

User's Guide



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OMB-LogBook User's Manual
Stand-Alone, Intelligent Systems for
16-bit Data Acquisition and Logging

p/n OMB-461-0901 Rev. 2.0



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

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

How To Use This Manual

This manual explains the setup and operation of the LogBook data acquisition system including LBK and DBK options.

Quick Start, LogBook/300 – Provides instructions for getting a basic LogBook/300 system connected, powered-up, and using *LogView* software to collect data.

Quick Start, LogBook/360 – Provides instructions for getting a basic LogBook/360 system connected, powered-up, and using *LogView* software to collect data.

Chapter 1 – System Considerations describes system features and an operational overview for both LogBook/300 and LogBook/360. Includes system block diagrams, information regarding hardware connections, and system testing. The chapter includes pinouts for P1, P2, and P3. Instructions on how to stack modules are included.

Chapter 2 – System Power describes power supplies and power requirements. Includes a *DBK Power Requirement Worktable* and material concerning the power-related DBK30A, DBK32A, DBK33, and DBK34.

Chapter 3 – LogView explains this windows-based application that is used to configure and run your LogBook acquisition system. A *How To...* section provides step-by-step instructions for a variety of acquisition tasks.

Chapter 4 – LBK Options discusses the RS-422/485 Communications Card, memory expansion, remote LogBook Terminal, four-channel Digital-to-Analog Output card, GPS support, Modem Support, and Upload Scheduler.

Chapter 5 – DBK Expansion Options discusses a large number of DBK options that can be used to expand your acquisition system.

Chapter 6 – Signal Management and Troubleshooting Tips explains basic concepts of data acquisition. Includes terminology, signal management, channel identification, and signal modes. A troubleshooting section provides solutions to common noise, wiring, and configuration problems.

Appendices

A – Calibrating DBK16 and DBK43A

B – Error Codes for *LogView* software and LogBook hardware.

C – Accelerometer Tutorial, primarily for the benefit of DBK4 users.

D – CE Compliance, describes general requirements for complying with CE standards.

E – Specifications lists physical and performance specifications for LogBooks, LBKs, and DBKs.

F – PostView explains how to use this program for post-acquisition data viewing.

G – PC-Card Compatibility identifies PC-Cards that are 100% compatible with LogBook's acquisition rates, as well as cards that are not compatible.

CAUTION



Using this equipment in ways other than described in this manual can cause personal injury or equipment damage. Pay special attention to all cautions and warnings.



Check the **README.TXT** file for information that may not have been available at the time this manual went to press.

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Quick Start, LogBook/360

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Quick Start, LogBook/300

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Reference Notes: You may need to refer to additional sections of this manual.

- Chapter 1, for system block diagrams, operational overviews, connections, memory upgrade procedure, or information on the RS-422/485 option.
- Chapter 2, in regard to calculating system power and ensuring an adequate power supply.
- Chapter 4, if using LBK options.
- Chapter 5, if using DBK options.

WARNING



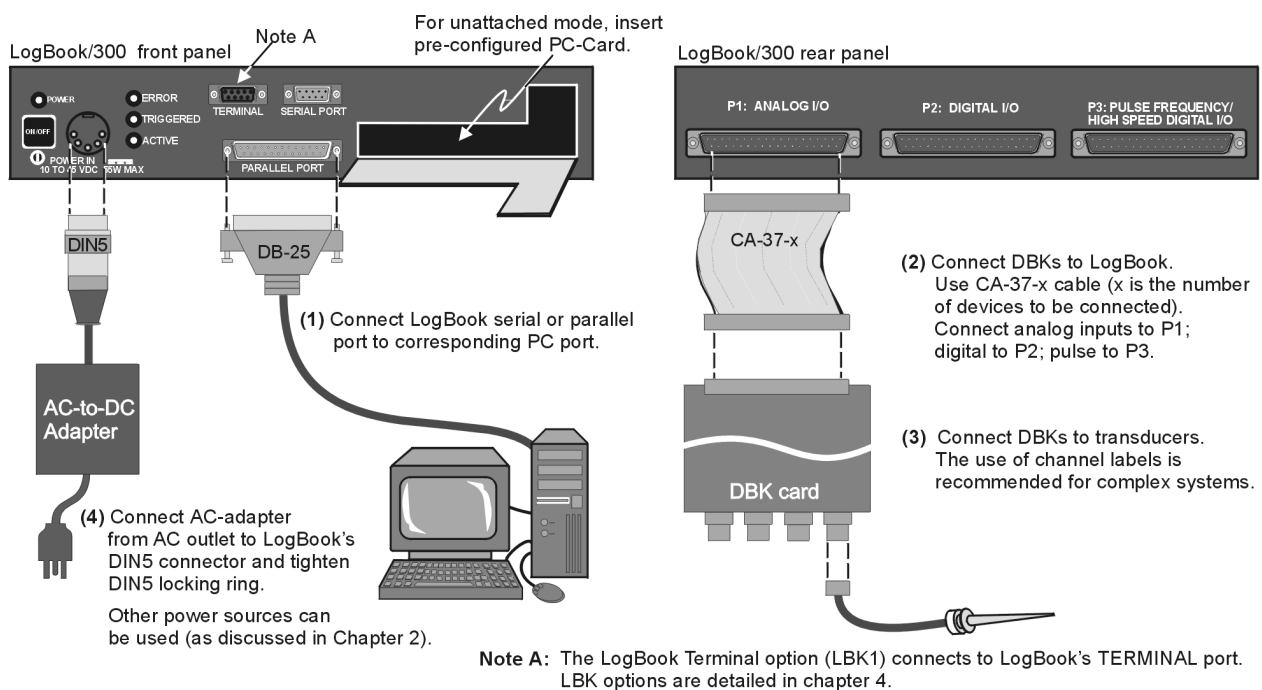
Electric shock hazard. Turn off power to all system-connected devices prior to connecting or disconnecting cables, or setting hardware configurations. Failure to do so could result in electric shock or death, and equipment damage, even under low-voltage conditions.



When using LogBook in *attached mode*, the PC-Card [in LogBook] must already have the file `logbook.sys`. Otherwise, LogView cannot communicate with LogBook, and LogBook will appear dead.

Hardware Connection

The following hardware-connection figure and procedure are generic; details vary with system complexity.



LogBook/300 System, Basic Connections

Note: There are two styles of LogBook/300. The earlier version's PC-Card door is hinged on the right edge. The newer model, represented in the figure, is hinged on the lower edge.

After verifying that all equipment power is off, hardware connection typically proceeds as follows. Refer to the previous figure as needed.

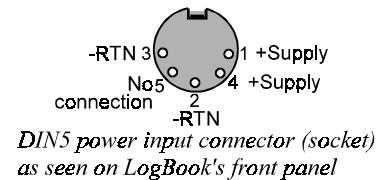
1. Connect LogBook to PC. There are three ways for LogBook to communicate with the host PC. These are: parallel port, serial port, or by physical transportation of the PC-Card. Note that the parallel port method is represented in the previous figure.
 - a) **Parallel port** – If using the parallel port, connect the supplied 2-foot parallel port (DB25) cable to PARALLEL PORT on LogBook, and to the corresponding parallel port on the PC. When this method is used, the PC must be set to the ECP mode. See *ECP Parallel Port*, page 4 for additional information.
 - b) **Serial port** – If using the serial port, connect the supplied 6-foot serial-port (DB9) cable to SERIAL PORT on LogBook, and to the corresponding serial port on the PC.
 - c) **PC-Card** - As described chapter 1's *PC-Card Swapping* section, LogBook does not require an electrical connection to the PC. The PC-Card must be pre-configured [from LogView on the PC] to contain the desired configuration file. Then the PC-Card is inserted into the corresponding slot behind the door on the LogBook's front panel.
2. Connect the LogBook to the DBK cards and modules. Most of the analog DBKs connect to P1 on the rear panel; the digital DBKs generally connect to P2—refer to documentation for your particular DBKs in chapter 5 and for general DBK installation details. The CA-37-*x* cable can daisy-chain several DBKs including the DBK41, which has a built-in P1 bus connection for 10 DBK cards. The *x* in the cable part number refers to the number of devices that can be connected (a CA-37-1 cable actually has two DB-37 connectors). The P1/P2 pinouts are included in chapter 1. Observe the input signal strength limitation as cautioned below—especially if using a non-DBK source.

CAUTION



For analog signal inputs via P1, do not exceed -35 VDC or +45 VDC. Exceeding these limits could result in equipment damage.

3. Connect DBK(s) to transducer(s). Follow instructions for particular DBK as described in chapter 5 and for the particular transducer. Some DBKs can accommodate both BNC and screw-terminal connections.
4. Connect LogBook to a suitable power source. The easiest connection is to use the TR-43 AC-to-DC power source or the DBK34. DC power sources such as a car batteries, etc must supply 10 to 45 VDC and use the correct DIN5 pinout (see figure). A locking DIN5 connector assures a secure power connection for applications subject to vibration or thermal stress.
5. (optional) Just one cable connects between the LBK1 (via RJ-11 connector) and the LogBook (via a DB9 connector). The standard cable is 6 ft long, and an optional cable is 25 ft long (see chapter 4 for LBK1 installation details).



Hardware Configuration



Reference Notes:

- (1) Refer to chapter 4 in regard to the various LBK options.
- (2) Some DBKs require manual configuration. Refer to chapter 5 for specific DBK information.

LogBook's top cover does not need to be removed, except to add or remove an LBK option, or to replace the fuse.

Most LogBook configuration is done via software as described in section, *LogBook/300 Device Configuration*. Except when using the RS-485 communication option, LogBook configuration does not require you to set jumpers or switches.

Software Installation

Note: The LogBook is supported under Windows95/98 and WindowsNT. Your computer should be a 486 or higher (Pentium® recommended) with at least 16 Mbytes of RAM. 32 Mbytes of RAM is recommended.

Note: Before installing software, ensure LogBook is connected to the selected port (serial, or ECP-parallel); and power-on the system.

Install installation CD-ROM (or installation disks, as applicable). Run the **Setup.exe** and follow screen prompts.

When the software installation is complete, you will be given two options:

- Exit running the configuration utility—if the LogBook is to be used immediately.
- Exit and return to operating system—you can run the configuration later from the control panel.

LogBook/300 Device Configuration

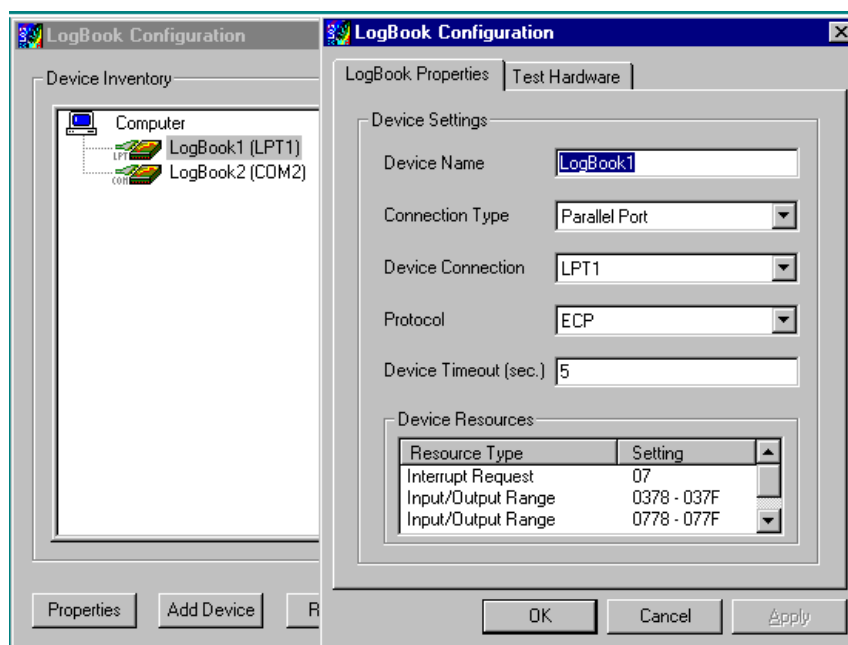
A configuration utility is supplied via a control panel applet. The **LogBook Configuration** applet allows you to add a device, remove a device, or change existing configuration settings. From this same window, you can also access a built-in utility to test the connected device for current setup and performance.

LogBook Configuration can be found in the Windows95/98/NT control panel. This can be navigated to from Window's desktop Start button:

Start ⇒ Settings ⇒ Control Panel

You can enter LogBook Configuration during driver installation or whenever you wish to add, remove or change device configuration settings. The following description applies to either method.

The 1st configuration window will display configured devices in the Device Inventory field based on the port they're connected to. Devices are indicated by their name and icon. If no devices are currently configured, no devices will appear in this field. (The figure shows the 1st and 2nd configuration windows overlapping.)



LogBook Configuration Windows

The 4 buttons across the bottom of the 1st configuration window (previous figure) are used as follows:

- **Properties.** Configuration settings for a device can be changed or modified from the corresponding properties window. To do so, double-click the device icon or single-click the device and then single-click the Properties button. The 2nd configuration window will appear for the selected device as shown in the previous figure.
- **Add.** The Add Device button is used to add a device configuration whenever a new device is added to the system. LogView cannot recognize a device unless listed in the configuration window.
- **Remove.** The Remove button is used to remove a device from the configuration. A device may be removed if it is no longer installed or if the device's configuration no longer applies.
- **Close.** The Close button may be used at any time to exit the LogBook Configuration applet.

The 2nd configuration window displays the properties for the selected LogBook. Fields include:

- **Device Name** is displayed with the default name, numbered successively as configured. This field can be changed to any descriptive name as desired.
- **Connection Type** can be serial or parallel port.
- **Device Connection** specifies the port name.
- **Protocol** is used to set the parallel port protocol (ECP only) or serial protocol (RS-232 or RS-485).
- **Device Timeout** specifies the number of seconds LogView will wait for a LogBook response before displaying an error condition.

ECP Parallel Port



To use parallel port communication with an attached LogBook, your PC *must* support the ECP protocol AND be set in the ECP mode.

PCs made since 1994 probably support the Enhanced Computer Port protocol (ECP). If your parallel port does not support ECP, you can communicate with the LogBook via the RS-232 serial port, or you can add an ECP-compatible ISA board or PC-Card parallel port. Setting the PC to ECP mode varies with different computers. On some computers, you can enter the BIOS Setup utility from Windows Settings or during startup by pressing the F1 function key. The Parallel Port Mode property can be found under the Peripheral Configuration group menu item. If necessary, consult your PC's documentation or your PC's manufacturer.



To ensure ECP compatibility after proper setup, use the Test Hardware utility (described on page 5). Before testing, make sure LogBook is properly connected, powered on, and that the Parallel Port Mode is set to ECP (in BIOS Setup).

CAUTION

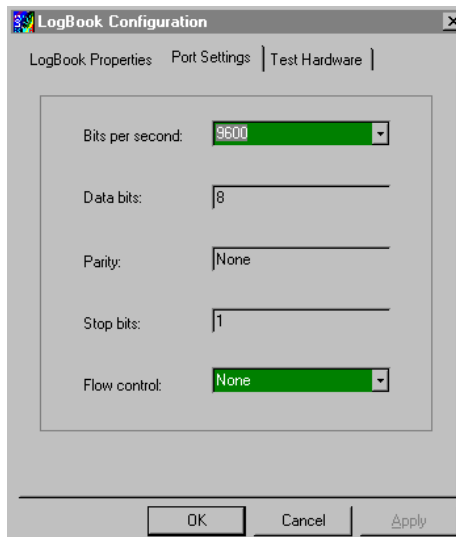


Making errors in BIOS Setup can disrupt your system's operation. If test hardware indicates a problem and you have inadequate experience with the BIOS Setup utility, consult your System Administrator or other qualified individual.

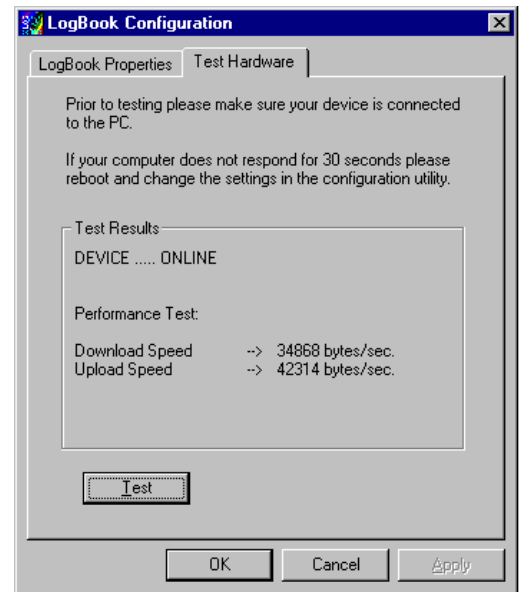
Serial Port

If the selected device is connected to a serial port the properties window will include the fields shown in the figure at right. Baud rate can be set from 1200 to 115200 bits per second (default 9600). When all fields have been changed to the desired settings, you can click on one of the following options:

- **Apply** to store the device configuration. Parameters are not locked in until you click the Apply button. If you make changes and don't click Apply, clicking the Test button in Test Hardware will yield unexpected errors.
- **OK** to store the configuration and exit the current property screen.
- **Cancel** to exit the current screen without storing any changes.
- **Test Hardware** to test the current device.



LogBook Properties Tab



Test Hardware Tab

Test Hardware

Before testing LogBook/300:

- (a) Verify the device has been properly installed
- (b) Make sure the communication cable (serial or parallel) is firmly in place to the proper ports.
- (c) Verify the device is powered-on.



Testing the LogBook device might cause the system to hang. If test results are not displayed within 30 seconds, or if the system does not respond properly: reboot the system. Upon power-up, re-enter the LogBook Configuration and ensure the LogBook configuration settings are correct. Change the settings as applicable.

To begin the test, click the Test button. Test results should be displayed within a few seconds.

Test results indicate if the device is online (properly connected, powered on and ready to transfer the data) or offline. If the device is online, Performance Test will display Download and Upload speed rates. These rates represent the maximum speed at which downloading and uploading files can be performed. Actual transfer time will depend on channel configuration and the size of the transfer.

Acquisition Configuration

An acquisition is configured using LogView on a PC and then stored as an acquisition setup file on a PC-Card. The PC-Card may be in an attached LogBook or in the PC to be later manually transferred to an unattached LogBook. The system's DBK cards are listed; the scan sequence is defined; the trigger conditions are specified, etc.



Reference Note: Configuring the acquisition is described in chapter 3, *LogView*.

Calibration

Calibration is typically performed automatically through LogView software; however, some DBKs may require manual calibration. LogView's 2-point calibration fine-tunes the reading's slope and offset error ($mx+b$). DBKs working with non-linear sensors typically condition/convert the reading to a linear form. Otherwise, a non-linear analog input signal is difficult to read accurately. Careful use of the calculated channels may yield usable approximations in simple, limited-range conditions.



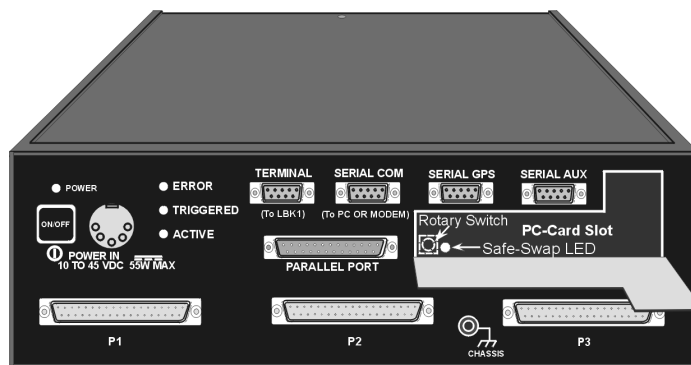
Reference Note: An example of 2-point calibration is given in the *How To...* section of chapter 3, *LogView*.

Appendix A details the calibration methods applicable to DBK16 and DBK43.

Quick Start, LogBook/360

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*Page numbers refer to QS-360 section.



LogBook/360, Front Panel



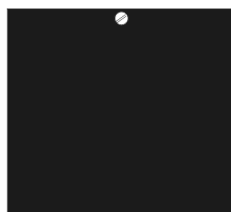
Reference Notes: You may need to refer to additional sections of this manual.

- Chapter 1, for system block diagrams, operational overviews, connections, memory upgrade procedure, or information on the RS-422/485 option.
- Chapter 2, in regard to calculating system power and ensuring an adequate power supply.
- Chapter 4, if using LBK options.
- Chapter 5, if using DBK options.

