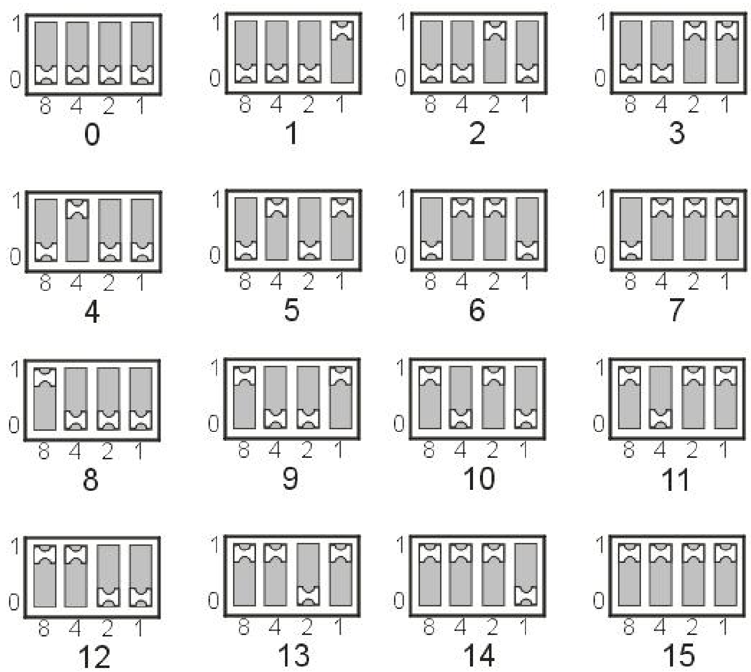
Module Configuration

Up to sixteen DBK90 modules can be attached to a single DaqBook/2000 Series device, WBK40, or WBK41. 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 DBK90 module, first locate the DIP switch on the unit's underside (the side opposite of the mini-TC connectors). 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 figure shows DIP switch settings for the 16 possible addresses.



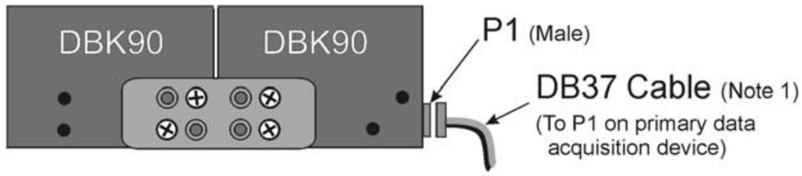
DBK90 Channel Address Settings

Each module in the system must have a unique address.

Connecting DBK90 Modules to other Devices

Mounting DBK90 Modules to Each Other – *Using Kit # 1109-0800*

Each 1109-0800 mounting kit includes two splice bars and eight screws. The kit is only intended for mounting one DBK90 module to another. However, other kits are available for mounting DBK90s to primary acquisition devices, for example, to a DaqBook/2000 Series device. Those kits are discussed shortly.



Two DBK90 Modules, Combined via Kit # 1109-0800

Follow these steps if you desire to mount DBK90 modules to each other using 8-hole splice bars.

1. Push the two DBK90 modules together such that their P1 connectors properly mate. Note that each DBK90 has a female P1 DB37 connector on one side and a male P1 DB37 connector on the other.
2. Align four holes of an 8-hole splice bar as indicated in the preceding figure. Note that the two holes for one DBK90 will be vertical, while the two holes for the other DBK90 will be diagonal (see figure).
3. Secure the splice bar to the DBK90 modules using the provided screws.
   The screws are 8-32 x 1/4 Phillips Pan Head Screws.
4. Use the second splice bar and set of 4 screws, to secure the other side of the assembly.

   Note: Additional splice bar kits can be used to add more DBK90 modules to the assembly.
5. Connect one end of a DB37 cable to the DBK90 male P1 connector (see figure).
6. Connect the other end of the DB-37 cable to the male P1 connector located on the primary data acquisition device.

This completes the procedure.

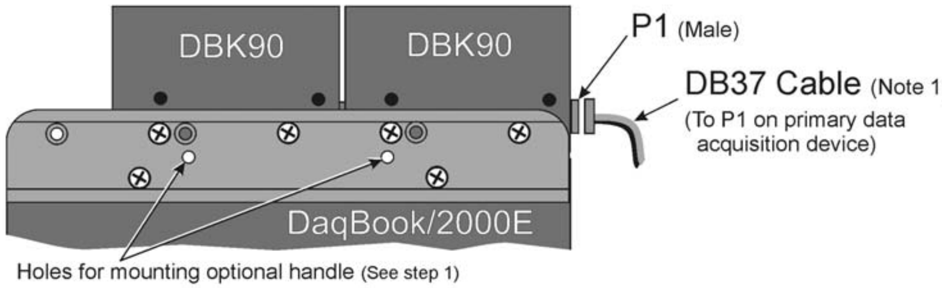
Note 1: The following female-to-female 37 pin connectors can be used to connect a DBK90 to the host data acquisition device. The use of shielded cables is recommended for scenarios in which signal noise is a problem.

CA-37-xT	cable with T-connector, not shielded
CA-37-x	cable, not shielded
CA-143-x	ribbon cable, shielded

Mounting one or two DBK90 Modules to a Primary Data Acquisition Device –

Using Kit # 1109-0802

Mounting kit p/n 1109-0802 includes two splice plates and the associated screws for securing the plates to the main data acquisition device, and then securing up to two DBK90 modules to the plates. An optional handle can be added, as discussed in step 1.



Two DBK90 Modules mounted to a DaqBook/2000E, via Kit # 1109-0802

Note that the DaqBook/2000 Series devices and the kit's splice-plates each have a length of 8.5 inches.

1. If you are attaching an optional handle:
   (a) Position the handle's mounting holes over the indicated holes in one splice plate.
   (b) Secure the handle by threading screws through the counter-sunk holes on the opposite side of the splice plate.
2. Align the lower two screw-holes of one splice-plate with the mating holes on the primary acquisition device.
3. Secure the splice-plate using two of the provided screws. The screws are 8-32 x 1/4 Phillips Pan Head Screws.
4. Mount the second splice-plate to the other side of the acquisition device.
5. Position a DBK90 module such that its male P1 connector is located on the same plane as the P1 connector on the primary device.
6. With the screw holes of the DBK90 aligned with those of a splice-plate (see figure), secure the module to the plate. Repeat this step for the other side of the module.
7. If you are connecting a second DBK90 module:
   (a) Mate the male P1 connector of the second DBK90 module with the female P1 connector of the first DBK90 module.
   (b) Secure the second DBK90 module to the two splice plates using two screws per side (see figure).
8. Connect one end of a DB37 cable to the first DBK90's P1 male connector (see figure).
9. Connect the other end of the CA-37 cable to the male P1 connector of the data acquisition device.

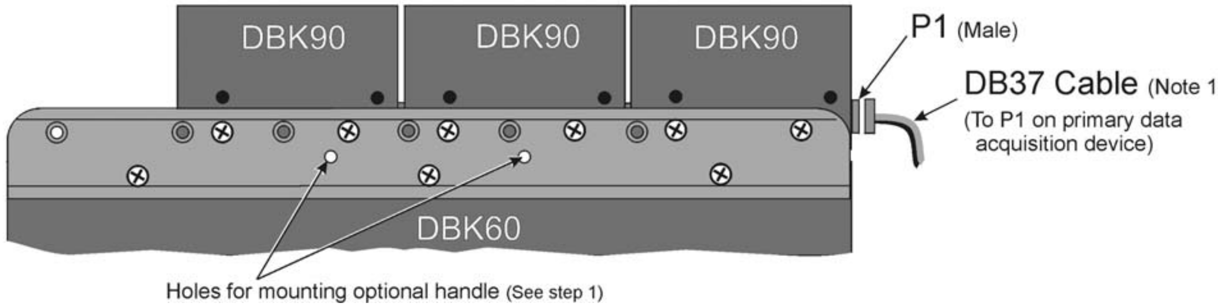
This completes the procedure.

Note 1: The following female-to-female 37 pin connectors can be used to connect a DBK90 to the host data acquisition device. The use of shielded cables is recommended for scenarios in which signal noise is a problem.

CA-37-xT	cable with T-connector, not shielded
CA-37-x	cable, not shielded
CA-143-x	ribbon cable, shielded

Mounting one, two, or three DBK90 Modules to a DBK60 – *Using Kit # 1109-0803*

Mounting kit p/n 1109-0803 is used to mount up to three DBK90 modules to a DBK60. The mounting kit includes two splice plates and the necessary screws.



Three DBK90 Modules Mounted to a DBK60 via Kit # 1109-0803

Note that the DBK60 and the splice-plates each have a length of 13 inches.

1. If you are attaching an optional handle:
   (a) Position the handle's mounting holes over the indicated holes in one splice plate.
   (b) Secure the handle by threading screws through the counter-sunk holes on the opposite side of the splice plate.
2. Align the lower three screw-holes of the splice-plate with the mating holes on the DBK60**.**
3. Secure the splice-plate to the DBK60 using three of the provided screws. Note that the screws are 8-32 x 1/4 Phillips Pan Head Screws.
4. Secure the second splice-plate to the other side of the DBK60.
5. Position a DBK90 module such that its male P1 connector is located on the same plane as the P1 connector of the DBK60.
6. Align the two lower screw holes of the DBK90 module with those on the splice-plate [the side nearest the DBK60's P1 connector] (see figure).
7. Use two of the provided screws to secure the DBK90 module to the splice-plate. Repeat this step for the other side of the assembly.
8. If you are connecting a second and/or third DBK90 module:
   (a) Mate the female P1 connector of the second [or third] DBK90 module with the male P1 connector of the previously mounted DBK90 module.
   (b) Secure the second [or third] DBK90 module to the two splice-plates using two screws per side (see figure).
9. Connect one end of a DB37 cable to the first DBK90's male P1 connector (see figure).
10. Connect the other end of the DB37 cable to the male P1 connector of the DBK60.

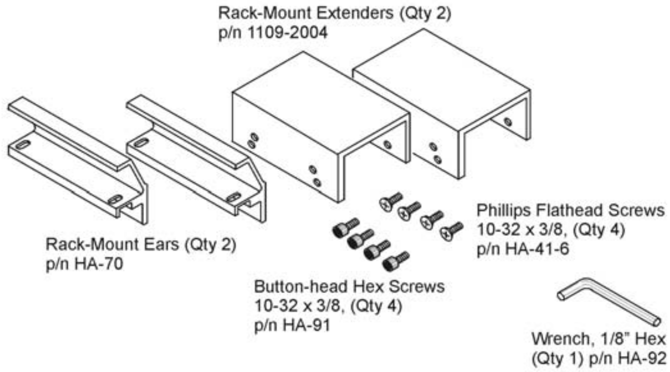
Note 1: The following female-to-female 37 pin connectors can be used to connect a DBK90 to the host data acquisition device. The use of shielded cables is recommended for scenarios in which signal noise is a problem.

CA-37-xT	cable with T-connector, not shielded
CA-37-x	cable, not shielded
CA-143-x	ribbon cable, shielded

This completes the procedure.

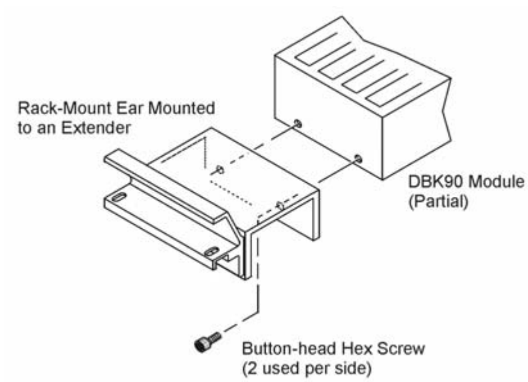
Mounting a DBK90 to a Rack – *Using Rack-Mount Kit # 1109-0801*

You can use Rack-Mount Kit # 1109-0801 to mount a DBK90 module to a standard instrument rack. The kit includes 2 rack mount ears, 2 rack-mount extenders, 4 button-head hex screws, 4 Phillips flathead screws, and a hex wrench.



Rack-Mount Kit # 1109-0801

Refer to the figures and to the following steps to prepare a DBK90 module for rack mounting.



Mounting an Ear/Extender Assembly to a DBK90

1. Align the screw-holes of a Rack-Mount Ear to the matching holes on a Rack-Mount Extender.
2. Fasten the two parts together using 2 of the Phillips Flathead Screws. The Ear/Extender assembly should resemble the one in the above illustration.
3. Using 2 Button-head Hex Screws, secure the Ear/Extender assembly to the DBK90 module. Proper orientation is indicated in the above figure.
4. Using the Hex Wrench [provided], tighten the Hex Screws.
5. Repeat steps 1 through 4 for assembling the remaining Ear/Extender components and attaching them to the other side of the DBK90.

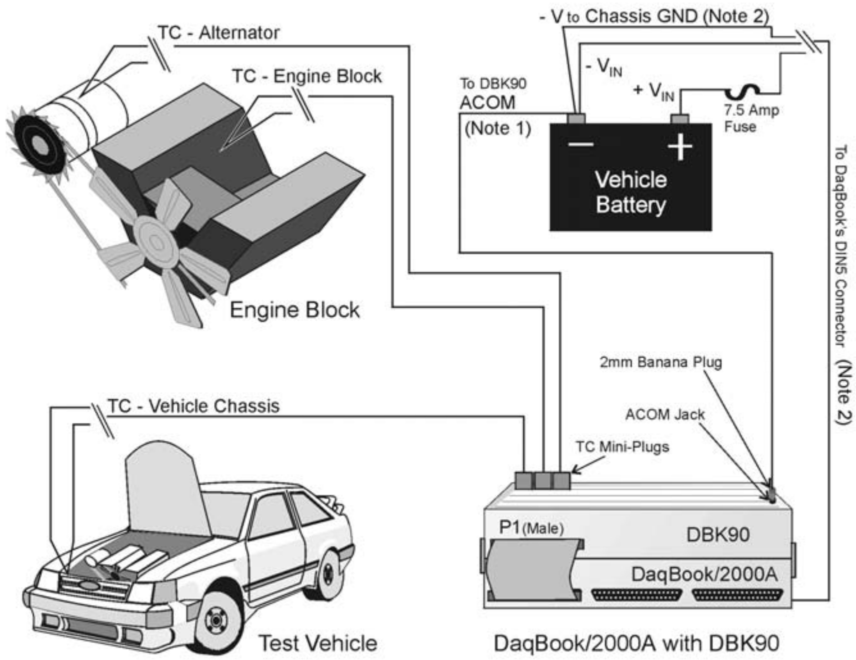
At this point the assembly can be mounted to a standard instrument rack.

Vehicle Testing and Noise Reduction

Power Connections and Analog Common

To properly measure vehicle-attached thermocouples differentially, it is necessary to have an analog common connection to the negative side of the vehicle's electrical system. A jack labeled ACOM, located on the DBK90's mini-TC panel, provides a connection point for analog common. If analog common is not connected, true differential readings cannot be obtained due to noise. For this reason, the chassis of the primary data acquisition device, e.g., DaqBook/2000A, must also have a good connection to the negative side of the vehicle's electrical system.

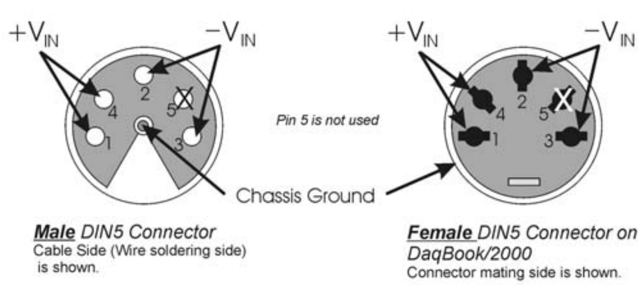
All grounds should come together at the negative terminal of the test vehicle's battery. Connecting the grounds at any other point may introduce noise. One line, with a 2mm banana plug is used to connect the battery's negative terminal to the DBK90's ACOM jack. The ACOM jack connects internally to the DBK90's P1, pin # 28 (AGND).



Connections for a Vehicle Test

Note 1: The ACOM connector is a 2mm banana jack. To ensure a good connection that will not damage the jack, use a Pomona® Electronics 2mm banana plug (p/n 5936-0). The use of a different plug (including a 0.08 inch tip type) may damage the ACOM jack.

Note 2: It is best to use a male DIN5 connector to connect the lines from the battery to the DaqBook/2000's female DIN5 connector. A Switchcraft® male DIN5 Connector (p/n 12BL5M) can be used for making your own cable.



The lines that will connect to the vehicle battery are soldered to the male DIN5 connector. As indicated in the first figure on this page, the $+V_{IN}$ line connects to the battery's positive (+) terminal and should have a 7.5 amp fuse in series with the line. The $-V_{IN}$ and Chassis Ground lines both connect to the battery's negative terminal.

Shielding

Using shielded TC wire with the shield connected to analog common [DBK90’s ACOM jack] will result in further noise reduction. Using a shielded ribbon cable to connect the DBK90’s male P1 connector to the P1 connector of the primary data acquisition device will also help minimize noise. CA-143-7 and CA-143-18 are female-to-female, DB37 shielded ribbon cables of 7-inch and 18-inch lengths, respectively.

If a thermocouple shield is connected to the DBK90 module, leave the shield unconnected at the other end of the thermocouple. Connecting the shield to common at both ends will result in a ground loop.

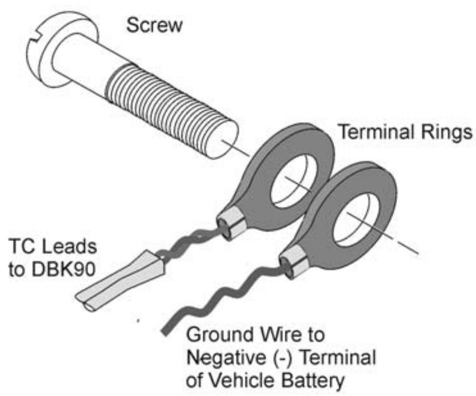
TC Common Mode

The maximum common-mode voltage for the DBK90 is ±10 volts. Common-mode voltage is the DC or AC voltage signal that is applied equally to both sides of a differential input.

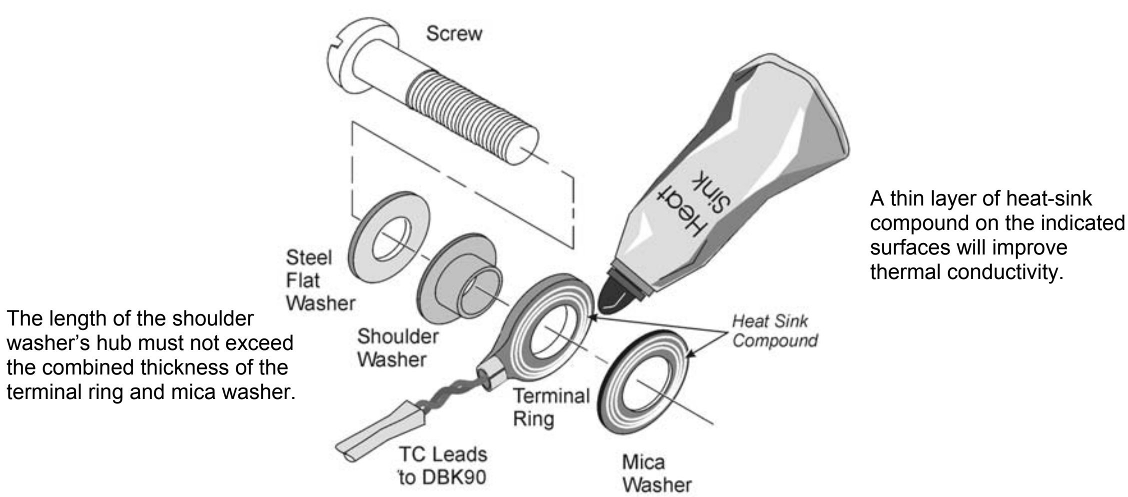
If a thermocouple is connected directly to a component in the vehicle at a potential that is over the maximum common-mode voltage, then very noisy or incorrect readings will be seen. Thermocouple connections that are made directly to the alternator or engine block may also result in high noise. Two methods of reducing noise are:

(a) Run a ground line from the bolt, as indicated in the first figure.

(b) Isolate the thermocouple leads with a set of washers, one of which is mica.
This is indicated in the second figure.



Running a Ground Wire to the Battery’s Negative Terminal



Using a Washer Set and Heat Sink to Isolate the Thermocouple

Software Setup

Reference Notes:

- **DaqView users** - Refer to *DBK Setup* in the *DaqView PDF*.
- **Programmers** using Daq devices should refer to related sections in the *Programmer's Manual*.

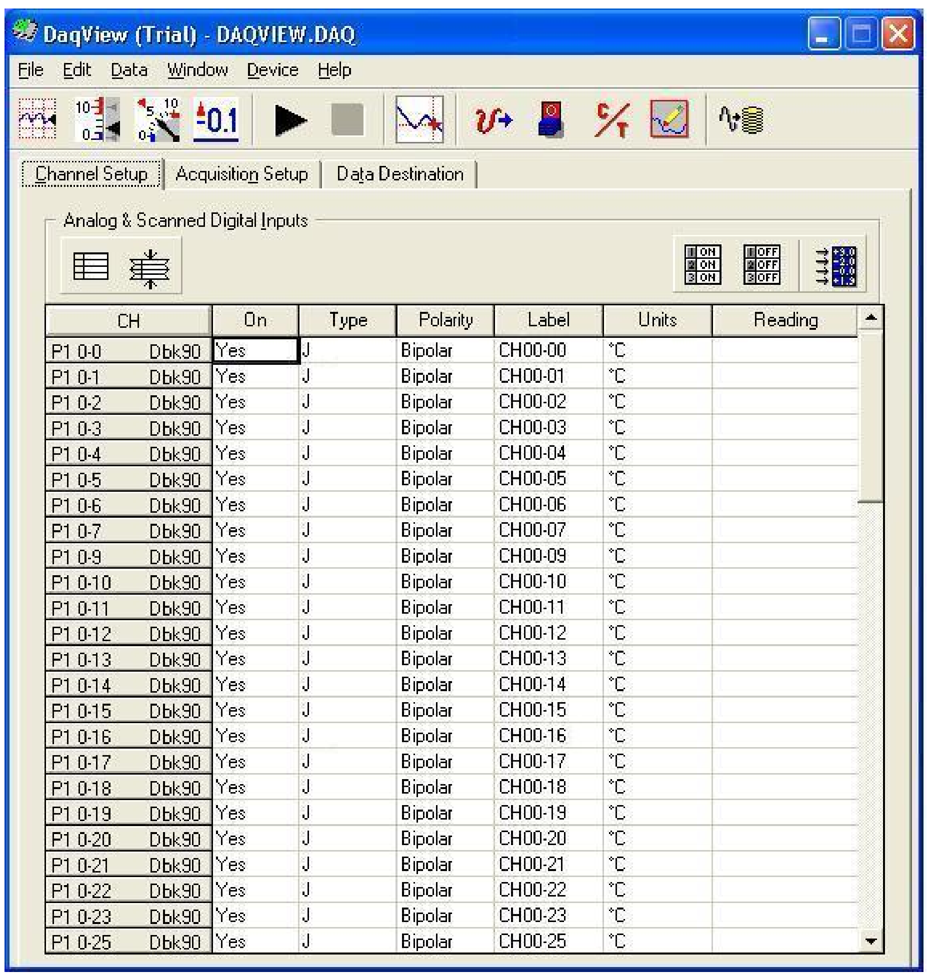
Note: DaqView includes functions for the conversion and linearization of thermocouple readings into temperature data.

When a DBK90 is selected in DaqView, thermocouple types must also be selected for the module's channels. The steps for this are as follows:

1. In DaqView's *Configure System Hardware Window*, select DBK90.
2. From the *Channel Setup Tab* (following figure) select the thermocouple types as applicable. Do this for each channel.

   Note: Channel types can be changed by double-clicking in the *Type* column, or by using the *Channel Type* pull-down list.

In the DaqView figure below we see that J-type thermocouples have been selected for a DBK90 module's Channels 0 through 25; possibly more, but we would have to scroll down to view information for the other channels. Note that channel 0 is designated as P1 0-0 and that channel 1 is seen as P1 0-1. The "0" indicates that the DBK90 module is the first such module in the acquisition system. A second DBK90 module would list channel 0 as P1 1-0 and would show channel 1 as P1 1-1. A third module would have P1 2-0, P1 2-1, and so on …



DaqView, Channel Setup

Using a Temperature Calibrator

The DBK90 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.

Note: The ambient temperature should be stabilized for at least one hour.

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 DBK90 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.

DBK90 – Specifications

Note: Specifications are subject to change without notice.

System Compatibility: Attaches to DaqBook/2000 Series, or to a WBK40 or WBK41

System Connectors: 1 male and 1 female DB37 connector for unit-to-unit mating and for mating with P1 on the primary data acquisition device.

TC Connectors: 56 Mini-TC connectors, oriented in 4 rows of 16

ACOM (Analog Common) Connector: DBK90's ACOM connector accepts a 2 mm banana plug (Pomona® Electronics p/n 5936-0). The ACOM connector and 2mm jack pin provide a convenient means of connecting a line to DBK90's analog common.

Inputs: 56 differential TC inputs, open TC detection per channel

TC Types: J, K, T, E, S, R, B, N28, N14

Speed: Maximum TC measurement rate is 1 ms/channel

Dimensions: 285 mm W x 88 mm D x 52 mm H (11" x 3.44" x 2.05")

Weight: 0.96 kg (2.12 lbs)

Power Requirements: 40 mA max from ±15V; 60 mA max from +5V

DBK90 Maximum Channel Capacity			
Device	**Max. Channel Capacity per Device**	**Max. Channel Capacity per System**	**Max. DBK90 Power Capacity per Device**
DaqBook/2000 Series	896 using 16 DBK90s	3,584* using 16 DBK90s	10 DBK90s ***
WBK40, WBK41	854 using 15 DBK90s	2,562** using 15 DBK90s	10 DBK90s ***

* Presumes 4 DaqBook/2000 Series devices per system.
** Presumes 3 WBK40 / WBK41 devices attached to a WaveBook/516E
*** Presumes that no other active DBK modules are attached. A DBK32A power supply is necessary to power additional DBK90s or other active DBK options.

Input Impedance: 4 MΩ (differential) in parallel with 400pF

Input Bandwidth: 1 kHz

Minimum Resolution: 0.1˚C for all TC types

TC Accuracy: Valid for one year 25˚C ambient, see following table and accuracy conditions

Operating Temperature: -20˚ to +80˚C

Relative Humidity: 0 to 95%, non-condensing

Temperature Coefficient of Accuracy: ±0.05˚C for every ˚C away from 25°C

Channel-to-Channel Crosstalk: -90 dB typ (0 to 100 Hz)

DC CMRR: -80 dB typ

AC CMRR: -80 dB typ (0 to 60 Hz)

Maximum Common Mode Voltage: ±10V

Over-Voltage Protection: ±40V

TC Accuracy at Measurement Temperature in °C (±°C)										
Type	**Min**	**Max**	**-100**	**0**	**100**	**300**	**500**	**700**	**900**	**1100**	**1400**
J	-200	760	0.8	0.7	0.7	0.8	0.9	0.9	—	—	—
K	-200	1200	0.9	0.8	0.8	0.9	1.1	1.1	1.2	1.3	—
T	-200	400	0.9	0.8	0.8	0.8	—	—	—	—	—
E	-270	650	0.8	0.7	0.7	0.7	0.8	—	—	—	—
S	-50	1768	—	3.1	2.4	2.0	2.0	1.9	2.0	2.1	2.1
R	-50	1768	—	3.1	2.1	2.0	1.9	1.9	1.7	1.9	2.0
B	50	1780	—	—	—	4.9	3.2	2.8	2.4	2.3	2.0
N28	-270	400	1.2	0.9	0.9	0.9	—	—	—	—	—
N14	0	1300	—	0.9	0.9	0.9	1.1	1.1	1.2	1.3	—

Accuracy conditions:

- Exclusive of thermocouple errors
- Exclusive of noise
- $V_{CM} = 0$

Ordering Information

Note: Ordering information is subject to change without notice.

	Description	Part No.
1	DBK90 56 channel thermocouple input module	DBK90
2	Mounting kit for attaching 1 or 2 DBK90 modules on top of a DaqBook/2000 Series device	1109-0802
3	Mounting kit for attaching 1,2, or 3 DBK90 modules on top of a DBK60	1109-0800
4	Mounting kit for mounting one DBK90 to another DBK90	1109-0803
5	2U high rack-mount kit for rack mounting one DBK90 module	1109-0801
6	Cables, DB37 type, female-to-female a) Unshielded T-connector cables b) Unshielded cables, no T connections c) Shielded ribbon cables, recommended for scenarios in which signal noise is a problem.	 CA-37-xT CA-37-x CA-143-x
7	2mm banana plug for DBK90's analog common connector (ACOM).	Pomona® Electronics p/n 5936-0

DBK100 Series   In-Vehicle Thermocouple Measurement System

DBK100/D, DBK100/T, and DBK101

System Compatibility:
DaqBook/2000* Series, DaqScan/2000 Series, and DaqLab/2000 Series Devices.

***Cannot be used with DaqBook/2000A, /2000E, or /2000X.**

DBK100/D

DBK100/T

DBK101

DBK100/D is terminated in a Deutsch connector, enabling watertight connections to a mating connector with up to 14 thermocouples. Custom pin-configurations are available to match with existing mating connectors. Inside the Deutsch connector [tethered to the DBK100/D] is the cold junction sensor, which is measured by the system and used to calculate the TC reading.

DBK100/T accepts 14 industry standard mini-TC connectors.

DBK101 You can connect one or two DBK101 hubs to a DaqBook/2000 series A/D module. A total system channel capacity of 896 channels per DaqBook/2000 system is possible when two DBK100 hubs are used.

Reference Notes:

- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- In regard to calculating system power requirements, refer to *DBK Basics* located near the front of this manual.

Overview

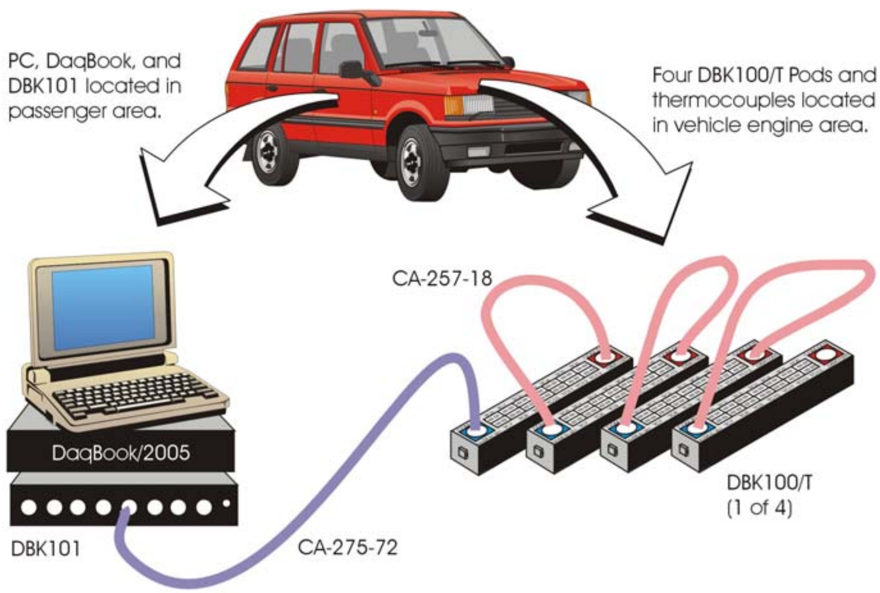
Features

- **Measure vehicle engine temperatures with remote DBK100s**
- **One cable transmits up to 56 channels of TC measurements from the engine compartment to the data acquisition system**
- **Up to 896 TCs per system**

DBK100/D and DBK100/T provide thermocouple measurement capability for in-vehicle applications, and are well suited for TC measurements in proximity to a vehicle engine. With operating temperatures in the range of -40° to +125°C, DBK100 Series devices are ideally suited for applications where engine compartment temperature measurements are required.

The DBK100/D is housed in a rugged and water resistant, all-metal package designed specifically for harsh environments. TC and system connections to each DBK100/D are water resistant, and are accessible from one direction, enabling the DBK100/D to be mounted and its I/O accessed without having to be removed.

Maximum system capacity is 896 thermocouples when two DBK101 modues are used; or 448 thermocouples when one DBK101 module is used, as indicated in the following figure. For clarity, thermocouple lines are not shown.



DBK100 System Example

These capacities were derived as follows:

- 14 thermocouples can be connected to each DBK100/T or DBK100/D.
- Up to four DBK100/T or DBK100/D units can be connected to a each DBK101 channel. This is illustrated in the preceding figure.
- DBK101 has 8 channels. Thus 32 DBK100 units can be connected to a DBK101. With 14 thermocouples possible per DBK100, 448 thermocouple connections are possible.
- Two DBK101 hubs can be connected to a DaqBook/2000 Series unit. When 2 hubs are used the system can have up to 896 thermocouples (448 x 2).

The benefit of a DBK100 system is that for every 56 TC input channels, only a single cable is required back to the measurement equipment. Thus the length of the TC wire can be much shorter, and the number of long cables back to the equipment is reduced by a factor of 56. Besides reducing the length of TC wire, this system substantially reduces the opening required between the engine compartment and the primary acquisition equipment, which is typically located in the passenger compartment of the test vehicle.

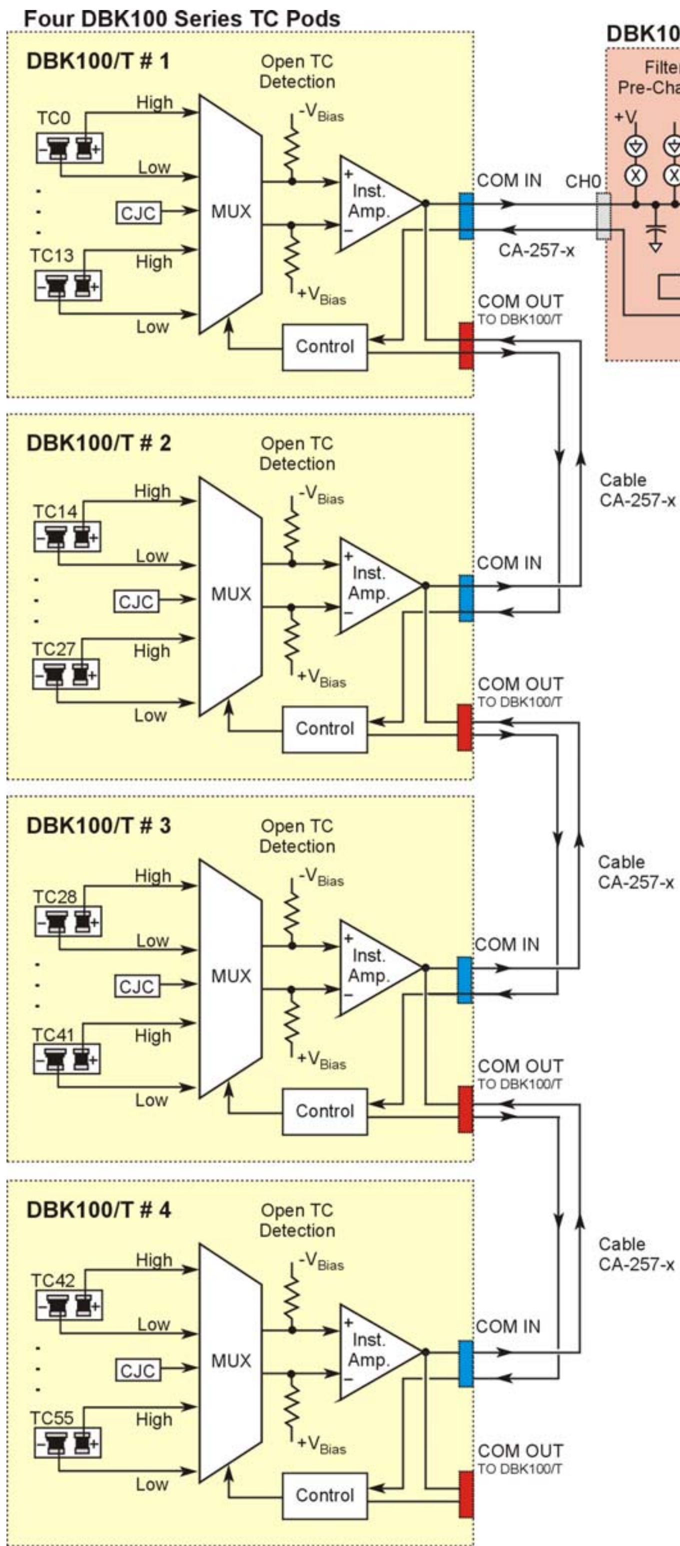
All linearization and cold-junction compensation is automatically corrected in the system, resulting in stable and accurate temperature measurements with typical accuracy of better than 2°C. Two versions of the DBK100 are available, differing by the way in which thermocouples are attached to the unit. With both models, the included software driver automatically determines the temperature based on the user's input as to what TC type is attached to each channel.

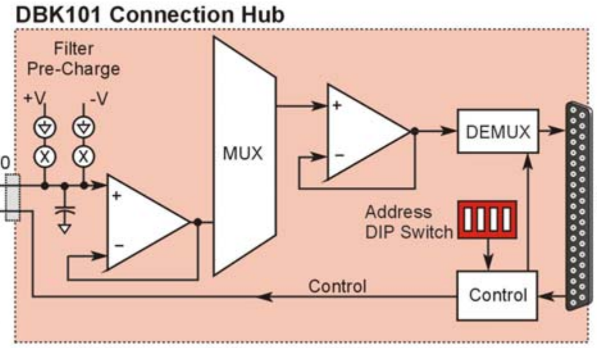
Each DBK100/D and DBK100/T includes a built-in cold junction compensation thermistor (CJC) for direct measurement of type J, K, T, E, N28, N14, S, R, and B thermocouples. The following table provides the temperature range for each type.

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

Cable Note:
There are three different sizes of CA-257-x interconnect cable. Any can be used to connect DBK100 units to each other, or to a DBK101. The cable lengths, in inches, are indicated by the last two digits of the part number. Thus:

- **CA-257-18** (18 inches)
- **CA-257-36** (36 inches)
- **CA-257-72** (72 inches)





DBK100

Connectors: 2 control connectors allow for daisy chaining between units and connection to the DBK101 hub. Each control connector has 9 signals (power, differential analog input, digital control.)

DBK100/D is terminated in a Deutsch connector for connecting up to 14 thermocouples via a mating connector. Though DBK100/D is not shown in the block diagram, the circuitry is the same as that indicated. Only the thermocouple connection differs.

DBK100/T accepts 14 industry standard mini-TC connectors.

Circuitry: The internal circuitry consists of a 16-channel multiplexor (MUX), differential instrumentation amplifier with a gain of 100, and digital control. The units include open thermocouple detection.

DBK101

Connectors: The DBK101 hub has 8 connectors located on the front panel, which link to DBK100 pods via cable. The rear panel of the DBK101 includes a P1 connector and an address switch.

Each DBK101 uses up to 8 of P1's 16 available input channels. A total of two DBK101 hubs can be connected to one DaqBook.