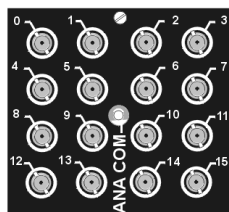
LogBook/360 combines the features and capabilities of LogBook/300 with a DBK60 expansion chassis. The *lower* portion of the **front panel** has three male DB37 connectors (P1, P2, and P3) for system expansion, and a post for connecting to CHASSIS ground.

The *upper* section is nearly identical to LogBook/300, and is detailed in chapter 1.

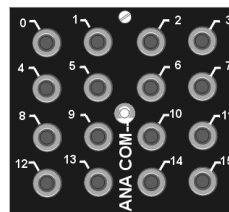
The **rear panel** consists of three termination panels. Many different combinations of three panels are possible. Termination panels available at the time of publication are represented in the following figure.



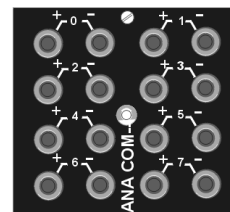
Blank Panel
DBK601



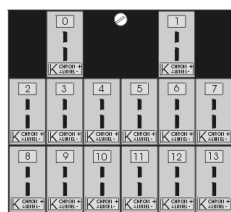
BNC Connectors
plus Analog Common
DBK602



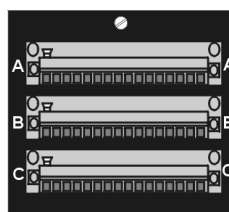
Safety Jacks, single-ended
plus Analog Common
DBK603



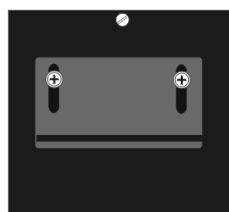
Safety Jacks, Differential
plus Analog Common
DBK604



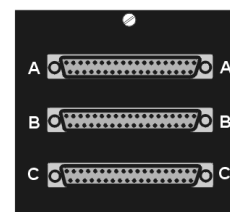
T/C Connectors, Differential
DBK605-B DBK605-R
DBK605-J DBK605-S
DBK605-K DBK605-T



Terminal Blocks,
16 connections per block
(48 connections per panel)
DBK606



Strain Relief Clamp
DBK607



DB37 Connectors, Female
DBK608

WARNING



Electric shock hazard. Turn off power to all system-connected devices prior to connecting or disconnecting cables, or setting hardware configurations. Failure to do so could result in electric shock or death, and equipment damage, even under low-voltage conditions.

CAUTION



Use ESD tools, containers, and procedures during setup of DBK cards. Electrostatic discharge can damage some components. To prevent pin damage, align DBK cards with the backplane DB37 connectors, then gently press them together.



When using LogBook in *attached mode*, the PC-Card [in LogBook] must already have the file `logbook.sys`. Otherwise, LogView cannot communicate with LogBook, and LogBook will appear dead.

Card Drawer Setup

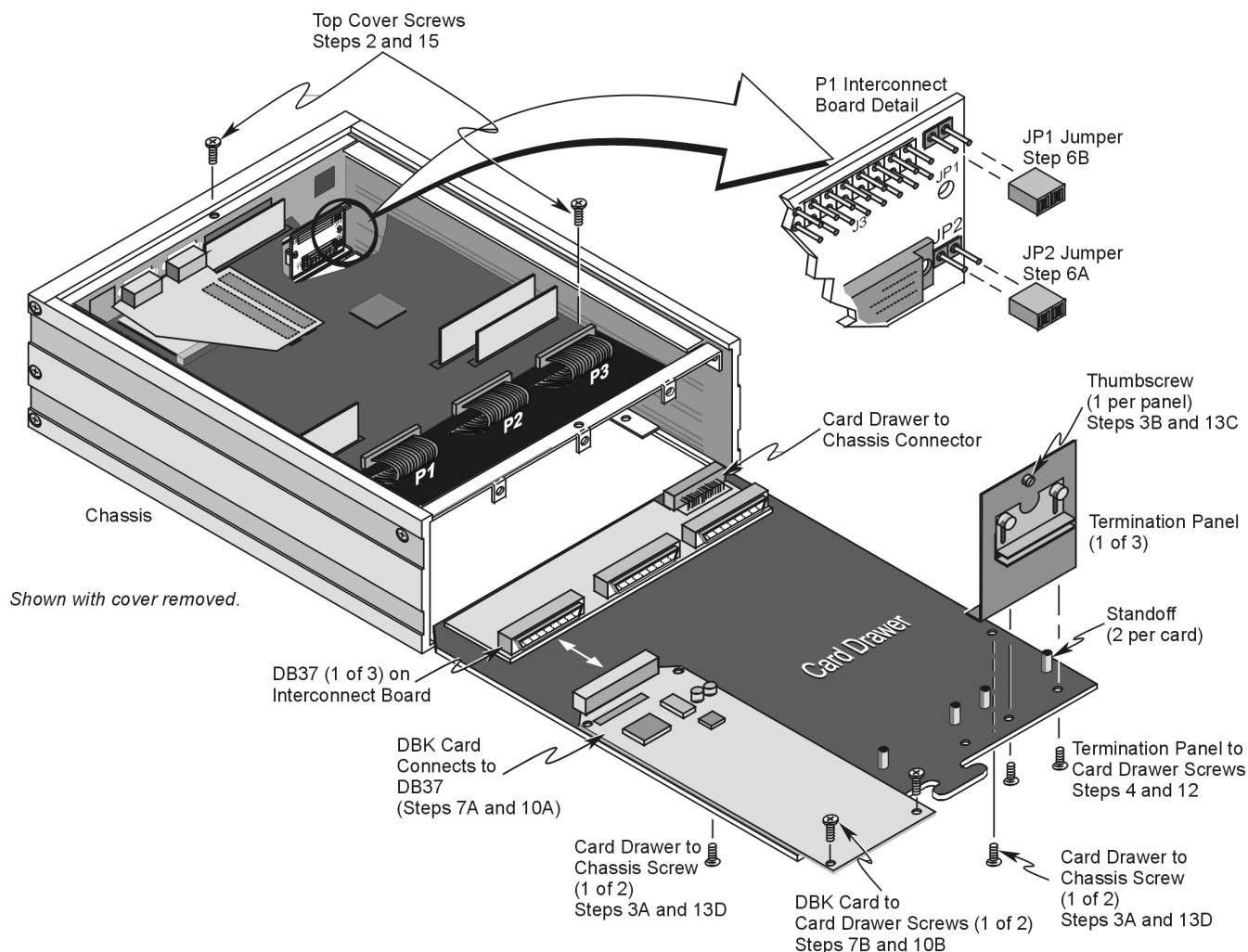
LogBook/360 can house three DBK cards internally, and makes use of various termination panels as depicted on page 1 of this Quick Start. For user convenience, a card drawer can be slid free of the device. The following steps should be used when adding, removing, or changing cards. Refer to the figure as needed.

1 – Turn off system power and disconnect LogBook/360.

Turn power off to the LogBook/360 and all connected devices. Disconnect LogBook/360 from the system.

2 – Remove top cover.

If you need to make any change on the LogBook motherboard, you will need to remove the top cover. Otherwise, the cover can remain in place. To remove the top cover, simply remove the two top cover screws and slide the cover free of the device.



3 – Remove card drawer.

- A. Remove the two screws that hold the card drawer to the chassis.
- B. Loosen the three termination panel thumbscrews.
- C. Carefully pull the card drawer free of the chassis.

4 – Remove termination panels.

For each termination panel, remove the two screws that mount it to the card drawer, then remove the termination panel.

5 – Determine power requirements.

Depending on the power needs of your system's DBK cards, you may need to add a power card. Refer to Chapter 2, System Power, in regard to calculating your power requirement.

If the required power is more than the available power (see chapter 2 for calculations), your system will require auxiliary power. One of two power supply cards can be used with LogBook:

- **DBK32A** – For use with a LogBook, DaqBook, or DaqBoard. It supplies ± 15 V.
- **DBK33** – For use with Log Book, DaqBook, DaqBoard, or Daq PC-Card. It supplies +5 V and ± 15 V.

6 – Configure chassis for power sources.

Proper jumper configuration limits LogBook's P1 bus to one power source. The P1 bus should never have more than one power source.

The JP1 and JP2 jumpers *located on the P1 Interconnect Board inside chassis* (see previous figure) control the +5V distribution. Both the JP1 and JP2 jumpers are installed as factory-default.

- A. **JP2.** *Only remove the JP2 jumper if* cards (on the internal P1 bus) are to be powered from LogBook's internal PCB.
- B. **JP1.** *Only remove the JP1 jumper if* a DBK33 is used with the system.

7 – Install power card if necessary.

If you determined in step 5 that additional power was needed, add a DBK32A or DBK33 power card to the chassis. Chapter 2 includes information regarding these power-related cards.

- A. Carefully align the power card's DB37 connector with a DB37 connector on the interconnect board and gently press them together.
- B. Mount the power card with two screws into the standoffs on the card drawer.

8 – Configure LogBook/360.

Refer to chapter 1. Note that if a LogBook/360 driver is not available in software, select LogBook/300.

9 – Configure DBK cards.

Configure unique channel addresses with the jumpers on the DBK cards. Some cards have other jumpers and/or DIP switches. Refer to the particular DBK sections of Chapter 5, as needed.

10 – Install DBK cards.

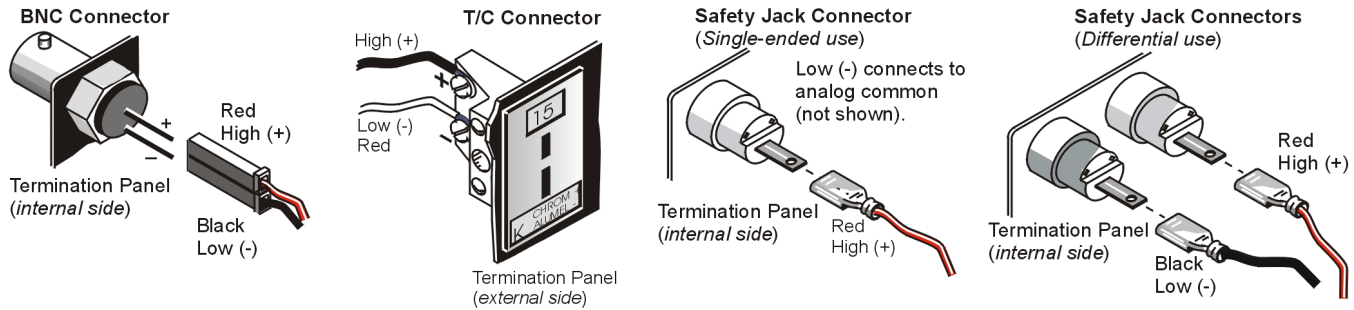
You must use **all analog** DBK cards in the LogBook/360; unless you have a factory modification that allows the use of **all digital** cards. You can not use both analog and digital cards at the same time.

- A. Carefully align the DBK card's DB37 connector with a DB37 connector on the interconnect board and gently press them together (see figure).
- B. Mount the DBK card with two screws into the standoffs on the card drawer (see figure).
- C. Continue installation of any remaining DBK cards.

11 – Connect internal signals.

Connect signal inputs from DBK cards to termination panels. DBK cards connect to the termination panels in various ways (see figure and particular DBK sections in manual):

- 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. Always make sure the T/C connector and wire type match the T/C type used.



12 – Install termination panels.

Mount the termination panels to the card drawer with two screws for each panel.

13 – Install card drawer.

The card drawer slides into the bottom track of the chassis.

- Hold the card drawer by its handle and tilt it up slightly. Place it on the bottom track of the chassis.
- 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.
- Tighten the three captive thumbscrews holding the termination panels to the chassis.
- Install the two screws holding the card drawer to the chassis.

14 – Connect external signals.

Connect signal inputs from sensors to termination panels.

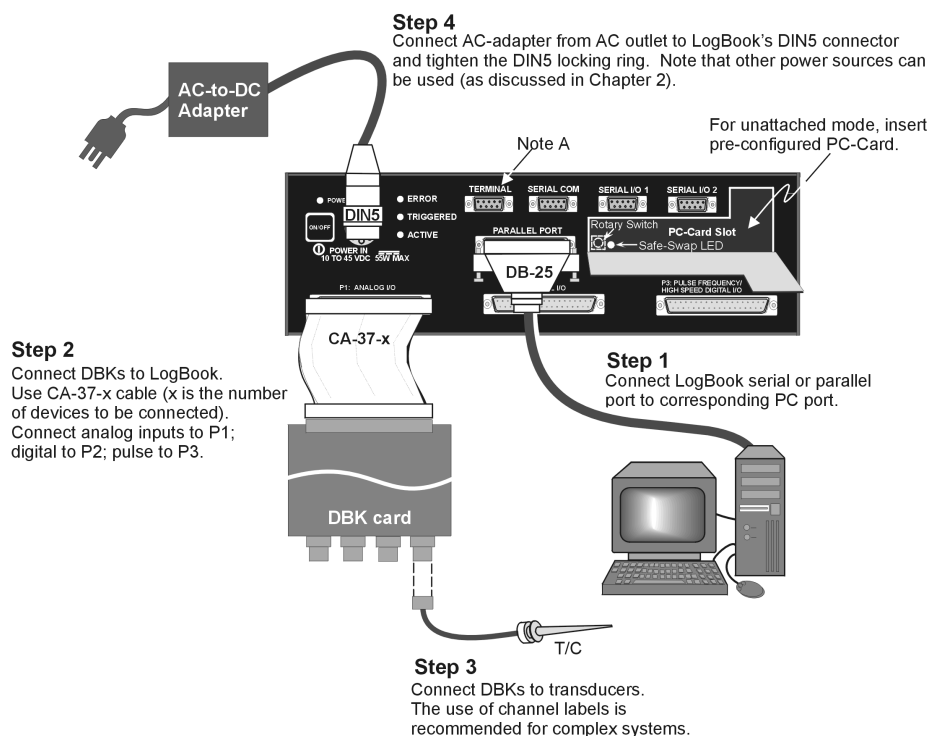
15 – Install top cover.

If the top cover was removed, slide it back into place and secure with two screws.

Connect LogBook/360 to PC, External DBKs, and Power*

The following hardware-connection figure and procedure are generic; details vary with system complexity. For “unattached mode,” a pre-configured PC-Card is inserted in the PC-Card slot, and no connection to a PC is made. The following figure illustrates the “attached” mode.

***Note:** Connecting LogBook/360 to a PC applies to the “attached mode” only. Many applications will make use of three internal DBK cards only, having no need to attach external DBK cards or modules as discussed in the following text.



Note A:
When used, the LogBook Terminal option (LBK1) connects to LogBook's TERMINAL port. LBK options are detailed in chapter 4.

LogBook/360 System, “Attached Mode,” Basic Connections

Note: Rear panel connections may be made via terminal blocks, as discussed in the previous section, *Card Drawer Setup*.

After verifying that all equipment power is off, hardware connection typically proceeds as follows. Refer to the above figure as needed.

1. Connect LogBook to PC. There are three ways for LogBook to communicate with the host PC. These are: parallel port, serial port, or by physical transportation of the PC-Card. Note that the parallel port method is represented in the previous figure.
 - a) **Parallel port** – If using the parallel port, connect the supplied 2-foot parallel port (DB25) cable to PARALLEL PORT on LogBook, and to the corresponding parallel port on the PC. When this method is used, the PC must be set to the ECP mode. See *ECP Parallel Port*, page 8 for additional information.
 - b) **Serial port** – If using the serial port, connect the supplied 6-foot serial-port (DB9) cable to SERIAL PORT on LogBook, and to the corresponding serial port on the PC.
 - c) **PC-Card** - As described chapter 1's *PC-Card Swapping* section, LogBook does not require an electrical connection to the PC. The PC-Card must be pre-configured [from LogView on the PC] to contain the desired configuration file. Then the PC-Card is inserted into the corresponding slot behind the door on the LogBook's front panel.

2. Connect LogBook to the DBK cards and modules. For connecting internal DBK cards, refer to the earlier section entitled, *Card Drawer Setup*.

Most analog DBKs connect to P1; digital DBKs generally connect to P2. Refer to chapter 5 for your particular DBKs and for general DBK installation details.

The CA-37-x cable can daisy-chain several DBKs including the DBK41, which has a built-in P1 bus connection for 10 DBK cards. The *x* in the cable part number refers to the number of devices that can be connected (a CA-37-1 actually has two DB-37 connectors).

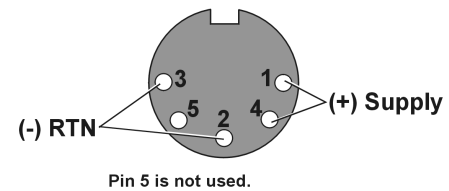
Note: Chapter 1 includes LogBook P1, P2, and P3 Pinouts.

CAUTION



For analog signal inputs via P1, do not exceed -35 VDC or +45 VDC. Exceeding these limits could result in equipment damage.

3. Connect DBK(s) to transducer(s). Follow instructions for particular DBK as described in chapter 5 and for the particular transducer. Some DBKs can accommodate both BNC and screw-terminal connections.
4. Connect LogBook to a suitable power source, such as a TR-43 AC-to-DC power adaptor or DBK34 vehicle UPS module. DC power sources such as a car batteries must supply 10 to 45 VDC and use the correct DIN5 pinout (see figure). A locking DIN5 connector assures a secure power connection for applications subject to vibration and thermal stress.



DIN5 Power Input Connector
(As seen on LogBook Front Panel)

Hardware Configuration



Reference Notes:

- (1) Refer to chapter 4 in regard to the various LBK options.
- (2) Some DBKs require manual configuration. Refer to chapter 5 for specific DBK information.

LogBook's top cover does not need to be removed, except to add or remove an LBK option, or to replace the fuse.

Most LogBook configuration is done via software as described in section, *LogBook/360 Device Configuration*. Except when using the RS-485 communication option, LogBook configuration does not require you to set jumpers or switches.

Software Installation

Note: The LogBook is supported under Windows95/98 and WindowsNT. Your computer should be a 486 or higher (Pentium® recommended) with at least 16 Mbytes of RAM. 32 Mbytes of RAM is recommended.

Note: Before installing software, you should attach LogBook to the selected port (serial, or ECP-parallel); and power-on the system.

Install installation CD-ROM (or installation disks, as applicable). Run the **Setup.exe** and follow screen prompts.

When the software installation is complete, you will be given two options:

- Exit running the configuration utility—if the LogBook is to be used immediately.
- Exit and return to operating system—you can run the configuration later from the control panel.

LogBook/360 Device Configuration

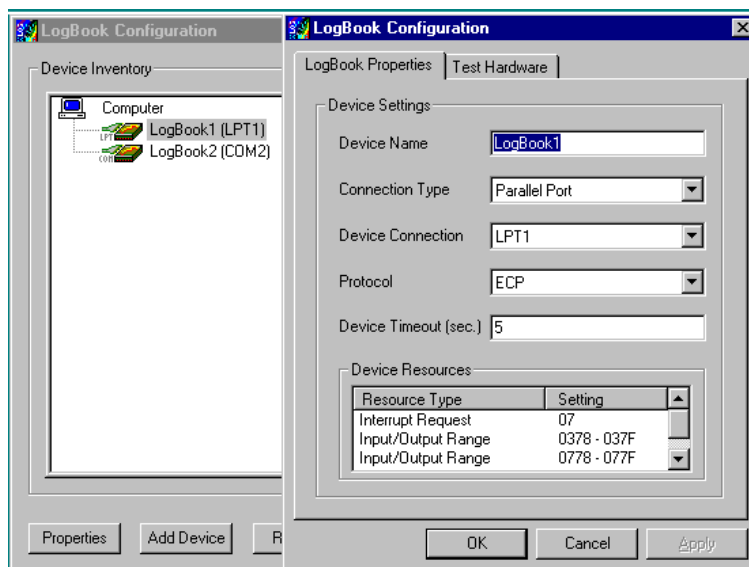
A configuration utility is supplied via a control panel applet. The **LogBook Configuration** applet allows you to add a device, remove a device, or change existing configuration settings. From this same window, you can also access a built-in utility to test the connected device for current setup and performance.

LogBook Configuration can be found in the Windows95/98/NT control panel. This can be navigated to from Window's desktop Start button:

Start ⇒ Settings ⇒ Control Panel

You can enter LogBook Configuration during driver installation or whenever you wish to add, remove or change device configuration settings. The following description applies to either method.

The 1st configuration window will display configured devices in the Device Inventory field based on the port they're connected to. Devices are indicated by their name and icon. If no devices are currently configured, no devices will appear in this field. (The figure shows the 1st and 2nd configuration windows overlapping.)



LogBook Configuration Windows

The 4 buttons across the bottom of the 1st configuration window (previous figure) are used as follows:

- **Properties.** Configuration settings for a device can be changed or modified from the corresponding properties window. To do so, double-click the device icon or single-click the device and then single-click the **P**roperties button. The 2nd configuration window will appear for the selected device as shown in the previous figure.
- **Add.** The **A**dd Device button is used to add a device configuration whenever a new device is added to the system. LogView cannot recognize a device unless listed in the configuration window.
- **Remove.** The **R**emove button is used to remove a device from the configuration. A device may be removed if it is no longer installed or if the device's configuration no longer applies.
- **Close.** The **C**lose button may be used at any time to exit the LogBook Configuration applet.

The 2nd configuration window displays the properties for the selected LogBook. Fields include:

- **Device Name** is displayed with the default name, numbered successively as configured. This field can be changed to any descriptive name as desired.
- **Connection Type** can be serial or parallel port.
- **Device Connection** specifies the port name.
- **Protocol** is used to set the parallel port protocol (ECP only) or serial protocol (RS-232 or RS-485).
- **Device Timeout** specifies the number of seconds LogView will wait for a LogBook response before displaying an error condition.

ECP Parallel Port



To use parallel port communication with an attached LogBook, your PC *must* support the ECP protocol AND be set in the ECP mode.

PCs made since 1994 probably support the Enhanced Computer Port protocol (ECP). If your parallel port does not support ECP, you can communicate with the LogBook via the RS-232 serial port, or you can add an ECP-compatible ISA board or PC-Card parallel port. Setting the PC to ECP mode varies with different computers. On some computers, you can enter the BIOS Setup utility from Windows Settings or during startup by pressing the F1 function key. The Parallel Port Mode property can be found under the Peripheral Configuration group menu item. If necessary, consult your PC's documentation or your PC's manufacturer.



To ensure ECP compatibility after proper setup, use the Test Hardware utility (described on page 9). Before testing, make sure LogBook is properly connected, powered on, and that the Parallel Port Mode is set to ECP (in BIOS Setup).

CAUTION

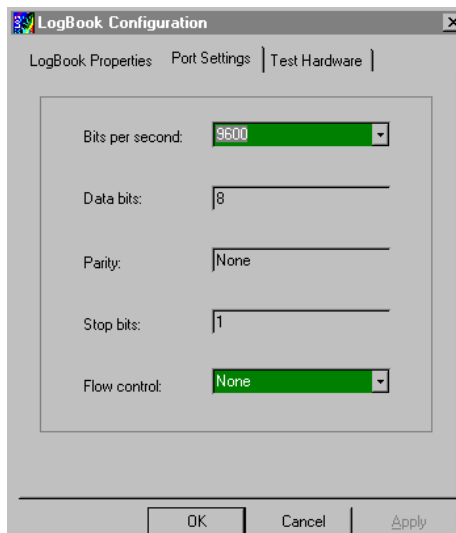


Making errors in BIOS Setup can disrupt your system's operation. If test hardware indicates a problem and you have inadequate experience with the BIOS Setup utility, consult your System Administrator or other qualified individual.

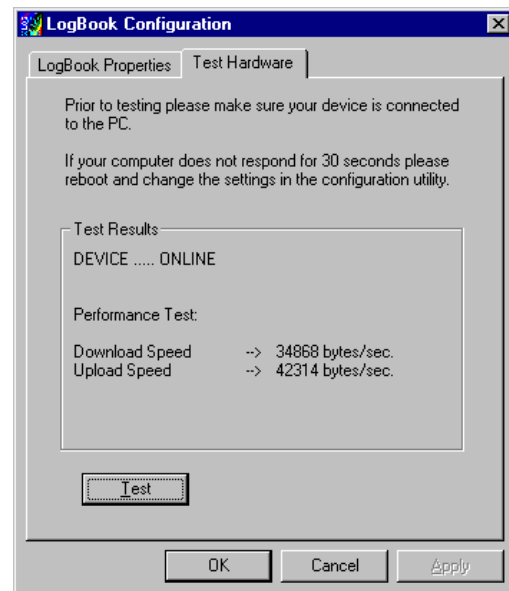
Serial Port

If the selected device is connected to a serial port the properties window will include the fields shown in the figure at right. Baud rate can be set from 1200 to 115200 bits per second (default 9600). When all fields have been changed to the desired settings, you can click on one of the following options:

- **Apply** to store the device configuration. Parameters are not locked in until you click the Apply button. If you make changes and don't click Apply, clicking the Test button in Test Hardware will yield unexpected errors.
- **OK** to store the configuration and exit the current property screen.
- **Cancel** to exit the current screen without storing any changes.
- **Test Hardware** to test the current device.



LogBook Properties Tab



Test Hardware Tab

Test Hardware

Before testing LogBook/360:

- (a) Verify the device has been properly installed
- (b) Make sure the communication cable (serial or parallel) is firmly in place to the proper ports.
- (c) Verify the device is powered-on.



Testing the LogBook device might cause the system to hang. If test results are not displayed within 30 seconds, or if the system does not respond properly: reboot the system. Upon power-up, re-enter the LogBook Configuration and ensure the LogBook configuration settings are correct. Change the settings as applicable.

To begin the test, click the Test button. Test results should be displayed within a few seconds.

Test results indicate if the device is online (properly connected, powered on and ready to transfer the data) or offline. If the device is online, Performance Test will display Download and Upload speed rates. These rates represent the maximum speed at which downloading and uploading files can be performed. Actual transfer time will depend on channel configuration and the size of the transfer.

Acquisition Configuration

An acquisition is configured using LogView on a PC and then stored as an acquisition setup file on a PC-Card. The PC-Card may be in an attached LogBook or in the PC to be later manually transferred to an unattached LogBook. The system's DBK cards are listed; the scan sequence is defined; the trigger conditions are specified, etc.



Reference Note: Configuring the acquisition is described in chapter 3, *LogView*.

Calibration

Calibration is typically performed automatically through LogView software; however, some DBKs may require manual calibration. LogView's 2-point calibration fine-tunes the reading's slope and offset error ($mx+b$). DBKs working with non-linear sensors typically condition/convert the reading to a linear form. Otherwise, a non-linear analog input signal is difficult to read accurately. Careful use of the calculated channels may yield usable approximations in simple, limited-range conditions.



Reference Note: An example of 2-point calibration is given in the *How To...* section of chapter 3, *LogView*.

Appendix A details the calibration methods applicable to DBK16 and DBK43.



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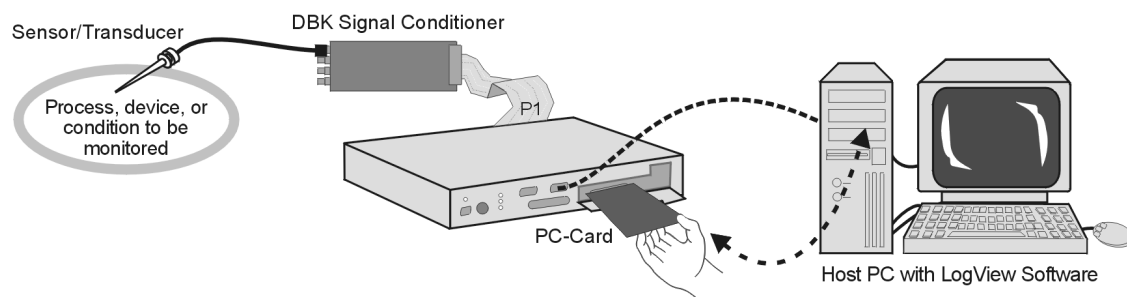
Reference Notes: Additional system considerations are covered in the following chapters.

- Chapter 2, refers to calculating system power and ensuring an adequate power supply.
- Chapter 4, details LBK options.
- Chapter 5, details DBK expansion options applicable to LogBook.

LogBook Basics

Introduction

LogBook/300 and LogBook/360 are PC-based data acquisition systems that can work in a *stand-alone mode* (no PC present), or linked to a PC. They combine onboard intelligence with a removable PC-Card that stores the configuration file and the collected data. LogBooks have many options, most of which are detailed in the LBK and DBK chapters. The PC link can be by serial or parallel port.

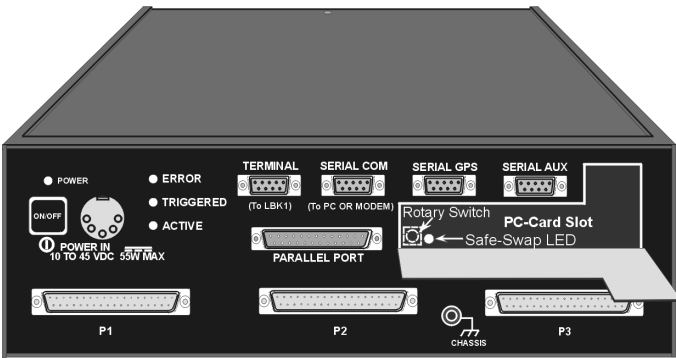


LogBook/300, Simple System Setup

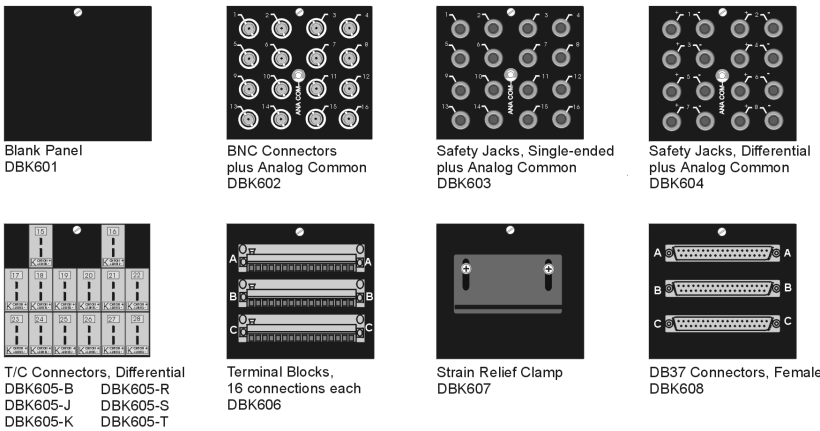
The PC-Card holds the configuration file [created by *LogView*]. The file tells LogBook how to perform a particular acquisition. The PC-Card also holds the acquired data files. The PC can upload to or download from the PC-Card by cable if the PC is attached to LogBook, or by physical transport of the PC-Card from one unit to the other. Multiple configuration files and multiple PC-Cards allow the system to handle complex data acquisition environments with a large number of data-files.

Front and Rear Panels

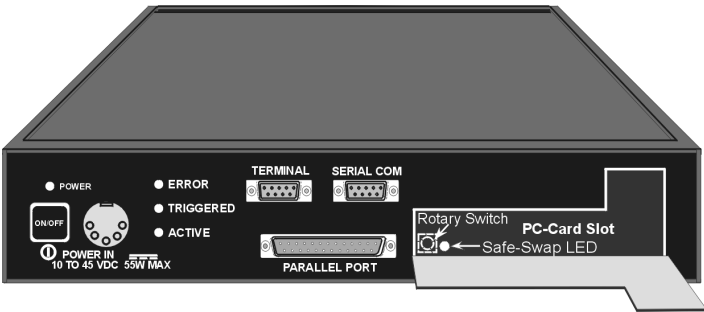
Note: Descriptions of panel items appear on the following page.



LogBook/360, Front Panel

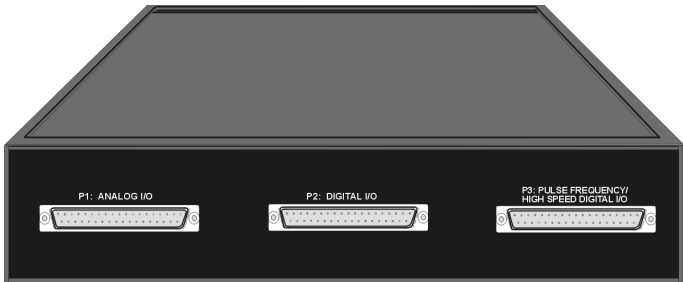


LogBook/360, Terminal Panels (A combination of 3 make up the rear panel)



LogBook/300, Front Panel

Note: In earlier models, the PC-Card Door has a right-edge hinge (not shown).



LogBook/300, Rear Panel

LogBook/360 panel items are listed in the following table. Not that LogBook/300 panel items are the same as those on the 360, except as called out in the following bulleted list:

- Slight differences in the overlay.
- P1, P2, and P3 appear on LogBook/300's rear panel.
- LogBook/300 has no SERIAL GPS connection.
- LogBook/300 has no SERIAL AUX connection.
- LogBook/300 has no CHASSIS grounding post.
- LogBook/300 does not make use of Terminal Panels.

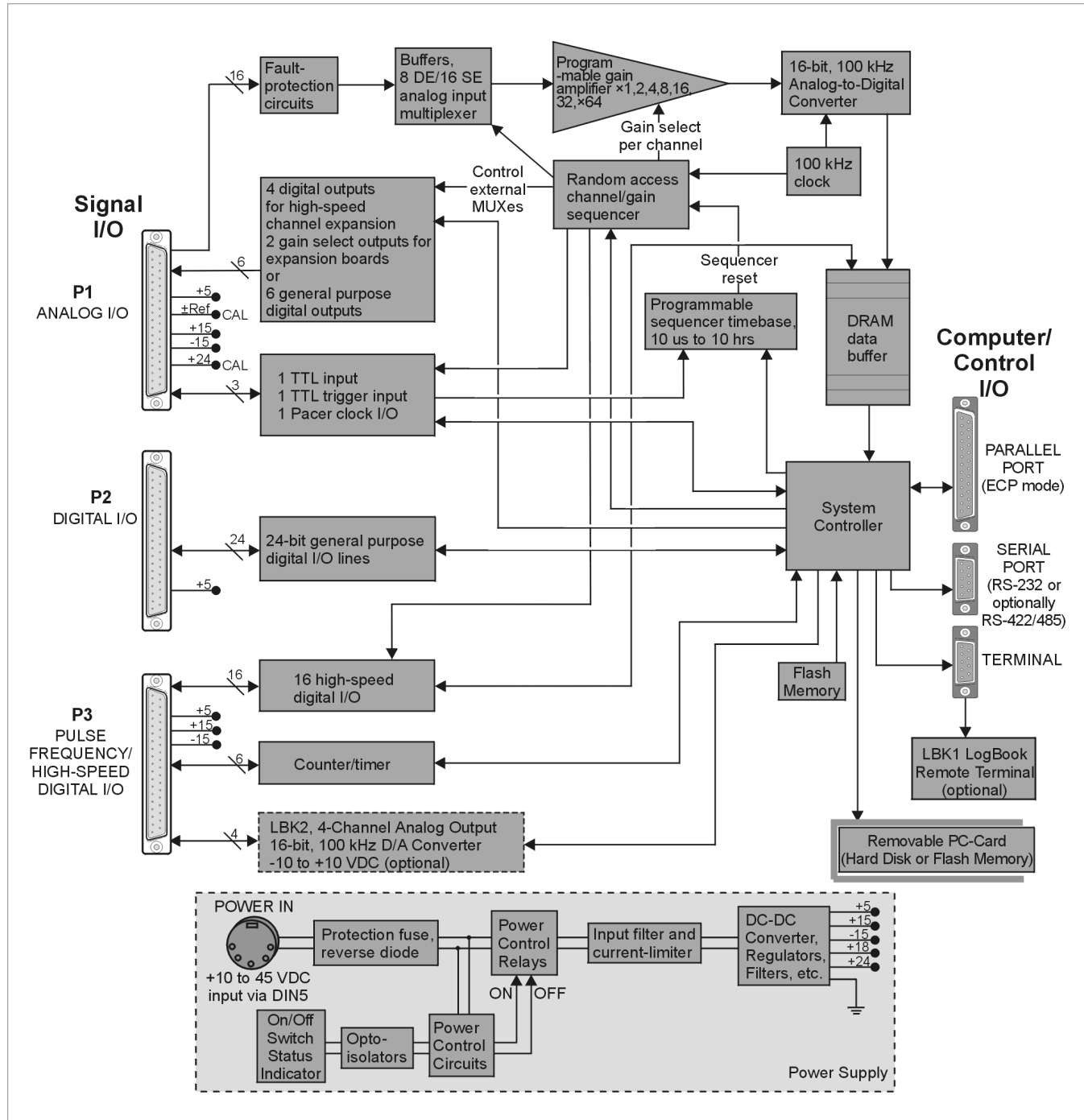
Switches	
ON/OFF	Depressing the push-button switch turns the power on.
(interior rotary switch)	PC-Card door provides access to a rotary switch to set device address when used in an RS-485 network.
Connectors	
POWER IN	This locking DIN5 input connector accepts +10 to +45 VDC.
PARALLEL PORT	This DB-25 plug is a parallel port connector to a host PC (set to ECP mode)
TERMINAL PORT (TO LBK1)	This DB-9 socket is a serial port connector for the LBK1 remote control panel (user-interface terminal).
SERIAL COMM (TO PC OR MODEM)	This DB-9 male serial COM port connects to a host PC or modem.
SERIAL GPS (LogBook/360 Only)	LogBook/360 only. This DB-9 male serial port option connects to a Global Positioning System.
SERIAL AUX (LogBook/360 Only)	LogBook/360 only. This DB-9 male serial port option connects to optional auxiliary devices.
P1 - ANALOG I/O	Provides 16 analog input channels, 3 TTL inputs, and various signals for driving expansion cards.
P2 - DIGITAL I/O	Provides 3 8-bit TTL programmable I/O ports and external interrupt input.
P3 - PULSE FREQUENCY / HIGH-SPEED DIGITAL I/O	Provides 4 16-bit counters, 4 analog outputs, and 16 high-speed digital I/O.
(PC-Card door, no label)	Door provides access to PCMCIA connector—for removable PC-Card memory devices.
Indicator LEDs	
POWER	LED lights when power is applied to LogBook and the power switch is depressed into the ON position.
ERROR	LED lights steady ON when a routine error occurs (e.g. disk full). LED flashes for fatal errors; refer to <i>Hardware Errors</i> in <i>Appendix B</i> . No data can be acquired until error is cleared.
TRIGGERED	LED lights after trigger event and during an A/D scan sequence.
ACTIVE	LED lights to show that LogBook is ready to begin a scan at the next trigger event.
Safe-Swap Light (interior green LED)	LED lights when it is safe to swap PC-Cards.