Circuitry: The circuitry inside the DBK101 provides the digital control and analog signal conditioning for the DBK100 pre-amplifier. The DBK101 contains a multiplexed pre-charge circuit. A digital control circuit monitors the addressing of DaqBook's P1 and generates serial bit streams for each DBK100 string.

The DBK101 draws all of its power from the host DaqBook through P1.

DBK100 / DBK101 System Block Diagram

In comparison to typical DBK options, the DBK101 demands significant power from P1. It is important that you calculate your system's power demand, as you may need to add auxiliary power supplies. For additional information refer to *Power Requirements* in the *DBK Basics* section.

Hardware Setup

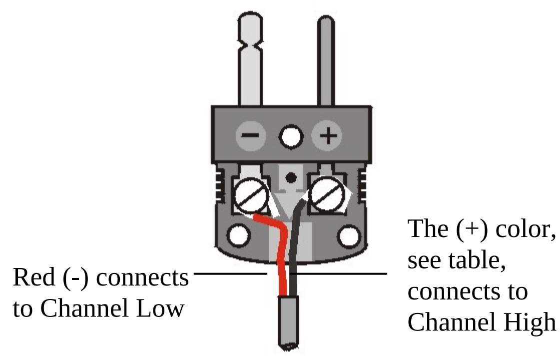
Connecting Thermocouples

Each DBK100/D and DBK100/T can accept up to 14 mini-TC plugs in its channels 0 through 13. All channels have the same level of functionality. Up to four DBK/100 units can be attached to a single channel of a DBK101 hub. With its 8 channels, a total of 32 DBK100 units can be connected to a single DBK101.

- 14 thermocouples can be connected to each DBK100/T or DBK100/D.
- Up to four DBK100/T or DBK100/D units can be connected to a each DBK101 channel.
- DBK101 has 8 channels. Thus 32 DBK100 units can be connected to a DBK101. With 14 thermocouples possible per DBK100 unit, 448 thermocouple connections are possible for one DBK101 hub.
- Two DBK101 hubs can be connected to a DaqBook/2000 Series unit. When 2 hubs are used the system can have up to 896 thermocouples (448 x 2).

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



DBK100/T users need to be aware that mini-TC plugs are type-specific. 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 DBK100/T connectors in one orientation, ensuring a correct connection.

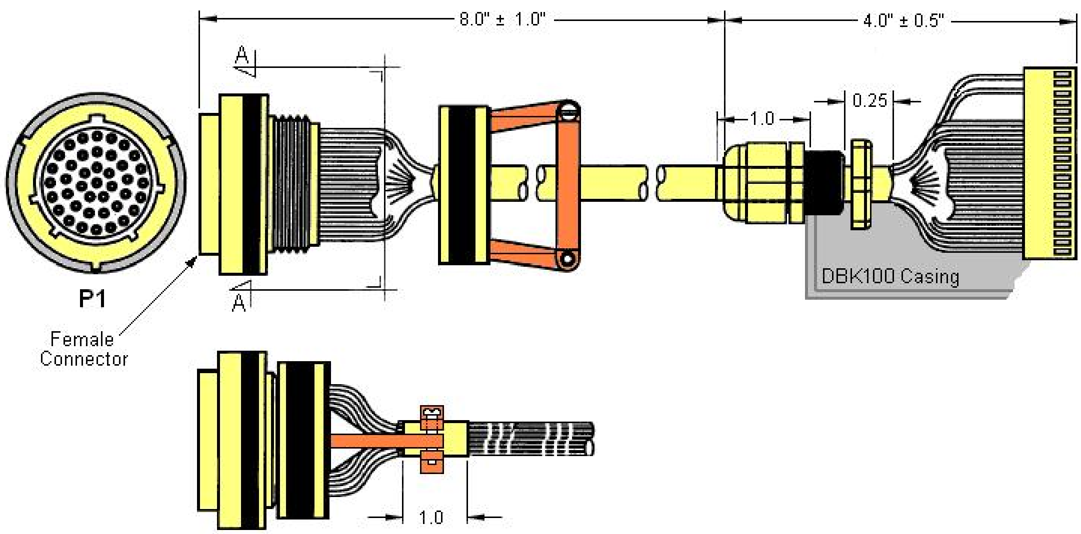
It should be noted that thermocouples output very small voltages and that long thermocouple leads can pickup a large amount of noise. If desired, noise reduction can be achieved through the use of shielded thermocouples and/or averaging.

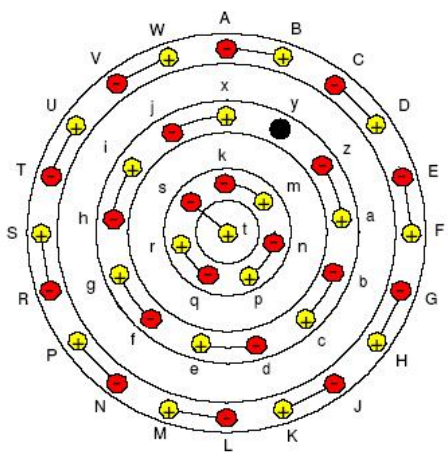
You can minimize the effect of noise by employing one or both of the following practices:
- **using shielded thermocouples**
- **averaging readings**

DBK101 includes a jack labeled “ACOM.” The jack is typically used for connecting the shield of a shielded thermocouple to the DBK101 analog common. When this connection is made the shield at the other end of the thermocouple is left unconnected.

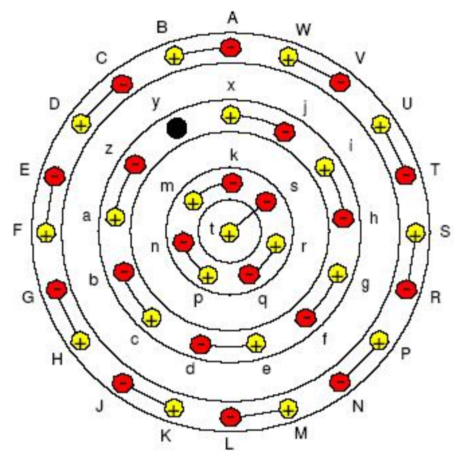
If a thermocouple shield is connected to the DBK101 hub, leave the shield unconnected at the other end of the thermocouple. Connecting the shield to common at both ends will result in a ground loop.

DBK100/D is terminated in a Deutsch connector, enabling watertight connections to a mating connector with up to 14 thermocouples. Custom pin-configurations are available to match with existing mating connectors. Inside the Deutsch connector [tethered to the DBK100/D] is the cold junction sensor, which is measured by the system and used to calculate the TC reading. The pinout follows.





Female Pin
(Looking at back side of Deutsch)



Male Pin
(Looking at back side of Deutsch)

P1	Signal
* f	CH 6 LO
R	CH 13 LO
* g	CH 6 HI
S	CH 13 HI
* h	CH 5 LO
T	CH 12 LO
* i	CH 5 HI
U	CH 12 HI
* j	CH 4 LO
V	CH 11 LO
* x	CH 4 HI
W	CH 11 HI
* z	CH 3 LO
A	CH 10 LO

P1	Signal
* a	CH 3 HI
B	CH 10 HI
* k	CH 2 LO
C	CH 9 LO
* m	CH 2 HI
D	CH 9 HI
* n	CH 1 LO
E	CH 8 LO
* p	CH 1 HI
F	CH 8 HI
* q	CH 0 LO
* b	CH 7 LO
* r	CH 0 HI
* c	CH 7 HI

P1	Signal
* t	CJC+
* s	CJC-

NOTE!
Do not make connections to pins t and s! Do not short pins t and s! Pins t and s are connected internally to Cold Junction Compensation!

* Asterisk denoted lowercase letter.

Open Thermocouple Detection

DBK101 is equipped with open thermocouple detection. 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.

DBK101 Hub Configuration

Up to thirty-two DBK100/D or DBK100/T pods can be attached to a single DBK101 hub. Up to two DBK101 hubs can be attached to a DaqBook/2000 Series device.* Each DBK101 must have a unique address setting according to the base channels which occupy it..

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 a DBK101; first locate the DIP switch on the unit's rear panel. Three of four micro-switches [on the DIP switch] are used to set the address. Position of the right-most switch is irrelevant. After ensuring that the system power is OFF, adjust the micro-switches to set the desired address. The following table explains various DIP switch settings.

Switch Number: **8 4 2 1**

Starting Address		Bank Select			Base Channels occupied by DBK101
Switch 8	Switch 4	Switch 2		Switch 1	
0	0	0 - Half	(4 channels)	N/A	Channels (00-03)
0	0	1 - Full	(8 channels)	N/A	Channels (00-07)
0	1	0 - Half	(4 channels)	N/A	Channels (04-07)
0	1	1 - Full	(8 channels)	N/A	Channels (04-11)
1	0	0 - Half	(4 channels)	N/A	Channels (08-11)
1	0	1 - Full	(8 channels)	N/A	Channels (08-15)
1	1	0 - Half	(4 channels)	N/A	Channels (12-15)
1	1	1 - Full	(0 channels)	N/A	No selected Channels. DBK101 is inhibited.

Example A: Two DBK101 hubs, one with 8 channels and one with 4 channels.

1st DBK101 has 8 strings of DBK100 pods (1 string per DBK101 channel).
2nd DBK101 has 4 strings of DBK100 pods (1 string each for DBK101channels: 0, 1, 2, and 3)

In this example the first DBK101 is using 8 channels and the user wants these assigned as channels (00 through 07) so he sets the DIP-switch to "**0 0 1 0**." (*See preceding table*).

The second DBK101 is using 4 channels and the user wants these assigned as channels (08 through 11) so he sets the DIP-switch to "**1 0 0 0**." (*See preceding table*). If he set the switch to 0 0 0 0 in he would have an address conflict since 00-03 is already accounted for by the first DBK101's DIP-switch setting.

Example B: Two DBK101 hubs, both with 8 channels.

Both DBK101 hubs have 8 strings of DBK100 modules (1 string per DBK101channel).

In this example the first DBK101 is using 8 channels and the user wants these assigned as channels (00 through 07) so he sets the DIP-switch to "**0 0 1 0**." (*See preceding table*).

The second DBK101 is also using 8 channels. To avoid conflict these must be 08 through 15. Thus the DIP-switch is set to "**1 0 1 0**." (*See preceding table*).

Example C: Two DBK101 hubs, both with 4 channels.

Both DBK101 hubs have 4 strings of DBK100 modules. Each is half occupied.

In this example the first DBK101 is using 4 channels and the user wants these assigned as channels (00 through 03) so he sets the DIP-switch to "**0 0 0 0**." (*See preceding table*).

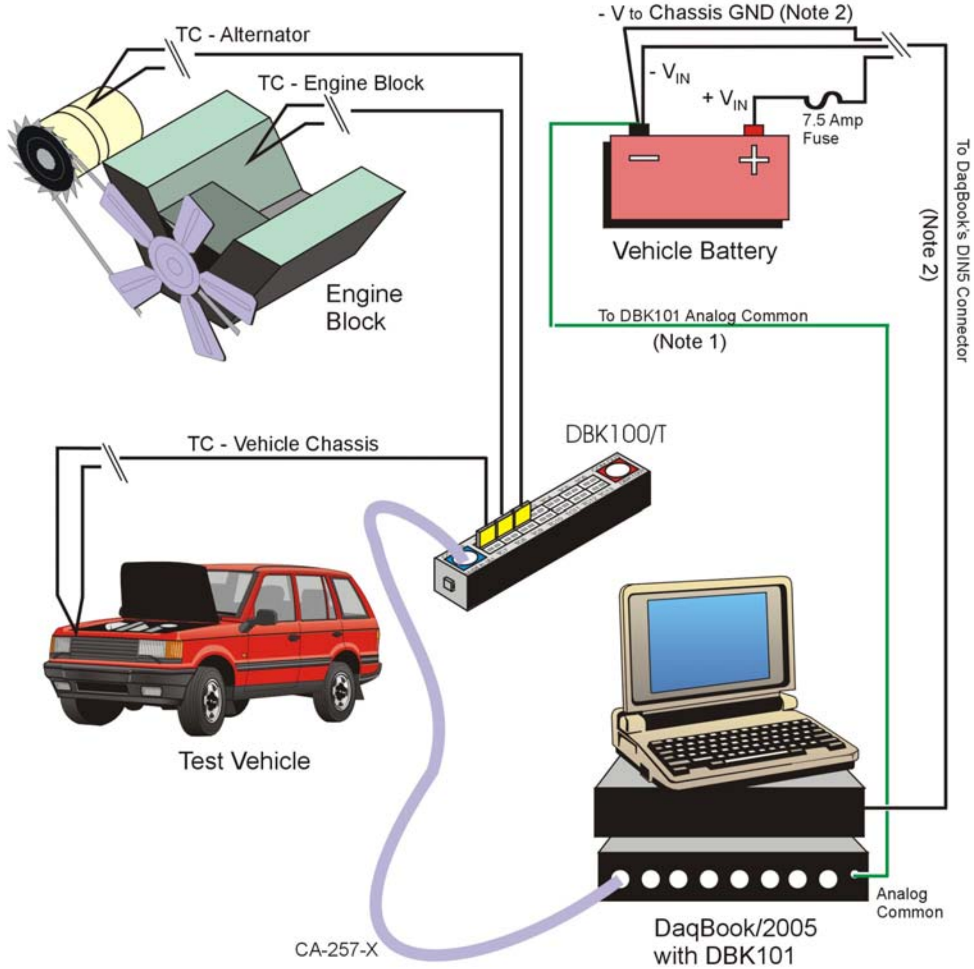
The second DBK101 is also using 4 channels. The user decides to have these channels assigned as 04 through 07. The DIP-switch is set to "**0 1 0 0**." (*See preceding table*).

Vehicle Testing and Noise Reduction

Power Connections and Analog Common

To properly measure vehicle-attached thermocouples differentially, it is necessary to have an analog common connection to the negative side of the vehicle's electrical system. A jack labeled ACOM, located on the DBK101 front panel, provides a connection point for analog common. If analog common is not connected, true differential readings cannot be obtained due to noise. For this reason, the chassis of the primary data acquisition device, e.g., DaqBook/2000 Series device, must also have a good connection to the negative side of the vehicle's electrical system.

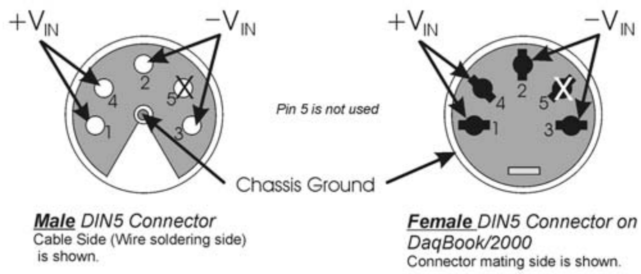
All grounds should come together at the negative terminal of the test vehicle's battery. Connecting the grounds at any other point may introduce noise. One line, with a banana plug is used to connect the battery's negative terminal to the DBK101 ACOM jack. The ACOM jack connects internally to the DBK101 P1, pin # 28 (AGND).



Connections for a Vehicle Test

Note 1: The ACOM connector is a banana jack. A stripped wire can be secured by: (1) unscrewing the banana jack housing, (2) inserting the wire sideways through the hole, and then (3) tightening the housing.

Note 2: It is best to use a male DIN5 connector to connect the lines from the battery to the DaqBook/2005 Series female DIN5 connector. A Switchcraft® male DIN5 Connector (p/n 12BL5M) can be used for making your own cable.



The lines that will connect to the vehicle battery are soldered to the male DIN5 connector. As indicated in the first figure on this page, the $+V_{IN}$ line connects to the battery's positive (+) terminal and should have a 7.5 amp fuse in series with the line. The $-V_{IN}$ and Chassis Ground lines both connect to the battery's negative terminal.

Shielding

Using shielded TC wire with the shield connected to analog common [DBK101 ACOM jack] will result in further noise reduction. Using a shielded ribbon cable to connect the DBK101 male P1 connector to the P1 connector of the primary data acquisition device (DaqBoard/2000) will also help minimize noise. CA-143-7 and CA-143-18 are female-to-female, DB37 shielded ribbon cables of 7-inch and 18-inch lengths, respectively.

If a thermocouple shield is connected to a DBK101 module, leave the shield unconnected at the other end of the thermocouple. Connecting the shield to common at both ends will result in a ground loop.

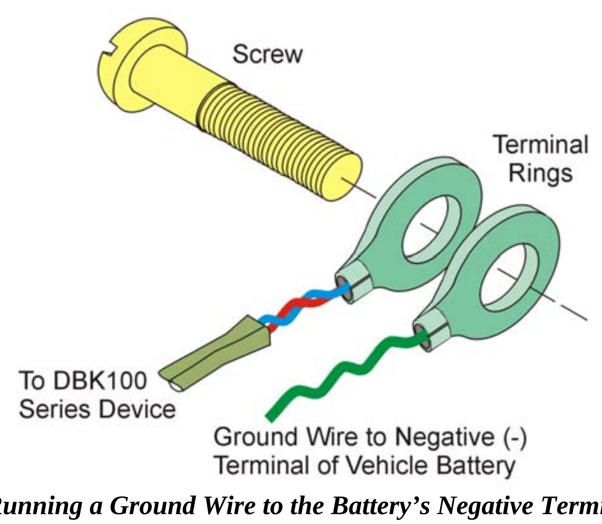
TC Common Mode

The maximum common-mode voltage for the DBK100 is ±5 volts. Common-mode voltage is the DC or AC voltage signal that is applied equally to both sides of a differential input.

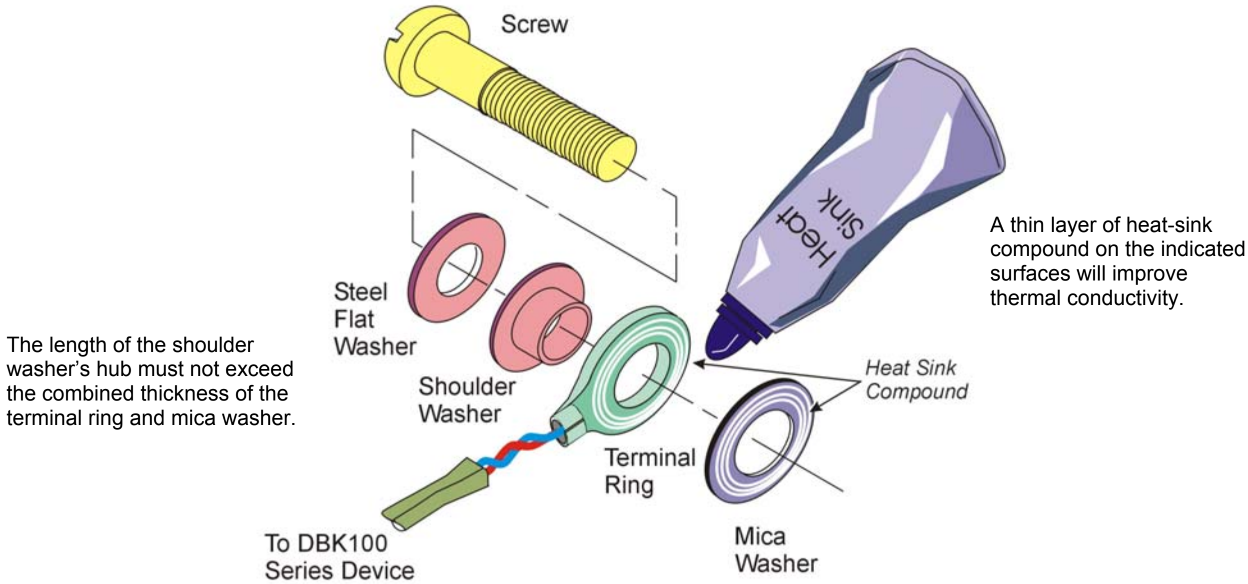
If a thermocouple is connected directly to a component in the vehicle at a potential that is over the maximum common-mode voltage, then very noisy or incorrect readings will be seen. Thermocouple connections that are made directly to the alternator or engine block may also result in high noise. Two methods of reducing noise are:

(a) Run a ground line from the bolt, as indicated in the first figure.

(b) Isolate the thermocouple leads with a set of washers, one of which is mica. This is indicated in the second figure.



Running a Ground Wire to the Battery's Negative Terminal



Using a Washer Set and Heat Sink to Isolate the Thermocouple

Software Setup

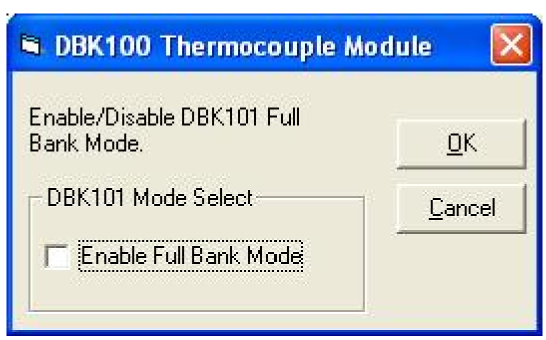
Reference Notes:

- **DaqView users** - Refer to *DBK Setup* in the *DaqView PDF*.
- **Programmers** using Daq devices should refer to related sections in the *Programmer's Manual*.

Note: DaqView includes functions for the conversion and linearization of thermocouple readings into temperature data.

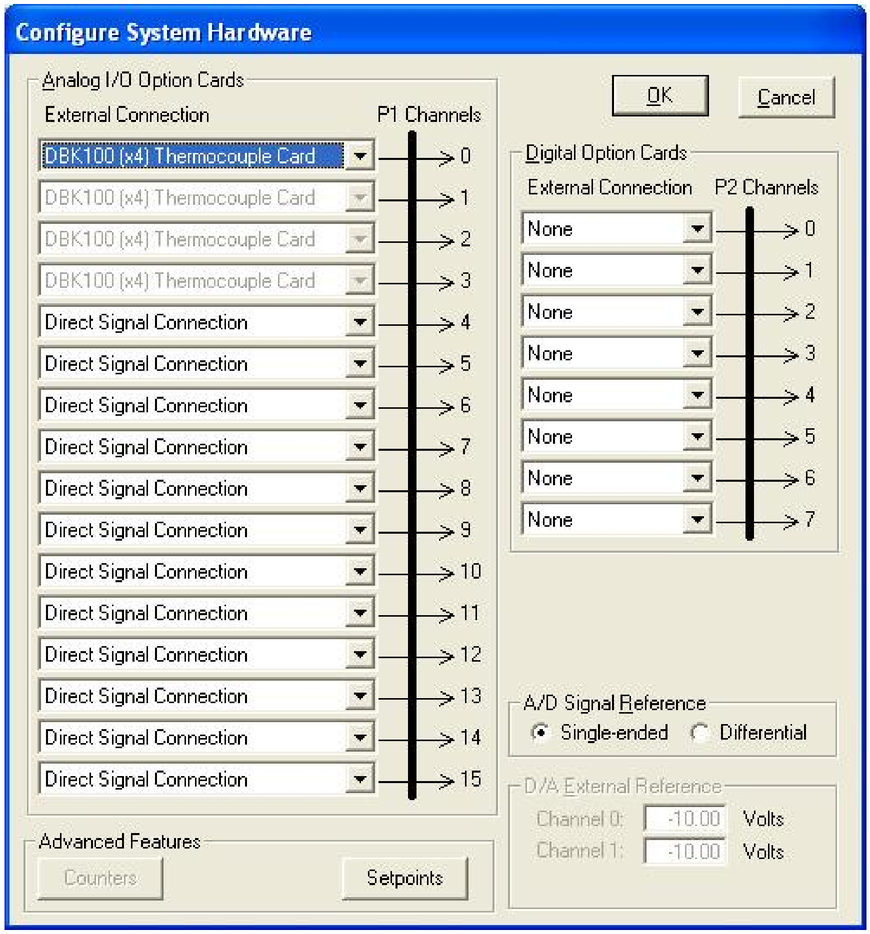
When a DBK101 is selected in DaqView, thermocouple types must also be selected for the module's channels. The steps for this are as follows:

1. In DaqView's *Configure System Hardware Window*, select **DBK101**.
2. *If you will be using more than 4 channels* for one DBK100, select to **Enable Full Bank Mode.** *If using 4 or less*, do not enable the full bank mode. See following figure.



Full-Bank Mode Disabled*

*When Full Bank Mode is enabled a DBK101 can be occupied with up to 8 Base Channels.



With One DBK101 and Full Bank Mode Disabled
Base Channels 0, 1, 2, and 3 are occupied

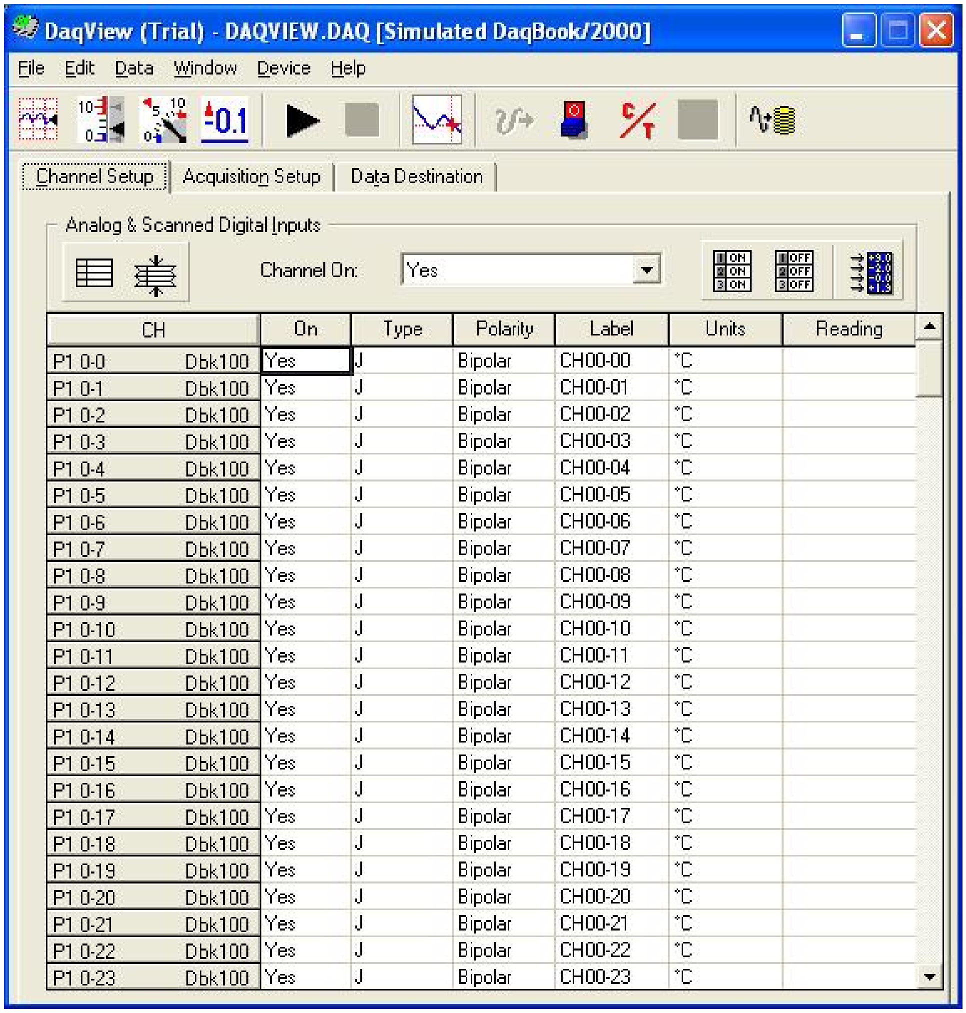
Reference Note:
In relation to the above figure, you may want to review the section, *DBK101 Hub Configuration*, on page 7. The section pertains to full-banks, half-banks, base channels, and associated DIP switch settings.

3. From the *Channel Setup Tab* (following figure) select the thermocouple types as applicable. Do this for each channel. Note that channels will be listed as DBK100 channels.

   Channel types can be changed by double-clicking in the *Type* column, or by using the *Channel Type* pull-down list.

In the following figure we see that J-type thermocouples have been selected for Channels 0 through 23; possibly more, but we would have to scroll down to view information for the other channels.

Notice Channel 0 is designated as P1 0-0 and that channel 1 is seen as P1 0-1. The “0” preceding the dash indicates that the DBK101 module is the first such module in the acquisition system. A second DBK101 module would list Channel 0 as P1 1-0 and would show Channel 1 as P1 1-1.



DaqView, Channel Setup

Using a Temperature Calibrator

DBK100 Series / DBK101 systems 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.

Note: The ambient temperature should be stabilized for at least one hour.

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 DBK100 device 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.

Specifications – DBK100 Series

Note: Specifications are subject to change without notice.

DBK100 Series Devices

Part No.	Description
DBK100/D	14-channel thermocouple input with Deutsch #AFD51-20-41PN1A connector
DBK100/T	14-channel thermocouple input with mini-TC connectors
DBK101	8-port hub for DBK100 (accepts up to 448 TC channels)

System Compatibility:
DaqBook/2000* Series, DaqScan/2000 Series, and DaqLab/2000 Series Devices
Connection is made via DBK101 hub.

***Cannot be used with DaqBook/2000A, /2000E, or /2000X.**

System Capacity (max): 896 thermocouples

- 14 thermocouples can be connected to each DBK100/T or DBK100/D.
- Up to four DBK100/T or DBK100/D units can be connected to a each DBK101 channel.
- DBK101 has 8 channels. Thus 32 DBK100 units can be connected to a DBK101. With 14 thermocouples possible per DBK100, 448 thermocouple connections are possible.
- Two DBK101 hubs can be connected to a DaqBook/2000 Series unit. When 2 hubs are used the system can have up to 896 thermocouples (448 x 2).

Connectivity:

To Connect	**DaqBook**	to	**DBK101**	use	**CA-255-2T**	(2 in.)
				or	**CA-255-4T**	(4 in.)
To Connect	**DBK100** or **DBK101**	to	**DBK100**	use	**CA-257-18**	(18 in.)
				or	**CA-257-36**	(36 in.)
				or	**CA-257-72**	(72 in.)

Total cabling length for one string of DBK100 pods should not exceed 20 ft.

TC Connectors, DBK100/D: 1 pigtail cable assembly to Deutsch MS3471L20-41P military style connector; CJC thermistor assembled onto connector.
TC Inputs: 14 differential TC inputs, open TC detection per channel
TC Types: J, K, T, E, S, R, B, N28, N14

Dimensions
DBK100/D:
Pod: 102 mm W x 57 mm D x 30 mm H (4” x 2.25” x 1.18”)
Deutsch Connector: 66.8 mm L x 31.8 mm diameter (2.63” x 1.25”); connected to DBK100/D via 8” cable
DBK100/T: 186 mm W x 44 mm D x 30 mm H (7.3” x 1.7” x 1.18”)
DBK101: 285 mm W x 220 mm D x 45 mm H (11” x 8.5” x 1.75”)

Weight
DBK100/D: 0.36 kg (0.80 lbs.)
DBK100/T: 0.36 kg (0.80 lbs.)
DBK101: 1.13 kg (2.5 lbs.)

Power Requirements

DBK100/D: 10 mA from +15V, 10 mA from -15V, 300 mW total
DBK100/T: 10 mA from +15V, 10 mA from -15V, 300 mW total
DBK101: 40 mA from +15V, 40 mA from -15V, 300 mA from +5V, 2700 mW total

Input Impedance: 4M Ohm (differential) in parallel with 400 pF
Input Bandwidth: 1 kHz
Minimum Resolution: 0.1°C for all TC types

TC Accuracy at Measurement Temperature in °C (±°C)											
Type	**Min**	**Max**	**-100**	**0**	**100**	**300**	**500**	**700**	**900**	**1100**	**1400**
J	-200	760	1.2	1.0	1.0	1.2	1.4	1.4	--	--	--
K	-200	1200	1.4	1.2	1.2	1.4	1.6	1.6	1.8	2.0	--
T	-200	400	1.4	1.2	1.2	1.2	--	--	--	--	--
E	-270	650	1.2	1.0	1.0	1.0	1.2	--	--	--	--
S	-50	1768	--	4.6	3.6	3.0	3.0	2.8	3.0	3.2	3.2
R	-50	1768	--	4.6	3.2	3.0	2.8	2.8	2.6	2.8	3.0
B	50	1780	--	--	--	7.4	4.8	4.2	3.6	3.4	3.0
N28	-270	400	1.8	1.4	1.4	1.4	--	--	--	--	--
N14	0	1300	--	1.4	1.4	1.4	1.6	1.6	1.8	2.0	--

TC Accuracy: Valid for one year 25°C ambient; see table above.
Accuracy conditions:

- Exclusive of thermocouple errors
- Exclusive of noise
- VCM = 0
- 25°C ambient temperature, stabilized for 1 hour

For applications where higher common-mode TC measurements are required, DaqBook systems offer high-isolation options up to 500V. These options would reside at the DaqBook, and require running the TC wire from the engine to the passenger compartment.

Operating Temperature:

DBK100/D & DBK100/T: -40° to +125°C
DBK101: -30° to +70°C

Storage Temperature: -40° to +125°C
Relative Humidity: 0 to 95% non-condensing
DBK100/D & DBK100/T: Water resistant
Temperature Coefficient of Accuracy for Type T TC: ±0.05°C for every °C away from 25°C
Channel-to-Channel Crosstalk: -90 dB typ (0 to 100 Hz)
DC CMRR: -80 dB typ
AC CMRR: -80 dB typ (0 to 60 Hz)
Maximum Common Mode Voltage: ±5V
Over-Voltage Protection: ±40V

DBK200 Series Matrix

The DBK200 Series Matrix is presented on the following page. It is preceded by information concerning connectivity issues. The matrix provides a quick comparison of the DBK200 Series adapter boards. Details for each board are provided in subsequent sections of this manual.

The **DaqBoard/2000 Series** devices communicate [external from the host PC] through a 100-pin P4 connector. DaqBoard/2000 Series boards have no on-board P1, P2, or P3 connectors.

The **DaqBook/2000 Series** devices communicate through 37-pin P1, P2, and P3 connectors and/or the device's P4 connector. In regard to DaqBook/2000 Series devices, it must be realized that P4 offers no additional I/O to that which is already provided for by P1, P2, and P3.

The **DaqBoard/500 Series and DaqBoard/1000 Series** devices communicate through a 68-pin SCSI connector. DBK215 was designed for use with the /500 and /1000 series devices.

CAUTION

DaqBook/2000 Series Users: Signal conflicts between a DaqBook/2000 Series device's P1, P2, P3 connectors and its P4 connector can result in erroneous readings and possible equipment damage.

Therefore, when DaqBook/2000 Series device connections have been made to P1, P2, and/or P3, use caution when making connections through P4, and visa versa.

DaqBook/2000 Series Users: The 100-pin P4 connector shares signal connections with the P1, P2, and P3 connectors. P4 offers no additional I/O. You can connect a DBK200 Series Option to P4 on a DaqBook/2000 Series device via a CA-195 cable. This essentially distances the P1, P2, P3 connections from the DaqBook/2000. See the preceding Caution.

The P4 connector on the **DaqBoard/2000 Series** boards typically connects to a P4 connector on one of the DBK200 Series adapter boards. Depending on which adapter board is used, the P4 lines terminate to P1, P2, and/or P3 connectors on the DBK option. Several of the adapter boards include related screw terminals.

The P4 connector on the **DaqBook/2000 Series** devices may or may not be used, as indicated in the following note.

DaqBook/2000 Series Users:

There are two ways to connect a DBK option to a DaqBook/2000 Series device. The first method is preferable, as it introduces less noise.

Preferred Method – (a) Connect a CA-37-x cable to the appropriate DB37 connector [P1, P2, or P3] on the DaqBook/2000 Series device. (b) Connect the free end of the cable to the DBK card or module.

Optional Method – (a) Connect a CA-195-x cable to the P4 connector on the DaqBook/2000 Series device. (b) Connect the free end of the cable to a DBK200 Series device. (c) Connect the DBK option to the DBK200 Series device, as applicable.

The primary reason that less noise is seen in the "preferred" method is that a DaqBook/2000 Series device's P1 connector pertains only to analog acquisition signals and the P2 connector pertains only to digital I/O. This provides a strong degree of isolation between the two signal types. However, in the case of a CA-195-x cable connected to P4, digital and analog signals co-exist in one cable.

If you need to use the P4 connection method, use of the 8-inch ribbon cable (CA-195-1) will result in the lowest level of crosstalk [for that method].

The following matrix provides a quick comparison of the DBK200 Series adapter boards. Details for each board are provided in subsequent 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.
210	Yes	Yes (Qty. 2)	No	Yes	Yes	Can carry Digital I/O mini-modules.	Supports Grayhill 70M-series mini-modules. Includes two P2 connectors.
213	Yes	Yes	Yes	Yes	Yes	3 Card-Slots	Closely related to DBK203. Includes three card-slots
214	Yes	Yes	Yes	Yes	Yes	BNC connectors 3 Card-Slots	Closely related to DBK203. Includes 16 BNC connectors and three card-slots
215	No	No	No	No	Yes	BNC connectors 68-pin SCSI	Closely related to DBK203. Includes 16 BNC connectors and one 68-pin SCSI connector (P5). Only used with DaqBoard/500 Series or DaqBoard/1000 Series boards.

Chapter 2 includes pinouts for P1, P2, P3, and P4.

DBK215 is used for DaqBoard/500 Series and DaqBoard/1000 Series boards. Refer to the DBK215 section of this document for details, including pinouts.

DBK202, DBK203, DBK204 Series

P4-to-P1 / P2 / P3 Adapters

For Analog I/O, Digital I/O, & Pulse/Frequency

For Use with DaqBook/2000 Series or DaqBoard/2000 Series Devices

DBK203A, Rear Panel

DBK	Decription
DBK202	Screw-terminal adapter board. Board only, no chassis.
DBK203	Screw-terminal adapter module with pull-out drawer. Superseded by DBK203A.
DBK203A	Screw-terminal adapter module (supersedes DBK203). DBK203A is the most popular of these 5 DBK options.
DBK204	DBK203A plus CA-209 CE cable kit. DBK204 units shipped prior to the release of DBK203A use a DBK203.
DBK204c	DBK203A plus CA-209c CE cable kit. For use with compact PCIs and DaqBoard/2000c Series boards. DBK204c units shipped prior to the release of DBK203A use a DBK203.

Each of these units includes:

(a) P1, Analog Input, DB37 connector

(b) P2, Digital I/O DB37 connector

(c) P3, internal 40-pin header, for Digital I/O and Analog Out. The 40-pin header connects to a Pulse/Frequency DBK card, or to a module's P3 connector via a CA-60 cable. These cables have a 40-pin female connector at one end and a DB37 (37-pin) male connector at the other end.

(d) P4, 100-pin connector which includes all signals found in P1, P2, and P3, collectively.