Highlight of Features

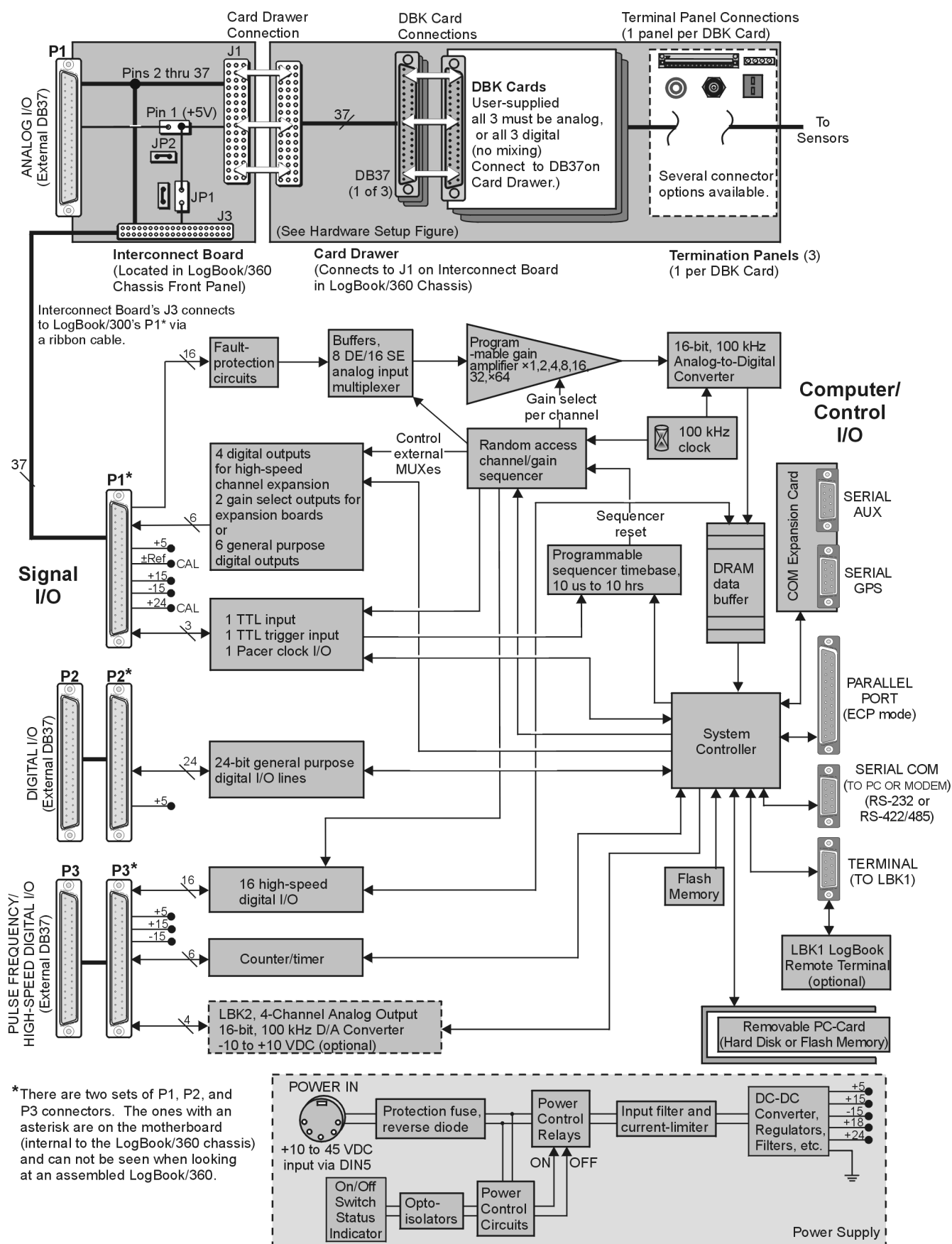
LogBooks can be left unattended for long testing periods and used in environments not suitable for PCs. With the use of PC-Cards, one PC can support several LogBooks. Other LogBook features include:

- Onboard processor capable of real-time data reduction and system control in stand-alone mode
- Non-volatile storage of configuration files and samples via removable, transportable PC-Cards
- 4 MB RAM onboard, expandable to 16 MB
- 100 kHz 16-bit Analog-to-Digital Conversion
- 8 differential, 16 single-ended inputs; expandable to 256 input channels via DBK cards
- 7 gain/input ranges, unipolar and bipolar
- 40 digital I/O lines, expandable to 208
- 4 pulse-counting inputs
- Gain and unipolar/bipolar settings are programmed in real time (10 μ s max)
- Scan-sequence memory (1024 analog channels plus 128 digital channels) for any combination of channels/gains
- Input power: 10 to 45 VDC (AC adapter included)
- Several LBK options (listed on page 1-13, and detailed in chapter 4)
- Several DBK options (listed on page 1-14 detailed in chapters 2 and 5)

LogBook/300 Block Diagram



LogBook/360 Block Diagram



The following components are represented in the previous block diagrams. Certain items apply only to LogBook/360, as noted.

- **Removable PC-Card.** A 12-520 MB capacity holds the software, operating system, user configurations and the acquired data. The PC-Card is at the center of LogBook operations. A PC-Card [pre-programmed by LogView] ensures an unattached LogBook comes up properly.
- **Power Supply.** The internal power supply accepts an input of 10 to 45 VDC and supplies filtered regulated voltages to its internal circuits and to accessories connected via P1/2/3. An external AC adapter for all standard voltages is included with the system.
- **System Controller.** A microprocessor chip is used within LogBook with either 4 MB (standard) of RAM or 16 MB (optional). A field-upgradeable 512 KB Flash memory is used to store the system startup code, self-diagnostics, and FPGA configuration.
- **Analog Input via P1.** 16 main channels that can each accommodate 16 sub-channels via multiplexing for a total of 256 analog input channels. Fault protection and buffer circuits prevent overloads and cross-channel noise due to impedance mismatch.
- **A/D Converter.** The A/D converter uses 16-bit resolution @ 100 kHz sample rate.
- **Digital I/O.** 16 high-speed digital inputs via P3, three 8-bit TTL programmable I/O ports via P2, three TTL inputs via P1. Note that LogBook/360 has P1, P2, and P3 connectors on the motherboard that are connected [by ribbon cable] to secondary P1, P2, and P3 connectors [located on the chassis front panel]. LogBook/300's P1, P2, and P3 are located on the rear panel.
- **LBK2 Analog Output (optional):** This option provides four channels of analog output, 16-bit @ 100 kHz @ ± 10 VDC.
- LogBook/360 only, **Interconnect Board, Card Drawer** (for three DBK cards), and three **Terminal Panels**.
- **Computer/Control/I/O** – Includes: PARALLEL PORT (ECP Mode), SERIAL PORT (for RS-232 or RS-422/485), TERMINAL PORT (for LBK1 LogBook Remote Terminal option). In addition, for LogBook/360 only, there is a COM Expansion Card with two serial ports (SERIAL AUX and SERIAL GPS). These two ports are for connecting auxiliary serial devices, such as a Global Positioning System.

System Software

LogBook software includes *LogView*, *Upload Scheduler (optional)*, *DIAdem-View*, and *PostView*. *LogView* and the *Upload Scheduler* are detailed in Chapters 3 and 4, respectively. *DIAdem-View* is discussed in it's own, separate user documentation. Appendix F covers *PostView*, which is similar to *DIAdem-View*, but much more limited. Each of these programs is discussed briefly below.

- **LogView** is a ready-to-use Windows program for data acquisition and logging. The program provides a means of selecting channels, gains, transducer types, and various parameters. After setting up the configuration on the PC, you must download the configuration file to LogBook's PC-Card. LogBook then uses the PC-Card to start the pre-configured acquisition. During an acquisition, LogView can display channel values in a spreadsheet, bargraph, analog meter, or digital indicator. LogBook data can be uploaded to your PC in various data formats (Excel™, SnapMaster™, MATLAB™, DASyLab™, Lotus®, Quattro, and ASCII) for compatibility with virtually all post-acquisition analysis software. *LogView* is detailed in chapter 3.
- **DIAdem-View** provides a means of viewing and analyzing data via interactive graphics. The basic *DIAdem-View* can be enhanced with optional software modules. Refer to the separate *DIAdem User's Manual* and the *DIAdem* on-line help for detailed information.
- **PostView** is a post-acquisition waveform-display program. The program permits the simultaneous viewing of up to 16 pre-recorded data channels. *PostView* allows you to expand, contract and auto-scale waveforms, and scroll forward or backward on the time line. *PostView* is detailed in Appendix F.
- **Upload Scheduler** is an application that exists as part of the LogBook/Modem option. *Upload Scheduler* allows you to configure upload events for one or more LogBooks. A scheduled event can be configured to execute one time, or periodically, with no post-configuration intervention by the user. The *Upload Scheduler* is detailed in chapter 4.

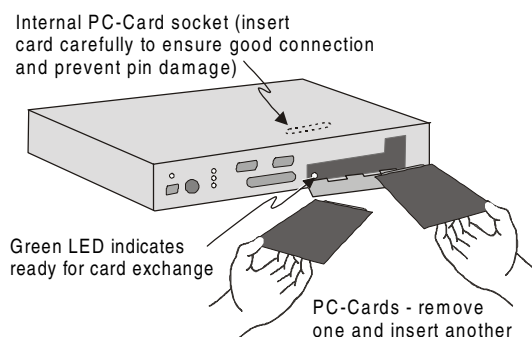
Hardware-Related Details

PC-Card Swapping

After the initial setup, you can interact with LogBook with PC-Cards. A safe-swap LED (inside the PC-Card access door) lights when it is safe to change PC-Cards. You can also interact with LogBook using the LBK1 Remote Terminal Panel option (discussed in chapter 4). The **LBK1** option provides limited LogBook control without use of the *LogView* program.

Note: during operation, *LogView* is the primary system interface for control and configuration.

You can change PC-Cards to load setup files, replace full cards, or transport data to an unattached PC. When the PC-Card door is opened, a detector starts a preparatory routine to clean up files on the installed disk. Within a few seconds, a green LED indicates it is safe to swap PC-Cards. Swapping should be done quickly to prevent gaps in the recorded data. 4 MB RAM provides about 10 seconds at 100 kHz and 1.75 minutes at 10 kHz. 16 MB RAM provides over a minute at 100 kHz and about 12 minutes at 10 kHz for one-channel scans.



Swapping PC-Cards in a LogBook/300

Note: Some models have PC-Card doors with right-edge hinges (not shown).



- Swapping time is measured from when the door opens. **Keep door closed unless you are in the process of swapping cards.**
- PC-Cards must be pre-configured by LogView—if anticipating the need for multiple cards, **download the exact SAME ACQUISITION SETUP FILE to each PC-Card.**
- The PCMCIA slot accepts a Type I, II, or III hard-disk card or ATA flash-memory solid-state card.

Physical/Environmental Conditions

LogBook/300 Dimensions: 8½ × 11 × 1-3/4 in. (216 × 279 × 44 mm). This enclosure has the same footprint as the DBK modules for easy stacking of units.

LogBook/360 Dimensions: 14 × 11 × 3-7/16 in. (330 × 279 × 84 mm). The 11 inch width provides for convenient stacking of DBK modules.

Operating temperature/humidity: 32° to 122°F (0° to 50°C) @ 0 to 95% RH, non-condensing. Operation of the unit in environments exceeding these limits requires that a temperature-regulated enclosure).

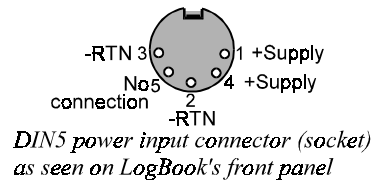
Storage temperature: 32° to 176°F (0° to 80°C). The standard case is rugged but not designed for immersion. Special enclosures are available for harsh environments.

All connectors, including the power connector, are locking. The D-sub connectors have thumbscrews and the DIN5 power connector has a twist-lock ring to ensure solid connections are maintained.

Power Supply

Power Input Connector

LogBook's front panel has a socket DIN5 connector to access power (10 to 45 VDC at 0.3 to 7.0 A). The included AC-to-DC adapter (TR-43) is recommended. However, various power supplies if properly wired (see figure) can be used.



Internal Power Supply

LogBook's power supply is a switching design (pulse-width modulated). The input will accept 10-45 VDC with a current range of 0.4 to 7.0 A. The input is protected by an 8 A fast-blow fuse. The fuse will open if the input voltage is applied with the wrong polarity.

The power supply provides the necessary voltages to P1, P2, and P3 for use by DBKs. You can refer to the P1, P2, and P3 pinouts (in this chapter) and to chapter 2, *System Power*, for detailed information.

AC-to-DC Adapter

An AC-to-DC adapter (TR-43) is provided with LogBook. This external, switching supply runs on US/Europe/Japan input voltage ranges. Output voltage and power are sufficient to run the system in most applications. Input: 90-260 V @ 50-60 Hz. Output: 15 VDC @ 2.3 A. If more power is needed, a 24 VDC, 2.2 A adapter (TR-44) is available as an option.

UPS

DBK34 is an optional uninterruptable Power Supply (UPS) that allows LogBook to operate for at least 30 minutes without any other source of power. This capability allows operation, for example, during starting and after switch-off of an automobile. Control circuits keep the on-board batteries fully charged when possible. For more information on the DBK34, refer to chapter 2, *System Power*.

Power Failure and Recovery

When power fails, LogBook preserves as much data as possible. LogBook also attempts to keep PC-Card file formats and structures intact. Due to disk drive latencies, power-supply limitations, and DOS file structure, it may not be possible to finish the shutdown process before a complete loss of power occurs.

Note: Recovery will not occur when power is restored, unless the shutdown process was completed.

Note: The DBK34 Vehicle UPS is recommended for applications that are subject to power problems, or are intolerant to down time. DBK34 is discussed in chapter 2, *System Power*.

Microprocessor

LogBook uses a high-integration microprocessor with up to 16 MB of memory (4 MB standard). The microprocessor and a Field-Programmable Gate Array (FPGA) control all LogBook operations including real-time control. Internal flash memory is used instead of EPROMs. This allows for field upgrades of virtually all functions, including FPGA circuitry. Most software will be read from the disk drive.

Field-Installation Racks and Enclosures

A special rack (p/n Mount1) is available to attach the LBK1 (Remote Terminal Panel option) to the top of LogBook. The LBK1 section of chapter 4 provides details. For applications in harsh environments, a special enclosure can be used to shield the unit from water and thermal stress. Consult your sales rep or factory for details.

P1, P2, P3 Port Connectors

LogBooks have three port connectors: P1, P2, and P3. For **LogBook/300**, these connectors are located on the rear panel. For **LogBook/360**, they are on the front panel (see note). Connector pinouts begin on the following page.

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

P1 (Analog Input)

LogBook's P1 connector is compatible with all DBK options. Features and capabilities of P1 signals include:

- High-performance signal connection for: ± 10 V and 0-20 V input ranges, gains from $\times 1$ to $\times 64$ (each gain and range calibrated individually), and an input stage with low crosstalk, high dynamic impedance, small signal injection.
- All calibration is performed digitally; there are no pots to adjust.
- The sequencer depth (the number of channel readings in a scan) is 1024 analog channels and 128 digital channels.
- P1 includes an enhanced DBK-50 protocol that allows DBK cards or modules to identify themselves and carry their own calibration data. These same connections can allow complete configuration of DBK cards with that capability (allowing them to be jumperless).

CAUTION



For analog signal inputs via P1, do not exceed -35 VDC or +45 VDC or equipment damage may result.

P2 (Digital I/O)

P2 is used with various kinds of digital I/O. For autonomous operation without an attached PC, the P2 outputs may be preset before the acquisition. The P2 digital outputs may be used as alarm outputs to identify the detection of specified levels in the acquired data.

P3 (Pulse Frequency, High-Speed Digital I/O)

Features and capabilities of P3 signals include:

- 4 16-bit pulse counter channels, scanable along with analog inputs
- Additional digital I/O control lines for high-speed digital input and output.
- 4 optional, internal, 16-bit ± 10 V analog output channels (LBK2), useable for waveform or control output, or additional control lines for external analog output expansion.

The 16 high-speed digital I/O lines, along with the additional digital I/O control lines can now be used for real-time digital peripherals such as expanded digital input, or current or voltage DACs.

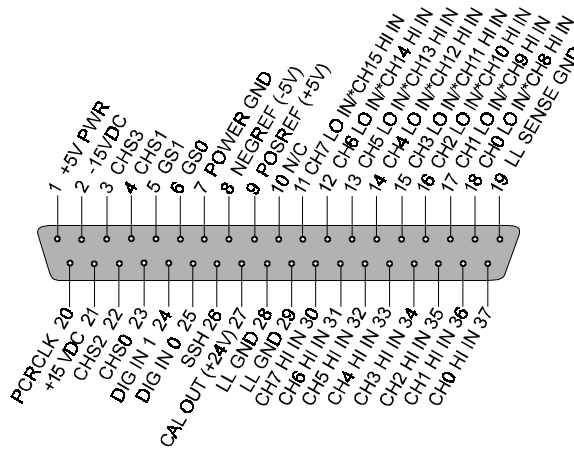
Optional, internal 4-channel 16-bit waveform/control ± 10 V DACs on P3:

- Initially setup to a static, preprogrammed voltage at the beginning of the acquisition.
- In the future, may be used for waveform or control outputs.

The following tables give the pinout use for P1, P2, and P3.

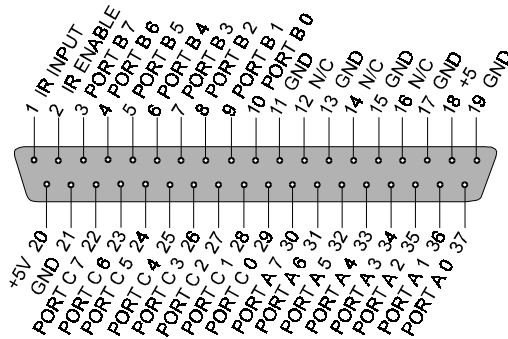
P1, P2, P3 Pinout Tables

You can connect signals to LogBook's P1, P2, and P3 port connectors using a CA-37-x cable (via a D-shell 37-pin female connector), or a DBK11 screw-terminal card with component sockets. This page and the next two contain P1, P2, and P3 pinouts.



P1 – Analog I/O

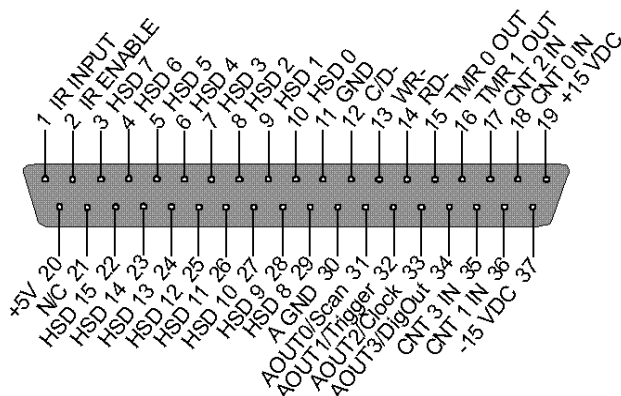
Pin	Signal Name	Description for P1 Pin Use
1	+5 PWR	+5 V supply @ 0.100 A (Refer to chapter 2, <i>System Power</i>)
2	-15 VDC with diode	-15 V supply @ 0.150 A (Refer to chapter 2, <i>System Power</i>)
3	CHS 3	Channel select line for expansion cards
4	CHS 1	Channel select line for expansion cards
5	GS 1	Gain select line for expansion cards
6	GS 0	Gain select line for expansion cards
7	POWER GND	Digital ground
8	NEGREF (-5 V)	-5.0000 VDC @ 0.005 A reference used for various DBKs
9	POSREF (+5 V)	+5.0000 VDC @ 0.005 A reference used for calibration with optional 4-channel D/A board
10	N/C	No Connection
11	CH 7 LO IN/CH 15 HI IN	Ch 7 LO IN (differential mode)/ch 15 HI IN (single-ended mode)
12	CH 6 LO IN/CH 14 HI IN	Ch 6 LO IN (differential mode)/ch 14 HI IN (single-ended mode)
13	CH 5 LO IN/CH 13 HI IN	Ch 5 LO IN (differential mode)/ch 13 HI IN (single-ended mode)
14	CH 4 LO IN/CH 12 HI IN	Ch 4 LO IN (differential mode)/ch 12 HI IN (single-ended mode)
15	CH 3 LO IN/CH 11 HI IN	Ch 3 LO IN (differential mode)/ch 11 HI IN (single-ended mode)
16	CH 2 LO IN/CH 10 HI IN	Ch 2 LO IN (differential mode)/ch 10 HI IN (single-ended mode)
17	CH 1 LO IN/CH 9 HI IN	Ch 1 LO IN (differential mode)/ch 9 HI IN (single-ended mode)
18	CH 0 LO IN/CH 8 HI IN	Ch 0 LO IN (differential mode)/ch 8 HI IN (single-ended mode)
19	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
20	PCRCLK	Pacer clock output/input
21	+15 VDC with diode	+15 V supply @ 0.150 A (Refer to chapter 2, <i>System Power</i>)
22	CHS 2	Channel select line for expansion cards
23	CHS 0	Channel select line for expansion cards
24	DIG IN 1	Digital input bit 1
25	DIG IN 0	External TTL trigger input
26	SSH	Simultaneous Sample and Hold Output
27	CAL24	Calibration output (+24 V @ 0.010 A)
28	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
29	L.L. GND	Low-level ground (analog ground - use with analog inputs and outputs)
30	CH 7 HI IN	Ch 7 HI IN (single-ended mode or differential mode)
31	CH 6 HI IN	Ch 6 HI IN (single-ended mode or differential mode)
32	CH 5 HI IN	Ch 5 HI IN (single-ended mode or differential mode)
33	CH 4 HI IN	Ch 4 HI IN (single-ended mode or differential mode)
34	CH 3 HI IN	Ch 3 HI IN (single-ended mode or differential mode)
35	CH 2 HI IN	Ch 2 HI IN (single-ended mode or differential mode)
36	CH 1 HI IN	Ch 1 HI IN (single-ended mode or differential mode)
37	CH 0 HI IN	Ch 0 HI IN (single-ended mode or differential mode)



P2 Digital I/O

Pin	Signal Name	Description for P2 Pin Use
1	IR INPUT	Interrupt line input (no functions to access this)
2	IR ENABLE	Interrupt line enable (no functions to access this)
3	PORT B 7	Digital input/output – port B bit 7
4	PORT B 6	Digital input/output – port B bit 6
5	PORT B 5	Digital input/output – port B bit 5
6	PORT B 4	Digital input/output – port B bit 4
7	PORT B 3	Digital input/output – port B bit 3
8	PORT B 2	Digital input/output – port B bit 2
9	PORT B 1	Digital input/output – port B bit 1
10	PORT B 0	Digital input/output – port B bit 0
11	GND	Digital ground
12	N/C	Pin not connected/not used
13	GND	Digital ground
14	N/C	Pin not connected/not used
15	GND	Digital ground
16	N/C	Pin not connected/not used
17	GND	Digital ground
18	+5 V	+5 V supply @ 0.100 A (Refer to chapter 2, <i>System Power</i>)
19	GND	Digital ground
20	+5 V	+5 V supply @ 0.100 A (Refer to chapter 2, <i>System Power</i>)
21	GND	Digital ground
22	PORT C 7	Digital input/output – port C bit 7
23	PORT C 6	Digital input/output – port C bit 6
24	PORT C 5	Digital input/output – port C bit 5
25	PORT C 4	Digital input/output – port C bit 4
26	PORT C 3	Digital input/output – port C bit 3
27	PORT C 2	Digital input/output – port C bit 2
28	PORT C 1	Digital input/output – port C bit 1
29	PORT C 0	Digital input/output – port C bit 0
30	PORT A 7	Digital input/output – port A bit 7
31	PORT A 6	Digital input/output – port A bit 6
32	PORT A 5	Digital input/output – port A bit 5
33	PORT A 4	Digital input/output – port A bit 4
34	PORT A 3	Digital input/output – port A bit 3
35	PORT A 2	Digital input/output – port A bit 2
36	PORT A 1	Digital input/output – port A bit 1
37	PORT A 0	Digital input/output – port A bit 0
Note: No local lines are available if digital expansion cards are in use.		

**P3 -
Pulse
Frequency/
High-Speed
Digital I/O**



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

System Setup and Expansion Options

Steps to Review

A review of the following steps can help you decide what type of setup best suits your application. Specifics of your actual application may alter the order and complexity of these steps. These steps should be reviewed prior to expanding a LogBook system.

1. **Determine what data you need and how data will be used and saved.** What units, ranges, sampling rates, etc are best for your needs? Will the data be charted graphically, statistically processed, or exported to other programs? Are secondary uses envisioned for a later date? Begin by analyzing the end use of the data and then working backwards to how you must collect it.
2. **Determine the channel assignments, and layout the whole system plan.** Typically, a hand-drawn pencil sketch can effectively note all system components and their relation to the others; however, a computer-drawn plan can be more useful in a complex system or one that will undergo frequent modification. Plan out the location of transducers, cable runs, DBKs, LogBook, and the computer. Assign channel-numbers and apply labels to your transducers, cables, and connectors. A well-documented and labeled system prevents confusion later on (especially helpful for troubleshooting and system expansion).
3. **Configure all the DBK cards and modules for your application.** Some DBKs are configured by software; however, on other DBKs, jumpers and DIP switches may need to be set manually (channel, gain, filters, signal mode, etc). Perform all hardware configurations before connecting signal and power lines.
4. **Route and connect all signal and power cables while all power is turned OFF.** To minimize noise, route all signal lines away from any RF, high-voltage, or strong magnetic fields (motors, etc). The *IOtech Signal Conditioning Handbook* (ISBN 0-9656789-0-3) contains excellent guidance in this area.



Additional power may be required for systems that use several DBKs [or transducers]. Chapter 2 contains power supply information and includes a “DBK Power Requirement Worktable.”

5. **Configure LogBook** (most settings are made in software). The software must recognize all the hardware in the system. Set all channels in the proper mode for the attached signal source; and configure LogView to use measurement units and ranges that suit your purpose.
6. **Energize LogBook and DBKs, and initiate a data acquisition.**
7. **Verify proper data acquisition and storage.** Can data be acquired, stored, retrieved, and used as needed?
8. **Verify system accuracy;** perform calibration or equipment adjustment as required.



Reference Notes: You may need to refer to additional sections of this manual.

- Chapter 2, for calculating system power and ensuring an adequate power supply. The chapter contains information regarding DBK30A, DBK32A, DBK33, and DBK44.
- Chapter 4, if using LBK options.
- Chapter 5, if using DBK expansion options.

Expansion Configurations

LBK Options

The following LBK options are detailed in chapter 4.

- **LBK/COM/422/485**, RS-232 Board with an RS-422/485 Option
- **LBKMEM1 or LBKMEM1U**, 16 MB DRAM Memory Expansion
- **LBK1**, a Remote Terminal with LCD screen for viewing system status, and a keypad to control the system’s basic operation when no PC is attached.
- **LBK2**, a 4-channel Digital-to-Analog Output card.
LBK2 has four 16-bit, high-speed (100 kHz) ± 10 V analog outputs.
- **LogBook/GPS**, Global Positioning System Support, *LogBook/360 Only*
- **LogBook/Modem**, Modem and Upload Scheduler Software Support

DBK Options

DBK cards and modules provide options for signal conditioning, analog output, system I/O, auxiliary power, and expansion. Various sensor types are accommodated, including high-voltage/current, strain gages, thermocouples, isolation, relays, accelerometers, filtering, and simultaneous sample and hold. A list of more than 30 DBK options is provided on the following page.



Reference Notes:

Power-related DBKs are discussed in chapter 2.

Signal-conditioning related DBKs are discussed in chapter 5.

Note: Modules attach to P1 or P2. Module footprints match that of LogBook, allowing for easy stacking.

DBK Option Cards and Modules		
Product	Name/Description	Capacity
Analog Signal Conditioning (see chapter 5, DBK Expansion Options)		
DBK4	Dynamic Signal Input Card	2 channels
DBK7	Frequency-to-Voltage Input Card	4 channels
DBK8	High-Voltage Input Card	8 channels
DBK9	RTD Measurement Card	8 channels
DBK12	Low-Gain Analog Multiplexing Card	16 channels
DBK13	High-Gain Analog Multiplexing Card	16 channels
DBK15	Universal Current/Voltage Input Card	16 channels
DBK16	Strain-Gage Measurement Card	2 channels
DBK17	Simultaneous Sample & Hold Card	4 channels
DBK18	Low-Pass Filter Card	4 channels
DBK19	High-Accuracy Thermocouple Card	14 channels
DBK42	5B Isolated Signal-Conditioning Module	16 channels
DBK43A	Strain-Gage Measurement Module	8 channels
DBK44	5B Isolated Signal-Conditioning Card	2 channels
DBK45	SSH and Low-Pass Filter Card	4 channels
DBK50	Isolated High-Voltage Input Module	8 channels
DBK51	Isolated Low-Voltage Input Module	8 channels
DBK52	Thermocouple Input Module	14 channels
DBK53	Low-Gain Analog Multiplexing Module	16 channels
DBK54	High-Gain Analog Multiplexing Module	16 channels
Digital I/O and Control (see chapter 5, DBK Expansion Options)		
DBK20	General-Purpose Digital I/O Card (Screw Terminals)	48 channels
DBK21	General-Purpose Digital I/O Card (DB37 Connectors)	48 channels
DBK23	Optically Isolated Digital-Input Module	24 channels
DBK24	Optically Isolated Digital-Output Module	24 channels
DBK25	Relay Output Card	8 channels
Expansion and Connection (see chapter 5, DBK Expansion Options)		
DBK1	16-Connector BNC Adapter Module	16 connectors
DBK10	3-Slot Expansion Chassis	3 cards
DBK11A	Screw-Terminal Option Card (DB37-Screw Terminal Block)	Component sockets
DBK35	PC-Card Interface Card	N/A
DBK40	BNC Interface	18 connectors
DBK41	Analog Expansion Enclosure	10 cards
DBK60	3-Slot Expansion Module with Termination Panels	3 cards
Power Supplies (see chapter 2, System Power)		
DBK30A	Rechargeable Battery/Excitation Module	3.4 A-hr @ 12 to 14 VDC 1.7 A-hr @ 24 to 28 VDC
DBK32A	Auxiliary Power Supply Card	15 VA
DBK33	Triple-Output Power Supply Card	±15 V @ 250 mA; +5 V @ 1 A
DBK34	Vehicle UPS Module	5 A-hr @ 12 VDC 2.5 A-hr @ 24 VDC

DBKs are designed for use with a LogBook or Daq* (DaqBook, DaqBoard, and Daq PC-Card). The DBKs can also be used with ISA bus-based data acquisition boards from other vendors. However, DBKs perform best when used with a LogBook or Daq* that can dynamically select both channel and gain/range. Dynamic channel and gain/range selection allows high channel-to-channel scan rates with a wide variety of transducers.

No matter what the signal input from the transducer, DBKs produce output signals suitable for analog-to-digital conversion (ADC). The output signals can be bipolar (typically -5 to +5 V) or unipolar (typically 0 to 10 V). The user can select a range of relevant values to correspond to the lowest and highest signal—this range selection guarantees the highest resolution in 16-bit conversion by the ADC.

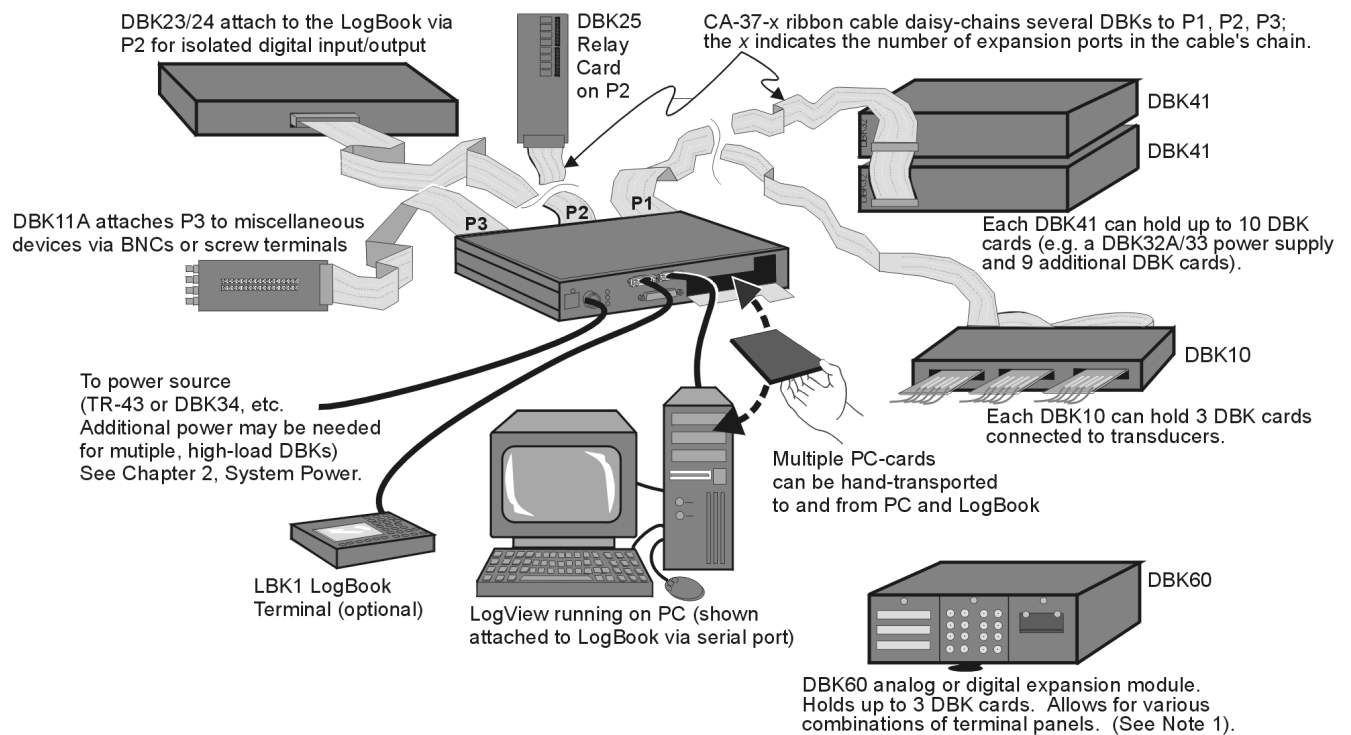
Note: DBKs vary in their outputs and gain settings. Refer to the specifications for the particular DBK used.

Most system expansions stem from the 37-pin Signal I/O ports P1, P2, and P3.

LogBook/360 combines the features and capabilities of LogBook/300 with those of a DBK60 expansion chassis. In addition, LogBook/360 has a pre-installed serial communications card that provides GPS and AUX serial ports as detailed in chapter 4.

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

The next figure illustrates various expansion possibilities. Note that additional options exist. Chapter 5 details the DBK expansion options available at the time this manual goes to print.



A Few Possible Expansion Configurations

Note 1: LogBook/360 (not shown) combines the features and capabilities of LogBook/300 with those of a DBK60. In addition, LogBook/360 has two additional serial ports, as discussed in chapter 4.

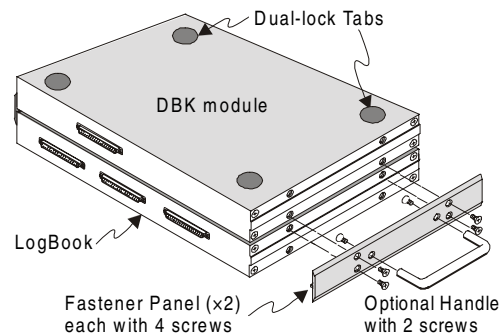
Mechanical Setup Options

Convenient modules for packaging DBK expansion cards are available with three slots (DBK10, DBK60) or 10 slots (DBK41). The best option depends on the number of DBK cards in your system. For three or fewer cards, you can use the stackable 3-slot DBK10, or 3-slot DBK60.

Note: DBK60 has several termination-panel options, e.g., BNC, Safety-jack, T/C, removable block screw-terminal, slotted, and DB37-style.

For more than six cards, use the 10-slot DBK41. Several DBK41s can be daisy-chained to handle a large number of DBKs in a system. Another packaging option is the use of special enclosures for harsh environments. These enclosures can be locked to prevent tampering, conditioned for heat and/or cold, and sealed air- or water-tight. For systems with many modules, stacking units together helps conserve space and assure easy cable runs. Such stacking can be accomplished with adhesive dual-lock tabs or by the use of fastener-panels (splice plates). The splice-plate method provides for a more rigid stacking, and is the preferred method. Dual-lock tabs are convenient for mounting a Notebook PC to a LogBook or DBK module.

- **Dual-lock tabs.** Some modules are shipped with installation kits that include adhesive dual-lock tabs.
- **Fastener panels.** Splice plate kits (included with several modules) provide rigid stacking. These kits include metal plates that form a vertical rack of two or more modules. This method allows the “enclosure” to size itself as needed. A handle can be attached for convenience.



System Power Considerations

Power options are available to accommodate a wide range of applications from laboratory to automotive and other field applications. LogBook power input range is wide (10 to 45 VDC) to allow use in various environments. LogBook is shipped with the TR-43 AC-to-DC power adapter which plugs into a standard outlet and the DIN5 power connector on LogBook. Optionally, an 8-ft CA-171 cable can connect to an automobile cigarette lighter.

Depending on system load, DBK cards can get their power from the P1 bus (either from LogBook or a DBK power card in a DBK41 expansion chassis). The DBK modules use any 10 to 20 VDC source or the included AC/DC adapter.

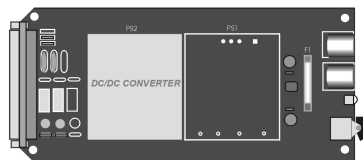


Reference Note: Chapter 2, *System Power* explains how to calculate and meet the power requirements for any combination of system devices.

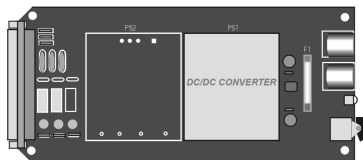
LogBook provides power via P1, P2, and P3. Additional power can be supplied by the following, as discussed in chapter 2.



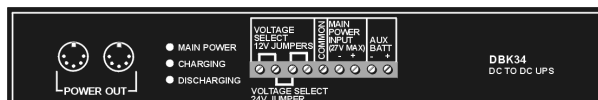
DBK30A module - provides power at 14 and 28 VDC with a rated capacity of 3.4 A-hr. The DBK30A's 28 V output will power 4 to 20 mA transducers.



DBK32A card - provides ± 15 VDC @ 500 mA.



DBK33 card - provides ± 15 VDC @ 250 mA and +5 VDC @ 1000 mA.



DBK34 module - provides 12 or 24 VDC, respectively with a 5.0 or 2.5 A-hr capacity. This module is an Uninterruptable Power Supply (UPS) that can be used for in-vehicle testing where the vehicle's electrical system will not affect LogBook power during starter-current surge or power-off.

Operational Features

Data Acquisition Overview

Note: Acquired data is signal-conditioned before it is logged (recorded by LogBook). The data can be post-processed via analytical programs.

A **Sensor/Transducer** reacts to a physical quantity (such as stress, strain, frequency, temperature, acceleration, light intensity, etc) and encodes that quantity into an analogous electrical signal. A wide variety of transducers produce signals that vary in type and strength—some generate a voltage; others alter an electrical property. As the measured condition changes, the analog sensor signal can vary directly or inversely and in a linear or non-linear way.



Although LogBook can read volts directly, many sensor types still require signal conditioning before they can be correctly interpreted.

The **Signal Conditioner** changes the raw transducer signal into a voltage for use by LogBook's **Analog-to-Digital Converter (ADC)**. Depending on signal quality, several steps may be involved (e.g., linearization, isolation of high voltages, amplification of weak signals, attenuation of strong signals, filtering of noise and irrelevant frequencies, differential voltage measurement, simultaneous sample-and-hold, and pulse/current-to-voltage conversions). DBK option modules are designed for conditioning a particular type of transducer signal. The signal conditioner's output voltage range is "normalized" to a user-selected range for the measured values.

Note: Multi-channel DBKs can multiplex several input signals into one of LogBook's 16 main inputs.

Multiplexing up to 16 analog channels for each LogBook main channel **allows system expansion up to 256 analog input channels**.

LogBook's onboard **microprocessor** and **PC-Card** allow it to operate independent of a host PC.

Functionally, LogBook can perform:

- **Analog-to-Digital Conversion.** The ADC changes a conditioned analog signal to a corresponding digital value. LogBook's 16-bit ADC uses 65,536 numbers (2^{16}) to quantify values within the specified range and gain. Each input channel's buffer amplifier ensures constant input impedance. The buffers also eliminate any noise effects from multiplexing of the input signals.
- **Acquisition Control.** The microprocessor controls the data acquisition by managing trigger conditions, gains, offsets, scan sequencing, and data formatting. LogBook can continuously collect information, or be used for exception-capturing (with triggers). Pre-trigger and post-triggers allow for capture of specific data, thus making more efficient use of memory.
- **Analog and Digital I/O.** With the standard digital I/O, standard analog input, and the optional analog output board, LogBook can perform virtually any data acquisition task as well as more complex tasks for alarm and control systems.
- **Data Logging.** Data can be saved in one of several formats and later downloaded to a PC.
- **Communication with PC.** LogBook provides for serial and parallel port communication. In the stand-alone mode, the PC-Card must be manually transported between the PC and LogBook.

The **PC-Card** is a memory device (rotating or flash, PCMCIA types I, II, or III) that holds the system software and the acquired data in multiple formats. System software includes the configuration file that directs a specific acquisition and LogBook's operating system. The PC-Card as programmed in LogView allows LogBook to operate without PC intervention if so desired. LogView can configure a PC-Card in LogBook if the PC and LogBook are electronically connected via serial or parallel port. In a stand-alone mode, the PC-Card must be physically transported between a PC with LogView and one or more LogBooks for uploading and downloading. Using a 500-Mbyte PC-Card, for example, you can store up to 250 million samples in non-volatile memory; that equates to more than forty minutes of recording time on one channel at the full 100 kHz acquisition rate. For continuous data collection, PC-Cards can be swapped while the acquisition is taking place. As one card becomes nearly full, it can be removed and another card inserted without causing a gap in the acquired data.