(e) Internal, on-board, screw-terminal blocks which correlate with P1, P2, and P3

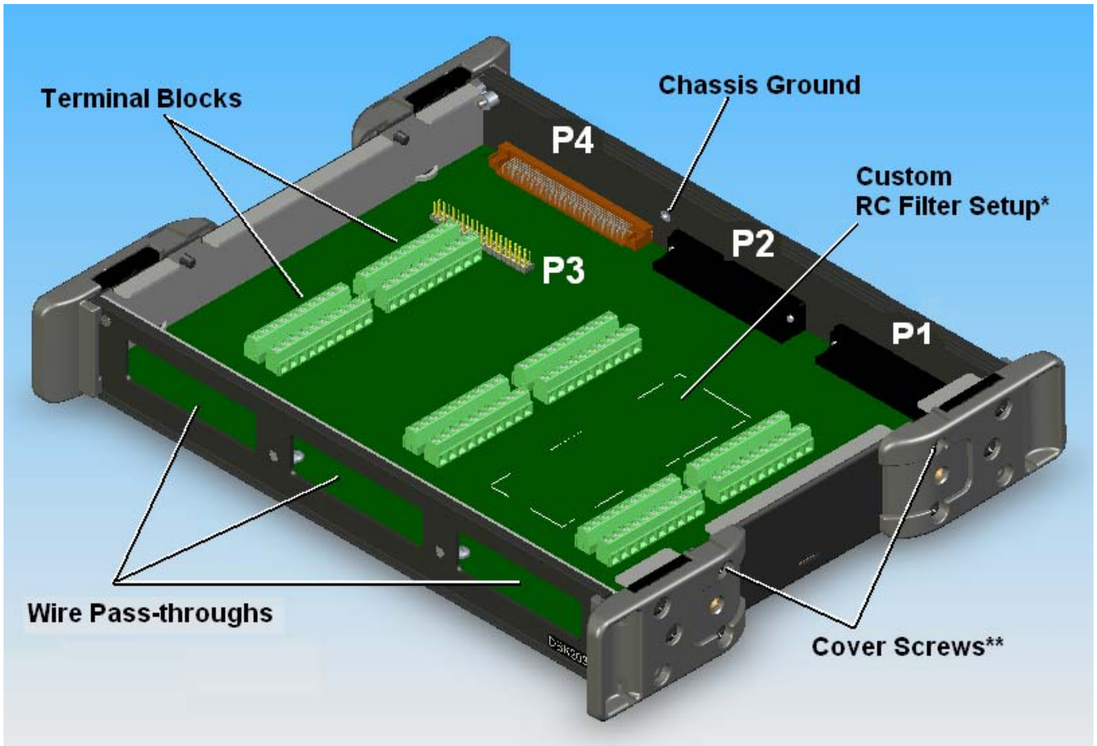
(f) Internal, on-board socket locations for custom RC Filter networks

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section.
- Refer to the *DaqBoard/2000 Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.
- The DBK213, /214, and /215 sections contain information on devices which are closely related to DBK203A.

Overview

The various part numbers [DBK202, /203, /203A, /204, and /204c] of these closely related products are described in the table on page 1. With exception of the DBK202 being a "board only," the layout for each is as indicated in the following figure.



DBK203A, Cover Plate Removed

* Custom RC Filter Setup is discussed in the section entitled, Adding Resistor/Capacitor Filter Networks, page 12.

** To remove the cover plate, remove the upper inside screw from each of the corner mounting brackets (often referred to as protective ears); then lift the plate from the unit.

The information included in this section, when combined with that found in related DBK card and DBK module sub-sections should enable you to set up your desired configuration.

It is important to note that the **DaqBoard/2000 Series** boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with these boards are subset connectors of the 100-pin P4 connector. Certain **DaqBook/2000 Series** devices have both a P4 connector and a set of P1, P2, and P3 connectors on the unit. The *System Connections and Pinouts* chapter includes pinouts for both types of devices, i.e., boards and "books."

Each of the adapters discussed in this section provide a DB37 P1 connector, DB37 P2 connector, and a 40-pin "on-board" P3 header.

- P1 is used for Analog Input
- P2 for Digital I/O
- P3 for Pulse/Frequency (Digital and Counter/Timer) I/O
- P4 includes all signals found in P1, P2, and P3

In addition to these four connectors, each device includes terminal blocks designated TB1 through TB12. The screw terminal blocks tie-in to P1, P2, and P3 and provide for easy signal connection.

Screw-Terminal Adapter Board

The DBK202 Board provides a means of connecting channel input signals to a /2000 Series device through one of three methods:

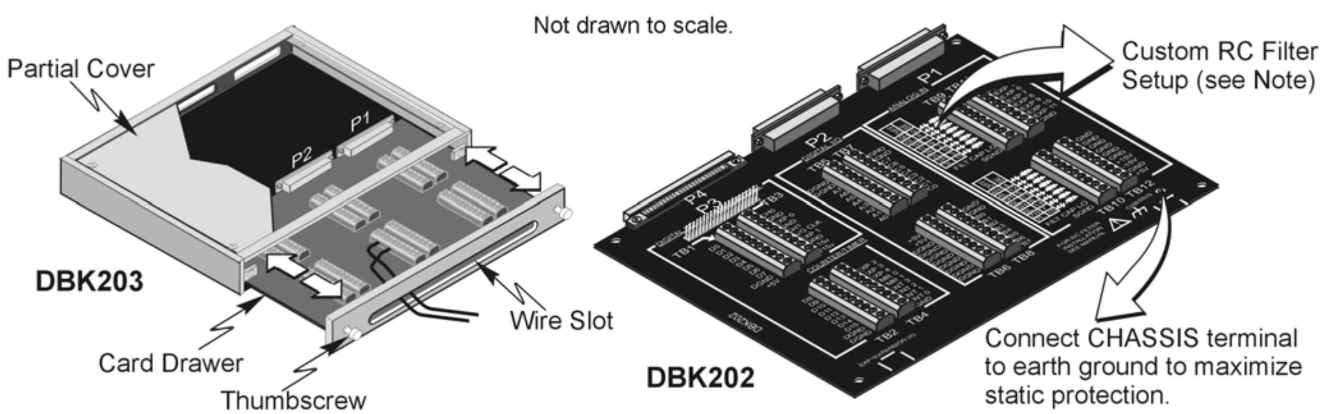
- With cables connected to P1, P2, and P3 connectors, as applicable.
- With signal wires connected to the appropriate screw-terminal blocks (TB1 through TB12). Note that the DBK202 board's silkscreen clearly identifies all screw terminals.
- With a combination of the above two methods.

When connecting a DBK202 to a P4 connector, a CA-195 cable is used. The cable has a P4 connector located at each end.

Note: DBK202 contains mounting holes that allow the board to be secured inside a user-provided enclosure.

Screw-Terminal Adapter Modules

The DBK203, DBK203A, DBK204, and DBK204c each consist of a DBK202 board housed in a chassis. The DBK203 [and DBK204 and DBK204c units that use it] include a card drawer that can be slid free of the module. The sliding card drawer provides easy access to the twelve terminal blocks and to the 40-pin P3 header. The DBK203A (which supersedes the DBK203) and the DBK204 and DBK204c units which use the DBK203A have no slide out drawer.



DBK203 Includes a Slide-Out DBK202 Board
DBK203A has no Slide-Out Option

Reference Note for Custom RC Filter Setup:
You can install resistors and capacitors to create RC networks for P1 Analog Input Channels. For detailed information, refer to *Adding Resistor/Capacitor Filter Networks,* which begins on page 12 of this DBK section.

Connection Tips

CAUTION

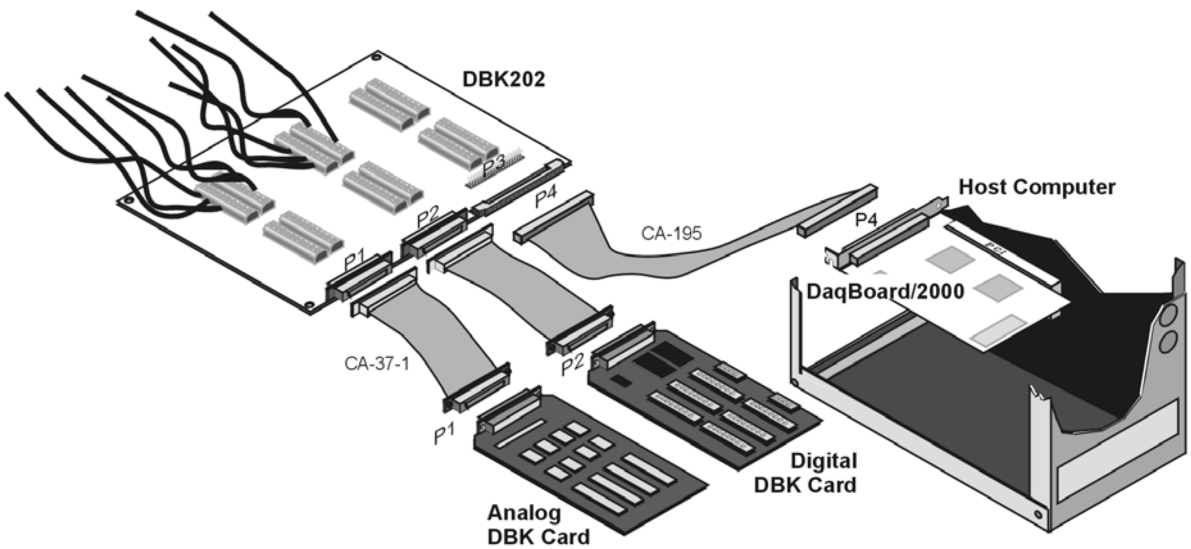
Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.

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

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.

Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.



Example of a DBK202 Connected to Analog and Digital DBK Cards via P1 and P2, Respectively

The illustrations and actual board silkscreen are the only references you should need to make proper connections.

A list of connection tips follows:

1. Ensure power is removed from the device(s) to be connected.
2. Observe ESD precautions when handling the board and making connections.
3. Do not make redundant connections. For example, for ANALOG IN you can use the P1 (DB37) connector or Terminal Blocks TB9 through TB12. You would not use both sets of ANALOG IN connectors.
4. There is no need to access the board within a DBK203, DBK203A, DBK204, or DBK204c unless you need to make connections to P3 or to a terminal block.

5. The board’s 100-pin P4 connector connects to the DaqBoard/2000 P4 connector via a CA-195 Cable.

6. To obtain maximum protection from static, connect the CHASSIS terminal to earth ground.

Notes: Regarding connections to DB37 connectors and to the P3 (40-pin) header:

(a) P1 connects to an analog DBK card or module’s P1 connector via a CA-37 cable.

(b) P2 connects to a Digital DBK card or module’s P2 connector via a CA-37 cable.

(c) The 40-pin header (P3) connects to a Pulse/Frequency DBK card, or to a module’s P3 connector via a CA-60 cable. Note that CA-60 cables have a 40-pin female connector at one end and a DB37 (37-pin) male connector at the other end.

7. To access the board, i.e., to connect to P3 or to terminal blocks:

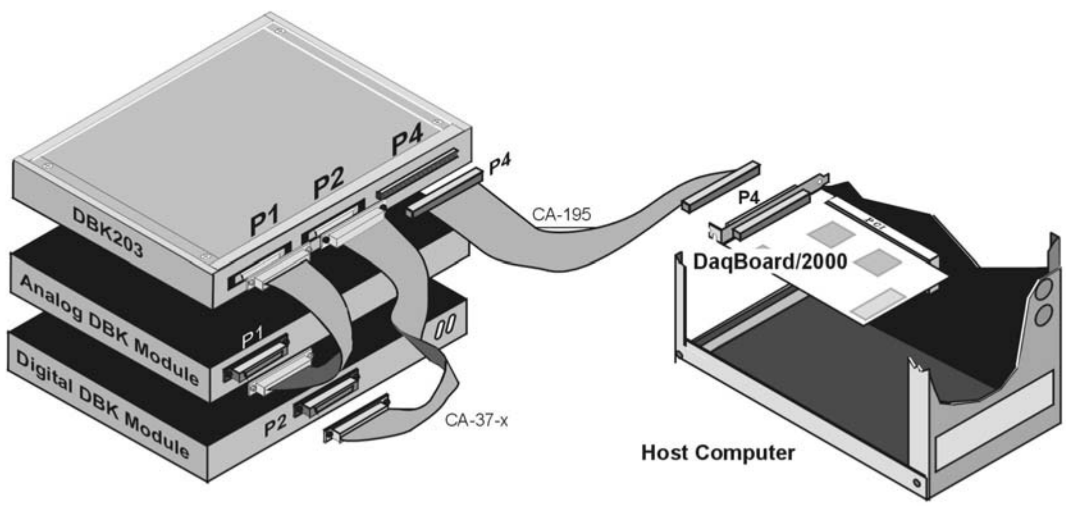
a) **DBK202** – access of the board is direct, or as determined by your own custom enclosure.

b) **DBK203** – Loosen the two thumbscrews on the front panel and slide the card drawer free of the unit.

c) **DBK203A** – Remove the upper inside screw from each of the four corner brackets (see figure, page 2) and lift the cover plate from the unit.

d) **DBK204** and **DBK204c** – Follow step 2b or 2c as applicable to your unit.

8. For DBK204 and DBK204c refer to the separate CE Cable Kit instructions that are included with the associated CE cable kit.



Example of a DaqBoard/2000 System using a DBK203 (or DBK203A)

Using Screw-Terminal Blocks

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.

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

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.

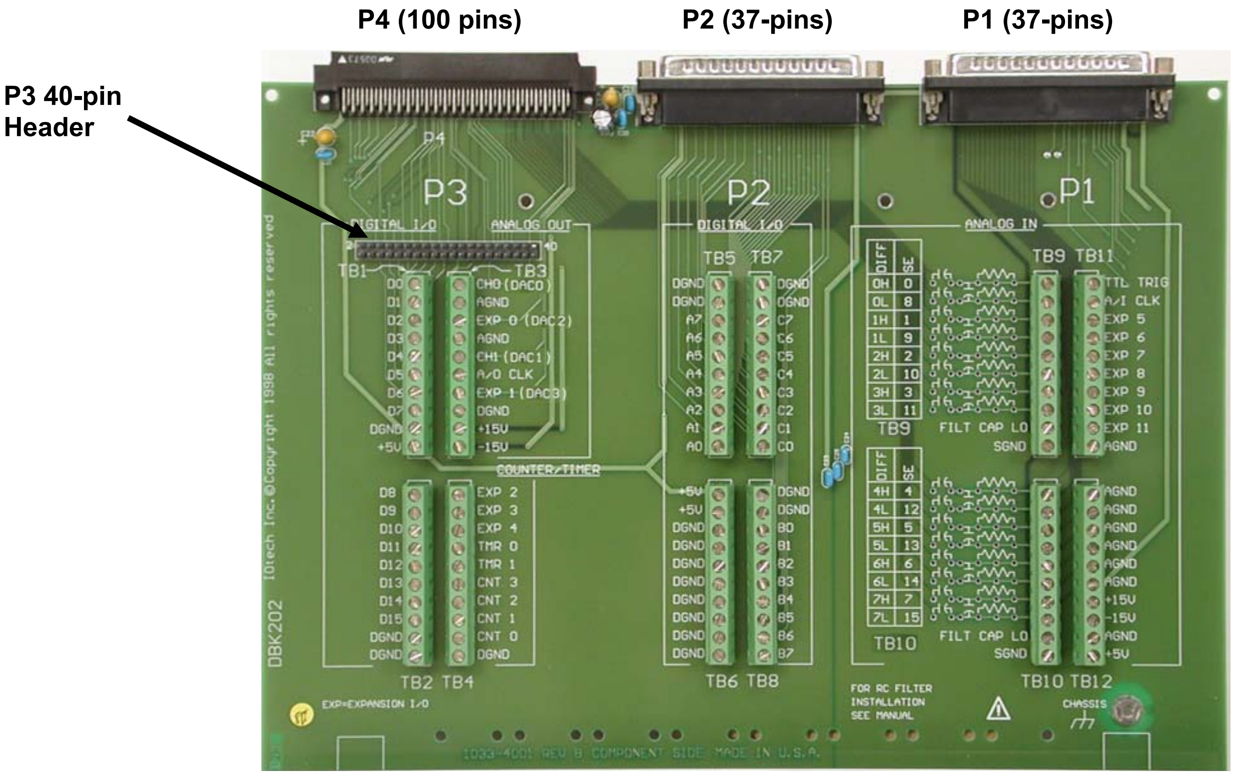
Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.

1. Review the preceding CAUTIONS and the P4 alignment note.
2. Access the terminal blocks:
   a) **DBK202** – access of the board is direct, or as determined by your own custom enclosure.
   b) **DBK203** – Loosen the two thumbscrews on the front panel and slide the card drawer free of the unit.
   c) **DBK203A** – Remove the upper inside screw from each of the four corner brackets (see figure, page 2) and lift the cover plate from the unit.
   d) **DBK204** and **DBK204c** – Follow step 2b or 2c as applicable to your unit.
3. Make the wiring connections to the terminals. Refer to the board's silkscreen and to the pin correlations on the next few pages.
4. Tighten the terminal block screws snug. Do not over-tighten.

In general, the following *terminal block-to-signal* relationships apply:

- **TB9**, **TB10**, **TB11**, and **TB12** are used for **ANALOG IN** and provide a connection option to the **P1** (DB37) connector.
- **TB5**, **TB6**, **TB7**, and **TB8** are used for **DIGITAL I/O** and provide a connection option to the **P2** (DB37) connector.
- **TB1**, **TB2**, **TB3**, and **TB4** are used for **Pulse/Frequency/Digital I/O** and provide a connection to the 40-pin header (**P3**).

The following pages correlate the DBK202 terminal block connectors with the associated pins of the P1, P2, and P3 DB37 connectors. Note that the *System Connections and Pinouts* chapter contains additional pin-outs, and includes references to the 100-pin P4 connector.



DBK202 Board

Correlation to P1 – Pertains to Terminal Blocks TB9, TB10, TB11, and TB12 for Analog I/O.

TB9		P1 Pin Number and Description (see Note 1)	
DIFF	SE		
0H	0	37	CH 0 IN (Single-Ended Mode) / CH 0 HI IN (Differential Mode)
0L	8	18	CH 8 IN (Single-Ended Mode) / CH 0 LO IN (Differential Mode)
1H	1	36	CH 1 IN (Single-Ended Mode) / CH 1 HI IN (Differential Mode)
1L	9	17	CH 9 IN (Single-Ended Mode) / CH 1 LO IN (Differential Mode)
2H	2	35	CH 2 IN (Single-Ended Mode) / CH 2 HI IN (Differential Mode)
2L	10	16	CH 10 IN (Single-Ended Mode) / CH 2 LO IN (Differential Mode)
3H	3	34	CH 3 IN (Single-Ended Mode) / CH 3 HI IN (Differential Mode)
3L	11	15	CH 11 IN (Single-Ended Mode) / CH 3 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB9

TB10		P1 Pin Number and Description (see Note 1)	
DIFF	SE		
4H	4	33	CH 4 IN (Single-Ended Mode) / CH 4 HI IN (Differential Mode)
4L	12	14	CH 12 IN (Single-Ended Mode) / CH 4 LO IN (Differential Mode)
5H	5	32	CH 5 IN (Single-Ended Mode) / CH 5 HI IN (Differential Mode)
5L	13	13	CH 13 IN (Single-Ended Mode) / CH 5 LO IN (Differential Mode)
6H	6	31	CH 6 IN (Single-Ended Mode) / CH 6 HI IN (Differential Mode)
6L	14	12	CH 14 IN (Single-Ended Mode) / CH 6 LO IN (Differential Mode)
7H	7	30	CH 7 IN (Single-Ended Mode) / CH 7 HI IN (Differential Mode)
7L	15	11	CH 15 IN (Single-Ended Mode) / CH 7 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB10

TB11	P1 Pin Number and Description	
TTL TRIG	25	TTL Trigger, Digital IN, External TTL Trigger Input
A/I CLK	20	A/I Clock, External ADC Pacer Clock Input/ Internal ADC Pacer Clock Output
EXP 5	5	Expansion 5. Digital OUT, external GAIN select bit 1
EXP 6	6	Expansion 6. Digital OUT, external GAIN select bit 0
EXP 7	3	Expansion 7. Digital OUT, external ADDRESS, select bit 3
EXP 8	22	Expansion 8. Digital OUT, external ADDRESS, select bit 2
EXP 9	4	Expansion 9. Digital OUT, external ADDRESS, select bit 1
EXP 10	23	Expansion 10. Digital OUT, external ADDRESS, select bit 0
EXP 11	26	Expansion 11. Simultaneous Sample and Hold (SSH)
AGND	*	Analog Ground, Common

P1 – TB11

TB12	P1 Pin Number and Description	
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
+ 15 V	21	Expansion, +15 V Power
- 15 V	2	Expansion, -15 V Power
AGND	*	Common Ground
+ 5 V	1	Expansion, +5 V Power

P1 – TB12

*Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

Note 1: For TB9 and TB10, the filter network portion of the silkscreen is not shown. Instead, the DIFF and SE channel identifiers have been moved next to the screws for ease in identification.

Correlation to P2 – Pertains to Terminal Blocks TB5, TB6, TB7, and TB8 for Digital I/O.

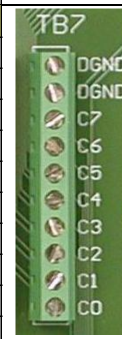
TB5	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
A7	30	Digital I/O: P2, Digital Port A, Bit 7; or P2 Expansion Data Bit 15
A6	31	Digital I/O: P2, Digital Port A, Bit 6; or P2 Expansion Data Bit 14
A5	32	Digital I/O: P2, Digital Port A, Bit 5; or P2 Expansion Data Bit 13
A4	33	Digital I/O: P2, Digital Port A, Bit 4; or P2 Expansion Data Bit 12
A3	34	Digital I/O: P2, Digital Port A, Bit 3; or P2 Expansion Data Bit 11
A2	35	Digital I/O: P2, Digital Port A, Bit 2; or P2 Expansion Data Bit 10
A1	36	Digital I/O: P2, Digital Port A, Bit 1; or P2 Expansion Data Bit 9
A0	37	Digital I/O: P2, Digital Port A, Bit 0; or P2 Expansion Data Bit 8

P2 – TB5

TB6	P2 Pin Number and Description	
+5 V	18	Expansion +5 V Power
+5 V	20	Expansion +5 V Power
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P2 – TB6

TB7	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
C7	22	Digital I/O: P2, Digital Port C, Bit 7; or P2 Expansion Data Bit 7
C6	23	Digital I/O: P2, Digital Port C, Bit 6; or P2 Expansion Data Bit 6
C5	24	Digital I/O: P2, Digital Port C, Bit 5; or P2 Expansion Data Bit 5
C4	25	Digital I/O: P2, Digital Port C, Bit 4; or P2 Expansion Data Bit 4
C3	26	Digital I/O: P2, Digital Port C, Bit 3; or P2 Expansion Data Bit 3
C2	27	Digital I/O: P2, Digital Port C, Bit 2; or P2 Expansion Data Bit 2
C1	28	Digital I/O: P2, Digital Port C, Bit 1; or P2 Expansion Data Bit 1
C0	29	Digital I/O: P2, Digital Port C, Bit 0; or P2 Expansion Data Bit 0



P2 – TB7

TB8	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
B0	10	Digital I/O: P2, Digital Port B, Bit 0; or P2 Expansion READ Output
B1	9	Digital I/O: P2, Digital Port B, Bit 1; or P2 Expansion WRITE Output
B2	8	Digital I/O: P2, Digital Port B, Bit 2; or P2 Expansion RESET Output
B3	7	Digital I/O: P2, Digital Port B, Bit 3; or P2 Expansion Address Bit 4 Out
B4	6	Digital I/O: P2, Digital Port B, Bit 4; or P2 Expansion Address Bit 3 Out
B5	5	Digital I/O: P2, Digital Port B, Bit 5; or P2 Expansion Address Bit 2 Out
B6	4	Digital I/O: P2, Digital Port B, Bit 6; or P2 Expansion Address Bit 1 Out
B7	3	Digital I/O: P2, Digital Port B, Bit 7; or P2 Expansion Address Bit 0 Out

P2 – TB8

* Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

Correlation to P3 – Pertains to Terminal Blocks TB1, TB2, TB3, and TB4 for Pulse/Frequency/Digital I/O.

TB1	P3 Pin Number and Description	
D0	10	P3 Digital Port Bit 0
D1	9	P3 Digital Port Bit 1
D2	8	P3 Digital Port Bit 2
D3	7	P3 Digital Port Bit 3
D4	6	P3 Digital Port Bit 4
D5	5	P3 Digital Port Bit 5
D6	4	P3 Digital Port Bit 6
D7	3	P3 Digital Port Bit 7
DGND	*	Digital Ground, Common
+5V	20	Expansion, +5 Volt Power

P3 – TB1

TB2	P3 Pin Number and Description	
D8	29	P3 Digital Port Bit 8
D9	28	P3 Digital Port Bit 9
D10	27	P3 Digital Port Bit 10
D11	26	P3 Digital Port Bit 11
D12	25	P3 Digital Port Bit 12
D13	24	P3 Digital Port Bit 13
D14	23	P3 Digital Port Bit 14
D15	22	P3 Digital Port Bit 15
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P3 – TB2

TB3	P3 Pin Number and Description	
CH0 (DAC0)	34	Analog Out; Analog DAC 0 Output
AGND	*	Analog Ground, Common; intended for use with DACs
EXP 0 (DAC2)	32	Analog Out; Analog DAC 2 Output
AGND	*	Analog Ground, Common; intended for use with DACs
CH1 (DAC1)	33	Analog Out; Analog DAC 1 Output
A/O CLK	21	Analog Out Clock; External DAC Pacer Clock Input/ Internal DAC Pacer Clock Output
EXP 1 (DAC3)	31	Analog Out; Analog DAC 3 Output
DGND	*	Digital Ground, Common
+15 V	19	Expansion, + 15 VDC
-15 V	37	Expansion, -15 VDC

P3 – TB3

TB4	P3 Pin Number and Description	
EXP 2	12	Reserved
EXP 3	13	Reserved
EXP 4	14	Reserved
TMR 0	15	P3 Timer 0 Output
TMR 1	16	P3, Timer 1 Output
CNT 3	35	P3 Counter 3 Input
CNT 2	17	P3 Counter 2 Input
CNT 1	36	P3 Counter 1 Input
CNT0	18	P3 Counter 0 Input
DGND	*	Digital Ground, Common

P3 – TB4

* Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

Using the P3 Header

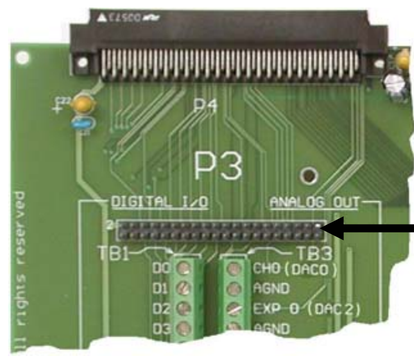
CAUTION

Disconnect the DBK202, DBK203, DBK203A, DBK204, or DBK204c from power and from signal sources prior to connecting the CA-60 cable to the 40-pin header.

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

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.



P3 40-Pin Header
If you need a DB37 connector for P3, connect a CA-60 cable to this 40-pin header.

The P3 Corner Section of a DBK202

The P3 40-pin header can be used to obtain a DB37 type connector via a CA-60 cable.
To make a DB37 connector available for P3:

1. Follow the preceding CAUTIONS and ensure power is removed from the system devices.
2. Access the terminal blocks:
   a) **DBK202** – access of the board is direct, or as determined by your own custom enclosure.
   b) **DBK203** – Loosen the two thumbscrews on the front panel and slide the card drawer free of the unit.
   c) **DBK203A** – Remove the upper inside screw from each of the four corner brackets (see figure, page 2) and lift the cover plate from the unit.
   d) **DBK204** and **DBK204c** – Follow step 2b or 2c as applicable to your unit.
3. Connect the CA-60 cable to the 40-pin header.
4. Return the system to normal operation.

Reference Note:
There is no direct pin-to-pin correlation between the pins on the header and those on the DB37 connector. For P3 pinout information refer to chapter 2, *System Connections and Pinouts*.

Adding Resistor/Capacitor Filter Networks

WARNING

Disconnect the DBK202, DBK203, DBK203A, DBK204, or DBK204c from power and from signal sources prior to installing capacitors or resistors.

CAUTION

Ensure wire strands do not short power supply connections (+15 V, -15 V, +5 V, etc.) to any terminal potential. Failure to do so could result in damage to DaqBook/2000 Series devices, DaqBoard/2000 Series boards, or DaqBoard/2000c Series boards.

Do not exceed maximum allowable inputs (as listed in product specifications). There should never be more than 30 V with reference to analog ground (AGND) or earth ground.

Do not operate DBK202 on an exposed metal surface.

You must provide strain-relief (lead slack) to all leads leaving DBK202, /203, /203A, /204, or /204c. Use tie-wraps [not included] to secure strain-relief.

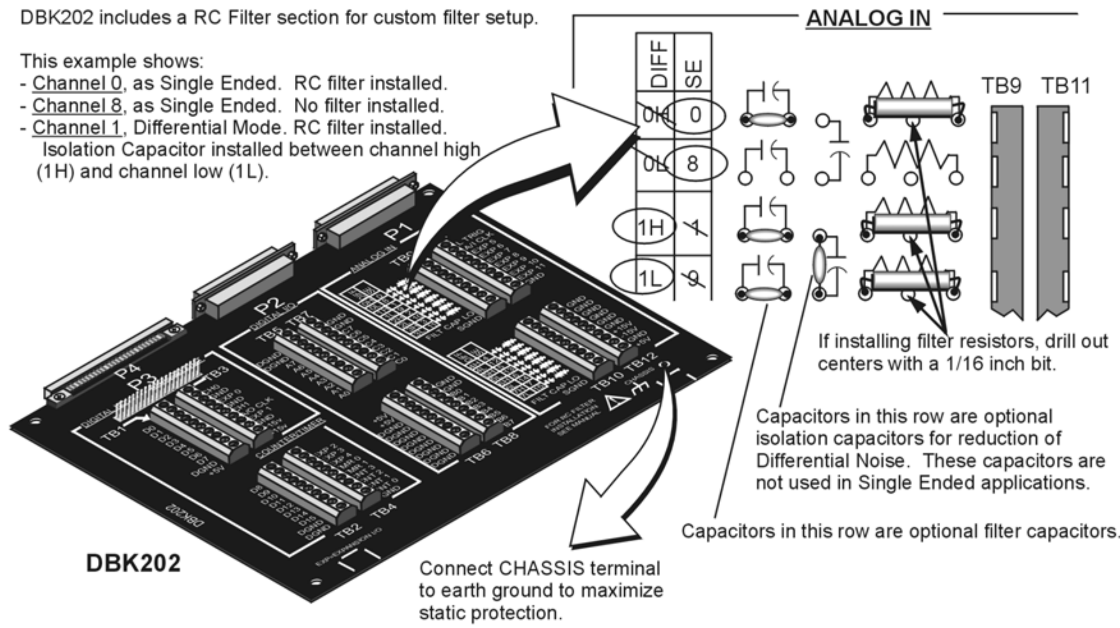
Always connect the CHASSIS terminal to earth ground. This will maximize static protection.

You can install customized RC filter networks to improve the signal-to noise ratio when an unacceptable level of noise exists. DBK202, /203, /203A, /204, and /204c include sockets for installing RC filter networks directly on the board.

The following table contains values that are typical for RC filter network components.

Typical One-Pole Low Pass Filter Values for DBK202, DBK203, DBK203A, DBK204, and DBK204c

R	C	f	f
Ohms	**µF**	**Hertz (-3dB)**	**kHz (-3dB)**
510	1	312	0.31
510	0.47	664	0.66
510	0.22	1419	1.42
510	0.1	3122	3.12
510	0.047	6643	6.64
510	0.022	14192	14.19
510	0.01	31223	31.22
510	0.0047	66431	66.43
470	0.0033	102666	102.67



An Example of Customer-Installed Capacitors and Filters for RC Networks on a DBK202

Prior to installing RC components, review the previous WARNING and CAUTION statements; then read over the following information regarding resistors and capacitors.

- **Do not use RC filters in conjunction with additional DBK expansion accessories.**
- **Prior to installing a resistor to the filter network you must drill a 1/16” hole through the center pinhole [beneath the board’s silkscreen resistor symbol] as indicated in the above figure. Failure to do so will short-circuit the resistor.**
- **Do not drill holes on the board for channels, unless those channels are to receive a filter network (see preceding statement).**
- **Resistors should be ¼ watt, film-type with up to 5% tolerance. Do not use wire-wound resistor types.**
- **A resistor value of 510 Ω is recommended. Do not exceed 510 Ω.**
- **Capacitors used are to be of the film dielectric type (e.g., polycarbonate or NPO ceramic), above 0.001 µF.**
- **RECOMMENDED: For reduction of both *Common Mode Noise* and *Differential Mode Noise*, use one capacitor between Channel High and AGND; and use a second capacitor between Channel Low and AGND.**
- **For reduction of *Differential Noise* [when no reduction of *Common Mode Noise* is needed] position a capacitor across the respective Channel High and Channel Low.**
- **When in Differential Mode, using capacitors between Channel High, Channel Low, and AGND may cause a slight degradation of *wideband Common Mode rejection*.**
- **When making a RC filter network, always install a wire jumper between the relevant FILT CAP LO and AGND. FILT CAP LO terminals are located on TB9 and TB10.**

Notes

For DaqBoard/2003 and cPCI DaqBoard/2003c

Not Applicable to DaqBook/2000 Series Devices

Note: DBK205 provides a 12-slot screw terminal for DaqBoard/2003 and cPCI DaqBoard/2003c.

This product is not used for LogBook applications.

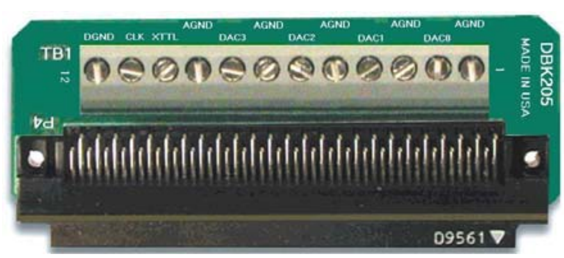
Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) for information pertaining to those products, as needed.

Overview

DaqBoard/2003 and cPCI DaqBoard/2003c boards communicate [external from the host PC] through a 100-pin P4 connector. The DBK205 provides 12 screw-terminal connections on one terminal block (TB1), as follows:

- four analog outputs (DAC0, DAC1, DAC2, and DAC3)
- one digital ground (DGND)
- five analog grounds (AGND)
- one external clock (CLK)
- one external trigger (XTTL)



DBK205
P4 to 12-Slot Screw Terminal Adapter Board

Note: The signal lines on DBK205's P4 connector correspond with *P3-associated pins* on the P4 connector of DaqBoard/2003 and cPCI DaqBoard/2003c.

Note: The P1, P2, and P3 connectors discussed in association with DaqBoard/2000 Series and /2000c Series boards are subset connectors of the 100-pin P4 connector that is located on those boards. Chapter 3, *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4.

Although a 3-foot, 100-conductor ribbon cable (part number CA-195) is typically used to connect a DaqBoard/2000 Series or /2000c Series board with a P4 adapter, the DBK205 adapter board can connect directly to the DaqBoard's P4 connector.

Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.

Connections

The DBK205 can be connected directly to the 100-pin P4 connector on the DaqBoard/2003, or /2003c.

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK205. Electric shock or damage to equipment can result even under low-voltage conditions.

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

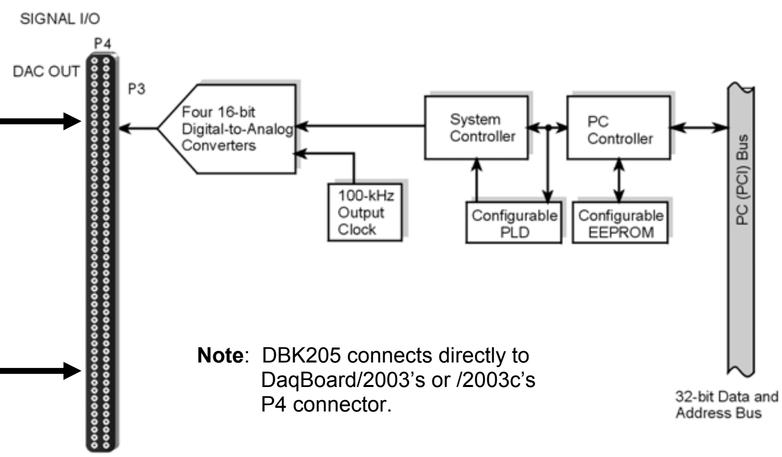
Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure that boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.

DBK205 Terminations

TB1-1	AGND
TB1-2	DAC0
TB1-3	AGND
TB1-4	DAC1
TB1-5	AGND
TB1-6	DAC2
TB1-7	AGND
TB1-8	DAC3
TB1-9	AGND
TB1-10	XTTL
TB1-11	CLK
TB1-12	DGND

DBK205 Adapter



DaqBoard/2003 Block Diagram

For Analog I/O, Digital I/O, & Pulse/Frequency

Note: DBK206 provides: P1, P2, and P3 connectors and corresponding screw-terminal blocks for use with DaqBook/2000 Series Devices, DaqBoard/2000 Series Boards, and cPCI DaqBoard/2000c Series Boards.

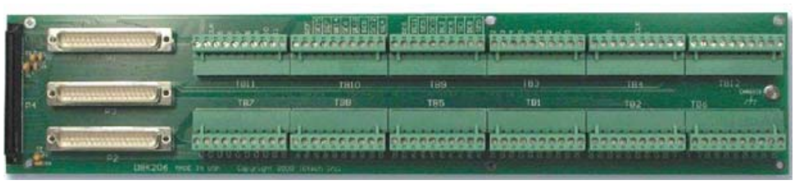
This product is not used for LogBook applications.

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.

Overview

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards communicate [external from the host PC] through a 100-pin P4 connector. The DBK206 provides a P1, P2, and P3 connector and corresponding screw-terminal blocks. P1 is used for ANALOG I/O, P2 for DIGITAL I/O, and P3 for PULSE/FREQUENCY (Digital and Counter/Timer) I/O.



DBK206, P4-to-P1/P2/P3 Adapter with Screw-Terminals

Note: The P1, P2, and P3 connectors discussed in association with DaqBook/2000 Series devices DaqBoard/2000 Series boards and cPCI DaqBoard/2000c Series boards are subset connectors of the 100-pin P4 connector that is located on those boards. Chapter *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4.

Connections

The DBK206 is suitable for both analog and digital expansion. Signal connection to a DaqBook/2000 Series device, DaqBoard/2000 Series board, or to a cPCI DaqBoard/2000c Series board can be made as follows:

- With cables connected to P1, P2, and P3 connectors, as applicable.
- With signal wires connected to the appropriate screw-terminal blocks (TB1 through TB12). Note that the DBK206 board's silkscreen clearly identifies all screw terminals.
- With a combination of the above two methods.