The **user's PC** (typically a laptop or desktop) runs the supplied **LogView** software. LogView's user-interface includes a virtual instrument panel with meters and controls to fit various applications. Through LogView you can configure the system, apply further data processing, or manage multiple LogBooks. LogView stores data in a conventional format so that other software can use the acquired data for analysis, control, alarms, reporting, etc.

Note: The PC can be attached to LogBook via a serial or parallel connection; alternatively in the stand-alone mode, the PC can be *unattached* and communicate with LogBook via a PC-Card that is manually transferred between the PC and LogBook.

LogBook System File

The file **logbook.sys** is LogBook's operating system. Without it, LogBook will not work; without it on LogBook's internal PC-Card, LogBook will not power-on. After software is installed [as discussed in the Quick Start sections] the 500-KB **logbook.sys** file will reside in the *LogView* folder (on the hard drive of the host PC). To be used by a LogBook, **logbook.sys** must have already been downloaded to the PC-Card inside LogBook.

Downloading. When LogView downloads the ***.lvc** acquisition setup file to a PC-Card, it checks to see if **logbook.sys** is already on the PC-Card. If so, fine; if not, **logbook.sys** must also be downloaded to the PC-Card. Thus, downloading to a PC-Card that is being used for the first time will take longer than subsequent downloads.



Due to the file size and relative transfer time, insert first-time PC-Cards into the PC's card socket rather than LogBook's. Downloading via the PC's socket takes only a few seconds; however, using LogBook's socket and a communications channel will take much longer (about 7 minutes at 9600 bps).

Swapping PC-Cards. Once LogBook has successfully powered on with a PC-Card containing **logbook.sys**, the file is no longer needed for continued operation. At this point, cards without the system file can be used to store acquired data.



Because LogBook needs the logbook.sys file to become operational after loosing power (due to an outage or being turned off), keep the logbook.sys file on all PC-Cards that will be used for data storage.

Communications

Protocols

LogBook uses only standard, supported, widely available communication channels to minimize device-driver development. The messages transmitted over these channels are also standard: human-readable ASCII for commands and status, and standard file-transfer protocols (such as X-modem) for block data transfers. The messages and protocols are independent of the choice of communication channel, except when a channel explicitly requires a different protocol (such as FTP over TCP/IP). The use of such standards makes LogBook easier to use and extend.

To implement these standards, LogBook includes a command parser and conversion software to convert measured voltages into physical measurements such as temperature, force, or acceleration. This software is used for monitoring transducer measurements, both at the PC and the LBK1. LogBook can return all data as physical quantities and/or raw voltage measurements.

Large blocks of raw or converted data (such as entire acquisitions or a set of consecutive scans) are transferred as binary files, using file-transfer protocols. Smaller blocks (such as individual readings or scans) are transferred in readable ASCII.

Parallel Port – ECP Mode

LogBook includes an ECP parallel port for high-speed local communication with a PC in the ECP mode (the only supported protocol is ECP). Your PC mode may need to be changed in its BIOS or in the Window Settings—consult your PC's documentation or the PC's manufacturer as needed.

Serial Port

LogBook includes an RS-232 (RS-422/485 optional, call factory for availability) serial port supporting both point-to-point and multi-drop remote communication.

Other Communication Channels

The serial communication protocols are standard so non-PC hosts can communicate with LogBook. The use of printable ASCII for commands and status and the use of standard file-transfer protocols make it practical to add additional ports such as USB, IEEE 488, TCP/IP. Consult factory for availability of these communication options.

Triggering and Scan Timing



Reference Note: For information on defining triggering conditions through *LogView*, refer to chapter 3's *Acquisition Configuration* section.

If data collection is desired only under specific conditions, you can specify appropriate trigger conditions. By defining a trigger, pre-trigger, and post-trigger, you can collect data surrounding a specific event. This event can be an absolute time or a defined condition such as a particular analog channel measuring a certain quantity. If a calculated channel is chosen as the trigger source, you have greater flexibility in defining the trigger based on multiple inputs and conditional logic. An auto re-arm feature allows many successive acquisitions to take place automatically, with each acquisition using the same settings.

LogBook can be triggered by several types of sources, including analog and digital triggering, multi-step triggering, multi-channel triggering, time-of-day triggering, and manual trigger. The manual trigger can be implemented in the following ways:

- With a computer attached, you can trigger LogBook from LogView's LogBook Monitor window.
- Without a computer, you can use a manual trigger switch by attaching it to the TTL trigger input (pin 25, on P1).
- With a logic device you can engage the TTL trigger on P1's pin 25, as programmed.
- Without a computer, you can use the LBK1's manual trigger button.

LogBook time-of-day clock has 1/256-second resolution for data-logging applications where acquisitions must be performed at specific times during the day. The time of occurrence of each acquisition and its trigger are also recorded with the data. The scan-to-scan timing may be set by a fixed-frequency pacer clock. Or, an external clock can start each scan individually to allow the scan rate to track a variable-speed event (such as engine revolutions).

Note: Time-stamping is done in 1/256-second units; but the absolute trigger is in 1-second units.

For data acquisition applications that include both fast and slow signals, multiple sample rates can be configured. In the acquisition setup dialog box, a primary acquisition rate and divisors for up to 3 more rates can be configured. Using multiple sample rates, fast signals like vibration can be sampled at a high rate while slow signals like thermocouples are sampled at lower rates, optimizing the system's storage capacity.

Scan Rate Limitations

LogBook's internal clock runs at 100 kHz, and this is the fastest scan rate possible with just one input channel in the scan list and no outputs. As input, calculated, and output channels are added to the scan list, the usable scan rate is correspondingly reduced. The system does not automatically compute an optimum scan rate for you. However, LogView will generate an error message in the LogBook Monitor window if timing problems occur, and the following sections explain such problems and how to solve them.

External TTL Trigger and Stop Events

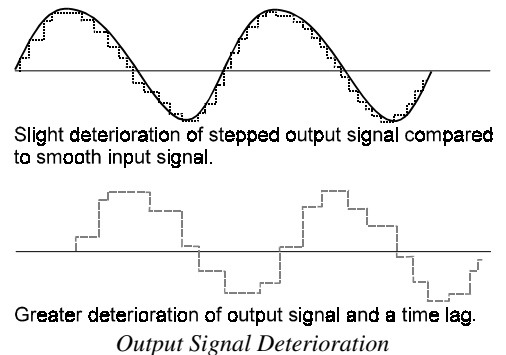
An external TTL trigger can repeat before the trigger block completes; extra trigger signals will be ignored. Likewise, multiple stop signals received before restarting the next scan will be ignored. Such ignored signals are noted in the LogBook Monitor window as “Losing Trigger Events” and “Losing Stop Events”.

Problems Arising From Too Fast a Scan Rate

If the user-specified scan rate does not provide enough time to complete the necessary tasks of the entire scan list, various problems can occur. Bear in mind that LogBook places the highest priority on reading input channels—it is primarily a data logger. Also realize that calculated and output channels are based on input channels and come typically at the end of the scan list. Thus, if the scan rate is too fast and the next sequence begins before the first is completed, the outputs may suffer. When outputs can't keep up with the inputs, possible consequences include:

- **Missing/late Outputs.** The outputs are not updated in a timely fashion and may not represent their sources in real time (LogBook Monitor error message is “Outputs Deteriorating”).
- **Missed Alarms.** Digital alarm outputs may not be initiated soon enough—important alarms might never go off.
- **Faulty Control.** Control systems based on digital outputs or a DBK25 could fail if dependent on a fast critical response time.
- **Distorted Outputs.** Analog outputs may appear to be “jaggy” or other distortions such as aliasing-type errors.

Ideally, each output signal is based on one input, resulting in an accurate output waveform. Factors such as scan rate, number of output channels and calculated channels can overload the system, resulting in one output signal for multiple input scans. The resulting signal deterioration can increase over time and shows up as a distorted and/or lagging output signal. Such output errors can resemble aliasing errors where output signals are distorted from their input signals because the effective sampling frequency was not high enough (see figure).



Solutions To Scan Rate Problems

To confirm a suspected timing problem with your acquisition, run the acquisition and then check:

- The LogBook Monitor window in LogView for a corresponding error message.
- Actual deterioration of outputs as described in the previous section.

To solve timing problems you may need to perform one or more of the following, in order of effectiveness:

- Choose a slower scan rate, or change the trigger parameters.
- Reduce the number of output channels.
- Reduce the number or complexity of calculated channels.
- Reduce the number of input channels.

Estimating an Optimum Scan Rate

Note: The scan rate can be measured **as a frequency** in Hz or kHz or **as a period** in ms or μ s. These two measures are reciprocals of each other; e.g., $1/100 \text{ kHz} = 10 \mu\text{s}$.

Processing input channels is LogBook's highest priority; each input channel is collected at $10 \mu\text{s}$. After all the inputs are collected, LogBook performs the necessary calculations and then updates the enabled outputs. The time to perform calculations and outputs varies with the type of calculation, and this makes it difficult to predict the exact length of time required. Simple calculations are done much faster than functions for non-linear thermocouples and RTDs or the use of logical and bitwise calculated channels. Output channels can take from $100 \mu\text{s}$ to $300 \mu\text{s}$; so for very approximate results, we'll use $200 \mu\text{s}$.

To *estimate* the maximum scan rate, use the following formula:

$$\text{approximate scan period} = (\text{number of inputs} \times 10 \mu\text{s}) + (\text{number of outputs} \times 200 \mu\text{s})$$

If only 5 input channels are enabled, the scan period equals 50 μ s with a frequency of 20 kHz. If one output channel is added, the period becomes 250 μ s with a frequency of 4 kHz.



After running the acquisition, check the LogBook Monitor screen for error messages. Appendix B provides a list of Software and Hardware-related error codes.

Use of Outputs to Alarm and Control



Reference Note: For information on how LogView allows you to set outputs based on *user-defined* conditions, refer to chapter 3's section entitled, *Calculated-Channel Configuration*.

By careful setup of LogBook's analog and digital outputs, you can control external devices and/or stimulate the unit-under-test. Using LogView's calculated channels, equations can be derived that can be used to stimulate digital outputs for use as alarms or for on/off control. For example, the equation:

$$\text{DIG1} = (\text{CH1} - \text{CH2}) < 2$$

turns on digital output "1" if the difference between channels 1 and 2 is less than 2.

The system's four 16-bit analog outputs can also be used for controlling or stimulating external devices. Using channel data derived from input channels and equations or canned waveforms, the analog outputs can be updated at rates as high as 100 kHz.

Acquisition

A selected acquisition can be armed:

- on command from the keypad or PC
- at power-on, or

After an acquisition, LogBook may continue the same or begin a new acquisition. The new acquisition can begin immediately, after a specified time interval, or at a specified time.

Data Storage and Retrieval

The quantity of acquired data can be reduced by **block averaging** or by **decimation** (skipping samples without averaging). Then, data is placed onto the DOS-compatible disk drive using a proprietary format in a DOS-compatible file. The acquisition setup name and a time stamp are also written to disk.

Post-processing programs can thereby correctly interpret the related data.

The PC can retrieve the acquired data through the serial or parallel port, during or after the acquisition. Upon command from the PC, LogBook can switch to storing data into a new file. After the PC retrieves data [from the first file], it can erase that file and reuse the space.

Note: Data is never erased without a specific command from the PC.

Data can also be retrieved from a PC-Card. LogBook copies enough information from the old card to the new (replacement) card to make sure the current acquisition can continue on the replacement PC-Card.



Replacement PC-Cards for use with LogBook must be pre-configured in order to store acquisition data.

Overview.....2-1

System Connections.....2-4

Installation and Configuration.....2-4

LogView Setup.....2-5

DBK30A Rechargeable Battery Module.....2-5

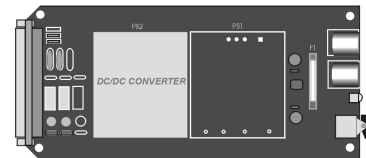
+12-14, 24-28 VDC (3.4 A-hr @ 14 VDC)



DBK30A

DBK32A Auxiliary Power Supply Card.....2-9

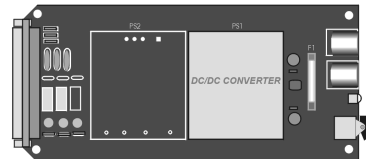
±15 V @ 500 mA



DBK32A

DBK33 Triple-Output Power Supply Card...2-10

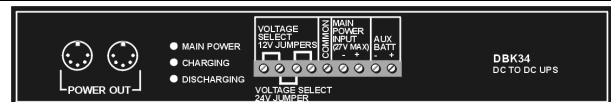
±15 V @ 250 mA; +5 V @ 1 A



DBK33

DBK34 Vehicle UPS Module.....2-11

12 or 24 VDC (5 A-hr @ 12 VDC)



DBK34

CAUTION



Improper power use can cause equipment damage. Your system may require additional power supplies.

Overview

This chapter is import as it concerns system power, and the improper use of power can cause system damage. The following terms are important in regard to understanding your system's power needs.

- **Supply** of power for the DBKs comes from a LogBook, a power card or module. If needed, the DBK32A and DBK33 can provide additional power to meet DBK power demands. The LogBook and DBK power supplies work off low-voltage DC that can come from the supplied AC adapter or a DC source such as a car battery.
- **Demand** for power comes from DBK cards and modules [and in some systems, from transducers]. You should use the **DBK Power Requirement Worktable** (page 2-3) to calculate your system's power needs. After completing the table, compare the total power demand to the supply power.
- **Distribution** of power to most DBKs is via the P1 interface. The DBK41 expansion chassis has a jumper to isolate +5 VDC power from P1. The P1 Pin designations are as follows:

Pin 1: +5 VDC

Pin 2: -15 VDC

Pin 21: +15 VDC

Pin 7 is digital ground; and pins 28 and 29 are analog ground.

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

Use of the DBK Power Cards

The DBK32A or DBK33 power card attaches directly to the P1 analog expansion bus and supplies power to analog expansion cards. The DBK32A/33 can be powered from an included AC adapter, an optional DBK30A battery module, or from a +10 to +20 VDC source such as a car battery. When installed in the DBK10 three-slot expansion chassis, the DBK32A or DBK33 is attached via the CA-37-x cable. If used with the DBK41 ten-slot expansion enclosure, it simply installs into one of the analog expansion slots on the unit's backplane.

Transducer Power

Some transducers (e.g., 2-wire 4-20 mA transmitters, bridge-configured sensors, etc) require an excitation voltage in order to work properly. The DBK30A supplies 14 and 28 VDC. Consult transducer documentation before applying power.

LogBook Power Requirements

The LogBook uses about 12 Watts. The TR-43 AC-to-DC adapter draws about 15 watts (15 VA) when powering the LogBook from 115 VAC, 60 Hz. If using battery-power, you can compute operational endurance from your battery's wattxhr rating and the following calculation tables.

Calculating Your Power Needs

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

Available Power Chart—Supply	
Product	Available Power
LogBook	+5 VDC @ 0.10 A from P1-1, P2-18, P2-20, P3-20 +15 VDC @ 0.15 A from P1-21 +15 VDC @ 0.05 A from P3-19 -15 VDC @ 0.15 A from P1-2 -15 VDC @ 0.05 A from P3-37
DBK32	7500 mW
DBK32A	15000 mW
DBK33	7500 mW
DBK34	5 A-hr in 12 V mode; fused at 8 A

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

1. In the Quantity column (5th), list the number of DBKs of that type in your system.
2. In the Sub Total column (7th), enter the product of column 5 and column 6 (mW).
3. Add the Sub Total column, and enter the sum at the bottom right of the table.
This result is your power requirement in mW.



DBK32, DBK32A, and DBK34 cannot supply +5 VDC.

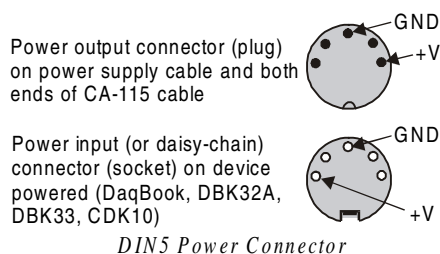
In cases that require +5 VDC, if the +5 VDC requirement exceeds 500 mW from a LogBook, then a DBK33 must be used. Note that DBK33 can supply 1000 mW at +5 VDC.

DBK Power Requirement Worktable—Demand						
DBK Options	Voltage Reference			Calculation		
	+15 VDC	-15 VDC	+5 VDC	Quantity	× mW	= Sub Total
DBK1	0	0	0		0	
DBK4	95 mA	80 mA	25 mA		2750	
DBK7	14 mA	8 mA	18 mA		420	
DBK8	15 mA	15 mA	<1 mA		455	
DBK9	21 mA	16 mA	<1 mA		560	
DBK11A	0	0	0		0	
DBK12	15 mA	15 mA	<1 mA		455	
DBK13	15 mA	15 mA	<1 mA		455	
DBK14	16 mA	16 mA	<1 mA		485	
DBK15	16 mA	16 mA	<1 mA		485	
DBK16	37 mA	32 mA	<1 mA		1040	
DBK17	30 mA	30 mA	<1 mA		905	
DBK18	36 mA	36 mA	<1 mA		1085	
DBK19	6 mA	7 mA	<1 mA		200	
DBK20	0	0	<10 mA		50	
DBK21	0	0	<10 mA		50	
DBK23*	0	0	<2 mA		10	
DBK24*	0	0	<2 mA		10	
DBK25	0	0	<2 mA		10	
DBK35	0	0	0		0	
DBK40	0	0	0		0	
DBK41	0	0	0		0	
DBK42	<1 mA	<1 mA	<1 mA		35	
DBK43A*	<1 mA	<1 mA	<1 mA		35	
DBK44	<1 mA	<1 mA	60 mA		330	
DBK45	52 mA	52 mA	<1 mA		1565	
DBK50*	<1 mA	<1 mA	<1 mA		35	
DBK51*	<1 mA	<1 mA	<1 mA		35	
DBK52	6 mA	7 mA	<1 mA		200	
DBK53	15 mA	15 mA	<1 mA		455	
DBK54	15 mA	15 mA	<1 mA		455	
DBK55	100 mA	100 mA	<1 mA		3005	
Total Power Requirement in mW						
* Module with internal power supply, powered separately						

Power Supplies and Connectors

The power supply commonly used with LogBook system is the TR-43. Input is 90-260 VAC, 50 or 60 Hz. Output is 15 VDC @ 2.3 A via a DIN5 connector on a 6 ft cord.

The DIN5 is the system's basic power connector (see figure). The CA-115 is a 6-in. cable with a plug DIN5 connector on both ends. The CA-115 connects DBK32As or DBK33s in parallel to be powered by the same supply.



Note: LogBook and DBK34 have inverted DIN5 connectors, relative to the orientation in other DBKs.

System Connections

The LogBook is designed to accommodate various DBK configurations—typically, analog inputs via P1 and digital inputs from P2. The CA-37-*x* cable comes in several variations with *x* indicating the number of devices to be attached. If using an expansion chassis, refer to those sections for related information. The DBK10 can use a CA-37-3 for 3 DBK cards; a DBK41 can use a CA-37-2 for 10 DBK cards since the DBK41 has a built-in P1 bus.

CAUTION



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



Take ESD precautions (proper packaging and handling, grounded wrist strap, etc) especially in dry or static-prone conditions.

Installation and Configuration

A successful installation involves setting up several pieces of equipment and setting software parameters. You may need to consult related sections of this manual to get the complete picture.

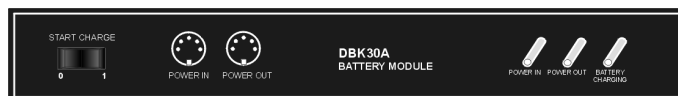
The DBKs are usually configured before the connections are made and power is applied. This order of installation can prevent equipment damage and help ensure proper operation on startup.

Many DBKs have on-board jumpers and/or DIP switches used for setting channels and other variables. These settings are discussed in the individual DBK sections.

For systems with many modules, stacking units together helps conserve space and assure easy cable runs. Such stacking is facilitated in two ways:

- **Velcro tabs.** DBK power cards are shipped with installation kits that include Velcro/adhesive tabs that allow modules to be stuck together and easily removed as needed.
- **Fastener Panels.** A splice kit provides a more rigid stacking arrangement and comes with several DBK modules. The kit includes metal plates that screw onto the sides of a module and form a vertical rack of several modules. An optional handle is available for portable use.