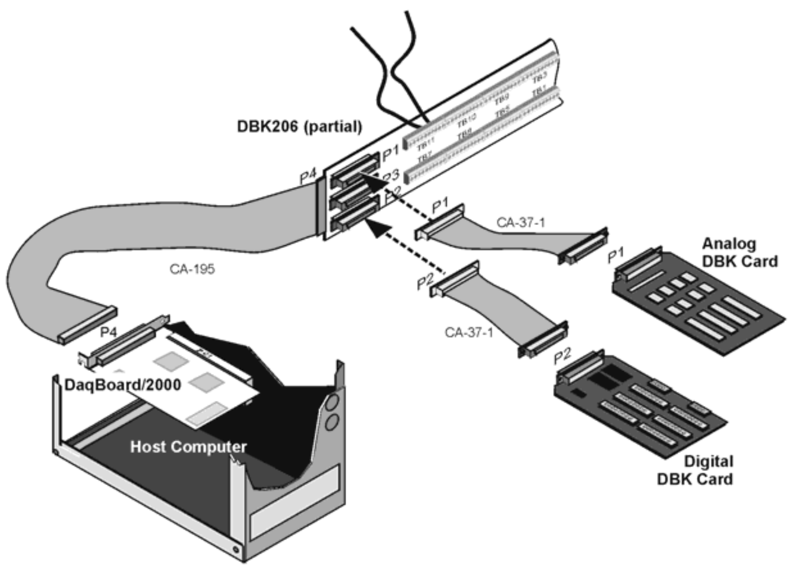
Regardless of which method is used, the DBK206 connects to the 100-pin P4 connector of a DaqBook/2000 Series device, DaqBoard/2000 Series board, or a cPCI DaqBoard/2000c Series board. The connection is made via a CA-195 cable. Note that DBK206 contains mounting holes that allow the board to be secured inside a user-provided enclosure (not shown).

CAUTION	
	Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.
ATTENTION OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES	**Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)** **Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.**
	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 illustrations and actual board silkscreen are the only references you should need to make proper connections.

A list of connection tips follows:

1. Ensure power is removed from the device(s) to be connected.
2. Observe ESD precautions when handling the board and making connections.
3. Do not make redundant connections. For example, for ANALOG IN you can use the P1 (DB37) connector or Terminal Blocks TB9 through TB12. You would not use both sets of ANALOG IN connectors.



Example of a DBK206 Connected to Analog and Digital DBK Cards Through P1 and P2, Respectively

Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.

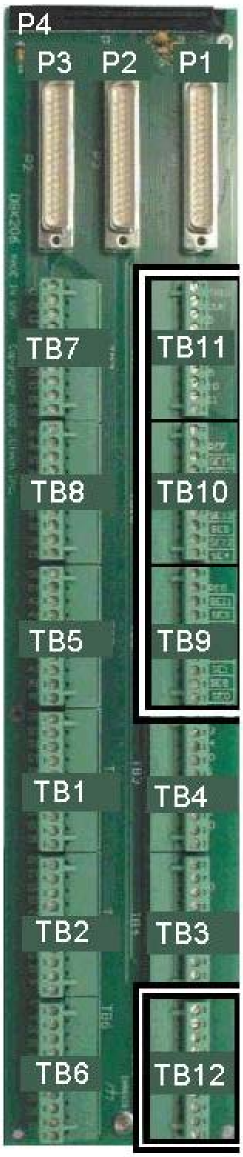
4. The DBK206 100-pin P4 connector connects to the DaqBoard/2000 Series P4 connector via a CA-195 Cable.

5. To obtain maximum protection from static, connect the CHASSIS terminal to earth ground.

6. For connections to DB37 connectors:
   - P1 connects to an analog DBK card or module’s P1 connector via a CA-37 cable.
   - P2 connects to a Digital DBK card or module’s P2 connector via a CA-37 cable.
   - P3 connects to a Pulse/Frequency DBK card or module’s P3 connector via a CA-37 cable.

7. In regard to Screw-Terminal Block Connections:
   - When tightening terminal block screws, tighten them snug, but do not over-tighten.
   - The DBK206 includes 12 terminal blocks. Each block contains 10 screw-terminal connectors.
   - The DBK206 silkscreen provides labels for each terminal block (TB1 through TB12) and for each of the block’s associated screw-terminals.
   - **TB9**, **TB10**, **TB11**, and **TB12** are used for **ANALOG IN** and provide a connection option to the **P1** (DB37) connector.
   - **TB5**, **TB6**, **TB7**, and **TB8** are used for **DIGITAL I/O** and provide a connection option to the **P2** (DB37) connector.
   - **TB1**, **TB2**, **TB3**, and **TB4** are used for **Pulse/Frequency/Digital I/O** and provide a connection to the **P3** (DB37) connector.
   - The following pages correlate the DBK206 terminal block connectors with the associated pins of the P1, P2, and P3 DB37 connectors. Note that the *System Connections and Pinouts* chapter contains additional pin-outs, and includes references to the 100-pin P4 connector.

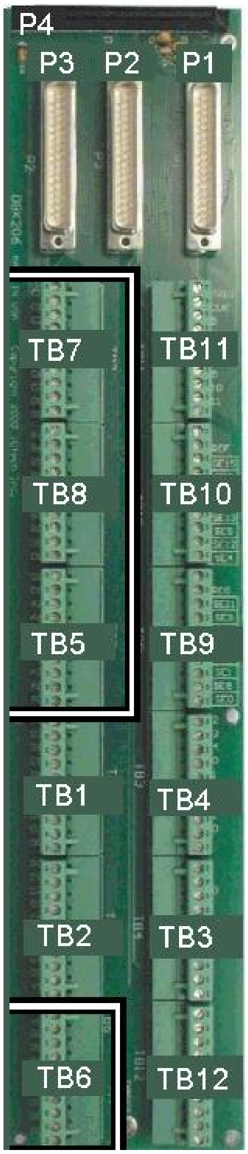
Correlation to P1 – TB11, TB10, TB9, and TB12 for Analog I/O.



TB11	**P1 Pin Number and Description**	
TTL TRIG	25	TTL Trigger, Digital IN, External TTL Trigger Input
A/I CLK	20	A/I Clock, External ADC Pacer Clock Input/ Internal ADC Pacer Clock Output
EXP 5	5	Expansion 5. Digital OUT, external GAIN select bit 1
EXP 6	6	Expansion 6. Digital OUT, external GAIN select bit 0
EXP 7	3	Expansion 7. Digital OUT, external ADDRESS, select bit 3
EXP 8	22	Expansion 8. Digital OUT, external ADDRESS, select bit 2
EXP 9	4	Expansion 9. Digital OUT, external ADDRESS, select bit 1
EXP 10	23	Expansion 10. Digital OUT, external ADDRESS, select bit 0
EXP 11	26	Expansion 11. Simultaneous Sample and Hold (SSH)
AGND	*	Analog Common
TB10	**P1 Pin Number and Description**	
SGND	19	Signal Ground, Sense Common
POSREF	9	Positive Reference, Analog +5 V reference
SE15	11	CH 15 IN (Single-Ended Mode) / CH 7 LO IN (Differential Mode)
SE7	30	CH 7 IN (Single-Ended Mode) / CH 7 HI IN (Differential Mode)
SE14	12	CH 14 IN (Single-Ended Mode) / CH 6 LO IN (Differential Mode)
SE6	31	CH 6 IN (Single-Ended Mode) / CH 6 HI IN (Differential Mode)
SE13	13	CH 13 IN (Single-Ended Mode) / CH 5 LO IN (Differential Mode)
SE5	32	CH 5 IN (Single-Ended Mode) / CH 5 HI IN (Differential Mode)
SE12	14	CH 12 IN (Single-Ended Mode) / CH 4 LO IN (Differential Mode)
SE4	33	CH 4 IN (Single-Ended Mode) / CH 4 HI IN (Differential Mode)
TB9	**P1 Pin Number and Description**	
SGND	19	Signal Ground, Sense Common
NEGREF	8	Negative Reference, Analog -5 V reference
SE11	15	CH 11 IN (Single-Ended Mode) / CH 3 LO IN (Differential Mode)
SE3	34	CH 3 IN (Single-Ended Mode) / CH 3 HI IN (Differential Mode)
SE10	16	CH 10 IN (Single-Ended Mode) / CH 2 LO IN (Differential Mode)
SE2	35	CH 2 IN (Single-Ended Mode) / CH 2 HI IN (Differential Mode)
SE9	17	CH 9 IN (Single-Ended Mode) / CH 1 LO IN (Differential Mode)
SE1	36	CH 1 IN (Single-Ended Mode) / CH 1 HI IN (Differential Mode)
SE8	18	CH 8 IN (Single-Ended Mode) / CH 0 LO IN (Differential Mode)
SE0	37	CH 0 IN (Single-Ended Mode) / CH 0 HI IN (Differential Mode)
TB12	**P1 Pin Number and Description**	
AGND	*	Analog Common
AGND	*	Analog Common
AGND	*	Analog Common
AGND	*	Analog Common
AGND	*	Analog Common
AGND	*	Analog Common
+ 15 V	21	Expansion, +15 V Power
- 15 V	2	Expansion, -15 V Power
AGND	*	Analog Common
+ 5 V	1	Expansion, +5 V Power

* Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

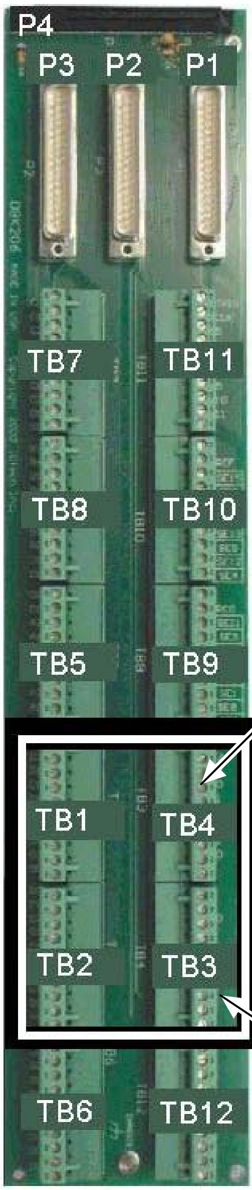
Correlation to P2 – TB5, TB6, TB7, and TB8 for Digital I/O.



TB7	P2 Pin Number and Description	
C0	29	Digital I/O: P2, Digital Port C, Bit 0; or P2 Expansion Data Bit 0
C1	28	Digital I/O: P2, Digital Port C, Bit 1; or P2 Expansion Data Bit 1
C2	27	Digital I/O: P2, Digital Port C, Bit 2; or P2 Expansion Data Bit 2
C3	26	Digital I/O: P2, Digital Port C, Bit 3; or P2 Expansion Data Bit 3
C4	25	Digital I/O: P2, Digital Port C, Bit 4; or P2 Expansion Data Bit 4
C5	24	Digital I/O: P2, Digital Port C, Bit 5; or P2 Expansion Data Bit 5
C6	23	Digital I/O: P2, Digital Port C, Bit 6; or P2 Expansion Data Bit 6
C7	22	Digital I/O: P2, Digital Port C, Bit 7; or P2 Expansion Data Bit 7
DGND	*	Digital Common
DGND	*	Digital Common
TB8	**P2 Pin Number and Description**	
B7	3	Digital I/O: P2, Digital Port B, Bit 7; or P2 Expansion Address Bit 0 Out
B6	4	Digital I/O: P2, Digital Port B, Bit 6; or P2 Expansion Address Bit 1 Out
B5	5	Digital I/O: P2, Digital Port B, Bit 5; or P2 Expansion Address Bit 2 Out
B4	6	Digital I/O: P2, Digital Port B, Bit 4; or P2 Expansion Address Bit 3 Out
B3	7	Digital I/O: P2, Digital Port B, Bit 3; or P2 Expansion Address Bit 4 Out
B2	8	Digital I/O: P2, Digital Port B, Bit 2; or P2 Expansion RESET Output
B1	9	Digital I/O: P2, Digital Port B, Bit 1; or P2 Expansion WRITE Output
B0	10	Digital I/O: P2, Digital Port B, Bit 0; or P2 Expansion READ Output
DGND	*	Digital Common
DGND	*	Digital Common
TB5	**P2 Pin Number and Description**	
DGND	*	Digital Common
DGND	*	Digital Common
A7	30	Digital I/O: P2, Digital Port A, Bit 7; or P2 Expansion Data Bit 15
A6	31	Digital I/O: P2, Digital Port A, Bit 6; or P2 Expansion Data Bit 14
A5	32	Digital I/O: P2, Digital Port A, Bit 5; or P2 Expansion Data Bit 13
A4	33	Digital I/O: P2, Digital Port A, Bit 4; or P2 Expansion Data Bit 12
A3	34	Digital I/O: P2, Digital Port A, Bit 3; or P2 Expansion Data Bit 11
A2	35	Digital I/O: P2, Digital Port A, Bit 2; or P2 Expansion Data Bit 10
A1	36	Digital I/O: P2, Digital Port A, Bit 1; or P2 Expansion Data Bit 9
A0	37	Digital I/O: P2, Digital Port A, Bit 0; or P2 Expansion Data Bit 8
TB6	**P2 Pin Number and Description**	
+5 V	18	Expansion +5 V Power
+5 V	20	Expansion +5 V Power
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common
DGND	*	Digital Common

* Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

Correlation to P3 – TB1, TB2, TB3, and TB4 for Pulse/Frequency/Digital I/O.



TB1	P3 Pin Number and Description	
D8	29	P3 Digital Port Bit 8
D9	28	P3 Digital Port Bit 9
D10	27	P3 Digital Port Bit 10
D11	26	P3 Digital Port Bit 11
D12	25	P3 Digital Port Bit 12
D13	24	P3 Digital Port Bit 13
D14	23	P3 Digital Port Bit 14
D15	22	P3 Digital Port Bit 15
DGND	*	Digital Common
DGND	*	Digital Common
TB2	**P3 Pin Number and Description**	
D0	10	P3 Digital Port Bit 0
D1	9	P3 Digital Port Bit 1
D2	8	P3 Digital Port Bit 2
D3	7	P3 Digital Port Bit 3
D4	6	P3 Digital Port Bit 4
D5	5	P3 Digital Port Bit 5
D6	4	P3 Digital Port Bit 6
D7	3	P3 Digital Port Bit 7
DGND	*	Digital Common
+5V	20	Expansion, +5 Volt Power
TB4	**P3 Pin Number and Description**	
EXP 2	12	Reserved
EXP 3	13	Reserved
EXP 4	14	Reserved
TMR 0	15	P3 Timer 0 Output
TMR 1	16	P3, Timer 1 Output
CNT 3	35	P3 Counter 3 Input
CNT 2	17	P3 Counter 2 Input
CNT 1	36	P3 Counter 1 Input
CNT0	18	P3 Counter 0 Input
DGND	*	Digital Common
TB3	**P3 Pin Number and Description**	
DAC0	34	Analog Out; Analog DAC 0 Output
AGND	*	Analog Common
DAC2	32	Analog Out; Analog DAC 2 Output
AGND	*	Analog Common
DAC1	33	Analog Out; Analog DAC 1 Output
A/O CLK	21	Analog Out Clock; External DAC Pacer Clock Input/ Internal DAC Pacer Clock Output
DAC3	31	Analog Out; Analog DAC 3 Output
DGND	*	Digital Common
+15 V	19	Expansion, + 15 VDC
-15 V	37	Expansion, -15 VDC

* Refer to Ground Correlation Tables in the *System Connections and Pinouts* chapter.

DBK207 and DBK207/CJC

5B Carrier Boards

For 5B-Compatible Analog Input Modules

Note: The DBK207 and DBK207/CJC each provide: (a) two P1 connectors, (b) footprints for sixteen 5B Modules, (c) 16 terminal blocks. In addition, DBK207/CJC provides Cold Junction Compensation. The DBK207 and DBK207/CJC each include a 100-pin P4 connector for use with DaqBoard/2000 Series and cPCI DaqBoard/2000c Series Boards, and DaqBook/2000 Series devices.

This product is not used for LogBook applications.

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- For information regarding a related product with a different form-factor, refer to the DBK44, *2-Channel 5B Signal-Conditioning Card* section of this manual.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.

Overview

The DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards are subset connectors of the 100-pin P4 connector that is located on those boards. Chapter *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4.

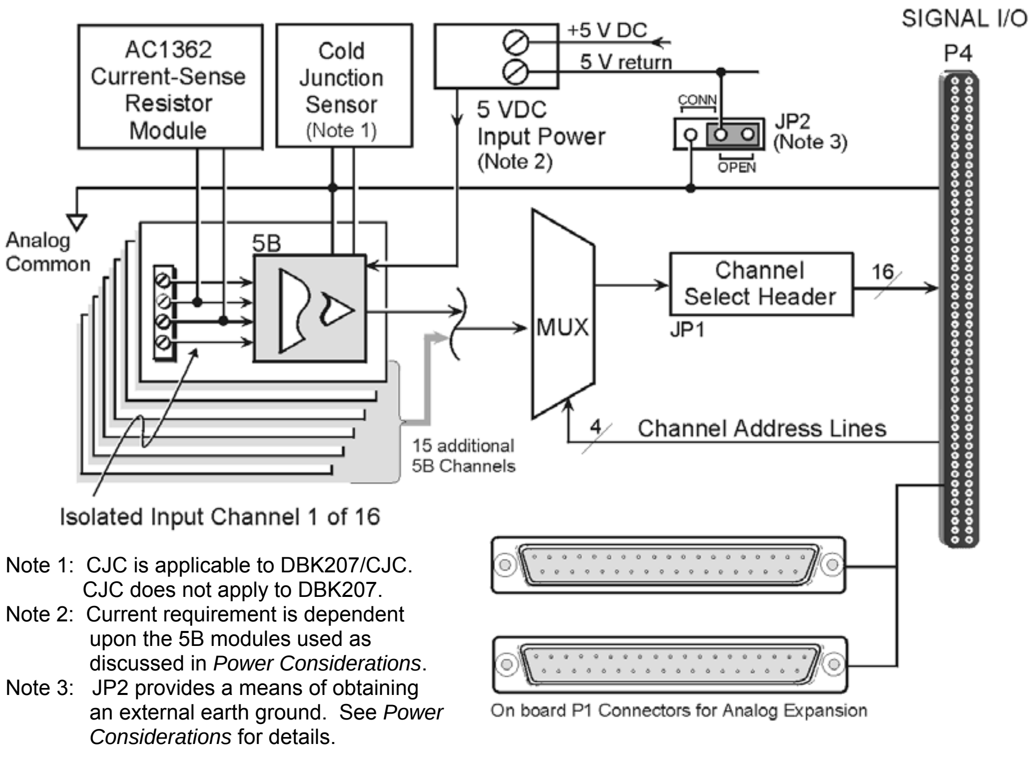
DBK207/CJC Carrier Board for 5B Compatible Modules

WARNING
Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

The DBK207 and DBK207/CJC are carrier boards for 5B-compatible analog input modules. These options each include two P1 connectors for analog expansion, a 5 VDC power terminal, and 16 signal terminal blocks. DBK207 and DBK207/CJC are typically installed in NEMA-type panels; however, they may be installed on DIN rails. Separate mounting instructions are included with Rack Mount Kit (part no. Rack-DBK-3) and with DIN-rail Mount Kit (part no. DIN-DBK-1).

DBK207 and DBK207/CJC allow Daq-based acquisition systems to use various combinations of sixteen 5B signal-conditioning modules. 5B modules can accommodate a variety of signals, including low-level thermocouple and strain-gage signals. Configuration options are flexible. You can select the type of signal attached to each channel. One Daq device can support up to 16 DBK207 [or DBK207/CJC] boards, providing a maximum of 256 isolated, analog input channels. Note that Daq devices scan the channels at the same 10 µs/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. Both DBK207 and DBK207/CJC include 16 screw-terminal blocks for signal inputs. In addition, the DBK207/CJC includes cold junction compensators (CJCs) for use with thermocouple 5B modules. Sockets are provided for user-installed AC1362 current-sense resistor modules, as discussed in *5B Module Connection* on page 5 of this section.



DBK207 and DBK207/CJC Block Diagram

Warnings, Cautions, and Tips

WARNING

Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

CAUTION

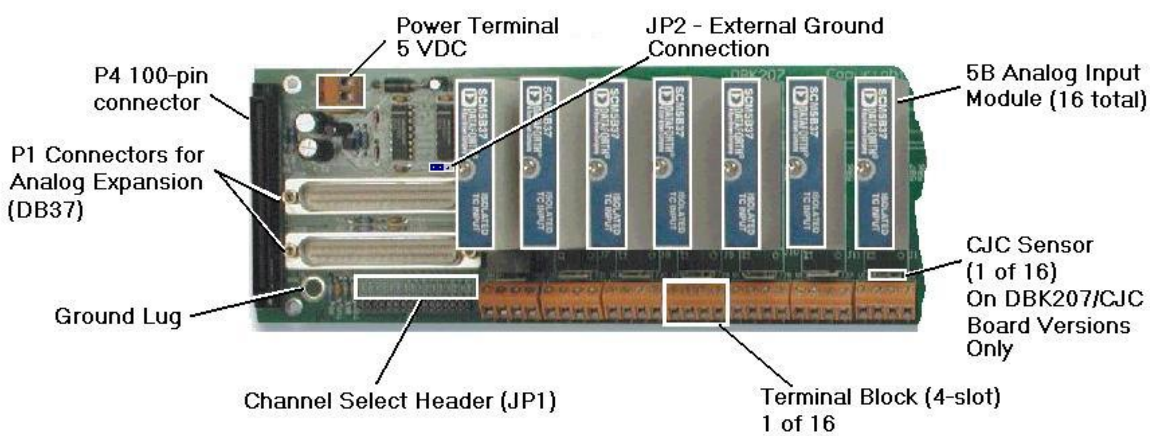
Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.

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

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.

1. Ensure that hard-wire emergency over-ride circuity exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.
2. Provide raceways (protective wiring routes) for all external I/O wiring.
3. Keep external I/O wiring away from ribbon cables.
4. Keep external I/O wiring away from low-voltage signal wiring.
5. Provide appropriate strain-relief and physical restraint to ensure that the wiring is held securely in the intended position, and without strain.
6. Ensure that all wiring with >50V potential is identified by the appropriate color codes and that warning labels are clearly visible.
7. Provide physical protection for the interface board. The level of protection is dependent upon the board's operating environment.



Partial DBK207/CJC

Power

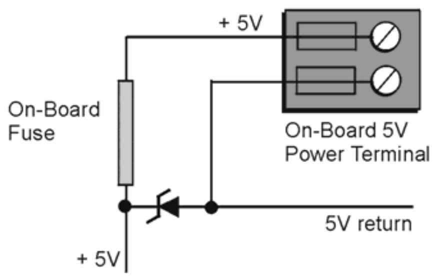
The DBK207 and DBK207/CJC require +5 VDC from a regulated DC power supply. External power attaches to the DBK207 [DBK207/CJC] via on-board screw terminal connections.

Power Requirements:

Voltage: +5 V regulated DC

Current: Dependent upon 5B Models used.

- SC-5B38 series modules each require 200 mA.
- SC-5B43 series modules require up to 200 mA.
- All other analog input 5B modules require 30 mA, unless otherwise specified.

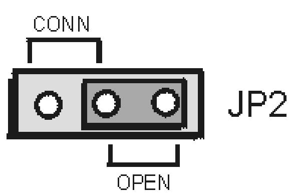


On-Board Power Connections for +5 Volts

CAUTION
External power supplied to DBK207 or DBK207/CJC must not exceed +5 VDC. Neither DBK207 nor DBK207/CJC regulate the external power input.

External Ground Connection

For optimum 5B module operation, the 5B must have one [and only one] earth ground. Accordingly, the DBK207 [DBK207/CJC] must be configured to provide its earth ground, if such a ground is not present on the power supply.



JP2 Shown in OPEN Default

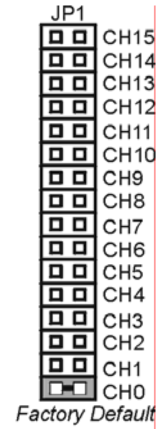
If the 5 VDC power supply provides output that is isolated from earth ground, then the jumper on JP2 should be placed in the CONN position. This will tie the 5V return on the power supply to the DBK207 [DBK207/CJC] ground system.

If the 5 VDC power supply is already referenced to earth ground, then the JP2 jumper should be placed to OPEN. This will prevent multiple earth ground connections and the resultant ground loop. Note that the OPEN position is JP2's default setting.

Channel Configuration

Up to 16 DBK207 [DBK207/CJC] boards can be connected to a Daq-based acquisition system. Since this is a daisy-chain interface, each module must appear unique and use a different analog input channel to the Daq device. To configure the board's channel, you must set the JP1 jumper to your chosen channel as follows.

1. Locate the 16×2-pin header (labeled JP1). Note the 16 jumper locations labeled CH0 through CH15 to match the Daq device's main channel.
2. Place the JP1 jumper on the channel you wish to use. Only one jumper is used per board.



Channel Configuration

5B Module Connection

DBK207 and DBK207/CJC analog input is processed through user-installed 5B signal-conditioning modules. Different 5B modules are used with different transducer and signal sources. To install the modules:

1. Remove all power from the DBK207 [DBK207/CJC].
2. Match the footprint of the module with the footprint on the printed circuit board.
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 near the input screw-terminal block for the desired channel.

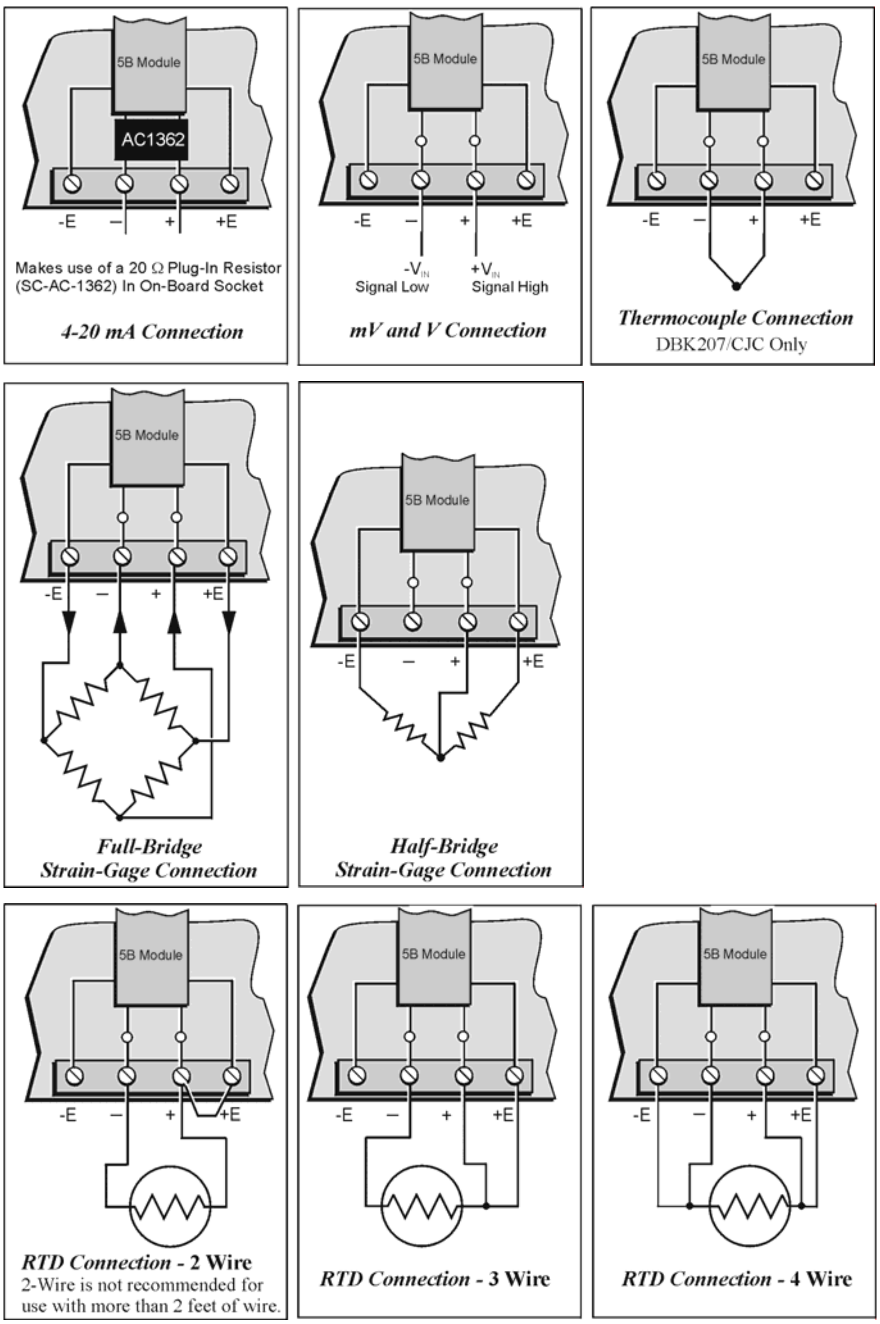
AC1362 Current Sense Resistor Install Location

Terminal Block Connection

WARNING

Shock Hazard. De-energize circuits connected to the DBK207, or DBK207/CJC before changing the wiring or configuration. Dangerous voltages may be present.

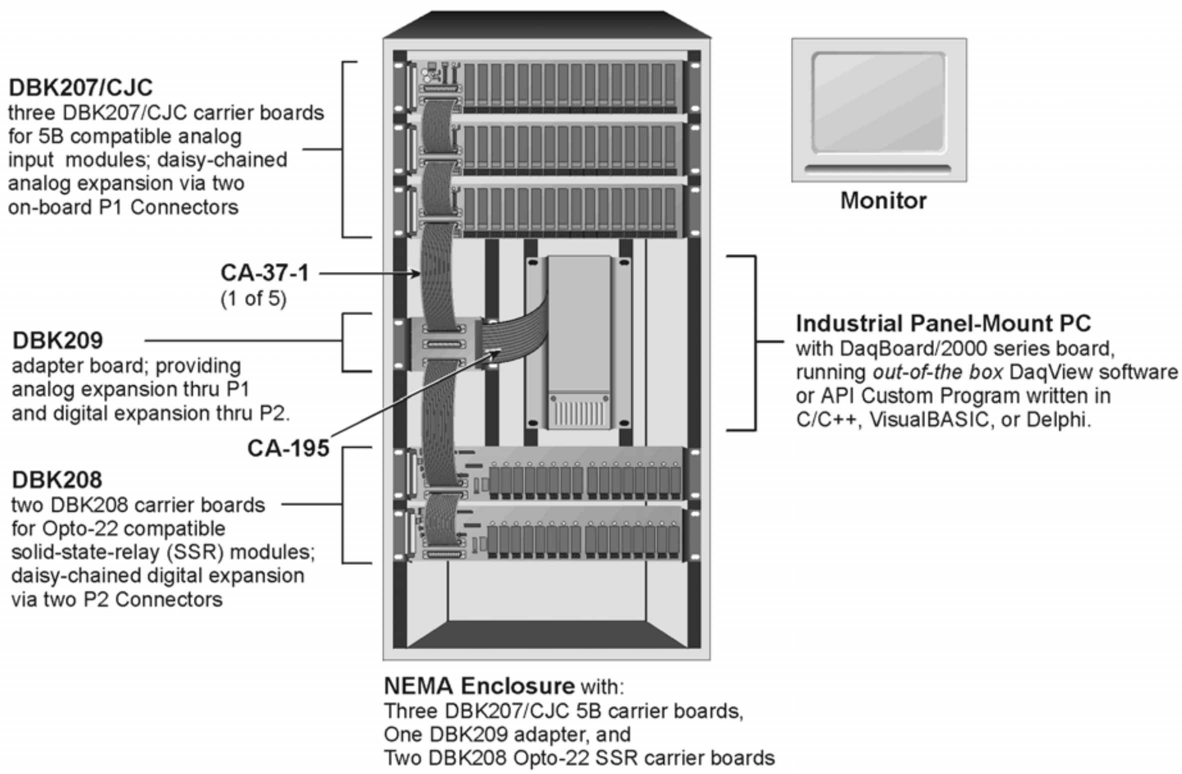
Input signals (and excitation leads) are wired to DBK207 [DBK207/CJC] via 16 four-contact terminal blocks that connect to corresponding 5B modules. The following figures depict various connection scenarios.



Connection Scenarios for 5B Modules

Connecting DBK207 or DBK207/CJC to a Daq Device

DBK207 and DBK207/CJC can be connected to the P4 connector of a DaqBook/2000 Series device or a DaqBoard/2000 Series board via a CA-195 cable or can be connected through the P1 connector of an applicable DBK200 series adapter board via CA-37-1 accessory ribbon cables.



Software Setup

Reference Notes:

- **DaqView users** - Refer to chapter 3, *DBK Setup in DaqView*.
- **LogView users** - Not Applicable.

DaqView software versions preceding 7.7 do not provide complete software support for the DBK207 or the DBK207/CJC carrier boards. If your version of DaqView precedes version 7.7, you must uninstall it, then install a more recent version of DaqView.

DBK207 and DBK207/CJC – Specifications

Name/Function:
DBK207 – Carrier Board for 5B-Compatible Analog Input Modules
DBK207/CJC – Carrier Board (with Cold Junction Compensation) for 5B-Compatible Analog Input Modules

Module Capacity: 16, input only, 5B modules

Cable (optional): CA-37-×

DC Input Fuse: 3A, reset type

Power Requirement: 5 VDC, regulated**.**

Operating Environment:
Temperature: 0°C to 70°C
Relative Humidity: 95% RH, non-condensing

Connectors:
P4 – 100-pin connector provides for connection to DaqBook/2000 Series device, DaqBoard/2000 Series board and cPCI DaqBoard/2000c Series P4 connector via a CA-195 cable.
P1 – Two P1 (DB37) connectors provide for analog expansion via CA-37-x cable.
Screw Terminals – 16 sets of 4-connector blocks provide wire connection for +E, -E, +, and -.

Isolation (DC or AC Peak):
Signal Inputs to Daq Device: 500 V
Input Channel-to-Channel: 500 V

CJC: Cold Junction Compensation, applicable to DBK207/CJC.
Not Applicable to DBK207.

DBK208 Relay Carrier Board

For Opto-22 Compatible Solid-State-Relays

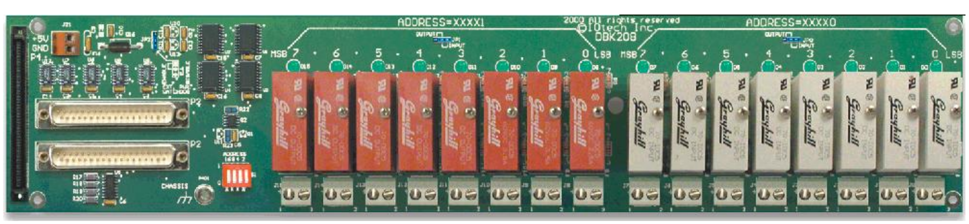
Note: The DBK208 provides: (a) two P2 connectors, (b) footprints for sixteen optically-isolated Solid-State-Relay (SSR) Modules, and (c) 16 dual-screw terminal blocks. DBK208 includes a 100-pin P4 connector for use with DaqBook/2000 Series Devices, DaqBoard/2000 Series Boards, and /2000c Series Boards.

This product is <u>not</u> used with:
- **LogBook**
- **DaqBook/100 Series devices**
- **DaqBoard/100 (ISA-type) Series devices**

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before this DBK200 section.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.

Overview



DBK208 Carrier Board for Opto-22 Compatible Solid-State-Relays

DaqBoard/2000 Series and cPCI DaqBoard/2000c Series boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with these boards are subset connectors of the 100-pin P4 connector. Chapter *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4.

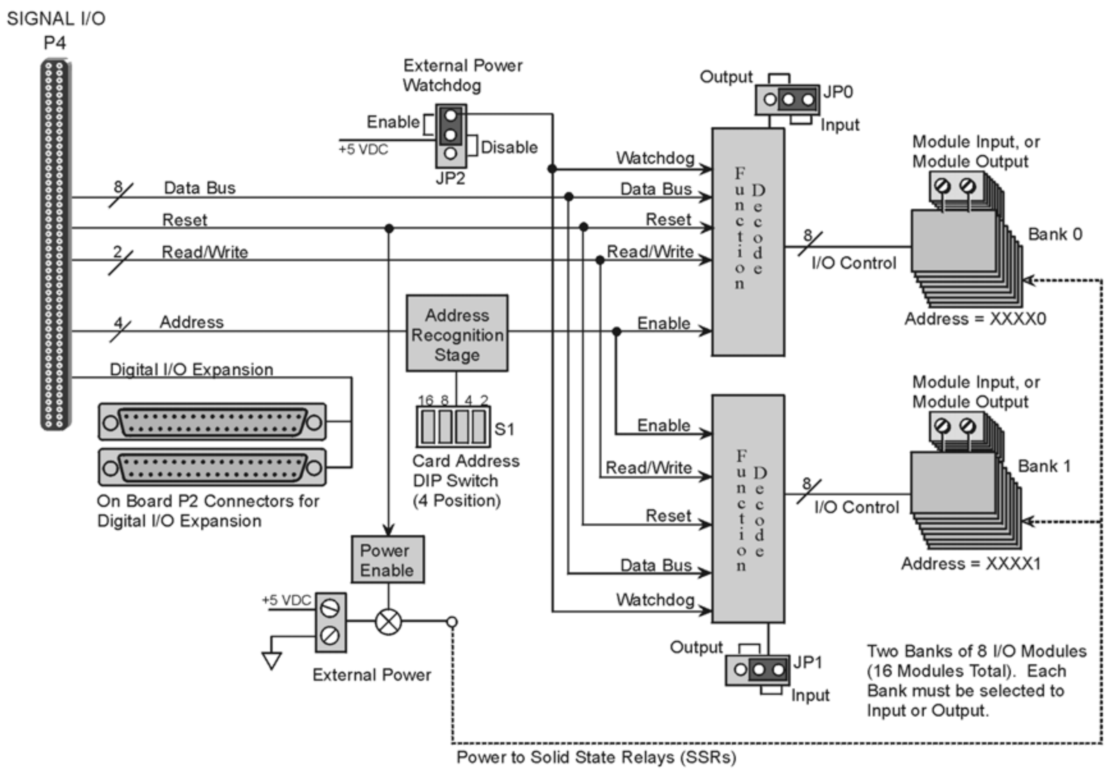
The information included in this section, when combined with that found in the related DBK option cards and modules subsections should enable you to set up your desired configuration.

DBK208 is a two-bank carrier board for optically-isolated Solid-State-Relay (SSR) modules. Each bank supports up to eight digital I/O modules. The banks can be independently set as "input" or "output" via jumpers (JP0 for Bank 0, and JP1 for Bank 1). The I/O modules are industry standard Opto-22 compatible, 5-volt logic level modules.

WARNING
Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

Note 1: DBK208 is not used with DaqBoard/2003.

Note 2: DBK208 can be used with DaqBook/200 and Daqboard/200 (ISA-type) series devices; but should not be used with DaqBook/100 or DaqBoard/100 (ISA-type) series devices.



DBK208 Block Diagram

DBK208 boards are typically installed in NEMA-type panels; however, they may alternatively be installed on DIN rails. Separate mounting instructions are included with Rack Mount Kit (part no. Rack-DBK-3) and with DIN-rail Mount Kit (part no. DIN-DBK-1).

DBK208 is controlled digitally from the Daq device (DaqBook or DaqBoard) through one of two connectors, as follows:

DaqBook/200 Series Devices – control is through the 37-pin P2 digital port of the DaqBook and one of two DBK208 P2 connectors.