DBK30A - Rechargeable Battery Module



DBK30A Front Panel

DBK30A contains two rechargeable nickel-cadmium batteries and shares the same base dimensions as other LogBook products, allowing for convenient stacking.

The included power adapter converts AC power to 24 VDC for charging DBK30A's two battery packs. Automatic charging circuits recharge the internal batteries quickly and safely. The charged battery runtime depends on the current load and mode of operation.

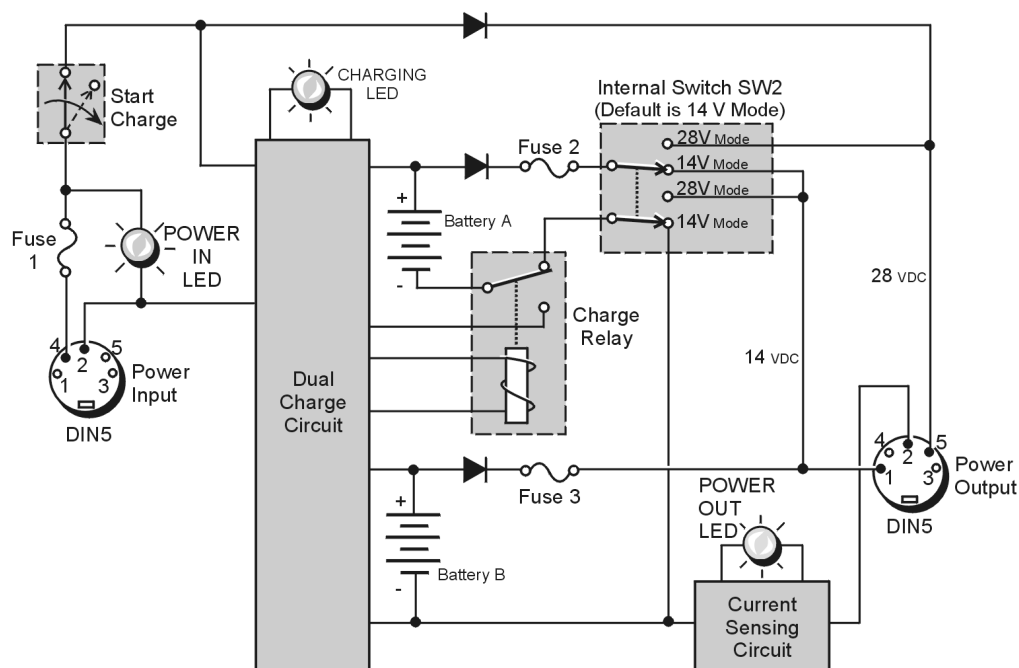
An internal slide switch (SW2) determines the unit's mode. The two modes are:

- **14 VDC Mode (default)**
- **28 VDC Mode**



You should check the power requirements of each component in your system, and then verify that the power source can provide sufficient power to meet your runtime requirements.

Fully charge DBK30A's batteries before use.



DBK30A Block Diagram

14 VDC Mode (default)

This mode provides 14 VDC for 3.4 A-hr. The typical battery runtime is from 3 to 6 hours depending on the load. Unless 28 VDC is required, the 14 VDC mode should be used in your LogBook applications.



Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

28 VDC Mode

The 28 VDC mode actually provides *both* 14 VDC and 28 VDC. Loop currents for two-wire, 4-20 mA transmitters (1.7 A-hr) require 28 VDC. The battery run-time typically ranges from 1 to 6 hours, depending on system configuration. In this mode, 14 VDC is used for unregulated bridge excitation (for bridge-configured sensors, such as load cells), and power to DBK expansion products.



Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

Hardware Setup

Configuration

The only configuration option is the choice of modes (**14 VDC**, or **28 VDC**). If you do not need 28 V, leave SW2 in the default position.



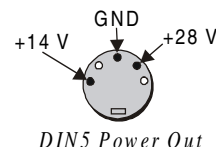
If you are using a pre-owned DBK30A, or are unsure of the mode selected, use the following steps to check SW2's position. Note that new units are always shipped with SW2 selected to the 14 VDC mode.

Internal switch SW2 is located on the printed circuit board, near the front center of the unit. To change or verify the mode:

1. Remove DBK30A's cover by removing one screw and sliding the cover forward until it separates from the module.
2. Look near the front center of the circuit board and locate slide switch SW2.
3. Check SW2's selection. The silkscreen indicates the 14 and 28 VDC positions.
4. Change the selection, if required. If you do not need 28 V, SW2 should be in the default position (14 VDC).
5. Replace the top cover, and secure with screw.

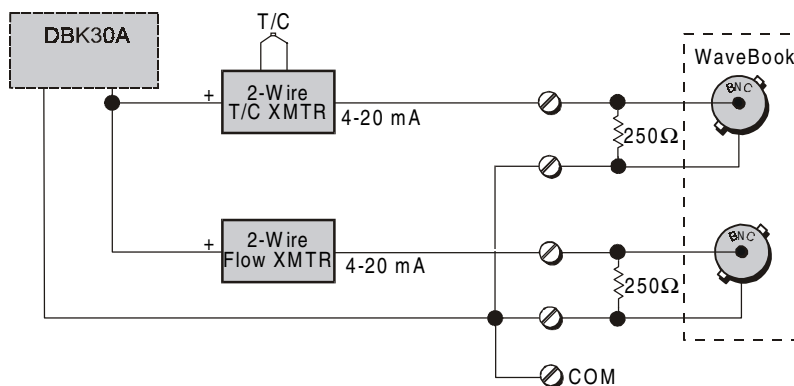
Power

Connection. The figure shows the pinout for the POWER OUT DIN5 connector. The 28 V pin is only active in the 28 VDC mode; however, the 14 V pin is active regardless of the mode selected.



Cable CA-115 is included in the DBK30A package. The cable connects to DBK30A's POWER OUT connector and WaveBook's POWER IN connector. The cable can be used to daisy-chain a DBK30A unit to a WBK expansion module.

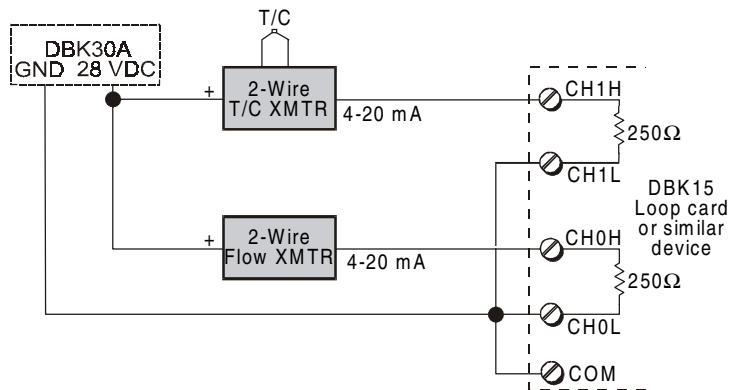
28 VDC Mode. The primary purpose of the 28 VDC mode is to provide power for external loop transmitters. The hookup is simple, as shown below.



Connecting Loop Transmitters

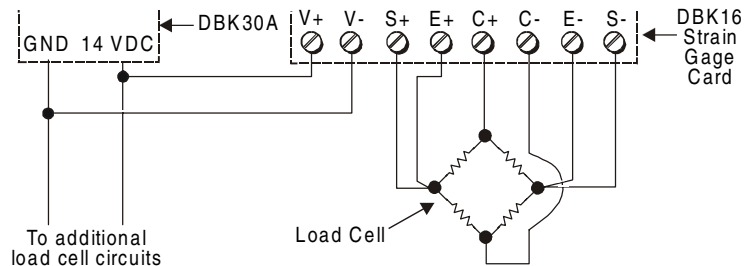
Another use of the 28 VDC mode is to provide excitation for bridge-type sensors, such as load cells (strain gages).

The primary purpose of the DBK31 mode is to power external user-supplied loop transmitters. The hookup is simple, as shown below. A DIN5 connector allows easy connection of lead wires.



Connecting Loop-Transmitter Wires

Another use for the DBK31 mode is providing an excitation source for bridge-type sensors such as load cells (strain gages). The excitation voltage is not regulated by the DBK30A; so, this voltage must be externally regulated to 10.00 V for most load cells.



Using Load Cells



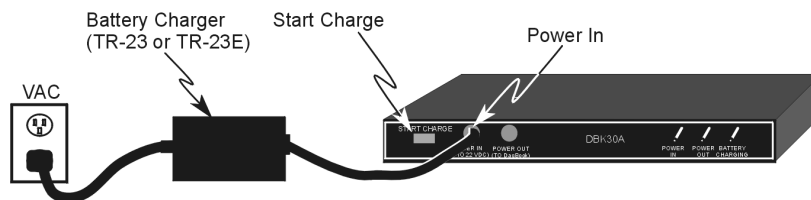
Excitation voltage from DBK30A is not regulated by the unit, and must therefore be regulated externally. For most load cells, excitation voltage should be regulated to 10 V.

Charging the Battery Module

To charge the DBK30A batteries:

1. Connect the adapter to DBK30A's POWER IN connector.
2. Plug the adapter into the AC power receptacle.

Note: The charge cycle will begin automatically whenever AC power is applied after an interruption. The charge cycle will automatically end when the batteries are fully charged.



Charging DBK30A's Batteries

3. To manually initiate a charge cycle, press the START CHARGE momentary rocker-arm switch. Note that subsequent charge cycles applied to a fully-charged DBK30A will have no ill effect. The module will sense the fully-charged status and revert to the trickle-charge state within a few minutes.

Three LEDs on the DBK30A provide status information on the charging process or the external load.

LED Indicators & Descriptions	
POWER IN	Indicates the charger is connected to a source of AC power and to the battery module.
BATTERY CHARGING	Steady Light - Indicates the battery is in the high-current (2 A) charge mode. Flashing - One or two flashes at a time indicates the batteries are fully charged.
POWER OUT	Indicates power is flowing out to an external device.

CAUTION



Periodically, fully discharge the DBK30A to inhibit “lazy chemistry” (memory) in the nickel-cadmium cells. To manually discharge a battery pack, connect a LogBook to the pack and leave it powered-on until the indicator lights go out.

Use While Charging. Both operating modes are capable of powering LogBook products while being charged; however, the charging current is reduced, and charging time increased. If AC power is interrupted, a new charge cycle will begin automatically when AC power returns.

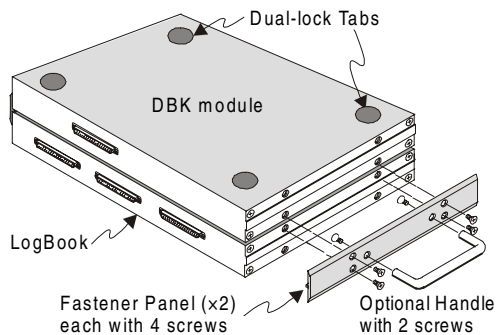
CAUTION



Even with the AC adapter, the batteries will eventually discharge under an operating load. Charging **DOES NOT BEGIN AUTOMATICALLY** (except on power-up). You must manually initiate the next charge cycle. Do not expect a device powered by a DBK30A to operate as if connected to an uninterruptable power supply.

Stacking Modules

Stacking can be accomplished with the included splice plates, discussed on page 1-16.

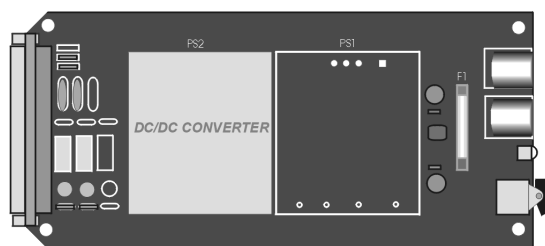


DBK30A – Specifications

Name/Function: Rechargeable Battery Module
Battery Type: Nickel-cadmium
Number of Battery Packs: 2
Battery Pack Configuration: 12 series-connected sub-C cells
Output Voltage: 14.4 V or 28.8 V (depending on the selected mode)
Output Fuses: 2 A
Battery Amp-Hours: 3.4 A-hr (1.7 A-hr/pack)

Charge Termination: Peak detection
Charge Time: 2 hours
Charging Voltage from Supplied AC Adapter: 22 to 26 VDC @ 2 A
AC Adapter Input: 95 to 265 VAC @ 47 to 63 Hz
Size: 221 mm × 285 mm × 35 mm (11" × 8-1/2" × 1-3/8")
Weight: 2.4 kg (6 lb)

DBK32A Auxiliary Power Supply Card

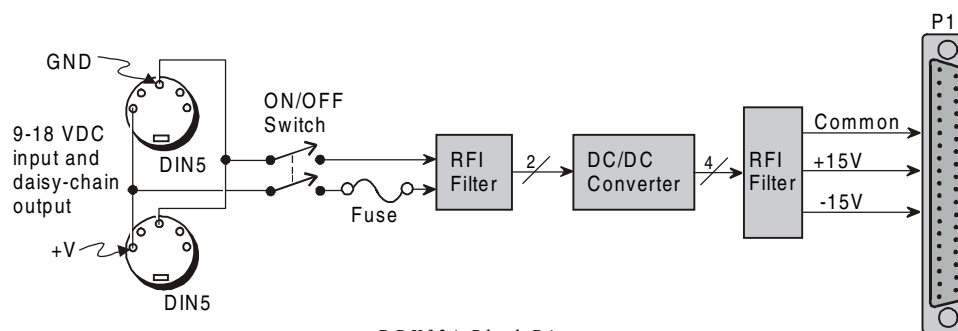


DBK32A Power Supply Card

Overview

The DBK32A provides added power in configurations where the number of expansion cards exceeds the power available from a LogBook. For power, the DBK cards rely on voltages supplied via the P1 connection. The DBK32A supplies ± 15 V via the P1 bus and is compatible with all analog DBK cards.

Notes: The DBK32A does not provide +5 V; if +5 V is required by the DBKs in use, you should use the DBK33 Triple-Output Power Supply Card.



DBK32A Block Diagram

Hardware Setup

LogBook/DBK Connection

The DBK32A has two DIN5 power connectors to allow daisy-chaining of multiple DBK32As or to share a common power source with a LogBook or a compatible DBK Module. Terminal block J1B can be used instead of the DIN5s (e.g., custom wiring with a DBK60). The DBK32A can be powered from the included AC adapter, a DBK30A battery module, or a 10-20 VDC source (e.g., a car battery).

Connect the DBK32A much like any other expansion card on a ribbon cable or inside an expansion chassis. The DBK32A can be installed into a DBK10, DBK60, or DBK41.

Note: The DBK32A is shipped from the factory with a protective shield. A DBK32A will not install into a DBK10 with the shield in place. To remove this shield, remove the five screws from the bottom side of the DBK32A board and lift off the shield and spacers as one unit. Any slot within the DBK10 may be used.

DBK32A - Specifications

Name/Function: Auxiliary Power Supply Card

Isolation, Input to Output:

DBK32A: 500 VDC
(DBK32: 250 VDC)

Output Voltages:

DBK32A: +15 VDC (nominal) @ 500 mA
-15 VDC (nominal) @ 500 mA
(DBK32: +15 VDC (nominal) @ 250 mA
-15 VDC (nominal) @ 250 mA)

Line Regulation: 0.5% (maximum)

Load Regulation: 1.0% (maximum)

Total Output Power: 7.5 VA (full load)

Input Voltage Range: 10-24 VDC

Input Current Range: 0.8 - 2.0 A

Size: 3-1/4" x 8-1/4" x 3/4"

Efficiency: 60% Typical

Input Connections: DIN-5 (x2 for daisy-chaining)

Output Connections: DB37 Male

Parallel Provision: OR-ing diodes in output lines

Controls: ON/OFF rocker arm switch

Indicators: LED driven by positive output

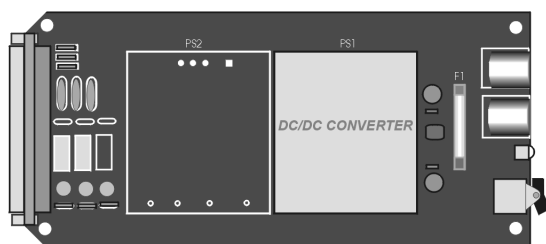
Over-Voltage Protection: Hardware SCR crowbar on (+) side

Switching Frequency: 150 kHz

Operating Temperature Range: 0-50°C

Input Fuse Size: 2 A (Littelfuse 251002)

DBK33 Triple-Output Power Supply Card

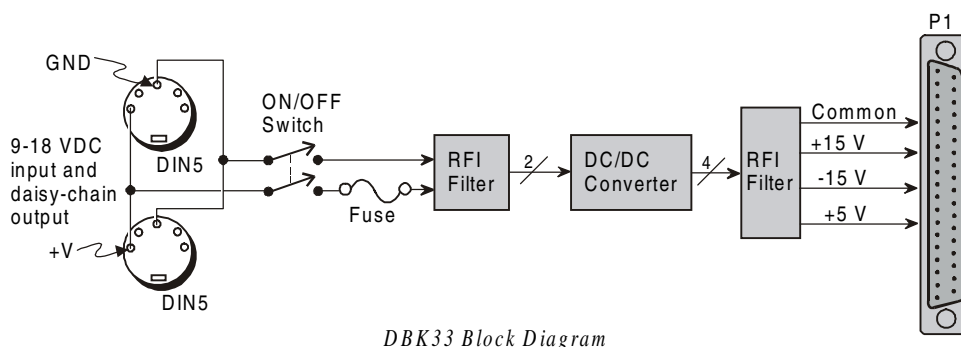


DBK33 Triple-Outlet Power Supply Card

Overview

The DBK33 provides added power (± 15 VDC and +5 VDC) via P1 in configurations where the expansion cards require more power than available from a LogBook or other power source. The card is compatible with all analog DBK cards and typically can support up to 12 DBK cards.

Note: If +5 V is not needed by the DBKs in use, you can use the DBK32A.



DBK33 Block Diagram

Hardware Setup

Cascading Power Connection

The DBK33 has two DIN5 power connectors to allow daisy-chaining of multiple DBK33s or to share a common power source with a LogBook. Terminal block J1B can be used instead of the DIN5s (e.g., custom wiring with a DBK60). The DBK33 can be powered from the included AC adapter, a DBK30A battery module, or a 9-18 VDC source (e.g., a car battery).

Connect the DBK33 much like any other expansion card in a DBK41 or DBK60 except as noted below.

Note: A jumper on the DBK41 or DBK60 must be set to disconnect the host's P1 +5 VDC from the internal +5 VDC output.

DBK33 - Specifications

Name/Function: Triple-Output Power Supply Card

Isolation, Input to Output: 500 VDC

Output Voltages:

+15 VDC nominal @ 250 mA

-15 VDC nominal @ 250 mA

+5 VDC nominal @ 1000 mA

Line Regulation: 0.2% max (+5 V); 5% max (± 15 V)

Load Regulation: 0.5% max (+5 V); 5% max (± 15 V)

Total Output Power: 15 VA (full load)

Input Voltage Range: 9 to 18 VDC

Included AC Adapter: 15 VDC @ 0.9 A

Size: 3-1/4" \times 8-1/4" \times 3/4"

Full-Load Efficiency: 80% Typical

Full-Load Input Current Range:

2.10 A @ 9VDC

1.05 A @ 18 VDC

Input Connections: DIN5 (x2 for daisy-chaining)

Output Connections: DB37 Male

Parallel Provision: OR-ing diodes on output lines allow use of multiple DBK33s in larger systems

Controls: ON/OFF rocker-arm switch

Indicators: LED driven by input voltage

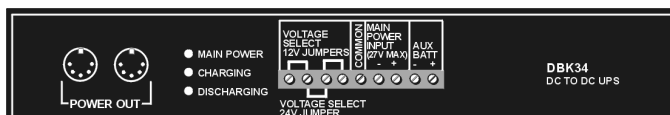
Over-Voltage Protection: Fuse followed by 19 V zener clamp

Switching Frequency: 100 kHz min

Operating Temperature Range: -20 to 70°C

Input Fuse: 3 A (Littelfuse 251003)

DBK34 - Vehicle UPS Module



DBK34 Front Panel

The DBK34 can power a data acquisition system in portable and in-vehicle applications (from 12 VDC or 24 VDC systems). Power storage capacity is:

5 A-hr @ 12 VDC or, 2.5 A-hr @ 24 VDC

For reliable data acquisition in a vehicle, the DBK34 provides clean and consistent operating power for the following instances:

- Prior to engine/generator start.
- During engine start-up (battery sag due to the high-current demand of starter motor and solenoid).
- After engine turn off.