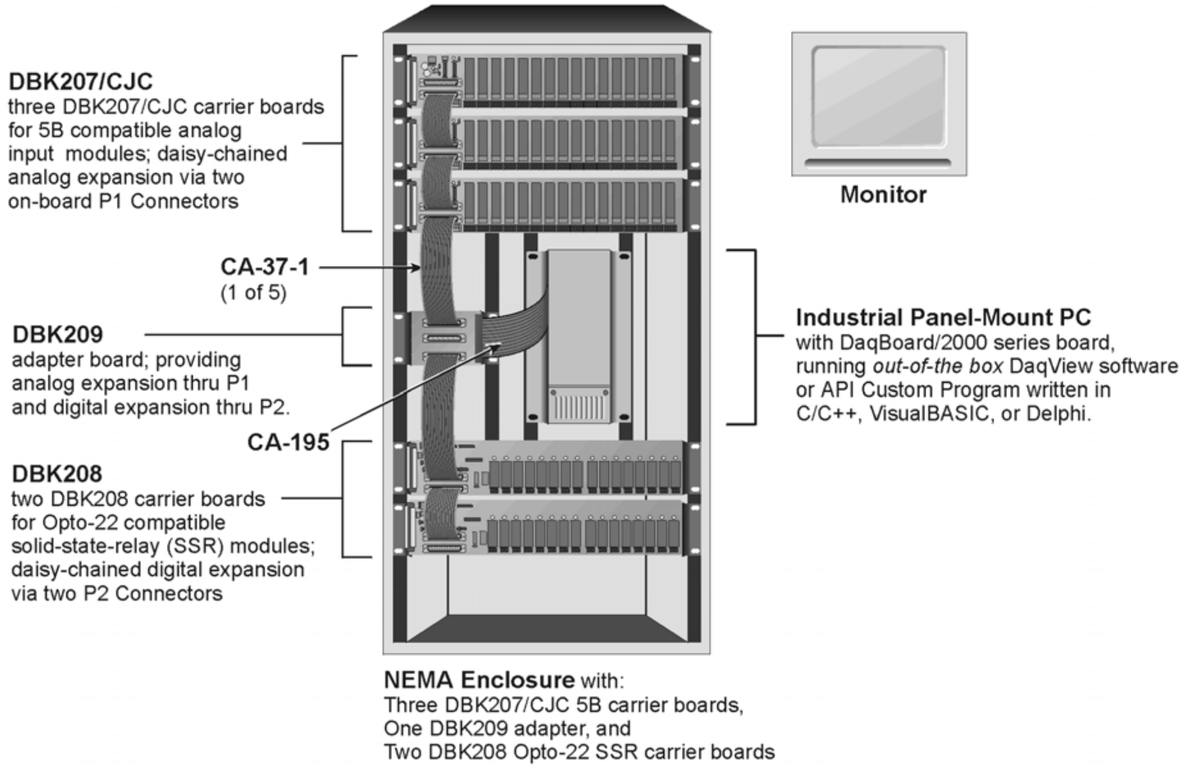
DaqBoard/200 Series boards [ISA-type] - control is through the 37-pin P2 digital port of the DaqBoard and one of the DBK208 P2 connectors.

DaqBook/2000 Series Devices, DaqBoard/2000 Series boards, and cPCI DaqBoard/2000c Series boards – control originates in the board's 100-pin P4 connector. Connection of these boards to DBK208 can be made directly or indirectly as follows:

- Direct connection can be made from the 2000 series board's 100-pin P4 connector to a DBK208's P4 connector via a CA-195 cable.
- Indirect connection can be made using one of the DBK200 Series P4-adapters that includes a 37-pin P2 connector (DBK201, DBK202, DBK203, DBK204, DBK206, DBK209, or another DBK208). CA-37 cables are used to connect from P2 to P2.

Note that a single Daq-based data acquisition system can support up to 16 DBK208 boards, providing a total of 256 channels. DBK208 boards contain two DB37 P2 connectors for the purpose of daisy-chaining to other DBK208s or to other P2-supported devices.

The following illustration is an example of a Data Acquisition System that includes two DBK208 boards for digital I/O. The two DBK208 boards are daisy-chained to a DBK209 P2 connector. The DBK209 is connected to a DaqBoard/2000 Series board via a CA-195 cable.

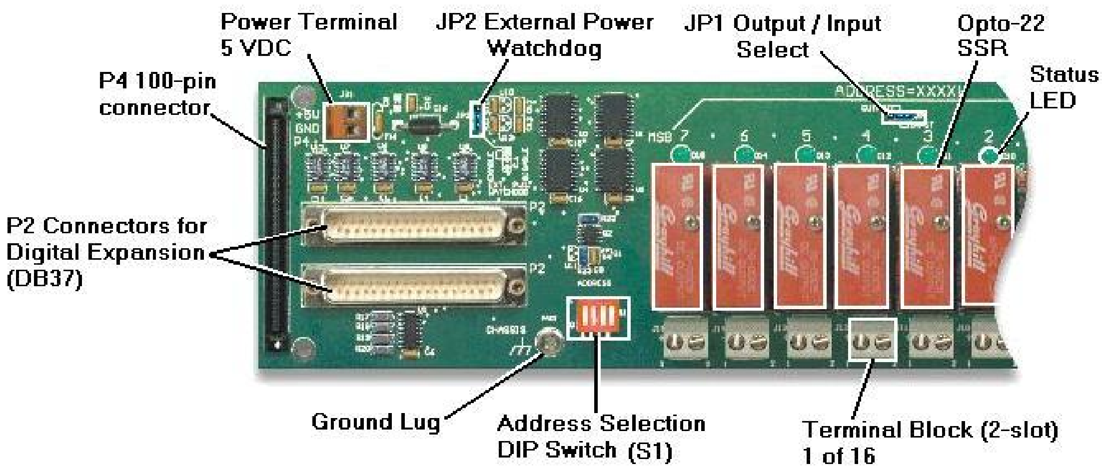


Warnings, Cautions, and Tips

WARNING
Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

CAUTION
Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.
Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.) **Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.**
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.

1. Provide raceways (protective wiring routes) for all external I/O wiring.
2. Keep external I/O wiring away from ribbon cables.
3. Keep external I/O wiring away from low-voltage signal wiring.
4. Provide appropriate strain-relief and physical restraint to ensure that the wiring is held securely in the intended position, and without strain.
5. Ensure that all wiring with >50V potential is identified by the appropriate color codes and that warning labels are clearly visible.
6. Provide physical protection for the I/O interface board. The level of protection is dependent upon the board's operating environment.

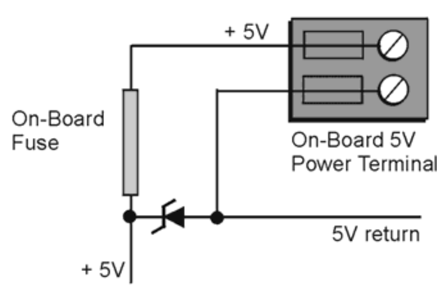


Partial DBK208

Power

The DBK208 requires an external isolated 5 volt DC supply with at least 0.25 amp current capacity. External power attaches to the DBK208 via on-board screw terminal connections. The board contains capacitors to filter input noise from the power supply.

Over-current protection is provided by an on-board 0.5 amp reset fuse in series with the 5 volt supply. Protection from over-voltage and reverse polarity power conditions is provided by a 6.8V zener diode.



External Power Watchdog

The External Power Watchdog is governed by the setting of the JP2 jumper. This jumper allows the user to determine the behavior of the digital output latches in the event of a loss and recovery of the external power supply.

With the jumper in the ENABLE position, the loss of external power will cause the output latches to be reset into a high-impedance condition. Even with a recovery of the external power, all output modules will be disabled until a write is done to the data bus. This setting is useful in an application that requires a serial enabling of output loads.

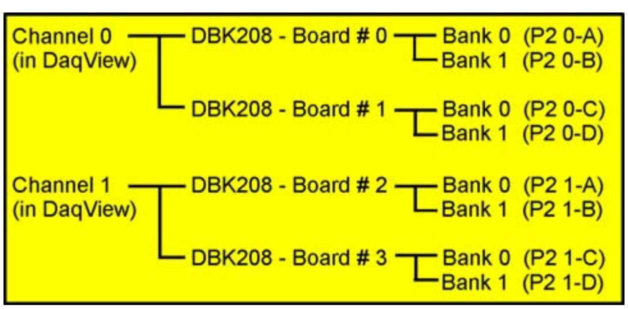
With the jumper in the DISABLE position, the loss of external power will have no effect on the state or continued control of the output latches. That is, data that is written to the output modules will continue to be latches as normal. A recovery of the external power would then cause the output modules to reflect the current state of the output latches. This setting is useful in the case where the operator halts the transfer of data and turns off the external power on purpose and then wants the system to assume the same state upon recovery of the external power.

The setting of the JP2 jumper has no effect on input modules with regards to external power. While a loss of external power will result in corruption of the data being read, the data bus will be valid again immediately upon the recovery of the external power. The default setting of the JP2 jumper is the ENABLE position.

Operation

The DBK208 P2 expansion protocol makes use of a 4-bit dip switch (S1) to configure the board's addresses. Addresses are seen as XXXX + 0 for Bank 0's set of eight modules and as XXXX + 1 for Bank 1's set of eight modules, where the four Xs represent the DIP switch settings of 16 8 4 and 2. With all four S1 micro-switches OFF (open), the first system board (designate as "0") has Bank 0 registered as 0 and Bank 1 registered as 1. With S1's micro-switch "2" closed, we would see Bank 0 registered as 2 and Bank 1 registered as 3. The following table portrays the addressing scheme and includes DaqView designations.

The following breakdown is provided to indicate the relationship of DaqView channels to DBK208 boards and banks. More detailed information follows.



Simplified Channel-to-DBK208 Relationship

DBK208 Board #	Switch S1 Configurations				Address		Designation in **DaqView** (see notes 2 & 3)		
	16	**8**	**4**	**2**	**Bank 0**	**Bank 1**	**Expanded Digital I/O in Async Digital I/O window**		**Channel**
0	OFF	OFF	OFF	OFF	0	1	P2 0-A	P2 0-B	0
1	OFF	OFF	OFF	**ON**	2	3	P2 0-C	P2 0-D	
2	OFF	OFF	**ON**	OFF	4	5	P2 1-A	P2 1-B	1
3	OFF	OFF	**ON**	**ON**	6	7	P2 1-C	P2 1-D	
4	OFF	**ON**	OFF	OFF	8	9	P2 2-A	P2 2-B	2
5	OFF	**ON**	OFF	**ON**	10	11	P2 2-C	P2 2-D	
6	OFF	**ON**	**ON**	OFF	12	13	P2 3-A	P2 3-B	3
7	OFF	**ON**	**ON**	**ON**	14	15	P2 3-C	P2 3-D	
8	**ON**	OFF	OFF	OFF	16	17	P2 4-A	P2 4-B	4
9	**ON**	OFF	OFF	**ON**	18	19	P2 4-C	P2 4-D	
10	**ON**	OFF	**ON**	OFF	20	21	P2 5-A	P2 5-B	5
11	**ON**	OFF	**ON**	**ON**	22	23	P2 5-C	P2 5-D	
12	**ON**	**ON**	OFF	OFF	24	25	P2 6-A	P2 6-B	6
13	**ON**	**ON**	OFF	**ON**	26	27	P2 6-C	P2 6-D	
14	**ON**	**ON**	**ON**	OFF	28	29	P2 7-A	P2 7-B	7
15	**ON**	**ON**	**ON**	**ON**	30	31	P2 7-C	P2 7-D	

Notes: (1) Switch S1 settings are made physically on the DBK208 boards and are checked in DaqView (see the following screen capture). The software aspect is detailed on the following page.

(2) The *Digital Option Cards External Connection* section of DaqView's *Configure System Hardware* window lists 8 channels (0 through 7) as shown in the following screen image.

(3) Each of the 8 channels can represent 2 DBK208 boards. For example, as seen in the table, System Board 0 and System Board 1 would both show up in DaqView's channel 0.

(4) In the *Async Digital I/O* window, each active channel (representing 2 boards) has divisions of A, B, C, and D. A represents Bank 0 of the first board. B represents Bank 1 of the first board.

C represents Bank 0 of the second board. D represents Bank 1 of the second board.

(5) Banks are selected to be "Input" or "Output" via jumpers. Jumper JP0 applies to Bank 0, JP1 applies to Bank 1.

Logic outputs provide signals for clocking data to registers for the Opto-22 SSR type modules. On-board jumpers (JP0 and JP1) are used to set the banks for "input" or "output." The banks can be set independently, however, all modules within a bank will have the same setting. For example, JP0 could be set to "Input," configuring all 8 modules of Bank 0 to Input; and JP1 could be set to "Output," configuring all Bank 1 modules to "Output."

Each Opto-22 module has a 2-connector terminal block for signal connections.

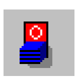
Software Setup

Note: DBK208 is not applicable to LogBook or LogView.

To use DBK208 from within DaqView, you must first configure the DaqView software to match the hardware setup.

1. From DaqView's main window, select the **Device** pull-down menu.
2. Select **Configure Hardware Settings**.

   The *Digital Option Cards External Connection* section of DaqView's *Configure System Hardware* window lists 8 channels (0 through 7) as shown in the following screen image.
3. Under Digital Option cards (on right side of screen), select **DBK208**. A DBK208 Configuration Settings window will appear. The window includes a "Switch Settings" section (see following figure).
4. Select the S1 switch settings that apply to your configuration. In the above screen example DaqView's Digital Channel 0 consists of two boards. Note that no more than two DBK208 boards are permitted per DaqView Channel. Both S1 check boxes are selected when two boards are used in a channel.
5. Check (or uncheck) JP-0 and JP-1 to match your hardware. A checked jumper indicates that the associated bank is digital Input. An unchecked jumper indicates Output. The first board in the channel has its banks designated as P2 0-A and P2 0-B. The second board's banks are designated as P2 0-C and P2 0-D.
6. After S1, JP-0, and JP-1 settings are complete, click the OK button.

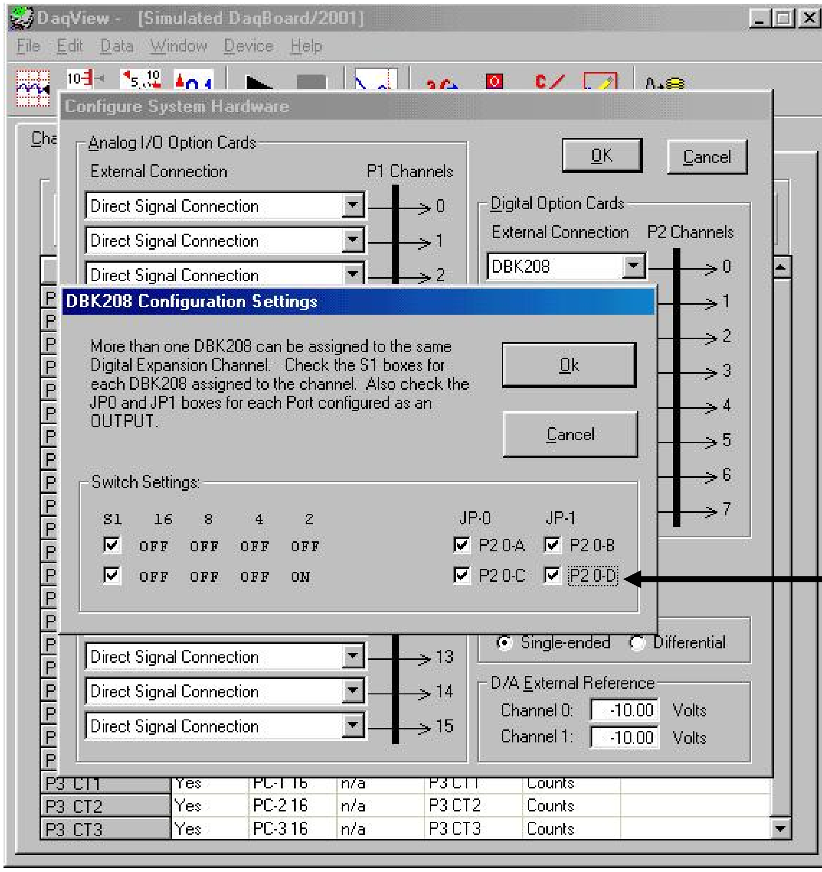


7. Select the Digital I/O icon from DaqView's main window toolbar. The *Async Digital I/O window* will appear.

   With the P2 Digital I/O tab selected in the *Async Digital I/O* window, each active channel (representing 2 boards) has divisions of A, B, C, and D.

   - "**A**" represents the 8-bit **Bank 0** of the first board.
   - "**B**" represents the 8-bit **Bank 1** of the first board.
   - "**C**" represents the 8-bit **Bank 0** of the second board.
   - "**D**" represents the 8-bit **Bank 1** of the second board.

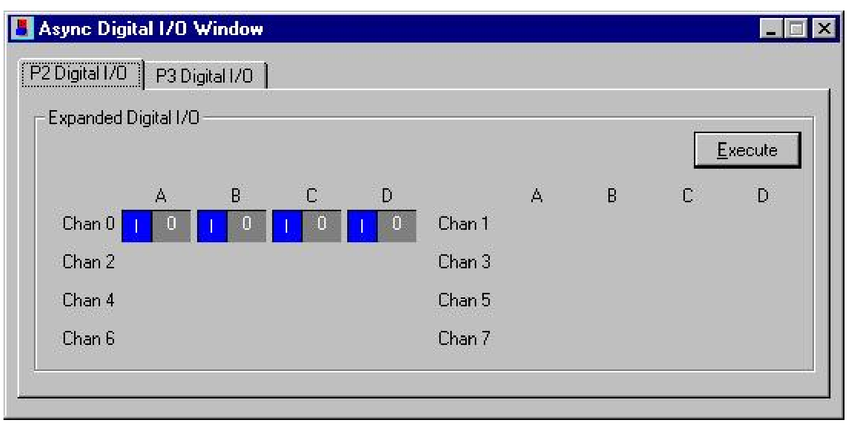
Switch Settings
The switch settings must agree with those on the actual DBK208 board. Refer to pages 5 and 6 of this section for configuration details.



For Digital Output
Ensure the JP0 and JP1 boxes are checked for each port configured as Digital Output.

For Digital Input
Ensure the JP0 and JP1 boxes are not checked for each port configured as Digital Input.

Configure System Hardware and DBK208 Configuration Settings Windows



Async Digital I/O Window – P2 Digital I/O Tab Selected

In the above screen shot of the Digital I/O Window, channel 0 represents two DBK208 boards. The first board consists of banks A and B, the second board consists of banks C and D. In this example all four banks are seen as Input. The input determination was made by the physical positions of hardware jumpers (JP0 and JP1) and software selections for JP-0 and JP-1, i.e., that for Digital Input they were not checked.

Note: When Output is selected, hexadecimal values must be entered in the "O" block for the applicable bank.

8. Upon completion of the configuration click the **Execute** button.

DBK208 – Specifications

Name/Function: Carrier Board for Opto-22 Compatible Solid-State-Relays

Module Capacity: 16, Opto-22 Solid-State-Relays

Cable (optional): CA-37-×

DC Input Fuse: 0.5A, re-set type

Power Requirement: 5 VDC, regulated. 0.25 amp minimum.

Operating Environment:
- **Temperature**: 0°C to 70°C
- **Relative Humidity**: 95% RH, non-condensing

Connectors:
- **P4** – 100-pin connector provides for connection to a DaqBook/2000 Series device's, DaqBoard/2000 Series board's or cPCI DaqBoard/2000c Series board's P4 connector via a CA-195 cable.
- **P2** – Two P2 (DB37) connectors provide for digital expansion via CA-37-x cable.
- **Screw Terminals** – 16 sets of 2-connector blocks for I/O signals.

Isolation:
- **Channel-to-System**: 500 V
- **Channel-to-Channel**: 500 V

Notes

For Analog I/O, Digital I/O, & Pulse/Frequency

Note: DBK209 connects to a P4 connector via cable and provides P1, P2, and P3 connectors.

This product is not used for LogBook applications.

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.

DBK209
P4-to-P1/P2/P3 Mini-adapter Board

Overview

DaqBoard/2000 Series and /2000c Series Boards communicate [external from the host PC] through a 100-pin P4 connector. Typically a DBK200 Series P4-adapter is used to provide one or more DB37 connectors (P1, P2, P3). The DBK200 Series also includes a few panel-mount card options that connect directly to the P4 connector via a cable.

The DBK209 is a mini-adapter board suitable for both analog and digital expansion. The board provides three DB37 connectors (P1, P2, and P3). DBK209 connects to DaqBook/2000 Series Device, DaqBoard/2000 Series Board or /2000c Series Board P4 connector via a CA-195 cable.

Other than the form factor, DBK209 is identical to DBK201.

Note: The P1, P2, and P3 connectors discussed in association with DaqBook/2000 Series devices, DaqBoard/2000 Series boards and cPCI DaqBoard/2000c Series boards are subset connectors of the 100-pin P4 connector that is located on those boards. Chapter 2, *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4.

Connections

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.

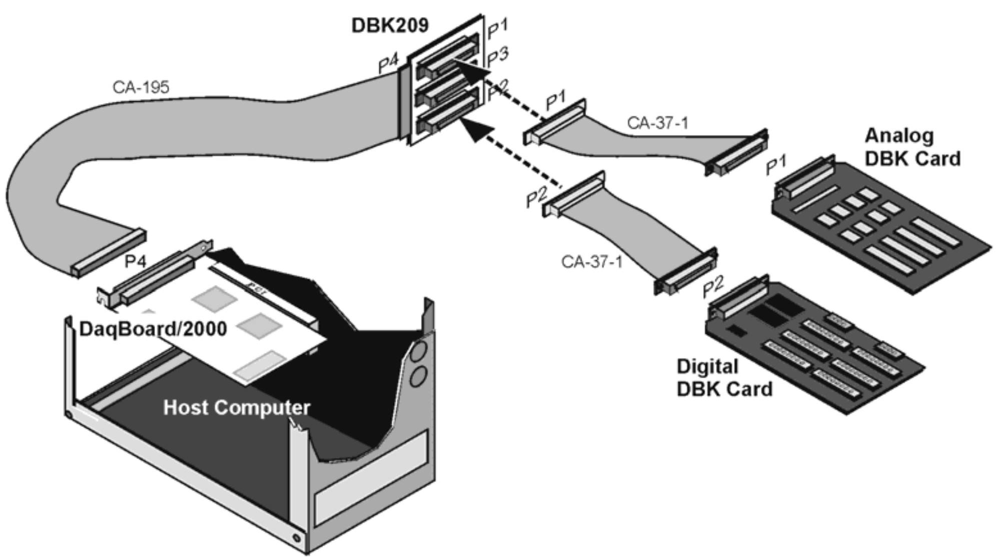
Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.

Be sure to align the P4 orientation indicators (♦) prior to mating the P4 connectors.

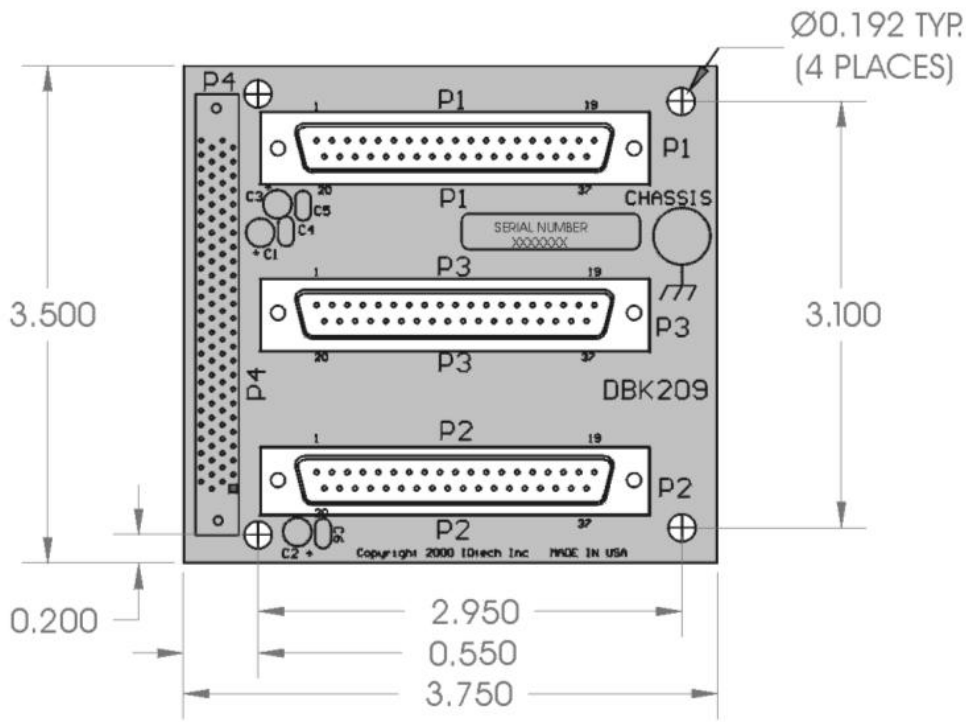
The following illustration and the actual board silkscreen are the only references you should need to make proper connections.



Using a DBK209 to Connect an Analog and a Digital DBK Card to DaqBoard/2000

Connection tips:

- Ensure power is removed from the device(s) to be connected.
- Observe ESD precautions when handling boards and making connections.
- P1 is used for ANALOG I/O.
- P2 is used for DIGITAL I/O.
- P3 is used for Pulse/Frequency (Digital and Counter/Timer) I/O.
- P4 (100-pin connector) connects to the DaqBook/2000 Series device's, DaqBoard/2000 Series board's, or cPCI DaqBoard/2000c Series board's P4 connector via a CA-195 Cable.



DBK209 Dimensional Drawing

Notes

DBK210 32 Channel Digital I/O Carrier Board

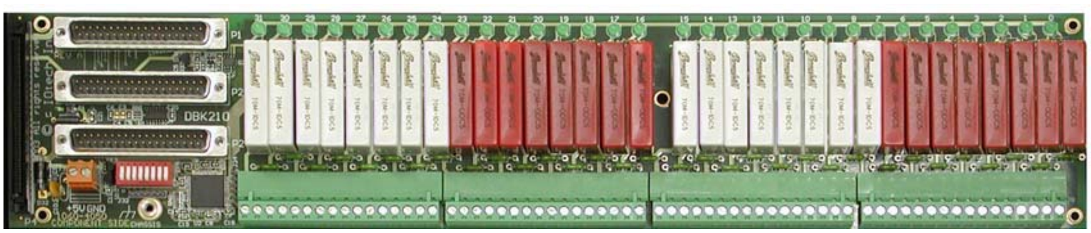
for Grayhill™ 70M-Series Mini-Modules

Note: The DBK210 provides: (a) two P2 connectors, (b) one P1 connector, (c) footprints for 32 optically-isolated Grayhill 70M-Series mini-modules, (d) a 100-pin P4 connector for use with DaqBook/2000 Series Devices and DaqBoard/2000 Series Boards, and (e) 4 removable screw terminal blocks. Each block supports 8 mini-modules.

This product is not used with:
- **LogBook**
- **DaqBook/100 Series devices**
- **DaqBoard/100 (ISA-type) Series devices**

Reference Notes:
- Refer to the *DBK Basics* section of this manual in regard to calculating system power requirements.
- Chapter 2, *System Connections and Pinouts*, includes pinouts for P1, P2, P3, and P4 connectors.
  Refer to the pinouts that are applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section of this manual.
- Refer to the *DaqBoard/2000 Series and cPCI DaqBoard/2000c Series User's Manual* (p/n 1033-0901) or the *DaqBook/2000 Series User's Manual* (p/n 1103-0901) for information pertaining to those products, as needed.

Overview



DBK210 Carrier Board for Grayhill 70M-Series Mini-Modules

The information included in this section, when combined with that found in related DBK sections, should enable you to set up your desired configuration.

It is important to note that the **DaqBoard/2000 Series** boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with these boards are subset connectors of the 100-pin P4 connector. **DaqBook/2000 Series** devices have both a P4 connector and a set of P1, P2, and P3 connectors on the unit. The *System Connections and Pinouts* chapter includes pinouts for both types of devices, i.e., DaqBoards and DaqBooks.

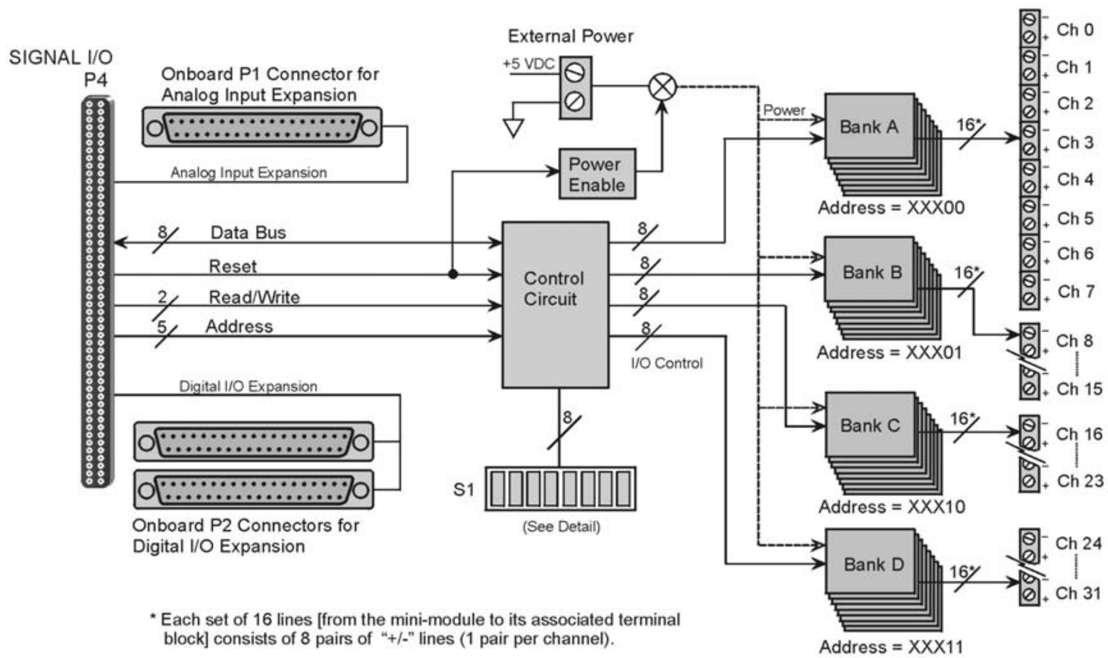
DBK210 is a four-bank carrier board for optically-isolated Grayhill 70M-Series mini-modules. Each bank supports up to eight digital I/O modules. Each bank can be independently set to input or output. The settings are made via micro-switches on S1 (see next two figures). The Grayhill 70M-Series I/O modules are industry standard, 5-volt logic level modules.

WARNING

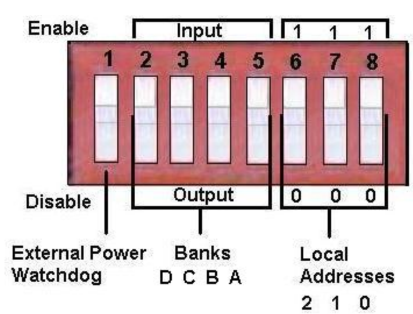
Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

Note 1: DBK210 is not used with DaqBoard/2003.

Note 2: DBK210 can be used with DaqBook/200 series and Daqboard/200 series devices; but should not be used with DaqBook/100 series or DaqBoard/100 series devices.



DBK210 Block Diagram



S1 Detail

The S1 settings for the Banks and the Local Addresses must match the associated settings in DaqView. This is explained in the *Software Setup* section, which begins on page 7.

Note: S1 functionality is explained in the following three sections: *External Power Watchdog* (pg. 5), *Setting Module Banks to Input or Output* (pg. 5), and *Setting the Local Addresses* (pg. 6).

DBK210 boards are typically installed in NEMA-type panels; however, they can be installed on DIN rails. Separate mounting instructions are included with Rack Mount Kit (part no. Rack-DBK-3) and with DIN-rail Mount Kit (part no. DIN-DBK-1).

DBK210 is controlled digitally from the Daq device (DaqBook or DaqBoard) as follows:

DaqBook/200 Series Devices – control is through the 37-pin P2 digital port of the DaqBook and one of two DBK210 P2 connectors.

DaqBoard/200 Series boards [ISA-type] - control is through the 37-pin P2 digital port of the DaqBoard and one of the DBK210 P2 connectors.

DaqBook/2000 Series Devices – control is achieved by *either* of the following two methods, *but not both at once*:

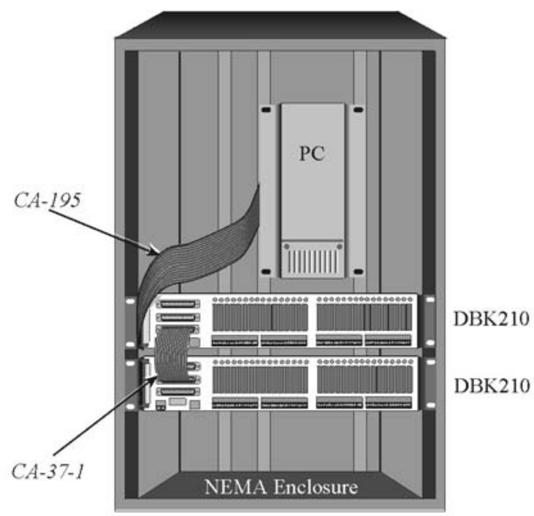
- Connect a CA-37-x cable to the P2 connector on the DaqBook/2000 Series device; then connect the free end of the cable to one of the two P2 connectors on the DBK210.
- Connect a CA-195 cable to the P4 connector on the DaqBook/2000 Series device; then connect the free end of the cable to the P4 connector on the DBK210.

DaqBoard/2000 Series boards – control is through the board's 100-pin P4 connector. Connection of these boards to DBK210 can be made directly or indirectly as follows:

- Direct connection can be made from a /2000 Series board's 100-pin P4 connector to a DBK210's P4 connector via a CA-195 cable.
- Indirect connection can be made using one of the DBK200 Series P4-adapters that includes a 37-pin P2 connector (DBK201, DBK202, DBK203, DBK204, DBK206, DBK209, or another DBK210). CA-37 cables are used to connect from the P2 connector of the adapter device to the P2 of the DBK210.

A single Daq-based data acquisition system can support up to 8 DBK210 boards, providing a total of 256 channels. The following figure represents a 64 channel digital I/O system using two DBK210s.

DBK210 boards contain three DB37 connectors, as follows: two P2 connectors for daisy-chaining to other DBK210s or to other P2-supported devices; one P1 connector for convenient access to the analog input channels of a 2000 Series DaqBook or a 2000 Series DaqBoard.



DBK210 System in a NEMA Enclosure

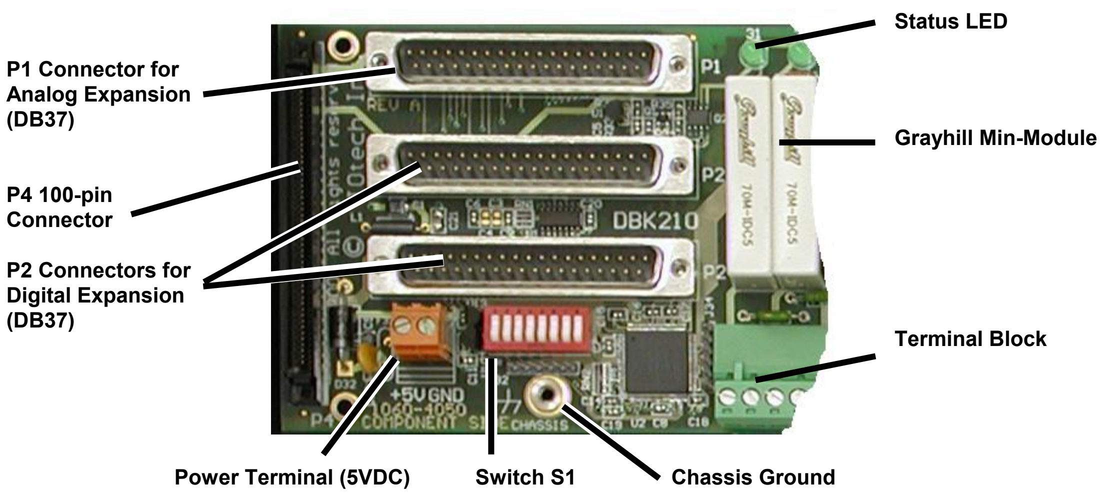
In the above figure, the upper DBK210 is connected to a DaqBoard/2000 Series board that has been installed in an industrial PC. The connection is made from the P4 connector on the installed DaqBoard to the P4 connector on one of the two DBK210 boards. A 100-conductor CA-195 ribbon cable is used. The two DBK210s are daisy-chained from a P2 connector on one board to a P2 connector on the other. Each board has a P1 connector making it possible for analog expansion.

Warnings, Cautions, and Tips

WARNING
Ensure that hard-wire emergency over-ride circuitry exists for all applications that make use of dangerous switch-loads. Do not operate such switch-loads unless emergency over-ride circuitry is present.

CAUTION
Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to the DBK. Electric shock or damage to equipment can result even under low-voltage conditions.
Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)   **Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.**
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.

1. Provide raceways (protective wiring routes) for all external I/O wiring.
2. Keep external I/O wiring away from ribbon cables.
3. Keep external I/O wiring away from low-voltage signal wiring.
4. Provide appropriate strain-relief and physical restraint to ensure that the wiring is held securely in the intended position, and without strain.
5. Ensure that all wiring with >50V potential is identified by the appropriate color codes and that warning labels are clearly visible.
6. Provide physical protection for the I/O interface board. The level of protection is dependent upon the board's operating environment.

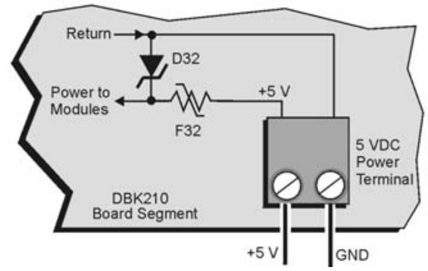


Partial DBK210

Power

The DBK210 requires an external isolated 5 volt DC power supply with at least 0.600 amp current capacity. External power attaches to the DBK210 via on-board screw terminal connections. The board contains capacitors to filter input noise from the power supply.

Over-current protection is provided by an on-board 3.0 amp resettable fuse (F32), which is in series with the 5 volt supply. Protection from over-voltage and reverse polarity power conditions is provided by a 6.8V zener diode (D32).

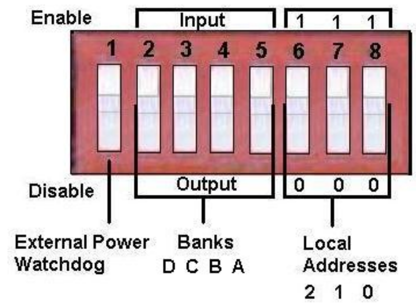


Connecting an External 5 VDC Supply

External Power Watchdog

Set via S1, Switch 1

The External Power Watchdog is governed by the position of micro-switch 1 on switch S1. The feature allows the user to set the desired behavior of the digital output latches in the event of a loss and recovery of the external power supply.



With micro-switch 1 in the **Enable** position, a loss of external power will cause the output latches to be reset into a high-impedance condition. Even with a recovery of the external power, all output modules will be disabled until a write is done to the data bus. This setting is useful in an application that requires a serial enabling of output loads.

With micro-switch 1 in the **Disable** position, a loss of external power will have no effect on the state or continued control of the output latches. That is, data that is written to the output modules will continue to be latched as normal. A recovery of the external power would then cause the output modules to reflect the current state of the output latches. This setting is useful in the case where the operator halts the transfer of data and turns off the external power on purpose and then wants the system to assume the same state upon recovery of the external power.

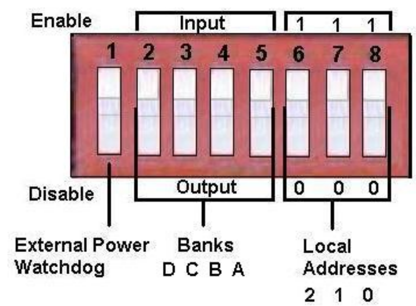
The position of micro-switch 1 has no effect on input modules in regard to external power. While a loss of external power will result in corruption of the data being read, the data bus will be valid again immediately upon the recovery of the external power.

Setting Module Banks to Input or Output

Set via S1, Switches 2, 3, 4, & 5

Four of the S1 micro-switches (2, 3, 4, and 5) are used to individually set the digital I/O module banks to input or output mode. The following table indicates the associations between the micro-switches, banks, and channels.

Micro-Switch	Affected Bank	Affected Channels
2	D	24 thru 31
3	C	16 thru 23
4	B	8 thru 15
5	A	0 thru 7



All eight channels for a given bank must be of the same type, i.e., digital input or digital output. However, the banks themselves can be set to input or output, regardless of how the other banks are set. For example, Bank A could be set to digital input and banks B, C, and D could be set to digital output.

The S1 settings for the Banks must match the associated settings in DaqView. This is explained in the *Software Setup* section, which begins on page 7.

Setting the Local Address **Set via S1, Switches 6, 7, & 8**

Up to eight DBK210 boards can be used in a single Daq system. However, each board contains four module banks and each bank must have a unique address. This is accomplished with three micro-switches (6, 7, and 8) on switch S1 and a fixed set of two digits for each bank.

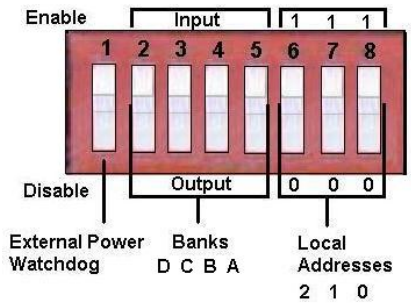
To illustrate, addresses are seen as follows where XXX represents a binary format; e.g., 000; 001, etc as determined by micro-switches 6, 7, and 8, since each can independently be set to "0"or to "1."

Bank A, Channels 0 through 7: XXX 00

Bank B, Channels 8 through 15: XXX01

Bank C, Channels 16 through 23: XXX10

Bank D, Channels 24 through 32: XXX11



Assuming we were using three DBK210 boards, for a total of 96 channels, we could use the following address scheme:

1st DBK210 board, micro-switch 6 set to 0, 7 set to 0, and 8 set to 0, resulting in 000.
2nd DBK210 board, micro-switch 6 set to 0, 7 set to 0, and 8 set to 1, resulting in 001.
3rd DBK210 Board, micro-switch 6 set to 0, 7 set to 1, and 8 set to 0, resulting in 010.

In this example the three boards would have addressing as follows:

DBK210, 1st Board	
Bank/Chs	**Address**
Bank A Chs 0 thru 7	00000
Bank B Chs 8 thru 15	00001
Bank C Chs 16 thru 23	00010
Bank D Chs 24 thru 31	00011

DBK210, 2nd Board	
Bank/Chs	**Address**
Bank A Chs 0 thru 7 (32 thru 39)	00100
Bank B Chs 8 thru 15 (40 thru 47)	00101
Bank C Chs 16 thru 23 (48 thru 55)	00110
Bank D Chs 24thru31 (56 thru 63)	00111

DBK210, 3rd Board	
Bank/Chs	**Address**
Bank A Chs 0 thru 7 (64 thru 71)	01000
Bank B Chs 8 thru 15 (72 thru 79)	01001
Bank C Chs 16 thru 23 (80 thru 87)	01010
Bank D Chs 24 thru 31 (88 thru 95)	01011

Example of Local Addresses for Three DBK210s in a Common Daq System

Note!

The Local Address must be unique for each board in the Daq system. In addition, the board's address must match the address setting in DaqView. The DaqView aspect is explained in the *Software Setup* section, which begins on page 7.

Software Setup

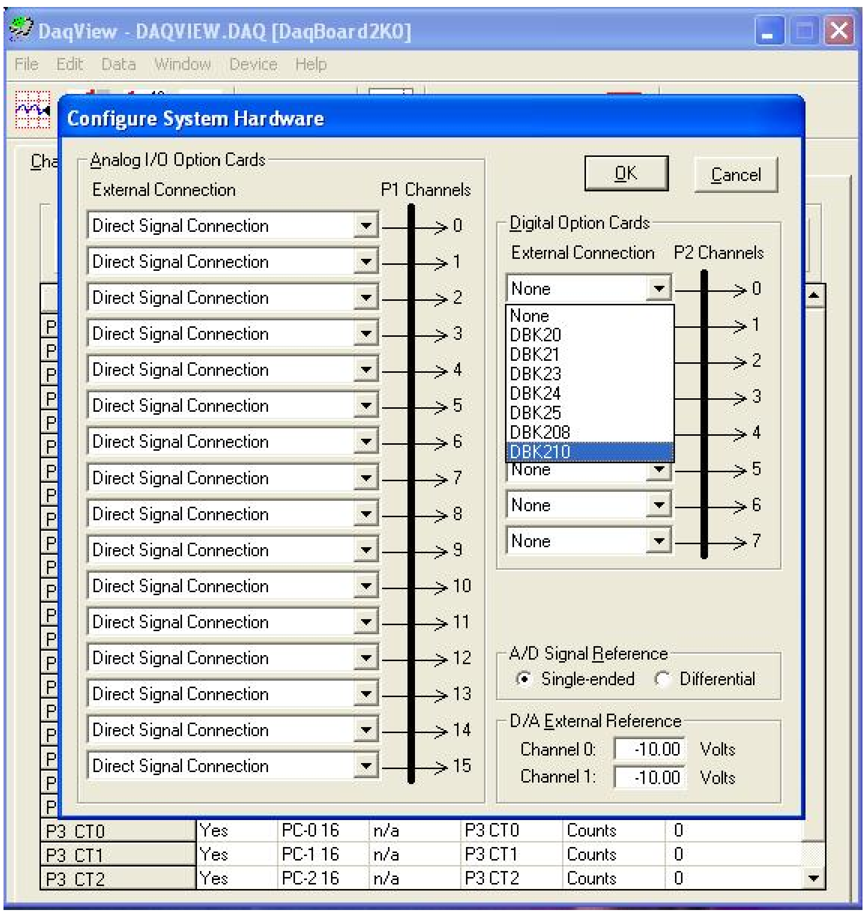
Note: DBK210 is not applicable to LogBook or LogView.

To use DBK210 from within DaqView, you must first configure the DaqView software to match the hardware setup.

1. From DaqView's main window, select the **Device** pull-down menu.
2. Select **Configure Hardware Settings**.

   The *Digital Option Cards External Connection* section of DaqView's *Configure System Hardware* window lists 8 channels (0 through 7) as shown in the following screen image.

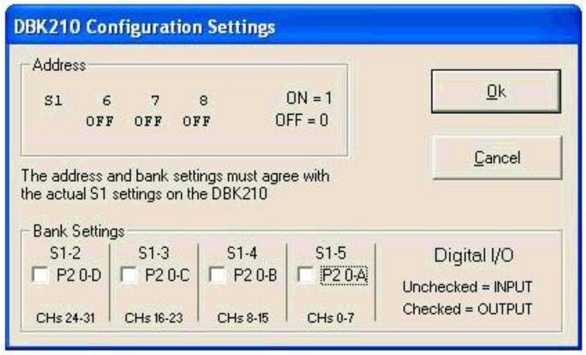
3. Select **DBK210** from the pull-down list in the Digital Option Cards panel. As seen in the following figure, the panel is on the right side of screen.



Selecting DBK210 in the Configure System Hardware Window

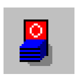
4. Click <OK>. A DBK210 Configuration Settings window will appear (following figure).

5. Set S1 micro-switches to agree with the actual settings of the switches on the DBK210 boards. Use "OFF" to obtain a setting of "0" for each switch and use "ON" to obtain a setting of "1." A detailed explanation of address settings is provided on 6.



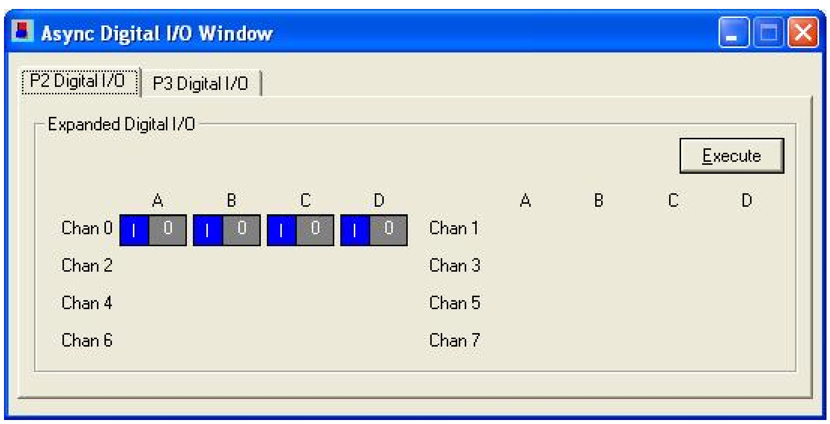
DBK210 Configuration Settings

6. Independently set the four banks P20-A, P20-B, P20-C, and P20-D. A checked box indicates that the associated bank is Digital Output. An unchecked box indicates Digital Input.
7. After S1 and the bank Input / Output settings are complete, click the <OK> button.



8. Select the Digital I/O icon from DaqView's main window toolbar. The *Async Digital I/O window* will appear (following figure).

   With the P2 Digital I/O tab selected in the *Async Digital I/O* window, each active channel has divisions for the four banks (A, B, C, and D).

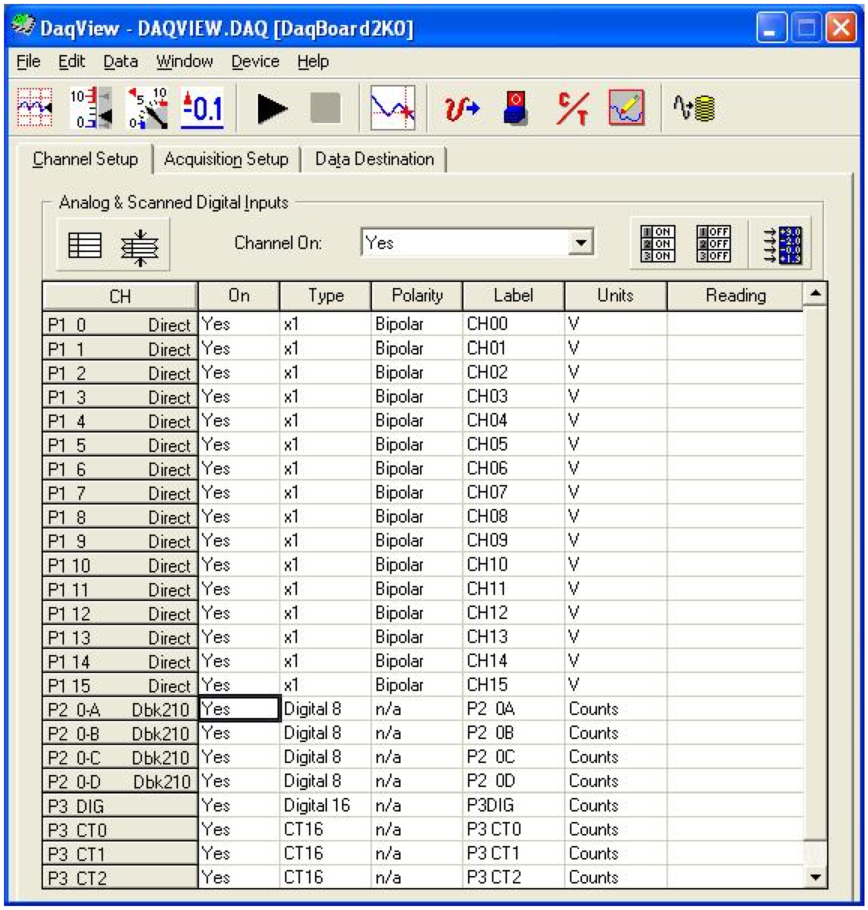


Async Digital I/O Window – P2 Digital I/O Tab Selected

   In the above screen shot, channel 0 represents one DBK210 board with its four banks: A, B, C, and D. In this example all four banks are seen as Input. The input determination was made by the physical positions of micro-switches 2, 3, 4, and 5 on switch S1. Because the 4 banks are set as input, the DBK210 Configuration Settings dialog box shows the Input / Output boxes as "unchecked."

   When Output is selected, hexadecimal values must be entered in the "O" block for the applicable bank.

9. Upon completion of the configuration click the <Execute> button.



DaqView's Channel Setup Tab

In the above figure the 4 Banks for one DBK210 card are listed in the CH column as: P2 0-A, P2 0-B, P2 0-C, and P2 0-D.

DBK210 – Specifications

Name/Function: Carrier Board for Grayhill™ 70M-Series Mini-Modules

Module Capacity: 32 Grayhill 70M-Series Mini-Modules per board

Cable (optional): CA-37-×

DC Input Fuse: 3.0A, resettable type

DC Input Connector: Non-removable screw terminal, (+5 VDC, GND)

Power Requirement: 5 VDC, ±5%. 0.600 amp minimum.

Operating Environment:
- **Temperature**: 0°C to 70°C
- **Relative Humidity**: 95% RH, non-condensing

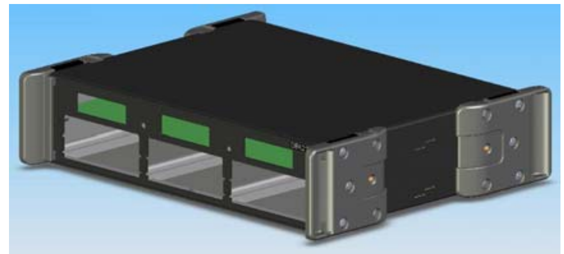
Connectors:
- **P1** – One P1 (DB37) connector provides for Analog input expansion via a CA-37-x cable.
- **P2** – Two P2 (DB37) connectors provide for digital expansion via a CA-37-x cable.
- **P4** – 100-pin connector provides for connection to the P4 connector of a DaqBook/2000 Series device, DaqBoard/2000 Series board, or cPCI DaqBoard/2000c Series board. P4-to-P4 connection is made via a CA-195 cable.

- **Screw Terminals** – 4 removable screw-terminal blocks. Each block has 16 connections for 8 mini-modules, i.e., 2 connections (+/-) per module.

Isolation:
- **Channel-to-System**: 250 V
- **Channel-to-Channel**: 250 V

Note: Specifications are subject to change without notice.

3-Card Slot, Includes P1/P2/P3/P4 compatibility for Analog I/O, Digital I/O, & Pulse/Frequency



DBK213 Front Panel
Upper Slots for Terminal Board Wiring Pass-Through
Lower Slots for Housing up to 3 DBK options, 1 per slot

The DBK213 module is compatible with the following products:

- DaqBook/2000 Series • DaqBoard/2000 Series • DaqLab • DaqScan

Overview

The DBK213 module includes:

- P1, male DB37 connector for Analog I/O.
- P2, male DB37 connector for Digital I/O.
- P3, male DB37 connector for Pulse/Frequency (Digital and Counter/Timer) I/O.
- P4, 100-pin connector. Provides same signal connection as P1, P2, and P3 combined.
- Three slots for housing optional DBK cards. The DB37 connector of each card will extend out through the rear panel where it can be secured with hex nuts.
- 12 on-board screw-terminal blocks (*accessible after removal of cover*)
- The terminal blocks [TB1 through TB12] tie in to P1, P2, P3, and P4 and provide for easy signal connection.
- Three front panel slots for wiring pass-through.
- On-board socket locations for custom RC Filter networks (*accessible after removal of cover*).

DBK213 Rear Panel

The upper section includes P1, P2, P3 and P4 connectors. The lower section has 3 openings for pass-through of DB37 connectors from optional DBK cards.

The three DB37 connectors can be used as direct connections points for I/O signals, or signals can be connected to each 37-pin connector via a DBK card or module. The lower section of the DBK213 includes three built-in expansion slots for housing card options.

The unit includes screw-terminal access to all analog and digital I/O from the host data acquisition device. Related to the screw-terminals are 3 front panel upper slots for routing all I/O wiring.

Connection Tips

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to DBKs. Electric shock or damage to equipment can result even under low-voltage conditions.

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

Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

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.

When using P4, e.g., for a DaqBoard/2000, be sure to align the P4 orientation indicators [white arrows] prior to mating the P4 connectors.

1. Ensure power is removed from the device(s) to be connected.
2. Observe ESD precautions when handling the board and making connections.
3. Do not make redundant connections. For example, for ANALOG IN you could use the P1 (DB37) connector or Terminal Blocks TB9 through TB12. You would not use both sets of ANALOG IN connectors.
4. You do not need to remove the cover unless you need to access a terminal block or customize an RC filter network. Information regarding both tasks follows shortly. Note that RC filter networks are not to be made or used in association with additional DBK expansion options.
5. DBK213's 100-pin P4 connects to a DaqBoard/2000 Series board's P4 via a CA-195 one-hundred conductor ribbon cable.

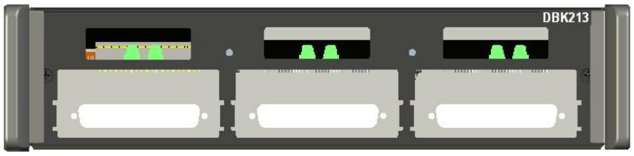
The DaqBoard/2000 Series boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with these boards are subset connectors of the 100-pin P4 connector. The *System Connections and Pinouts* chapters of the product hardware manuals include pinouts.

6. Connections to the DB37 connectors are made via CA-37 cables or CA-255 cables:
   (a) P1 connects to an analog DBK card or module's P1 connector.
   (b) P2 connects to a Digital DBK card or module's P2 connector.
   (c) P3 connects to a Pulse/Frequency DBK card module's P3 connector.

7. Refer to the separate CE Cable Kit instructions that are included with the associated CE cable kit.

Installing DBK Cards

Front Panel with 3 Vacant Card Slots



Beneath P3   *Beneath P2*   *Beneath P1*

P1   P2   P3

Rear Panel View with No Card Installed

Rear Panel View with
Card Installed in Slot 2 Beneath P2

The DBK213 has three card slots which allow for the easy installation of DBK cards. To install a card observe the following CAUTION and then complete the few simple steps.

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to DBKs. Electric shock or damage to equipment can result even under low-voltage conditions.

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

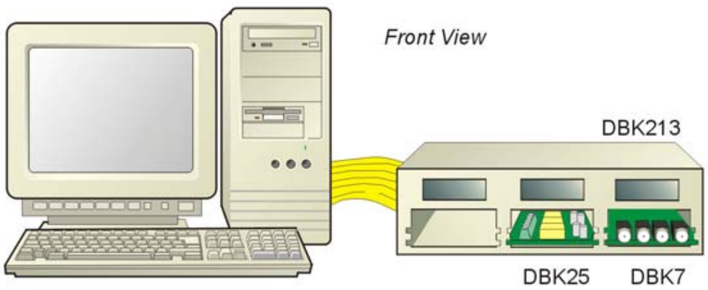
Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.

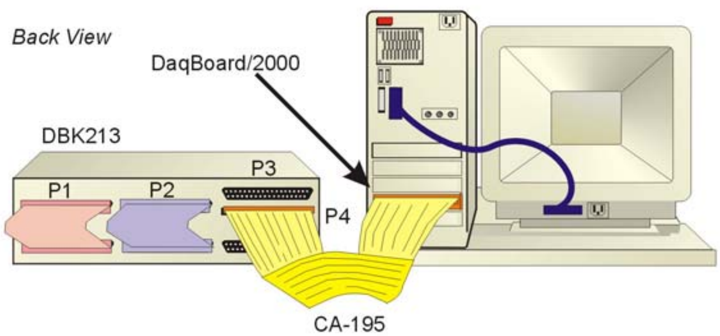
1. Refer to your specific DBK card instructions prior to installing the card. You may need to make physical hardware configurations, for example, regarding channel assignments.
2. Complete all DBK card configuration per your application and channel assignment needs.
3. Make signal line connections on your DBK card as applicable. Screw-terminal connections and BNC connections are typical.
4. If hex nuts are present on your DBK card's DB37 connector, remove them and put them aside for reuse in step 7.
5. Using the lower card-edge-guide on the DBK213 front panel [and possibly the upper guide for high cards such as the DBK82], carefully slide the card into the desired slot such that the card's DB37 connector goes to the rear panel of the DBK213. The following should be considered when choosing a card slot.
   - Analog I/O cards will connect to the DBK213's P1 male DB37 connector.
   - Digital I/O cards will connect to the DBK213's P2 male DB37 connector.
   - Pulse/Frequency (Digital and Counter/Timer) I/O will connect to the DBK213's P3 male DB37 connector.
6. Push the DBK card until its DB37 connector extends through the rear panel of the DBK213.
7. Using the hex nuts removed in step 4 (or replacement hex nuts if needed), secure the card at the rear panel. Tighten the hex nuts snug, but do not over tighten.
8. Repeat these steps for each remaining card.

System Examples

Example 1:

DaqBoard/2000 • DBK7 Analog I/O Card • DBK25 Digital I/O Card





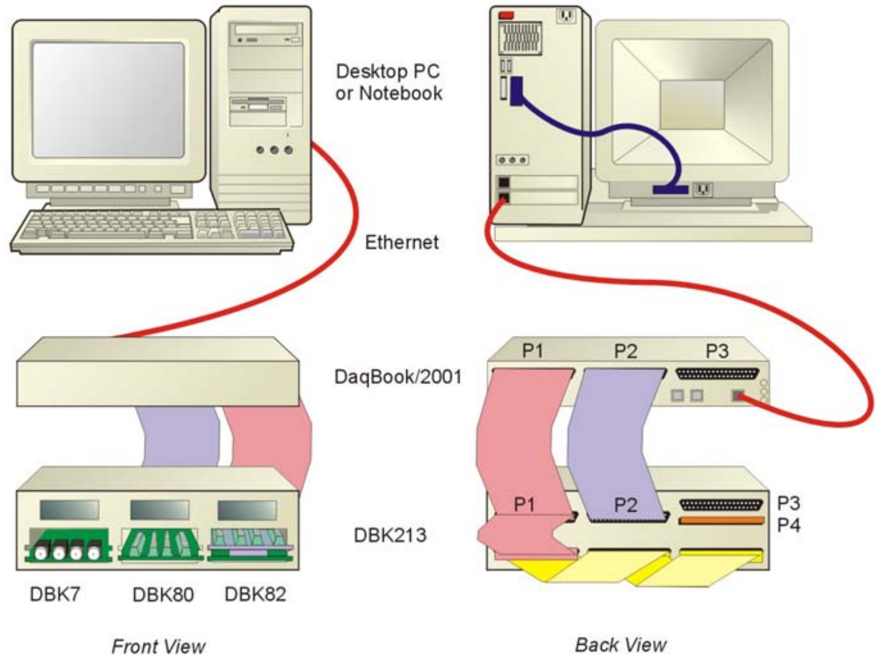
Notes regarding the above system example:

1) A CA-195 100-conductor ribbon cable connects the P4 connector of the DBK213 to the P4 connector of the DaqBoard/2000 (which is installed in the host PC).
2) In the illustration, DBK213 is housing a DBK7 (Analog I/O card) and a DBK25 (Digital I/O card).
3) A CA-255 [or CA-37] cable is used to connect the DBK7's DB37 P1 connector to the DBK213's P1 connector.
4) A CA-255 [or CA-37] cable is used to connect the DBK25's DB37 P2 connector to the DBK213's P2 connector.

Example 2:

DaqBoook/2001 • DBK7 • DBK80 • DBK82

-------- (3 Analog I/O Cards)---------



Notes regarding the above system example:

1) Either of two Ethernet cables can be used: CA-242 is a 1.5 ft cable; CA-242-7 is a 7 ft. cable.

2) In the illustration, DBK213 is housing a DBK7, DBK80, and DBK82. Each is an analog card that will make use of P1 in regard to analog signal I/O.

3) 1st P1 Cable (*back view, bottom cable*): A CA-37-3 cable is being used to link together to DB37 connectors of all three analog DBK cards.

4) 2nd P1 Cable (*back view, left cable*): A CA-255-2T is being used to connect the other P1 cable and the DBK213's P1 to the P1 connector of the DaqBook/2001.

5) The DBK213's P1 connector [rear panel, upper-left] connects to the internal screw-terminal board to which analog I/O signals could be connected via wire. The wires would be routed out through the upper slots of the front panel.

6) A CA-255 [or CA-37] cable is used to connect the DBK213's P2 connector to the DaqBook/2001 P2 connector.

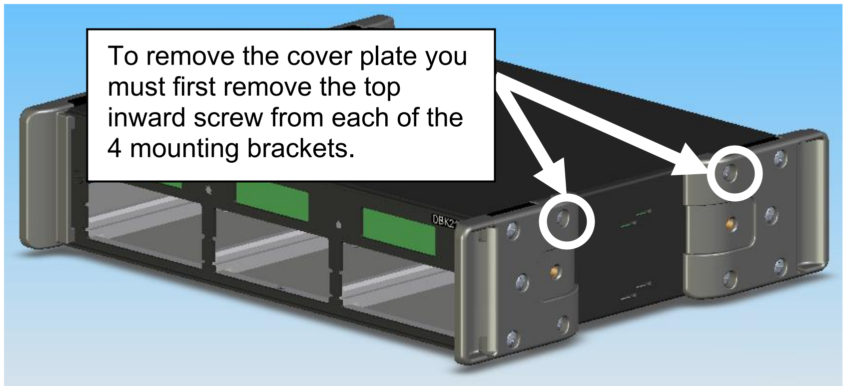
7) The DBK213's P2 connector connects to the internal screw-terminal board, to which digital I/O signals could be connected via wire. The wires would be routed out through the upper slots of the front panel.

8) In a different scenario, the DBK213's P2 connector could be connected to digital DBK options instead of connecting the P1 connector to analog DBK options as illustrated.

Using the Screw-Terminal Blocks

You must remove the DBK213 module's cover plate to access the screw terminal blocks. This is described in steps 1 and 2 below.

1. Remove the top inward screws from each of the 4 mounting brackets. See following figure.

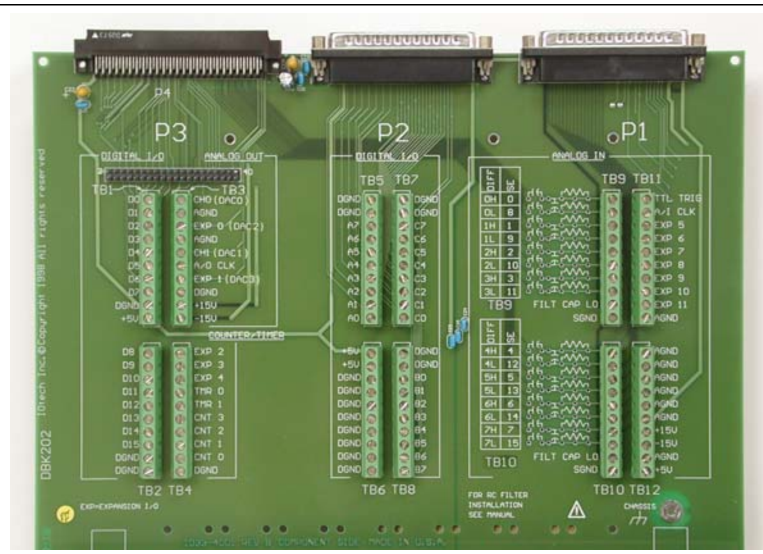


The Cover Plate is Secured by 4 Srews [2 Screws per-side]

2. After the 4 screws have been removed, carefully remove the cover plate.
3. Make the wiring connections to the terminals. Refer to the board's silkscreen and to the pin correlations on the next few pages.

In general, the following *terminal block-to-signal* relationships apply:

DBK213 Terminal Blocks	Used for . . .	Alternative
TB9 TB10 TB11 TB12	ANALOG I/O	P1 or P4*
TB5 TB6 TB7 TB8	DIGITAL I/O	P2 or P4*
TB1 TB2 TB3 TB4	PULSE/ FREQUENCY/ DIGITAL I/O	P3 or P4*



DBK213 Board

Note that the P3 DB37 Connector and its associated board cable has been removed for clarity.

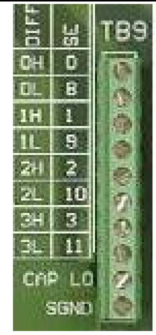
* P4 is used for connecting to DaqBoard/2000 Series devices.

4. Tighten the terminal block screws snug; but do not over-tighten.
5. After all terminal connections are made and verified correct, return the cover to the unit and secure in place with the 4 screws removed earlier. Tighten snug, but do not over-tighten.

The following pages correlate the DBK213 terminal block connectors with the associated pins of the P1, P2, and P3 DB37 connectors. Note that the *System Connections and Pinouts* chapter contains additional pin-outs, and includes references to the 100-pin P4 connector.

Correlation to P1 – Pertains to Terminal Blocks TB9, TB10, TB11, and TB12 for Analog I/O.

TB9		P1 Pin Number and Description (see Note 1)	
DIFF	SE		
0H	0	37	CH 0 IN (Single-Ended Mode) / CH 0 HI IN (Differential Mode)
0L	8	18	CH 8 IN (Single-Ended Mode) / CH 0 LO IN (Differential Mode)
1H	1	36	CH 1 IN (Single-Ended Mode) / CH 1 HI IN (Differential Mode)
1L	9	17	CH 9 IN (Single-Ended Mode) / CH 1 LO IN (Differential Mode)
2H	2	35	CH 2 IN (Single-Ended Mode) / CH 2 HI IN (Differential Mode)
2L	10	16	CH 10 IN (Single-Ended Mode) / CH 2 LO IN (Differential Mode)
3H	3	34	CH 3 IN (Single-Ended Mode) / CH 3 HI IN (Differential Mode)
3L	11	15	CH 11 IN (Single-Ended Mode) / CH 3 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

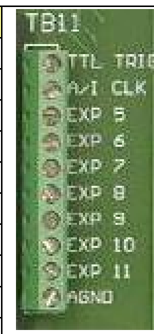


P1 – TB9

TB10		P1 Pin Number and Description (see Note 1)	
DIFF	SE		
4H	4	33	CH 4 IN (Single-Ended Mode) / CH 4 HI IN (Differential Mode)
4L	12	14	CH 12 IN (Single-Ended Mode) / CH 4 LO IN (Differential Mode)
5H	5	32	CH 5 IN (Single-Ended Mode) / CH 5 HI IN (Differential Mode)
5L	13	13	CH 13 IN (Single-Ended Mode) / CH 5 LO IN (Differential Mode)
6H	6	31	CH 6 IN (Single-Ended Mode) / CH 6 HI IN (Differential Mode)
6L	14	12	CH 14 IN (Single-Ended Mode) / CH 6 LO IN (Differential Mode)
7H	7	30	CH 7 IN (Single-Ended Mode) / CH 7 HI IN (Differential Mode)
7L	15	11	CH 15 IN (Single-Ended Mode) / CH 7 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB10

TB11	P1 Pin Number and Description	
TTL TRIG	25	TTL Trigger, Digital IN, External TTL Trigger Input
A/I CLK	20	A/I Clock, External ADC Pacer Clock Input/ Internal ADC Pacer Clock Output
EXP 5	5	Expansion 5. Digital OUT, external GAIN select bit 1
EXP 6	6	Expansion 6. Digital OUT, external GAIN select bit 0
EXP 7	3	Expansion 7. Digital OUT, external ADDRESS, select bit 3
EXP 8	22	Expansion 8. Digital OUT, external ADDRESS, select bit 2
EXP 9	4	Expansion 9. Digital OUT, external ADDRESS, select bit 1
EXP 10	23	Expansion 10. Digital OUT, external ADDRESS, select bit 0
EXP 11	26	Expansion 11. Simultaneous Sample and Hold (SSH)
AGND	*	Analog Ground, Common



P1 – TB11

TB12	P1 Pin Number and Description	
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
+ 15 V	21	Expansion, +15 V Power
- 15 V	2	Expansion, -15 V Power
AGND	*	Common Ground
+ 5 V	1	Expansion, +5 V Power

P1 – TB12

*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

Note 1: For TB9 and TB10, the filter network portion of the silkscreen is not shown. Instead, the DIFF and SE channel identifiers have been moved next to the screws for ease in identification.

Correlation to P2 – Pertains to Terminal Blocks TB5, TB6, TB7, and TB8 for Digital I/O.

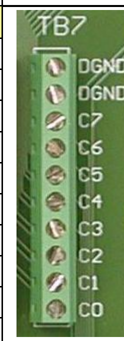
TB5	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
A7	30	Digital I/O: P2, Digital Port A, Bit 7; or P2 Expansion Data Bit 15
A6	31	Digital I/O: P2, Digital Port A, Bit 6; or P2 Expansion Data Bit 14
A5	32	Digital I/O: P2, Digital Port A, Bit 5; or P2 Expansion Data Bit 13
A4	33	Digital I/O: P2, Digital Port A, Bit 4; or P2 Expansion Data Bit 12
A3	34	Digital I/O: P2, Digital Port A, Bit 3; or P2 Expansion Data Bit 11
A2	35	Digital I/O: P2, Digital Port A, Bit 2; or P2 Expansion Data Bit 10
A1	36	Digital I/O: P2, Digital Port A, Bit 1; or P2 Expansion Data Bit 9
A0	37	Digital I/O: P2, Digital Port A, Bit 0; or P2 Expansion Data Bit 8

P2 – TB5

TB6	P2 Pin Number and Description	
+5 V	18	Expansion +5 V Power
+5 V	20	Expansion +5 V Power
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P2 – TB6

TB7	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
C7	22	Digital I/O: P2, Digital Port C, Bit 7; or P2 Expansion Data Bit 7
C6	23	Digital I/O: P2, Digital Port C, Bit 6; or P2 Expansion Data Bit 6
C5	24	Digital I/O: P2, Digital Port C, Bit 5; or P2 Expansion Data Bit 5
C4	25	Digital I/O: P2, Digital Port C, Bit 4; or P2 Expansion Data Bit 4
C3	26	Digital I/O: P2, Digital Port C, Bit 3; or P2 Expansion Data Bit 3
C2	27	Digital I/O: P2, Digital Port C, Bit 2; or P2 Expansion Data Bit 2
C1	28	Digital I/O: P2, Digital Port C, Bit 1; or P2 Expansion Data Bit 1
C0	29	Digital I/O: P2, Digital Port C, Bit 0; or P2 Expansion Data Bit 0



P2 – TB7

TB8	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
B0	10	Digital I/O: P2, Digital Port B, Bit 0; or P2 Expansion READ Output
B1	9	Digital I/O: P2, Digital Port B, Bit 1; or P2 Expansion WRITE Output
B2	8	Digital I/O: P2, Digital Port B, Bit 2; or P2 Expansion RESET Output
B3	7	Digital I/O: P2, Digital Port B, Bit 3; or P2 Expansion Address Bit 4 Out
B4	6	Digital I/O: P2, Digital Port B, Bit 4; or P2 Expansion Address Bit 3 Out
B5	5	Digital I/O: P2, Digital Port B, Bit 5; or P2 Expansion Address Bit 2 Out
B6	4	Digital I/O: P2, Digital Port B, Bit 6; or P2 Expansion Address Bit 1 Out
B7	3	Digital I/O: P2, Digital Port B, Bit 7; or P2 Expansion Address Bit 0 Out

P2 – TB8

*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

Correlation to P3 – Pertains to Terminal Blocks TB1, TB2, TB3, and TB4 for Pulse/Frequency/Digital I/O.

TB1	**P3 Pin Number and Description**	
D0	10	P3 Digital Port Bit 0
D1	9	P3 Digital Port Bit 1
D2	8	P3 Digital Port Bit 2
D3	7	P3 Digital Port Bit 3
D4	6	P3 Digital Port Bit 4
D5	5	P3 Digital Port Bit 5
D6	4	P3 Digital Port Bit 6
D7	3	P3 Digital Port Bit 7
DGND	*	Digital Ground, Common
+5V	20	Expansion, +5 Volt Power

P3 – TB1

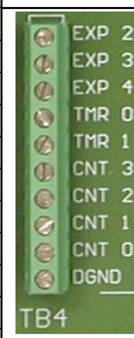
TB2	**P3 Pin Number and Description**	
D8	29	P3 Digital Port Bit 8
D9	28	P3 Digital Port Bit 9
D10	27	P3 Digital Port Bit 10
D11	26	P3 Digital Port Bit 11
D12	25	P3 Digital Port Bit 12
D13	24	P3 Digital Port Bit 13
D14	23	P3 Digital Port Bit 14
D15	22	P3 Digital Port Bit 15
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P3 – TB2

TB3	**P3 Pin Number and Description**	
CH0 (DAC0)	34	Analog Out; Analog DAC 0 Output
AGND	*	Analog Ground, Common; intended for use with DACs
EXP 0 (DAC2)	32	Analog Out; Analog DAC 2 Output
AGND	*	Analog Ground, Common; intended for use with DACs
CH1 (DAC1)	33	Analog Out; Analog DAC 1 Output
A/O CLK	21	Analog Out Clock; External DAC Pacer Clock Input/ Internal DAC Pacer Clock Output
EXP 1 (DAC3)	31	Analog Out; Analog DAC 3 Output
DGND	*	Digital Ground, Common
+15 V	19	Expansion, + 15 VDC
-15 V	37	Expansion, -15 VDC

P3 – TB3

TB4	**P3 Pin Number and Description**	
EXP 2	12	Reserved
EXP 3	13	Reserved
EXP 4	14	Reserved
TMR 0	15	P3 Timer 0 Output
TMR 1	16	P3, Timer 1 Output
CNT 3	35	P3 Counter 3 Input
CNT 2	17	P3 Counter 2 Input
CNT 1	36	P3 Counter 1 Input
CNT0	18	P3 Counter 0 Input
DGND	*	Digital Ground, Common



P3 – TB4

*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

Adding Resistor/Capacitor Filter Networks

WARNING

Disconnect the DBK213 from power and signal sources prior to installing capacitors or resistors.

CAUTION

Ensure wire strands do not short power supply connections (+15 V, -15 V, +5 V, etc.) to any terminal potential. Failure to do so could result in damage to DaqBook/2000 Series devices or DaqBoard/2000 Series boards.

Do not exceed maximum allowable inputs (as listed in product specifications). There should never be more than 30 V with reference to analog ground (AGND) or earth ground.

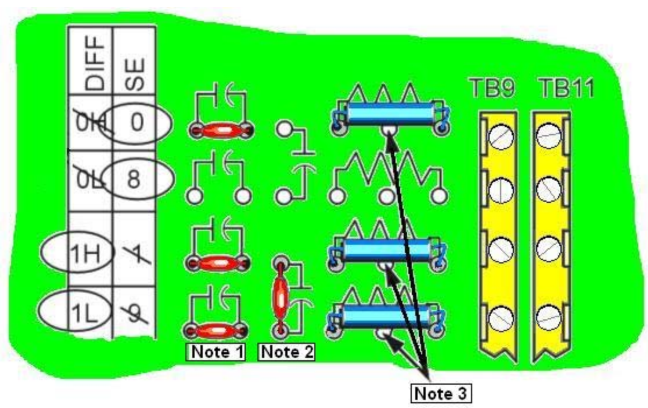
You must provide strain-relief (lead slack) to all leads leaving the module. Use tie-wraps [not included] to secure strain-relief.

Always connect the CHASSIS terminal to earth ground. This will maximize static protection.

If a channel is not associated with a DBK expansion option you can install a customized RC filter network to improve the signal-to noise ratio, assuming that an unacceptable level of noise exists. DBK213's internal board includes silk-screened sockets for installing RC filter networks. The following table contains values that are typical for RC filter network components.

Typical One-Pole Low Pass Filter Values for DBK213			
R	**C**	**f**	**f**
Ohms	**µF**	**Hertz (-3dB)**	**kHz (-3dB)**
510	1	312	0.31
510	0.47	664	0.66
510	0.22	1419	1.42
510	0.1	3122	3.12
510	0.047	6643	6.64
510	0.022	14192	14.19
510	0.01	31223	31.22
510	0.0047	66431	66.43
470	0.0033	102666	102.67

Do not use RC filters in conjunction with additional DBK expansion accessories.



An Example of Customer-Installed Capacitors and Filters for RC Networks

In this example Channels 0 and 8 are shown as *Single-Ended*. Channel 1 is *Differential*, i.e., using 1H and 1L (channel High and Low).

The following three notes pertain to the above figure.

Note 1: The 3 horizontal capacitors [as oriented in the illustration] are optional filter capacitors.

Note 2: The vertical capacitor [as oriented in the illustration] is an optional isolation capacitor used for the reduction of *Differential* noise. Such capacitor placement is <u>not</u> used in *Single-Ended* applications.

Note 3: If installing filter resistors, carefully drill out the indicated centers with a 1/16 inch drill-bit. Otherwise the resistor will be short-circuited.

Prior to installing RC components, review the previous Warning and Caution statements, then read over the following information regarding resistors and capacitors.

- **Do not use RC filters in conjunction with additional DBK expansion accessories.**
- **Prior to installing a resistor to the filter network you must drill a 1/16" hole through the center pinhole [beneath the board's silkscreen resistor symbol] as indicated in the preceding figure. Failure to do so will short-circuit the resistor.**
- **Do not drill holes on the board for channels, unless those channels are to receive a filter network (see preceding statement).**
- **Resistors should be ¼ watt, film-type with up to 5% tolerance. Do not use wire-wound resistor types.**
- **A resistor value of 510 Ω is recommended. Do not exceed 510 Ω.**
- **Capacitors used are to be of the film dielectric type (e.g., polycarbonate or NPO ceramic), above 0.001 µF.**
- **RECOMMENDED: For reduction of both *Common Mode Noise* and *Differential Mode Noise*, use one capacitor between Channel High and AGND; and use a second capacitor between Channel Low and AGND.**
- **For reduction of *Differential Noise* [when no reduction of *Common Mode Noise* is needed] position a capacitor across the respective Channel High and Channel Low.**
- **When in Differential Mode, using capacitors between Channel High, Channel Low, and AGND may cause a slight degradation of *wideband Common Mode rejection*.**
- **When making a RC filter network, always install a wire jumper between the relevant FILT CAP LO and AGND. FILT CAP LO terminals are located on TB9 and TB10.**

Specifications for DBK213

Operating Environment:

Temperature: -30°C to 70°C
Relative Humidity: 95% RH, non-condensing

Connectors:

P1: male DB37 connector for analog expansion or connection to primary acquisition device*

P2: male DB37 connector for digital expansion or connection to primary acquisition device*

P3: male DB37 connector for pulse/frequency/digital I/O, or connection to primary acquisition device*
P4: 100-pin connector for connection to a /2000 Series device that includes a P4 connector; e.g., DaqBoard/2000.

Screw Terminals: 12 banks of 10-connector blocks

Dimensions:
285 mm W x 220 mm D x 45 mm H (11" x 8.5" x 2.7")

Weight:
1.45 kg (3.2 lbs)

Cables and Accessories:

Item Description	Part Number
Rack Mount Kit, p/n	RackDBK4
100-conductor expansion cables; mate with P4 connectors:	
3 ft., non-CE Compliant	CA-195
3 ft., CE Compliant	CA-209
6 ft., non-CE Compliant	CA-195-6
37-conductor cables; mate with DB37 connectors:	
2 in., shielded T-cable	CA-255-2T
4 in., shielded T cable	CA-255-4T
8 in., shielded T cable	CA-255-8T
37-conductor ribbon cable	CA-37-X

*DaqBook/2000 Series, DaqLab/2000 Series, DaqScan/2000 Series

Specifications subject to change without notice.

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section of this manual.
- Refer to the documentation for your primary data acquisition device as needed.

Notes

DBK214 — 16-Connector BNC Interface Module

Includes P1/P2/P3/P4 compatibility for Analog I/O, Digital I/O, & Pulse/Frequency

DBK214 Front Panel
Upper Slot for Terminal Board Wiring Pass-Through
Lower section of 16 BNC Connectors

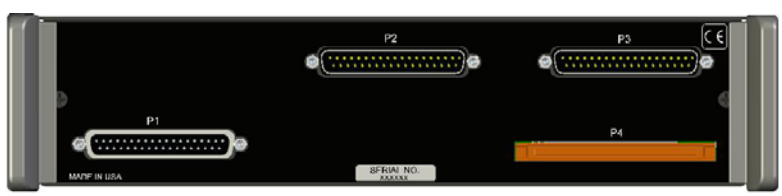
The DBK214 module is compatible with the following products:

- DaqBook/2000 Series • DaqBoard/2000 Series • DaqLab • DaqScan

Overview

The DBK214 module includes:

- P1, male DB37 connector for Analog Input.
- P2, male DB37 connector for Digital I/O.
- P3, male DB37 connector for Pulse/Frequency (Digital and Counter/Timer) I/O, and Analog Output.
- P4, 100-pin connector. Provides same signal connection as P1, P2, and P3 combined.
- 14 on-board screw-terminal blocks (*accessible after removal of cover*)
- The terminal blocks tie in to P1, P2, P3, and P4 and provide for easy signal connection.
- 8 BNC connectors (BNC0 through BNC7) for Analog Input
- 8 BNC connectors (BNCA through BNCH), custom configured by user for accessing Analog I/O, Digital I/O, or Counter/Timer signals.
- On-board socket locations for custom RC Filter networks (*accessible after removal of cover*).

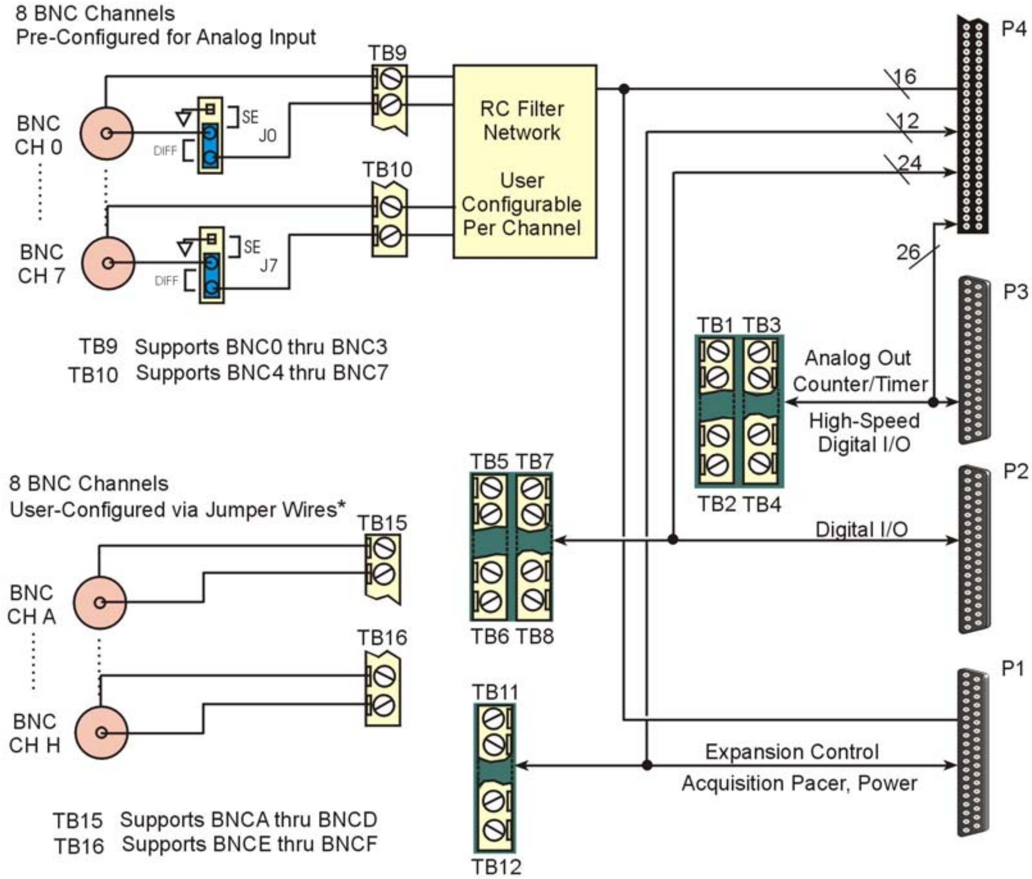


DBK214 Rear Panel

Upper section includes P2 and P3 DB37 connectors.
Lower section includes P1 DB37 connector and P4 100-pin connector.

The three DB37 connectors (P1, P2 and P3) can be used as direct connection points for I/O signals. Optionally, convenient removable DB37 connectors [provided] can be used. Often signals are connected to P1, P2, and/or P3 via cable and a DBK card or module.

The DBK214 provides BNC and screw-terminal access to all analog and digital I/O from the host data acquisition device. Related to the screw-terminals is a front panel slot for routing all I/O wiring.



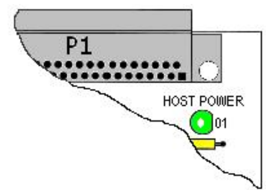
DBK214 Block Diagram

***** Accessory Kit p/n 1139-0800 includes jumper wires and a screw driver.

Connection Tips

CAUTION
Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to DBKs. Electric shock or damage to equipment can result even under low-voltage conditions.
Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)
Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.
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.

When using P4, e.g., for a DaqBoard/2000, be sure to align the P4 orientation indicators [white arrows] prior to mating the P4 connectors.



Location of DBK214's Host Power LED

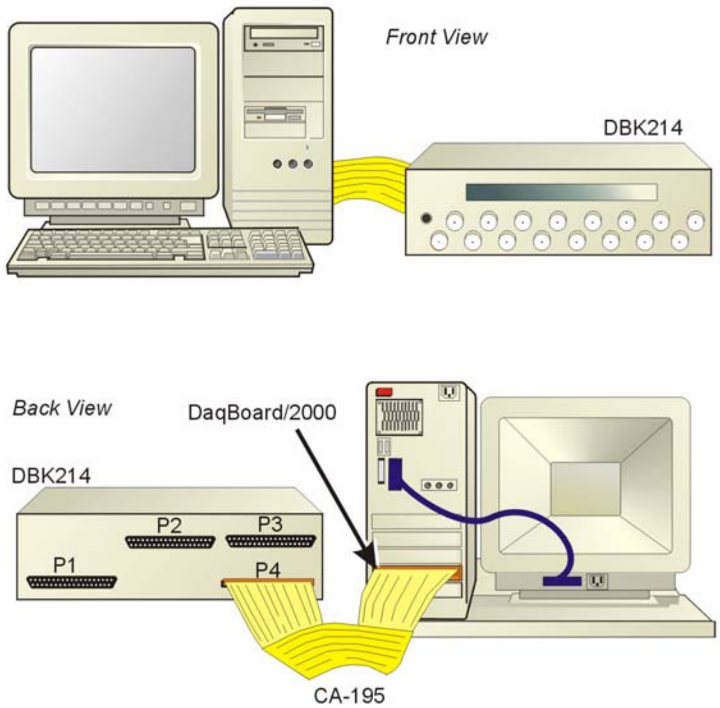
1. Ensure power is removed from all device(s) to be connected.
2. As soon as the DBK214 cover is removed, verify that the Host Power LED is "Off." See figure at right for location.
3. Observe ESD precautions when handling the board and making connections.
4. Do not make redundant connections. For example, for ANALOG IN you could use the P1 (DB37) connector, or Terminal Blocks TB9 through TB12, or BNC connectors. **Redundant connections must be avoided**.
5. You do not need to remove the cover unless you need to access a terminal block, customize an RC filter network, or set a BNC channel to Single-Ended mode or to Differential mode (via Jumpers J0 through J7). Information regarding these tasks follows shortly. **RC filter networks are not to be made or used in association with additional DBK expansion options**.
6. DBK214's 100-pin P4 typically connects to a DaqBoard/2000 Series board's P4 via a CA-195
one-hundred conductor ribbon cable.

   The DaqBoard/2000 Series boards communicate [external from the host PC] through a 100-pin P4 connector. The P1, P2, and P3 connectors discussed in association with these boards are subset connectors of the 100-pin P4 connector. The *System Connections and Pinouts* chapters of the product hardware manuals include pinouts.

7. Connections to the DB37 connectors are made via CA-37 cables or CA-255 cables:
   (a) P1 connects to an analog DBK card or module's P1 connector.
   (b) P2 connects to a Digital DBK card or module's P2 connector.
   (c) P3 connects to a Pulse/Frequency DBK card module's P3 connector.
8. Refer to the separate CE Cable Kit instructions that are included with the associated CE cable kit. Refer to the Declaration of Conformity in regard to meeting CE requirements.

System Examples

Example 1:

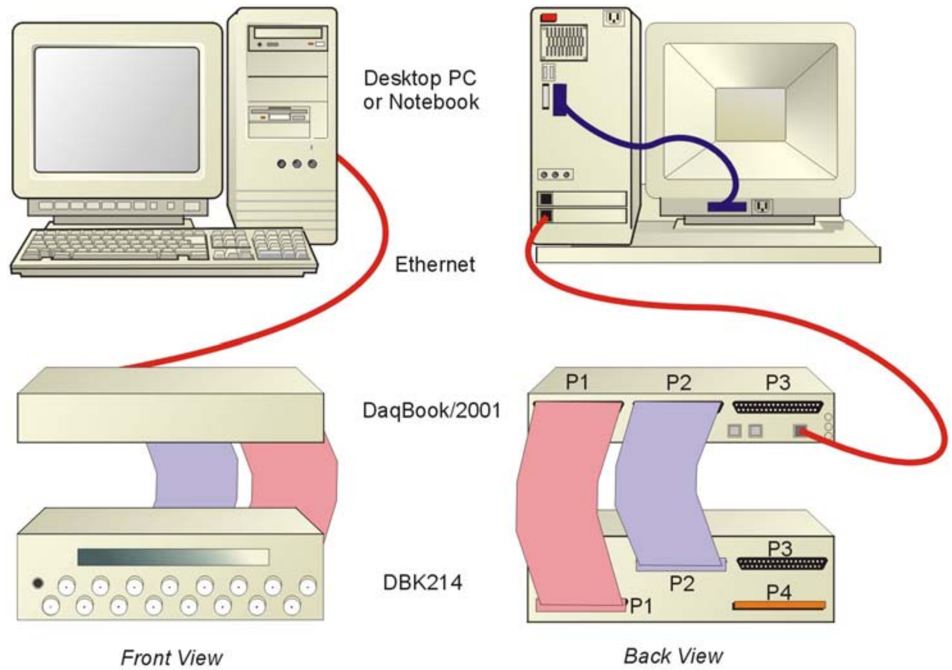


DBK214 Connected to a DaqBoard/2000

Note regarding the above system example:

A CA-195 100-conductor ribbon cable connects the P4 connector of the DBK214 to the P4 connector of the DaqBoard/2000 (which is installed in the host PC).

Example 2:



DBK214 Connected to a DaqBook/2001

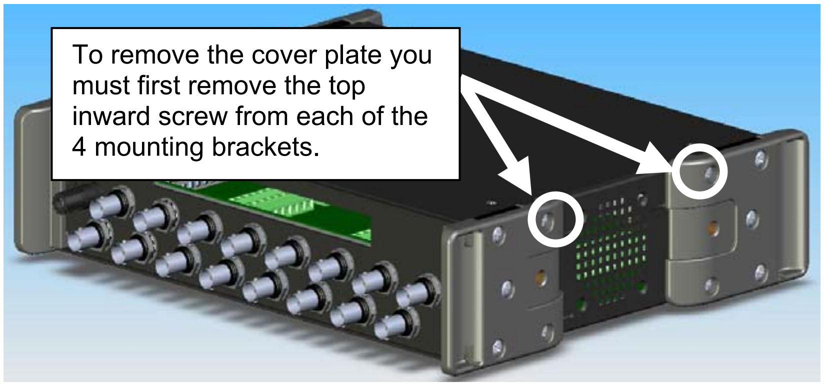
Notes regarding the above system example:

1) Either of two Ethernet cables can be used: CA-242 is a 1.5 ft cable; CA-242-7 is a 7 ft. cable.
2) A CA-255 [or CA-37] cable is being used to connect the DBK214's P1 connector to the P1 connector of the DaqBook/2001.
3) The DBK214's P1 connector [rear panel, lower-left] connects to the internal screw-terminal board to which analog I/O signals could be connected via wire. The wires would be routed out through the upper slots of the front panel. In addition, BNC connectors (for channels 0 through 7) connect [through the printed circuit board] to the P1 terminal blocks.
4) A CA-255 [or CA-37] cable is used to connect the DBK214's P2 connector to the DaqBook/2001 P2 connector.
5) The DBK214's P2 connector connects to the internal screw-terminal board, to which digital I/O signals could be connected via wire. The wires would be routed out through the upper slots of the front panel.

Using the Screw-Terminal Blocks

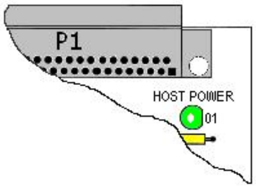
You must remove the DBK214 module's cover plate to access the screw terminal blocks. This is described in steps 1 and 2 below.

1. Remove the top inward screws from each of the 4 mounting brackets. See following figure.



The Cover Plate is Secured by 4 Srews [2 Screws per-side]

2. After the 4 screws have been removed, carefully remove the cover plate.
3. As soon as the DBK214 cover is removed, verify that the Host Power LED is "Off." See following figure for location.

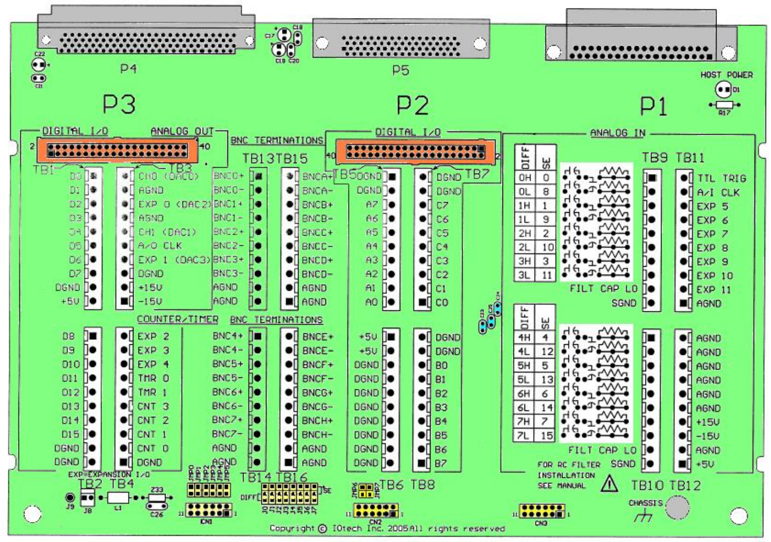


Host Power LED Location

4. Make the wiring connections to the terminals. Refer to the board's silkscreen and to the pin correlations on the next few pages.
5. Tighten the terminal block screws snug; but do not over-tighten.
6. After all terminal connections are made and verified correct, return the cover to the unit and secure in place with the 4 screws removed earlier. Tighten snug, but do not over-tighten.

In general, the following *terminal block-to-signal* relationships apply:

DBK214 Terminal Blocks	Used for . . .	Alternative
TB9 TB10	ANALOG INPUT	P1, P4* BNC 0 thru 7
TB11 TB12	ANALOG INPUT	P1, P4*
TB5 TB6 TB7 TB8	DIGITAL I/O	P2 or P4*
TB13** TB14**	ANALOG INPUT BNC Channels 0 thru 7**	P1, P4* TB9,TB10
TB15 TB16 (Note 1)	USER CONFIGURABLEBNC Channels A thru H	(See Note 1)
TB1 TB2 TB3 TB4	PULSE/ FREQUENCY/ DIGITAL I/O ANALOG OUTPUT	P3 or P4*



DBK214 Board

Notes: (1) The P2 and P3 DB37 Connectors and their associated "device-internal" cables are not shown.

(2) DBK214 does not make use of P5 [top center].

* P4 is used for connecting to DaqBoard/2000 Series devices.

** TB13 and TB14 are "virtual" terminal blocks which are routed in the printed circuit board to TB9 and TB10. The TB13 and TB14 silk-screened locations on the DBK214 board do not have physical screw terminal blocks.

Note 1: TB15 and TB16 are used for optional user-configured BNC connectors A through H. These connectors can be configured on a per-channel basis as Analog [Input or Output], Digital I/O, or Counter/Timer. When BNC A through H are used, the user must route wires from the "BNC routing terminal blocks" (TB15 and TB16) to the appropriate functional TB termination points.

Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.

The following pages correlate the DBK214 terminal block connectors with the associated pins of the P1, P2, and P3 DB37 connectors. Note that chapter 2 of the DBK Options Manual (457-0905) contains additional pin-outs, and includes references to the 100-pin P4 connector. Also note that hardware manuals for the primary data acquisition devices include pinout chapters.

Correlation to P1 – Pertains to Terminal Blocks TB9, TB10, TB11, and TB12 for Analog I/O.

Also see "Correlation to BNC Terminations (TB13 and TB14) on page DBK214-11."

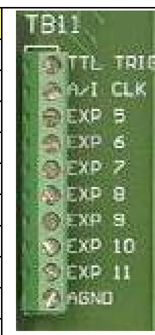
TB9		P1 Pin Number and Description	
DIFF	**SE**		
0H	0	37	CH 0 IN (Single-Ended Mode) / CH 0 HI IN (Differential Mode)
0L	8	18	CH 8 IN (Single-Ended Mode) / CH 0 LO IN (Differential Mode)
1H	1	36	CH 1 IN (Single-Ended Mode) / CH 1 HI IN (Differential Mode)
1L	9	17	CH 9 IN (Single-Ended Mode) / CH 1 LO IN (Differential Mode)
2H	2	35	CH 2 IN (Single-Ended Mode) / CH 2 HI IN (Differential Mode)
2L	10	16	CH 10 IN (Single-Ended Mode) / CH 2 LO IN (Differential Mode)
3H	3	34	CH 3 IN (Single-Ended Mode) / CH 3 HI IN (Differential Mode)
3L	11	15	CH 11 IN (Single-Ended Mode) / CH 3 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB9
(Note 2)

TB10		P1 Pin Number and Description	
DIFF	**SE**		
4H	4	33	CH 4 IN (Single-Ended Mode) / CH 4 HI IN (Differential Mode)
4L	12	14	CH 12 IN (Single-Ended Mode) / CH 4 LO IN (Differential Mode)
5H	5	32	CH 5 IN (Single-Ended Mode) / CH 5 HI IN (Differential Mode)
5L	13	13	CH 13 IN (Single-Ended Mode) / CH 5 LO IN (Differential Mode)
6H	6	31	CH 6 IN (Single-Ended Mode) / CH 6 HI IN (Differential Mode)
6L	14	12	CH 14 IN (Single-Ended Mode) / CH 6 LO IN (Differential Mode)
7H	7	30	CH 7 IN (Single-Ended Mode) / CH 7 HI IN (Differential Mode)
7L	15	11	CH 15 IN (Single-Ended Mode) / CH 7 LO IN (Differential Mode)
FILT CAP LO		N/A	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		19	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB10
(Note 2)

TB11	P1 Pin Number and Description	
TTL TRIG	25	TTL Trigger, Digital IN, External TTL Trigger Input
A/I CLK	20	A/I Clock, External ADC Pacer Clock Input/ Internal ADC Pacer Clock Output
EXP 5	5	Expansion 5. Digital OUT, external GAIN select bit 1
EXP 6	6	Expansion 6. Digital OUT, external GAIN select bit 0
EXP 7	3	Expansion 7. Digital OUT, external ADDRESS, select bit 3
EXP 8	22	Expansion 8. Digital OUT, external ADDRESS, select bit 2
EXP 9	4	Expansion 9. Digital OUT, external ADDRESS, select bit 1
EXP 10	23	Expansion 10. Digital OUT, external ADDRESS, select bit 0
EXP 11	26	Expansion 11. Simultaneous Sample and Hold (SSH)
AGND	*	Analog Ground, Common



P1 – TB11

TB12	P1 Pin Number and Description	
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
+ 15 V	21	Expansion, +15 V Power
- 15 V	2	Expansion, -15 V Power
AGND	*	Common Ground
+ 5 V	1	Expansion, +5 V Power

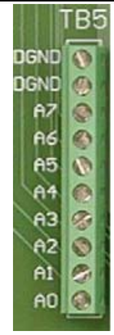
P1 – TB12

*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

Note 2: For TB9 and TB10, the filter network portion of the silkscreen is not shown. Instead, the DIFF and SE channel identifiers have been moved next to the screws for ease in identification.

Correlation to P2 – Pertains to Terminal Blocks TB5, TB6, TB7, and TB8 for Digital I/O.

TB5	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
A7	30	Digital I/O: P2, Digital Port A, Bit 7; or P2 Expansion Data Bit 15
A6	31	Digital I/O: P2, Digital Port A, Bit 6; or P2 Expansion Data Bit 14
A5	32	Digital I/O: P2, Digital Port A, Bit 5; or P2 Expansion Data Bit 13
A4	33	Digital I/O: P2, Digital Port A, Bit 4; or P2 Expansion Data Bit 12
A3	34	Digital I/O: P2, Digital Port A, Bit 3; or P2 Expansion Data Bit 11
A2	35	Digital I/O: P2, Digital Port A, Bit 2; or P2 Expansion Data Bit 10
A1	36	Digital I/O: P2, Digital Port A, Bit 1; or P2 Expansion Data Bit 9
A0	37	Digital I/O: P2, Digital Port A, Bit 0; or P2 Expansion Data Bit 8

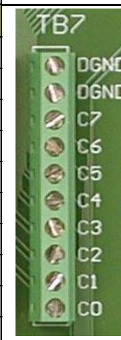


P2 – TB5

TB6	P2 Pin Number and Description	
+5 V	18	Expansion +5 V Power
+5 V	20	Expansion +5 V Power
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P2 – TB6

TB7	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
C7	22	Digital I/O: P2, Digital Port C, Bit 7; or P2 Expansion Data Bit 7
C6	23	Digital I/O: P2, Digital Port C, Bit 6; or P2 Expansion Data Bit 6
C5	24	Digital I/O: P2, Digital Port C, Bit 5; or P2 Expansion Data Bit 5
C4	25	Digital I/O: P2, Digital Port C, Bit 4; or P2 Expansion Data Bit 4
C3	26	Digital I/O: P2, Digital Port C, Bit 3; or P2 Expansion Data Bit 3
C2	27	Digital I/O: P2, Digital Port C, Bit 2; or P2 Expansion Data Bit 2
C1	28	Digital I/O: P2, Digital Port C, Bit 1; or P2 Expansion Data Bit 1
C0	29	Digital I/O: P2, Digital Port C, Bit 0; or P2 Expansion Data Bit 0



P2 – TB7

TB8	P2 Pin Number and Description	
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common
B0	10	Digital I/O: P2, Digital Port B, Bit 0; or P2 Expansion READ Output
B1	9	Digital I/O: P2, Digital Port B, Bit 1; or P2 Expansion WRITE Output
B2	8	Digital I/O: P2, Digital Port B, Bit 2; or P2 Expansion RESET Output
B3	7	Digital I/O: P2, Digital Port B, Bit 3; or P2 Expansion Address Bit 4 Out
B4	6	Digital I/O: P2, Digital Port B, Bit 4; or P2 Expansion Address Bit 3 Out
B5	5	Digital I/O: P2, Digital Port B, Bit 5; or P2 Expansion Address Bit 2 Out
B6	4	Digital I/O: P2, Digital Port B, Bit 6; or P2 Expansion Address Bit 1 Out
B7	3	Digital I/O: P2, Digital Port B, Bit 7; or P2 Expansion Address Bit 0 Out

P2 – TB8

*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

Correlation to P3 – Pertains to Terminal Blocks TB1, TB2, TB3, and TB4 for Pulse/Frequency/Digital I/O.

TB1	P3 Pin Number and Description	
D0	10	P3 Digital Port Bit 0
D1	9	P3 Digital Port Bit 1
D2	8	P3 Digital Port Bit 2
D3	7	P3 Digital Port Bit 3
D4	6	P3 Digital Port Bit 4
D5	5	P3 Digital Port Bit 5
D6	4	P3 Digital Port Bit 6
D7	3	P3 Digital Port Bit 7
DGND	*	Digital Ground, Common
+5V	20	Expansion, +5 Volt Power

P3 – TB1

TB2	P3 Pin Number and Description	
D8	29	P3 Digital Port Bit 8
D9	28	P3 Digital Port Bit 9
D10	27	P3 Digital Port Bit 10
D11	26	P3 Digital Port Bit 11
D12	25	P3 Digital Port Bit 12
D13	24	P3 Digital Port Bit 13
D14	23	P3 Digital Port Bit 14
D15	22	P3 Digital Port Bit 15
DGND	*	Digital Ground, Common
DGND	*	Digital Ground, Common

P3 – TB2

TB3	P3 Pin Number and Description	
CH0 (DAC0)	34	Analog Out; Analog DAC 0 Output
AGND	*	Analog Ground, Common; intended for use with DACs
EXP 0 (DAC2)	32	Analog Out; Analog DAC 2 Output
AGND	*	Analog Ground, Common; intended for use with DACs
CH1 (DAC1)	33	Analog Out; Analog DAC 1 Output
A/O CLK	21	Analog Out Clock; External DAC Pacer Clock Input/ Internal DAC Pacer Clock Output
EXP 1 (DAC3)	31	Analog Out; Analog DAC 3 Output
DGND	*	Digital Ground, Common
+15 V	19	Expansion, + 15 VDC
-15 V	37	Expansion, -15 VDC

P3 – TB3

TB4	P3 Pin Number and Description	
EXP 2	12	Reserved
EXP 3	13	Reserved
EXP 4	14	Reserved
TMR 0	15	P3 Timer 0 Output
TMR 1	16	P3, Timer 1 Output
CNT 3	35	P3 Counter 3 Input
CNT 2	17	P3 Counter 2 Input
CNT 1	36	P3 Counter 1 Input
CNT0	18	P3 Counter 0 Input
DGND	*	Digital Ground, Common

P3 – TB4

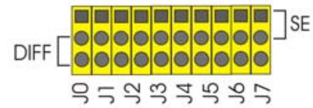
*Refer to Ground Correlation Tables in the DBK Options Manual (457-0905), chapter 2, *System Connections and Pinouts*.

P1 Correlation to Analog Input BNC Terminations – BNC Ch 0 through BNC Ch 7

“Virtual” Terminal Blocks TB13 and TB14 for ANALOG INPUT connect to TB9 and TB10 through the printed circuit board.

TB13 (“Virtual” Terminal Block)			**P1 Pin Number and Description**		
BNC CH	**DIFF**	**SE**	**Pin**	**SE** = Single Ended ; **DIFF** = Differential	**Jumper Used**
BNC0+	0H	0	37	CH 0 IN (SE) / CH 0 HI IN (DIFF)	J0
BNC0-	0L	8	18	CH 8 IN (SE) / CH 0 LO IN (DIFF)	
BNC1+	1H	1	36	CH 1 IN (SE) / CH 1 HI IN (DIFF)	J1
BNC1-	1L	9	17	CH 9 IN (SE) / CH 1 LO IN (DIFF)	
BNC2+	2H	2	35	CH 2 IN (SE) / CH 2 HI IN (DIFF)	J2
BNC2-	2L	10	16	CH 10 IN (SE) / CH 2 LO IN (DIFF)	
BNC3+	3H	3	34	CH 3 IN (SE) / CH 3 HI IN (DIFF)	J3
BNC0+	3L	11	15	CH 11 IN (SE) / CH 3 LO IN (D DIFF)	
AGND	N/A	N/A	*	Analog Ground	N/A
AGND	N/A	N/A	*	Analog Ground	N/A

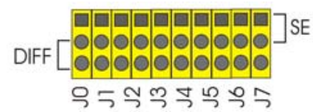
TB13 does not physically exist on DBK214. A silkscreen of TB13 is present as a visual aid to signal routing and configuration.



A header located beneath TB14 and TB16 is used to set the BNC channels to Single-Ended or to Differential. Simply place channel’s 2-pin jumper in the appropriate position (SE or DIFF).

TB14 (“Virtual” Terminal Block)			**P1 Pin Number and Description**		
BNC CH	**DIFF**	**SE**	**Pin**	**SE** = Single Ended ; **DIFF** = Differential	**Jumper Used**
BNC4+	4H	4	33	CH 4 IN (SE) / CH 4 HI IN (DIFF)	J4
BNC4-	4L	12	14	CH 12 IN (SE) / CH 4 LO IN (DIFF)	
BNC5+	5H	5	32	CH 5 IN (SE) / CH 5 HI IN (DIFF)	J5
BNC5-	5L	13	13	CH 13 IN (SE) / CH 5 LO IN (DIFF)	
BNC6+	6H	6	31	CH 6 IN (SE) / CH 6 HI IN (DIFF)	J6
BNC6-	6L	14	12	CH 14 IN (SE) / CH 6 LO IN (DIFF)	
BNC7+	7H	7	30	CH 7 IN (SE) / CH 7 HI IN (DIFF)	J7
BNC7+	7L	15	11	CH 15 IN (SE) / CH 7 LO IN (DIFF)	
AGND	N/A	N/A	*	Analog Ground	N/A
AGND	N/A	N/A	*	Analog Ground	N/A

TB14 does not physically exist on DBK214. A silkscreen of TB14 is present as a visual aid to signal routing and configuration.



A header located beneath TB14 and TB16 is used to set the BNC channels to Single-Ended or to Differential. Simply place channel’s 2-pin jumper in the appropriate position (SE or DIFF).

Correlation to Custom BNC Terminations – BNC Ch A through BNC Ch H

Pertains to Terminal Blocks TB15 and TB16 for Custom Configuration on a per-channel basis.

TB15 (“Routing” Terminal Block)	
BNC CH	**Description**
BNCA+	BNC channels A through D are configured on a per-channel basis by the user. TB15 is a routing terminal block used to connect BNCs (A thru D) to the desired signals, which are selected via a second DBK214 terminal block. For example: a user could run a wire from BNCA+ to TB4 screw terminal “TMR0” and BNCA- to TB4 DGND to create a BNC timer connection. Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.
BNCA-	
BNCB+	
BNCB-	
BNCC+	
BNCC-	
BNCD+	
BNCD+	
AGND	Analog Ground *
AGND	Analog Ground *

TB15

TB16 (“Routing” Terminal Block)	
BNC CH	**Description**
BNCA+	BNC channels E through H are configured on a per-channel basis by the user. TB16 is a routing terminal block used to connect BNCs (E thru H) to the desired signals, which are selected via a second DBK214 terminal block. Customizing is as described for BNCA through BNCD above. Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.
BNCA-	
BNCB+	
BNCB-	
BNCC+	
BNCC-	
BNCD+	
BNCD+	
AGND	Analog Ground *
AGND	Analog Ground *

TB16

Adding Resistor/Capacitor Filter Networks

WARNING

Disconnect the DBK214 from power and signal sources prior to installing capacitors or resistors.

CAUTION

Ensure wire strands do not short power supply connections (+15 V, -15 V, +5 V, etc.) to any terminal potential. Failure to do so could result in damage to DaqBook/2000 Series devices or DaqBoard/2000 Series boards.

Do not exceed maximum allowable inputs (as listed in product specifications). There should never be more than 30 V with reference to analog ground (AGND) or earth ground.

You must provide strain-relief (lead slack) to all leads leaving the module. Use tie-wraps [not included] to secure strain-relief.

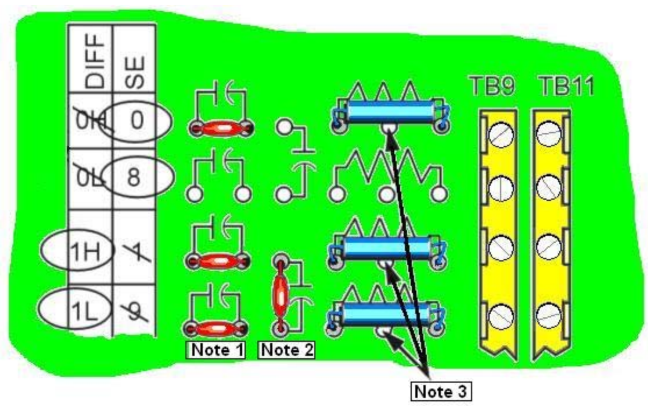
Always connect the CHASSIS terminal to earth ground. This will maximize static protection.

If a channel is not associated with a DBK expansion option you can install a customized RC filter network to improve the signal-to noise ratio, assuming that an unacceptable level of noise exists. DBK214's internal board includes silk-screened sockets for installing RC filter networks. The following table contains values that are typical for RC filter network components.

Typical One-Pole Low Pass Filter Values for DBK214

R	C	f	f
Ohms	µF	Hertz (-3dB)	kHz (-3dB)
510	1	312	0.31
510	0.47	664	0.66
510	0.22	1419	1.42
510	0.1	3122	3.12
510	0.047	6643	6.64
510	0.022	14192	14.19
510	0.01	31223	31.22
510	0.0047	66431	66.43
470	0.0033	102666	102.67

Do not use RC filters in conjunction with additional DBK expansion accessories.



An Example of Customer-Installed Capacitors and Filters for RC Networks

In this example Channels 0 and 8 are shown as *Single-Ended*. Channel 1 is *Differential*, i.e., using 1H and 1L (channel High and Low).

The following three notes pertain to the above figure.

Note 1: The 3 horizontal capacitors [as oriented in the illustration] are optional filter capacitors.

Note 2: The vertical capacitor [as oriented in the illustration] is an optional isolation capacitor used for the reduction of *Differential* noise. Such capacitor placement is not used in *Single-Ended* applications.

Note 3: If installing filter resistors, carefully drill out the indicated centers with a 1/16 inch drill-bit. Otherwise the resistor will be short-circuited.

Prior to installing RC components, review the previous Warning and Caution statements, then read over the following information regarding resistors and capacitors.

- **Do not use RC filters in conjunction with additional DBK expansion accessories.**
- **Prior to installing a resistor to the filter network you must drill a 1/16” hole through the center pinhole [beneath the board’s silkscreen resistor symbol] as indicated in the preceding figure. Failure to do so will short-circuit the resistor.**
- **Do not drill holes on the board for channels, unless those channels are to receive a filter network (see preceding statement).**
- **Resistors should be ¼ watt, film-type with up to 5% tolerance. Do not use wire-wound resistor types.**
- **A resistor value of 510 Ω is recommended. Do not exceed 510 Ω.**
- **Capacitors used are to be of the film dielectric type (e.g., polycarbonate or NPO ceramic), above 0.001 µF.**
- **RECOMMENDED: For reduction of both *Common Mode Noise* and *Differential Mode Noise*, use one capacitor between Channel High and AGND; and use a second capacitor between Channel Low and AGND.**
- **For reduction of *Differential Noise* [when no reduction of *Common Mode Noise* is needed] position a capacitor across the respective Channel High and Channel Low.**
- **When in Differential Mode, using capacitors between Channel High, Channel Low, and AGND may cause a slight degradation of *wideband Common Mode rejection*.**
- **When making a RC filter network, always install a wire jumper between the relevant FILT CAP LO and AGND. FILT CAP LO terminals are located on TB9 and TB10.**

Specifications for DBK214

Operating Environment:

Temperature: -30°C to 70°C
Relative Humidity: 95% RH, non-condensing

Connectors:

P1: male DB37 connector for analog expansion or connection to primary acquisition device*

P2: male DB37 connector for digital expansion or connection to primary acquisition device*

P3: male DB37 connector for pulse/frequency/digital I/O, analog output, or connection to primary acquisition device*

P4: 100-pin connector for connection to a /2000 Series device that includes a P4 connector; e.g., DaqBoard/2000.

Screw Terminals: 14 banks of 10-connector blocks
Wire Size: 12 to 28 AWG

Dimensions:
285 mm W x 220 mm D x 45 mm H (11” x 8.5” x 2.7”)

Weight:
1.36 kg (3 lbs)

Cables and Accessories:

Item Description	Part Number
Rack Mount Kit, p/n	RackDBK4
100-conductor expansion cables; mate with P4 connectors:	
3 ft., non-CE Compliant	CA-195
3 ft., CE Compliant	CA-209
6 ft., non-CE Compliant	CA-195-6
37-conductor cables; mate with DB37 connectors:	
2 in., shielded T-cable	CA-255-2T
4 in., shielded T cable	CA-255-4T
8 in., shielded T cable	CA-255-8T
37-conductor ribbon cable	CA-37-X
Accessory Wire Kit	1139-0800
Includes jumper wires and a screwdriver.	

*DaqBook/2000 Series, DaqLab/2000 Series, DaqScan/2000 Series

Specifications subject to change without notice.

Reference Notes:

- In regard to calculating system power requirements refer to the *DBK Basics* section.
- Chapter 2 of the DBK Options Manual includes pinouts for P1, P2, P3, and P4. Refer to pinouts applicable to your system, as needed.
- For a quick comparison of all DBK200 Series boards, refer to the *DBK200 Series Matrix*. The matrix is located just before the DBK200 section of this manual.
- Refer to the user manual for the primary data acquisition device as needed. The user's manuals include device specific pinouts.

Notes

With 68-Pin SCSI Adaptability for Analog I/O, Digital I/O, & Pulse/Frequency

DBK215 Front Panel
Upper Slot for Terminal Board Wiring Pass-Through
Lower section of 16 BNC Connectors

The DBK215 module is compatible with the following products:

- DaqBoard/500 Series • DaqBoard/1000 Series • DaqBoard/3000USB Series

Overview

DBK215 Rear Panel
Includes a 68-pin SCSI connector designated as P5.

The DBK215 module includes:

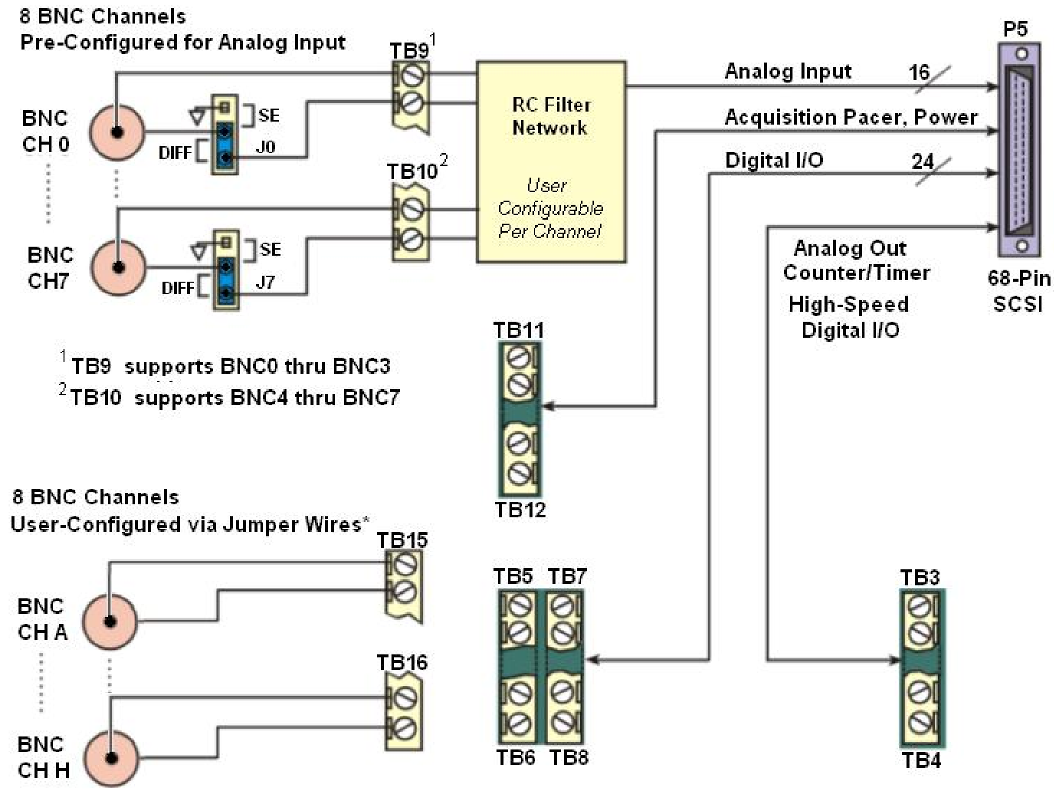
- o BNC Access to 16 inputs or outputs (on front panel)
- o on-board screw-terminal blocks*
- o on-board socket locations for custom RC Filter networks*
- o 68-pin SCSI connector (on rear panel)

* The top cover plate must be removed to access the terminal blocks and the RC filter network section of the board.

The DBK215's 68-pin SCSI connector (P5) connects to another SCSI connector on the main device, e.g., DaqBoard/500, /1000, or /3000USB Series board. Connection between the DBK215 and the board is made via a CA-G55, CA-G56, or CA-G56-6 cable. Cable descriptions are provided on page 2.

The DBK215 provides BNC and screw-terminal access to all analog and digital I/O from the host data acquisition device. Related to the screw-terminals is a front panel slot for routing all I/O wiring.

Reference Note:
DBK215 is intended for DaqBoard/500, /1000, and /3000USB Series applications. Refer to product-specific documentation for detailed information. For information concerning similar16 channel BNC connectivity/interface boards, designed for use with other products, refer to the DBK213 and DBK214 sections of the DBK Options manual (p/n 457-0905).



DBK215 Block Diagram

* Accessory Kit p/n 1139-0800 includes jumper wires and a screw driver.

Note that the 68-pin SCSI (P5) connector typically connects to a DaqBoard/500, /1000, or /3000USB Series board SCSI connector via a CA-G55, CA-G56, or CA-G56-6 cable.

- CA-G55 is a 3-foot long cable.
- CA-G56 is a 3-foot long shielded cable.
- CA-G56-6 is a 6-foot long shielded cable.

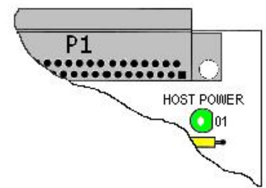
Connection Tips

CAUTION

Turn off power to the host PC and externally connected equipment prior to connecting cables or signal lines to DBKs. Electric shock or damage to equipment can result even under low-voltage conditions.

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

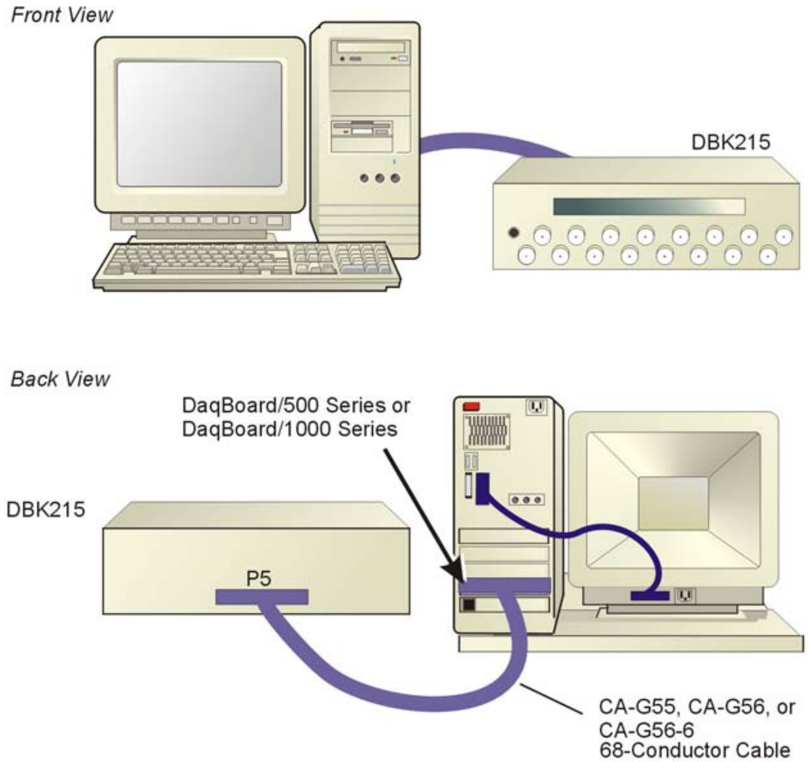
Use care to avoid touching board surfaces and onboard components. Only handle boards by their edges (or ORBs, if applicable). Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.



Location of DBK215's Host Power LED

1. Ensure power is removed from all device(s) to be connected.
2. As soon as the DBK215 cover is removed, verify that the Host Power LED is "Off." See figure at right for location.
3. Observe ESD precautions when handling the board and making connections.
4. You do not need to remove the cover unless you need to access a terminal block, customize an RC filter network, or set a BNC channel to Single-Ended mode or to Differential mode (via Jumpers J0 through J7). Information regarding these tasks follows shortly.
5. DBK215's 68-pin SCSI (P5) connector typically connects to a DaqBoard/500, /1000, or /3000USB Series board via a CA-G55, CA-G56, or CA-G56-6 cable.
    - CA-G55 is a 3-foot long cable.
    - CA-G56 is a 3-foot long shielded cable.
    - CA-G56-6 is a 6-foot long shielded cable.
6. Refer to the separate CE Cable Kit instructions that are included with the associated CE cable kit. Refer to the Declaration of Conformity in regard to meeting CE requirements.

System Example



DBK215 Connection to a DaqBoard/500 Series or DaqBoard/1000 Series Board*

*__Note__: DaqBoard/3000USB Series boards reside external to the host PC and are connected to the PC via USB cable.

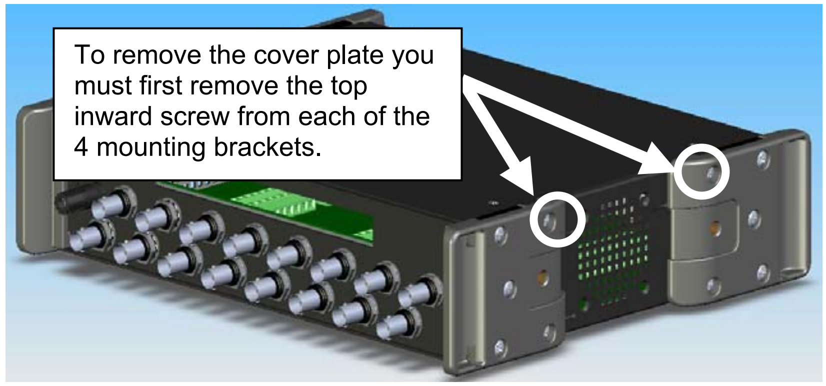
Notes regarding the above system example:

1) Any of three 68-conductor SCSI ribbon cables can be used.
    - CA-G55 is a 3-foot long cable.
    - CA-G56 is a 3-foot long shielded cable.
    - CA-G56-6 is a 6-foot long shielded cable.
2) Signal lines connect to front panel BNC connectors or to the internal screw-terminal board.
3) When signal lines are connected to terminal blocks (instead of the BNC connectors) the wires are routed out through the upper slot of the front panel.

Using the Screw-Terminal Blocks

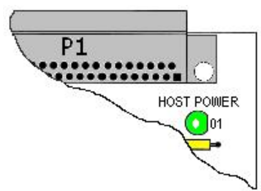
You must remove the DBK215 module's cover plate to access the screw terminal blocks.
This is described in steps 1 and 2 below.

1. Remove the top inward screws from each of the 4 mounting brackets. See following figure.



The Cover Plate is Secured by 4 Srews [2 Screws per-side]

2. After the 4 screws have been removed, carefully remove the cover plate.
3. As soon as the DBK215 cover is removed, verify that the Host Power LED is "Off." See following figure for location.

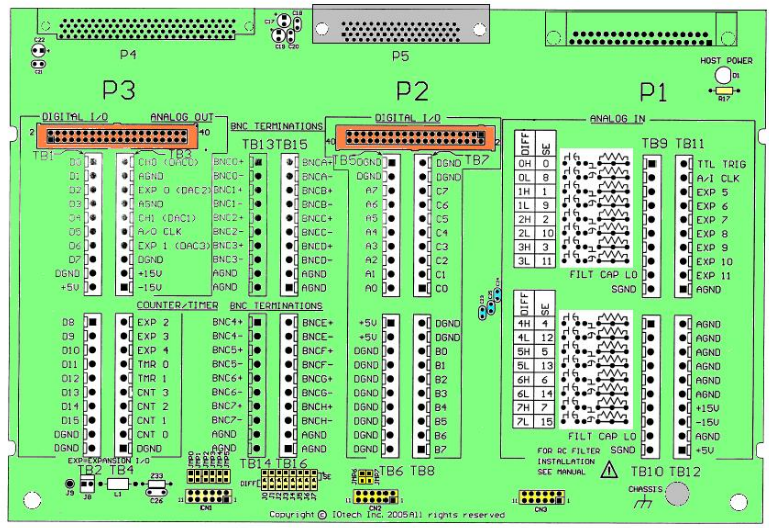


Host Power LED Location

4. Make the wiring connections to the terminals. Refer to the board's silkscreen and to the pin correlations on the next few pages.
5. Tighten the terminal block screws snug; but do not over-tighten.
6. After all terminal connections are made and verified correct, return the cover to the unit and secure in place with the 4 screws removed earlier. Tighten snug, but do not over-tighten.

In general, the following *terminal block-to-signal* relationships apply:

DBK215 Terminal Blocks	Used for . . .	Alternative
TB9 TB10	ANALOG INPUT	BNC 0 thru 7
TB11 TB12	ANALOG INPUT	N/A
TB5 TB6 TB7 TB8	DIGITAL I/O	N/A
TB13** TB14**	ANALOG INPUT BNC Channels 0 thru 7**	TB9,TB10
TB15 TB16 (Note 1)	USER CONFIGURABLEB NC Channels A thru H	(See Note 1)
TB1 TB2	-- Not Used---	N/A
TB3 TB4	PULSE/ FREQUENCY ANALOG OUTPUT	N/A



DBK215 Board

* P4 is used for connecting to DaqBoard/2000 Series devices.

** TB13 and TB14 are "virtual" terminal blocks which are routed in the printed circuit board to TB9 and TB10. The TB13 and TB14 silk-screened locations on the DBK215 board do not have physical screw terminal blocks.

Note 1: TB15 and TB16 are used for optional user-configured BNC connectors A through H. These connectors can be configured on a per-channel basis as Analog [Input or Output], Digital I/O, or Counter/Timer. When BNC A through H are used, the user must route wires from the "BNC routing terminal blocks" (TB15 and TB16) to the appropriate functional TB termination points.

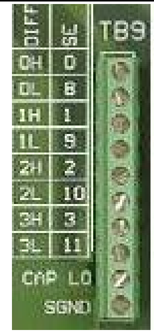
Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.

The following pages correlate the DBK215 terminal block connectors with the 68-pin SCSI connector.

Analog I/O Correlation to 68-pin SCSI

Also see "Correlation to BNC Terminations (TB13 and TB14) on page DBK215-10."

TB9		**Pin Number and Description**	
DIFF	**SE**		
0H	0	68	CH 0 IN (Single-Ended Mode) / CH 0 HI IN (Differential Mode)
0L	8	34	CH 8 IN (Single-Ended Mode) / CH 0 LO IN (Differential Mode)
1H	1	33	CH 1 IN (Single-Ended Mode) / CH 1 HI IN (Differential Mode)
1L	9	66	CH 9 IN (Single-Ended Mode) / CH 1 LO IN (Differential Mode)
2H	2	65	CH 2 IN (Single-Ended Mode) / CH 2 HI IN (Differential Mode)
2L	10	31	CH 10 IN (Single-Ended Mode) / CH 2 LO IN (Differential Mode)
3H	3	30	CH 3 IN (Single-Ended Mode) / CH 3 HI IN (Differential Mode)
3L	11	63	CH 11 IN (Single-Ended Mode) / CH 3 LO IN (Differential Mode)
FILT CAP LO		**N/A**	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND. Note that there is no association between FILT CAP LO and P4.
SGND		62	Signal Ground, Sense Common; reference ground, not for general use.

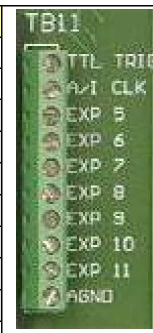


P1 – TB9
(Note 2)

TB10		**Pin Number and Description**	
DIFF	**SE**		
4H	4	28	CH 4 IN (Single-Ended Mode) / CH 4 HI IN (Differential Mode)
4L	12	61	CH 12 IN (Single-Ended Mode) / CH 4 LO IN (Differential Mode)
5H	5	60	CH 5 IN (Single-Ended Mode) / CH 5 HI IN (Differential Mode)
5L	13	26	CH 13 IN (Single-Ended Mode) / CH 5 LO IN (Differential Mode)
6H	6	25	CH 6 IN (Single-Ended Mode) / CH 6 HI IN (Differential Mode)
6L	14	58	CH 14 IN (Single-Ended Mode) / CH 6 LO IN (Differential Mode)
7H	7	57	CH 7 IN (Single-Ended Mode) / CH 7 HI IN (Differential Mode)
7L	15	23	CH 15 IN (Single-Ended Mode) / CH 7 LO IN (Differential Mode)
FILT CAP LO		**N/A**	For RC filter networks install a wire jumper between the relevant FILT CAP LO and AGND.
SGND		62	Signal Ground, Sense Common; reference ground, not for general use.

P1 – TB10
(Note 2)

TB11	**Pin Number and Description**	
TTL TRIG	6	TTL Trigger, Digital IN, External TTL Trigger Input
A/I CLK	2	A/I Clock, External ADC Pacer Clock Input/ Internal ADC Pacer Clock Output
EXP 5	**N/A**	Expansion 5. Digital OUT, external GAIN select bit 1
EXP 6	**N/A**	Expansion 6. Digital OUT, external GAIN select bit 0
EXP 7	**N/A**	Expansion 7. Digital OUT, external ADDRESS, select bit 3
EXP 8	**N/A**	Expansion 8. Digital OUT, external ADDRESS, select bit 2
EXP 9	**N/A**	Expansion 9. Digital OUT, external ADDRESS, select bit 1
EXP 10	**N/A**	Expansion 10. Digital OUT, external ADDRESS, select bit 0
EXP 11	**N/A**	Expansion 11. Simultaneous Sample and Hold (SSH)
AGND	*	Analog Ground, Common



P1 – TB11

TB12	**Pin Number and Description**	
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
AGND	*	Analog Ground, Common
+ 15 V	**N/A**	Expansion, +15 V Power
- 15 V	**N/A**	Expansion, -15 V Power
AGND	*	Common Ground
+ 5 V	19	Expansion, +5 V Power

P1 – TB12

*The following SCSI Pins connect to Analog Common: 24, 27, 29, 32, 55, 56, 59, 64, and 67.

Note 2: For TB9 and TB10, the filter network portion of the silkscreen is not shown. Instead, the DIFF and SE channel identifiers have been moved next to the screws for ease in identification.

Digital I/O Correlation to 68-pin SCSI

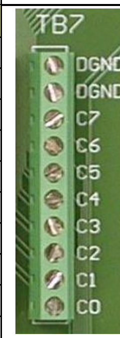
TB5	Pin Number and Description	
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
A7	49	Digital I/O: Port A, Bit 7
A6	15	Digital I/O: Port A, Bit 6
A5	50	Digital I/O: Port A, Bit 5
A4	16	Digital I/O: Port A, Bit 4
A3	51	Digital I/O: Port A, Bit 3
A2	17	Digital I/O: Port A, Bit 2
A1	52	Digital I/O: Port A, Bit 1
A0	18	Digital I/O: Port A, Bit 0

P2 – TB5

TB6	Pin Number and Description	
+5 V	19	Expansion +5 V Power
+5 V	19	Expansion +5 V Power
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common

P2 – TB6

TB7	Pin Number and Description	
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
C7	41	Digital I/O: Port C, Bit 7
C6	7	Digital I/O: Port C, Bit 6
C5	42	Digital I/O: Port C, Bit 5
C4	8	Digital I/O: Port C, Bit 4
C3	43	Digital I/O: Port C, Bit 3
C2	9	Digital I/O: Port C, Bit 2
C1	44	Digital I/O: Port C, Bit 1
C0	10	Digital I/O: Port C, Bit 0



P2 – TB7

TB8	Pin Number and Description	
DGND	**	Digital Ground, Common
DGND	**	Digital Ground, Common
B0	14	Digital I/O: Port B, Bit 0
B1	48	Digital I/O: Port B, Bit 1
B2	13	Digital I/O: Port B, Bit 2
B3	47	Digital I/O: Port B, Bit 3
B4	12	Digital I/O: Port B, Bit 4
B5	46	Digital I/O: Port B, Bit 5
B6	11	Digital I/O: Port B, Bit 6
B7	45	Digital I/O: Port B, Bit 7

P2 – TB8

* The following SCSI Pins connect to Analog Common: 24, 27, 29, 32, 55, 56, 59, 64, and 67.
** The following SCSI Pins connect to Digital Common: 35, 36, 40, and 53.

Pulse/Frequency Correlation to 68-pin SCSI

TB1	Pin Number and Description	
D0	**N/A**	P3 Digital Port Bit 0
D1	**N/A**	P3 Digital Port Bit 1
D2	**N/A**	P3 Digital Port Bit 2
D3	**N/A**	P3 Digital Port Bit 3 **TB1 is NOT USED**
D4	**N/A**	P3 Digital Port Bit 4
D5	**N/A**	P3 Digital Port Bit 5
D6	**N/A**	P3 Digital Port Bit 6
D7	**N/A**	P3 Digital Port Bit 7
DGND	**N/A**	Digital Ground, Common
+5V	**N/A**	Expansion, +5 Volt Power

P3 – TB1 (not used)

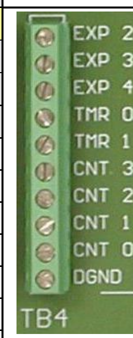
TB2	Pin Number and Description	
D8	**N/A**	P3 Digital Port Bit 8
D9	**N/A**	P3 Digital Port Bit 9
D10	**N/A**	P3 Digital Port Bit 10
D11	**N/A**	P3 Digital Port Bit 11 **TB2 is NOT USED**
D12	**N/A**	P3 Digital Port Bit 12
D13	**N/A**	P3 Digital Port Bit 13
D14	**N/A**	P3 Digital Port Bit 14
D15	**N/A**	P3 Digital Port Bit 15
DGND	**N/A**	Digital Ground, Common
DGND	**N/A**	Digital Ground, Common

P3 – TB2 (not used)

TB3	Pin Number and Description	
CH0 (DAC0)	22	Analog Out; Analog DAC 0 Output
AGND	*	Analog Ground, Common; intended for use with DACs
EXP 0 (DAC2)	**N/A**	Analog Out; Analog DAC 2 Output
AGND	*	Analog Ground, Common; intended for use with DACs
CH1 (DAC1)	21	Analog Out; Analog DAC 1 Output
A/O CLK	1	Analog Out Clock; External DAC Pacer Clock Input/ Internal DAC Pacer Clock Output
EXP 1 (DAC3)	**N/A**	Analog Out; Analog DAC 3 Output
DGND	**	Digital Ground, Common
+15 V	**N/A**	Expansion, + 15 VDC
-15 V	**N/A**	Expansion, -15 VDC

P3 – TB3

TB4	Pin Number and Description	
EXP 2	**N/A**	Reserved
EXP 3	**N/A**	Reserved
EXP 4	**N/A**	Reserved
TMR 0	3	P3 Timer 0 Output
TMR 1	37	P3, Timer 1 Output
CNT 3	38	P3 Counter 3 Input
CNT 2	4	P3 Counter 2 Input
CNT 1	39	P3 Counter 1 Input
CNT0	5	P3 Counter 0 Input
DGND	**	Digital Ground, Common



P3 – TB4

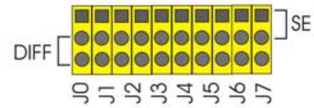
* The following SCSI Pins connect to Analog Common: 24, 27, 29, 32, 55, 56, 59, 64, and 67.
** The following SCSI Pins connect to Digital Common: 35, 36, 40, and 53.

Correlation to Analog Input BNC Terminations – BNC 0 through BNC 7

"Virtual" Terminal Blocks TB13 and TB14 for ANALOG INPUT connect to TB9 and TB10 through the printed circuit board.

TB13 ("Virtual" Terminal Block)			68-Pin SCSI Connector, Pin Number and Description		
BNC CH	**DIFF**	**SE**	**Pin**	**SE** = Single Ended ; **DIFF** = Differential	**Jumper Used**
BNC0+	0H	0	68	CH 0 IN (SE) / CH 0 HI IN (DIFF)	J0
BNC0-	0L	8	34	CH 8 IN (SE) / CH 0 LO IN (DIFF)	
BNC1+	1H	1	33	CH 1 IN (SE) / CH 1 HI IN (DIFF)	J1
BNC1-	1L	9	66	CH 9 IN (SE) / CH 1 LO IN (DIFF)	
BNC2+	2H	2	65	CH 2 IN (SE) / CH 2 HI IN (DIFF)	J2
BNC2-	2L	10	31	CH 10 IN (SE) / CH 2 LO IN (DIFF)	
BNC3+	3H	3	30	CH 3 IN (SE) / CH 3 HI IN (DIFF)	J3
BNC0+	3L	11	63	CH 11 IN (SE) / CH 3 LO IN (D DIFF)	
AGND	N/A	N/A	*	Analog Ground	N/A
AGND	N/A	N/A	*	Analog Ground	N/A

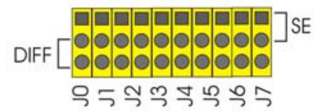
TB13 does not physically exist on DBK215. A silkscreen of TB13 is present as a visual aid to signal routing and configuration.



A header located beneath TB14 and TB16 is used to set the BNC channels to Single-Ended or to Differential. Simply place channel's 2-pin jumper in the appropriate position (SE or DIFF).

TB14 ("Virtual" Terminal Block)			68-Pin SCSI Connector, Pin Number and Description		
BNC CH	**DIFF**	**SE**	**Pin**	**SE** = Single Ended ; **DIFF** = Differential	**Jumper Used**
BNC4+	4H	4	28	CH 4 IN (SE) / CH 4 HI IN (DIFF)	J4
BNC4-	4L	12	61	CH 12 IN (SE) / CH 4 LO IN (DIFF)	
BNC5+	5H	5	60	CH 5 IN (SE) / CH 5 HI IN (DIFF)	J5
BNC5-	5L	13	26	CH 13 IN (SE) / CH 5 LO IN (DIFF)	
BNC6+	6H	6	25	CH 6 IN (SE) / CH 6 HI IN (DIFF)	J6
BNC6-	6L	14	58	CH 14 IN (SE) / CH 6 LO IN (DIFF)	
BNC7+	7H	7	57	CH 7 IN (SE) / CH 7 HI IN (DIFF)	J7
BNC7+	7L	15	23	CH 15 IN (SE) / CH 7 LO IN (DIFF)	
AGND	N/A	N/A	*	Analog Ground	N/A
AGND	N/A	N/A	*	Analog Ground	N/A

TB14 does not physically exist on DBK215. A silkscreen of TB14 is present as a visual aid to signal routing and configuration.



A header located beneath TB14 and TB16 is used to set the BNC channels to Single-Ended or to Differential. Simply place channel's 2-pin jumper in the appropriate position (SE or DIFF).

Correlation to Custom BNC Terminations – BNC A through BNC H

Pertains to Terminal Blocks TB15 and TB16 for Custom Configuration on a per-channel basis.

TB15 ("Routing" Terminal Block)	
BNC CH	**Description**
BNCA+	BNC channels A through D are configured on a per-channel basis by the user. TB15 is a routing terminal block used to connect BNCs (A thru D) to the desired signals, which are selected via a second DBK215 terminal block. For example: a user could run a wire from BNCA+ to TB4 screw terminal "TMR0" and BNCA- to TB4 DGND to create a BNC timer connection. Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.
BNCA-	
BNCB+	
BNCB-	
BNCC+	
BNCC-	
BNCD+	
BNCD+	
AGND	Analog Ground *
AGND	Analog Ground *

TB15

TB16 ("Routing" Terminal Block)	
BNC CH	**Description**
BNCA+	BNC channels E through H are configured on a per-channel basis by the user. TB16 is a routing terminal block used to connect BNCs (E thru H) to the desired signals, which are selected via a second DBK215 terminal block. Customizing is as described for BNCA through BNCD above. Accessory Wire Kit, p/n 1139-0800 includes jumper wires and a screwdriver.
BNCA-	
BNCB+	
BNCB-	
BNCC+	
BNCC-	
BNCD+	
BNCD+	
AGND	Analog Ground *
AGND	Analog Ground *

TB16

* The following SCSI Pins connect to Analog Common: 24, 27, 29, 32, 55, 56, 59, 64, and 67.

Adding Resistor/Capacitor Filter Networks

WARNING

Disconnect the DBK215 from power and signal sources prior to installing capacitors or resistors.

CAUTION

Ensure wire strands do not short power supply connections to any terminal potential. Failure to do so could result in damage to equipment.

Do not exceed maximum allowable inputs (as listed in product specifications). There should never be more than 30 V with reference to analog ground (AGND) or earth ground.

You must provide strain-relief (lead slack) to all leads leaving the module. Use tie-wraps [not included] to secure strain-relief.

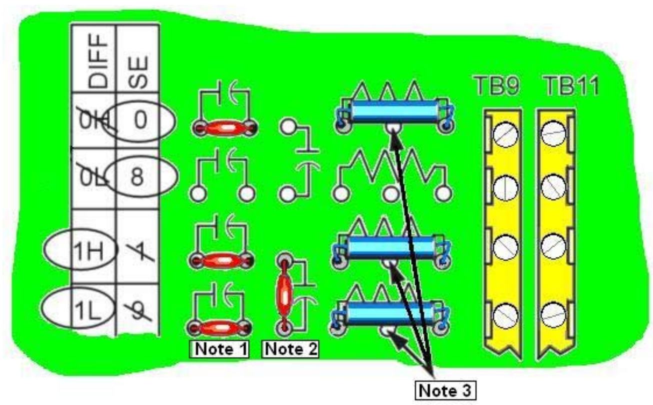
Always connect the CHASSIS terminal to earth ground. This will maximize static protection.

If a channel is not associated with a DBK expansion option you can install a customized RC filter network to improve the signal-to noise ratio, assuming that an unacceptable level of noise exists. DBK215's internal board includes silk-screened sockets for installing RC filter networks. The following table contains values that are typical for RC filter network components.

Typical One-Pole Low Pass Filter Values for DBK215

R	C	f	f
Ohms	µF	Hertz (-3dB)	kHz (-3dB)
510	1	312	0.31
510	0.47	664	0.66
510	0.22	1419	1.42
510	0.1	3122	3.12
510	0.047	6643	6.64
510	0.022	14192	14.19
510	0.01	31223	31.22
510	0.0047	66431	66.43
470	0.0033	102666	102.67

Do not use RC filters in conjunction with additional DBK expansion accessories.



An Example of Customer-Installed Capacitors and Filters for RC Networks

In this example Channels 0 and 8 are shown as *Single-Ended*. Channel 1 is *Differential*, i.e., using 1H and 1L (channel High and Low).

The following three notes pertain to the above figure.

Note 1: The 3 horizontal capacitors [as oriented in the illustration] are optional filter capacitors.

Note 2: The vertical capacitor [as oriented in the illustration] is an optional isolation capacitor used for the reduction of *Differential* noise. Such capacitor placement is not used in *Single-Ended* applications.

Note 3: If installing filter resistors, carefully drill out the indicated centers with a 1/16 inch drill-bit. Otherwise the resistor will be short-circuited.

Prior to installing RC components, review the previous Warning and Caution statements, then read over the following information regarding resistors and capacitors.

- **Do not use RC filters in conjunction with additional DBK expansion accessories.**
- **Prior to installing a resistor to the filter network you must drill a 1/16" hole through the center pinhole [beneath the board's silkscreen resistor symbol] as indicated in the preceding figure. Failure to do so will short-circuit the resistor.**
- **Do not drill holes on the board for channels, unless those channels are to receive a filter network (see preceding statement).**
- **Resistors should be ¼ watt, film-type with up to 5% tolerance. Do not use wire-wound resistor types.**
- **A resistor value of 510 Ω is recommended. Do not exceed 510 Ω.**
- **Capacitors used are to be of the film dielectric type (e.g., polycarbonate or NPO ceramic), above 0.001 µF.**
- **RECOMMENDED: For reduction of both *Common Mode Noise* and *Differential Mode Noise*, use one capacitor between Channel High and AGND; and use a second capacitor between Channel Low and AGND.**
- **For reduction of *Differential Noise* [when no reduction of *Common Mode Noise* is needed] position a capacitor across the respective Channel High and Channel Low.**
- **When in Differential Mode, using capacitors between Channel High, Channel Low, and AGND may cause a slight degradation of *wideband Common Mode rejection*.**
- **When making a RC filter network, always install a wire jumper between the relevant FILT CAP LO and AGND. FILT CAP LO terminals are located on TB9 and TB10.**

Specifications for DBK215

Operating Environment:
Temperature: -30°C to 70°C
Relative Humidity: 95% RH, non-condensing

Connectors:
P5: 68-Pin SCSI
Screw Terminals: 14 banks of 10-connector blocks
Wire Size: 12 TO 28 AWG

Dimensions:
285 mm W x 220 mm D x 45 mm H (11" x 8.5" x 2.7")

Weight:
1.36 kg (3 lbs)

Cables and Accessories:

Item Description	Part Number
Rack Mount Kit, p/n	RackDBK4
68-conductor expansion cables; mate with P5 (SCSI, 68-pin) connectors:	
3 ft., non-shielded	CA-G55
3 ft., shielded	CA-G56
6 ft., shielded	CA-G56-6
Accessory Wire Kit Includes jumper wires and a screwdriver.	1139-0800

Specifications subject to change without notice.

Notes

DBK601 through DBK609 Termination Panels

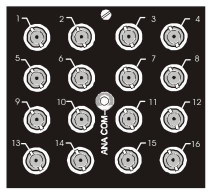
For use with DaqBook/260, DBK60, and LogBook/360

Reference Notes:

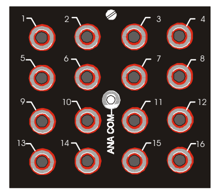
- **DaqBook/260 users** – refer to the *DaqBook/100 Series & /200 Series User's Manual* (p/n 457-0906) for installation instructions.
- **DBK60 users –** refer to the DBK60 document module that is included in the *DBK Option Cards & Modules User's Manual* (p/n 457-0905).
- **LogBook/360 users** – refer 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.

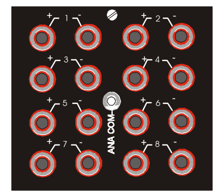
Blank Panel
DBK601



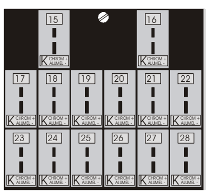
BNC Connectors
plus Analog Common
DBK602



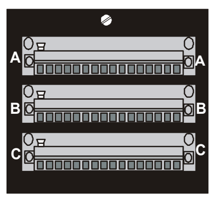
Safety Jacks, Single-ended
plus Analog Common
DBK603



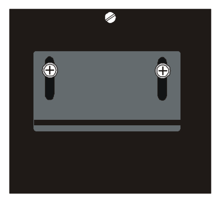
Safety Jacks, Differential
plus Analog Common
DBK604



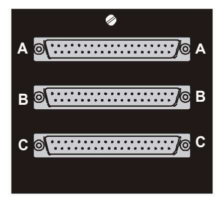
T/C Connectors, Differential
DBK605-B DBK605-R
DBK605-J DBK605-S
DBK605-K DBK605-T



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.

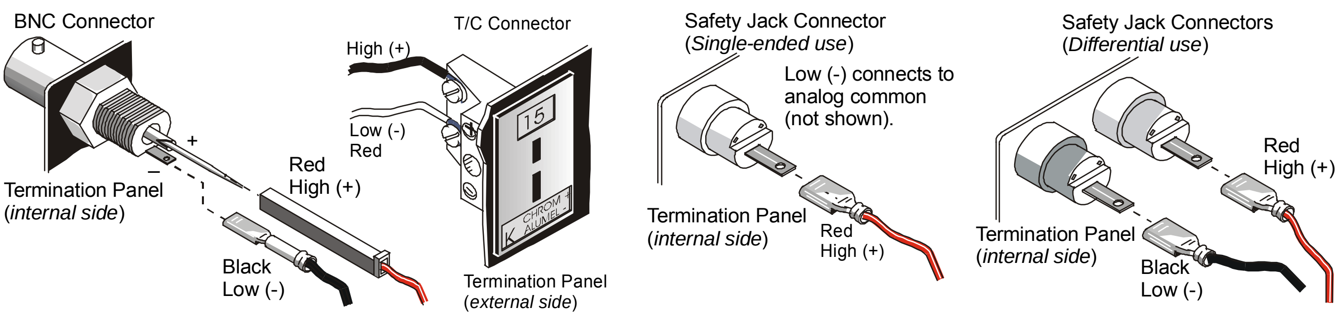
The signal inputs, from DBK cards, connect directly to the *600-series* termination panels, with exception of the DBK601 (blank panel) and the DBK607 (strain relief clamp). In the case of the DBK601 (blank panel), there are no connections. In regard to DBK607, wires pass through a slot in the panel, 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/100 Series & /200 Series User's Manual* (p/n 457-0906) 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.

WARRANTY/DISCLAIMER

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

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

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

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

RETURN REQUESTS/INQUIRIES

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

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

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

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

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

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