DBK34 contains two sealed-lead rechargeable batteries, associated charging circuits, and current indicators. Typically, the batteries can last more than 500 full cycles and up to 10 years standby lifetime at room temperature. Recharging is fast, and extreme temperature performance is good. DBK34 can be used with LogBook, DaqBook, WaveBook, and related DBKs and WBKs. The unit's rugged metal package has a compatible 8x11" footprint for convenient stacking with Velcro tabs and optional splice plates and handles for carrying.

Main and auxiliary power input comes from 12 or 24 VDC via a terminal block (TB1) on the unit's front panel. The voltage mode is configured with jumpers on TB1. Automatic charging circuits recharge the internal batteries quickly and safely. The charged battery runtime will depend on the load and mode of operation.

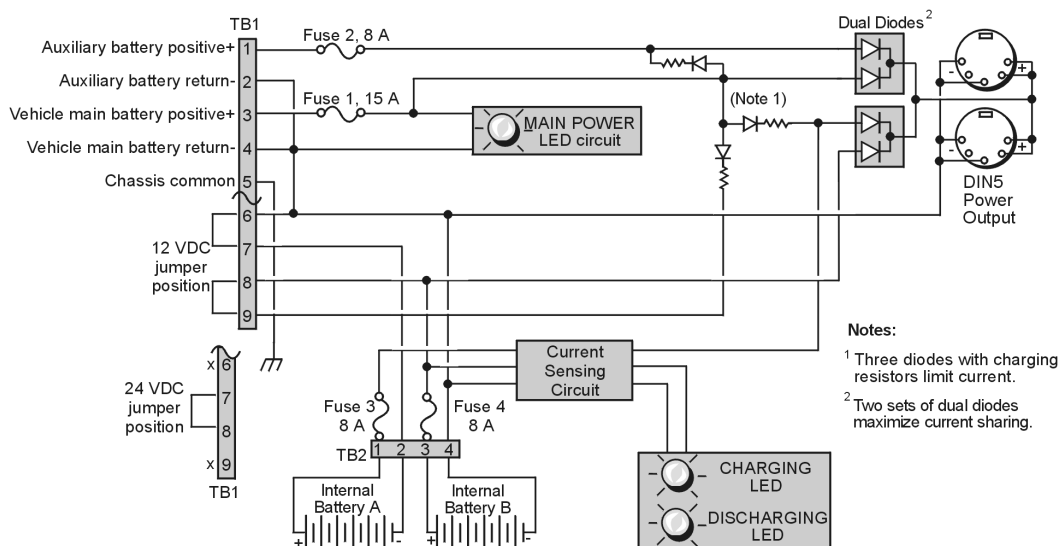
Note: Current protection is provided by four fuses. Two 8A fuses for the units internal batteries, one 8 A fuse for an auxiliary (external) battery, and a 15 A fuse for a vehicle battery.



You can use a CA-172 cable to connect a vehicle battery (via a cigarette lighter) to the DBK34 terminal board. The cable is six feet long, contains a cigarette lighter adapter at one end, and stripped leads (for terminal connection) at the other.



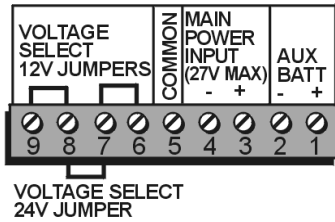
For trouble-free operation, you must fully charge the batteries before use.



DBK34 Block Diagram

Hardware Setup

Configuration



DBK34's Screw Terminal Board, TB1

DBK34's screw terminals read from right to left when viewed from the front panel (see figure).

For 12 Volt Operation:

- (1) Remove jumper from terminals 8 and 7, if present.
- (2) Use a jumper to short terminals 9 and 8
- (3) Use a jumper to short terminals 7 and 6

For 24 Volt Operation:

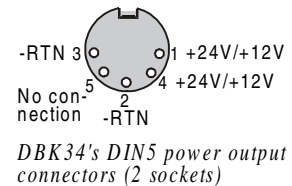
- (1) Remove jumpers from terminals 9 and 8, if present
- (2) Remove jumpers from terminals 7 and 6, if present.
- (3) Use a jumper to short terminals 8 and 7.

Power

Note: Refer to the above figure, as needed.

Power In (for vehicle main/auxiliary batteries, 12 or 24 VDC only). Connect main battery positive to terminal 3 of TB1 and main negative to terminal 4. If an auxiliary battery is used, connect its positive to terminal 1 and negative to terminal 2.

Power Out. The figure shows the pinout for the POWER OUT DIN5 connectors. The DBK34 package includes a short connecting cable to connect to the powered device. This cable connects the POWER OUT connector on the DBK34 to the POWER IN connector on the WaveBook, LogBook, DaqBook, or WBK/DBK module.



Indicators. Three front-panel LED indicators provide power and charging status information.

LED Indicators & Descriptions	
MAIN POWER	Lights when the DBK34 is connected to a live vehicle (main) battery.
CHARGING	Lights when internal batteries are being charged at a rate of 0.025 to 0.050 A or greater.
DISCHARGING	Lights when internal batteries are discharging at a rate of 0.025 to 0.050 A or greater.

Runtime. Approximate runtime under various loads can be computed from the storage capacity (5 A-hr in 12 V mode; 2.5 A-hr in 24 V mode) and the load (main unit and other DBKs). See the section, *Power Management*, at the beginning of this chapter. Factory testing determined the following run-times:

Run-times & Load Conditions	
240 minutes	DBK34 with 1.20 watt external load @ 23°C
190 minutes	DBK34 with 2.34 watt external load @ 23°C
120 minutes	DBK34 with 6.79 watt external load @ 23°C

Charging. In general, lead-acid batteries require charging at 120% of drain energy (for example, the 5 A-hr DBK34 requires a charge equal to or greater than 6 A-hr). Charging time varies but is typically 4 to 5 hours at 14 V for a totally empty battery.

CAUTION



Voltage applied to charge a DBK34 must not exceed 15 VDC in 12 V mode or 30 VDC in 24 V mode. If not charging from the vehicle, a generic auto-battery charger (3 A) in 12-V mode is recommended.

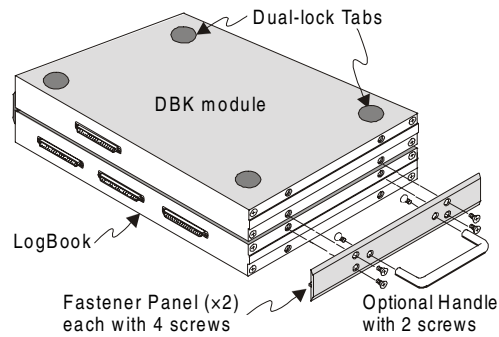
CAUTION



Environmental Concern. DBK34's lead batteries contain toxic materials (Pb and H₂SO₄). After the battery's life cycle is over (up to 500 full cycles, or 5-10 years of use), sealed-lead batteries must be properly discarded, or recycled.

Stacking Modules

Stacking can be accomplished with the included splice plates, as discussed on page 1-16.



DBK34 - Specifications

Name/Function: Vehicle UPS Module

Battery Type: Sealed-lead rechargeable

Number of Battery Packs: 2

Battery Pack Configuration: 6 series-connected D cells

Output Voltage: 12 V or 24 V (depending on jumpers)

Output Fuses: 8 A on each internal battery (2)

Input Fuses: 8 A for auxiliary battery,
15 A for vehicle battery

Battery Capacity (Amp-Hours):

5 A-hr in 12 V mode (parallel)

2.5 A-hr in 24 V mode (series)

Operating Temperature: -20°F to 122°F (-29°C to 50°C)

Size: 8½ × 11 × 1¾ in. (216 × 279 × 44 mm)

Weight: 7.2 lb (3.27 kg)



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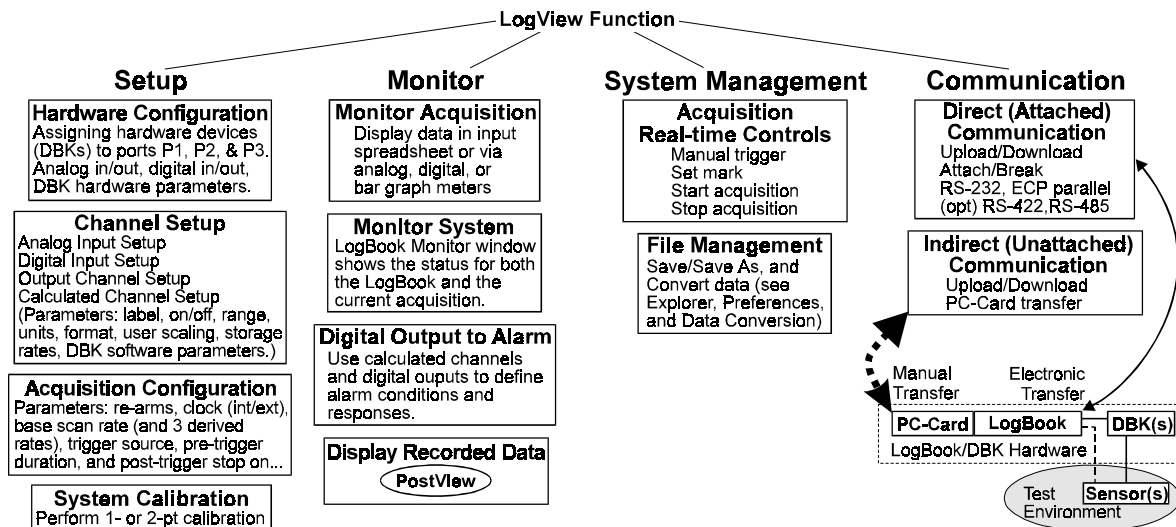
Understanding LogView

LogView provides for easy setup and operation of LogBook. LogView's flexibility can handle virtually any data-acquisition environment. The graphical Windows interface can display a variety of spreadsheets, dialog boxes, graphs, charts, and meters; and accepts user input from a mouse and keyboard. The easy-to-learn interface does not require programming or the configuration block diagrams.

It is important to understand the central role of the PC-Card in LogBook/LogView operation. When LogBook operates in a *stand-alone mode* (not attached to the PC), LogView must download the system and acquisition setup files to a PC-Card. The PC-Card must then be manually transferred to LogBook. Later LogBook's PC-Card must be transferred back to the PC for uploading. When LogBook and PC are attached in direct communication, LogView can download to [or upload from] LogBook in real time via the communications link.

Modes of LogView Operation

The next figure outlines *LogView*'s functional modes to help you visualize what *LogView* can do. This functional organization is not the same as the menu organization.



Setup

System **Setup** includes the hardware, the channels in the scan, and the triggering. Before data acquisition can begin, all setups must be complete and the resulting setup file downloaded to the PC-Card in LogBook. [page number references shown in parentheses]

- **Hardware Configuration** asks you to set the software parameters to match your hardware. For some DBKs, you may need to adjust the DBK's jumpers and DIP switches—or at least verify that the *LogView* software setting matches the DBK hardware setting (3-26).
- **Channel Setup** includes setting parameters as needed for the 4 different types of channels. These parameters vary by the channel type but are all set in software. The 4 channel types are: Analog Input (3-27), Digital Input (3-29), Output Channels (3-31), and Calculated Channel (3-31). The flexibility of the Calculated Channel allows you to create a virtual channel based on math and logic functions of real channels (analog and digital), other virtual channels, and arbitrary numerical values.
- **Acquisition Configuration** asks you to determine when, how often, and for how long to get data readings. Trigger/pre-trigger/post-trigger conditions and timebases are discussed on page 3-37.
- **System Calibration** allows you to perform 1- or 2-pt calibrations to fine-tune system accuracy.

Monitor

- **Monitor Acquisition.** In real-time, *LogView* can display system parameters and channel values in a spreadsheet style. If so desired, readings can be formatted into bargraphs, analog meters, and digital indicators (3-48).
- **LogBook Monitor** shows you the status of the current acquisition and the LogBook system (3-43).
- **Programmed Digital Outputs Used As Alarms.** The monitoring function can be automated via calculated channels and digital outputs to engage alarms when pre-defined conditions occur.
- **Display Recorded Data.** *DIAdem* (called independently, or from within *LogView*) allows you to graphically view previously recorded data for analysis and comparison. *DIAdem* is covered under separate documentation. Another program, *PostView*, can also be used to view and analyze data. *PostView* is discussed in Appendix F.

System Management

LogView allows you to manage aspects of an acquisition in progress and file saving/conversion:

- **Direct Acquisition Controls** of LogBook include manual triggering and setting reference marks (via LogBook Monitor, 3-43) and starting/stopping an acquisition. In these ways, *LogView* gives you immediate access to LogBook operation.
- **File Management** includes managing data/configuration files and converting data file formats. The *LogView* Explorer window allows you to manage files on the PC-Card.

Communication

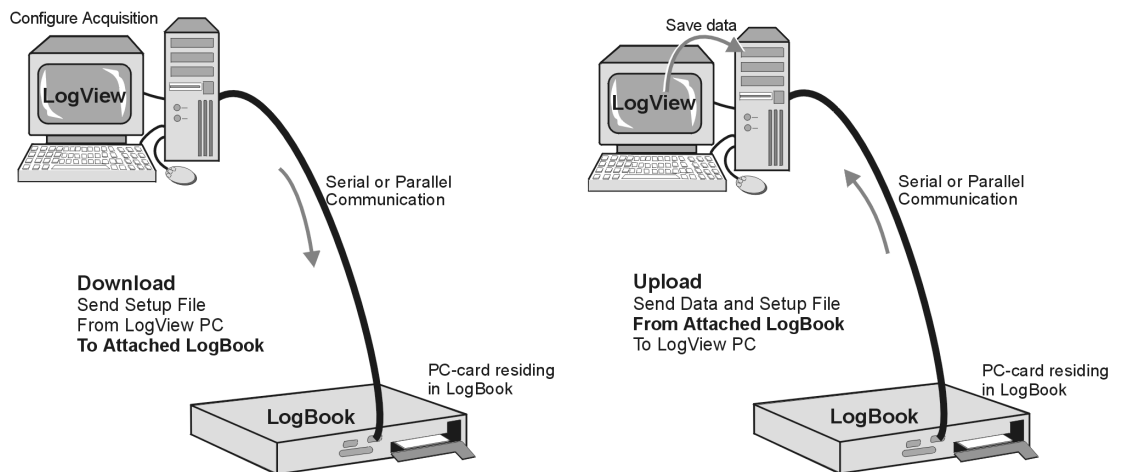
Communication between *LogView* and LogBook is actually between the PC and a PC-Card. During the communication, the PC-Card can reside in a LogBook for **direct (attached) communication** or in the PC's PC-Card socket for **indirect (unattached) communication** (and later manually transferred to LogBook).

Whether direct or indirect, communication involves downloading and uploading:

- **Downloading** sends the acquisition setup file (created in *LogView*'s Setup mode) to LogBook's PC-Card. LogBook uses the setup file to run the acquisition (also needs **logbook.sys**).
- **Uploading** receives recorded data from LogBook's PC-Card. After the data has been collected and temporarily saved on LogBook's PC-Card, the data must be uploaded to *LogView* for processing, conversions, use in other programs, and/or archival saving.

In the **Direct (Attached) Communication** mode, communication occurs through the electronic connection (cabling via serial or parallel port). While attached, LogBook can do 2-point calibration, look at current readings, and download/upload without handling the PC-Card.

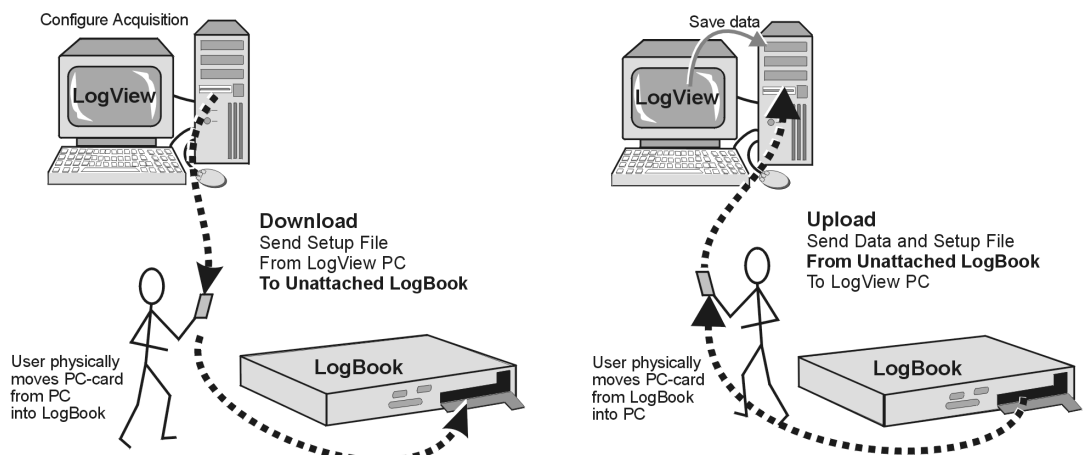
Note: In some cases, data transfer may be faster by placing LogBook's PC-Card in the computer's PC-Card socket and bypassing the attached communication.



Direct Downloading and Uploading With Attached PC

In the **Indirect (Unattached) Communication** mode, no electrical connection exists between the PC and LogBook. A PC-Card carrying the setup file and/or data must be physically transported between the PC and LogBook.

Note: The LBK1 remote operation terminal can be used with an unattached LogBook for limited control and monitoring. The LBK1 option is detailed in chapter 4.



Indirect Downloading and Uploading With Unattached PC

LogView Features and Capabilities

In setting up an acquisition, LogView can:

- Configure parameters for all input, output, and calculated channels without using special programming skills.
- Provide flexible triggering to acquire continuous data, capture exceptions or, to trigger based on calculated channels.
- Configure and operate expansion chassis, including the DBK option cards and modules designed for various signal-conditioning environments.
- Provide utilities (convert units, calibrate sensors, calculate channels, control outputs/alarms, etc).

In handling data, LogView can:

- Download an acquisition setup file to a PC-Card for physical transport to a remote LogBook, or send the setup file directly to the PC-Card in a LogBook via the serial or parallel port.
- Upload the recorded data from LogBook by corresponding means.
- Create files for use by other Windows programs; e.g., database or analysis.

Utility-wise, LogView can:

- Calibrate all gains and offsets on a per-channel basis.
- Launch DIAdem, a separate program that allows you to graphically view pre-recorded data. DIAdem is described in separate documentation.
- Interact with LogBook while the acquisition is taking place including manual trigger and event marking.

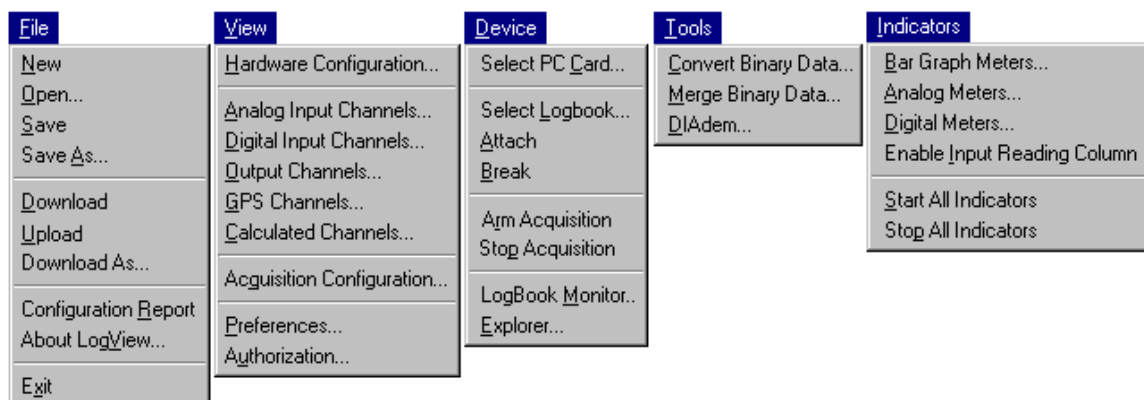
In monitoring an acquisition, LogView can:

- Display readings and status in real-time. On-screen indicators provide channel feedback during an acquisition. Channel values can be displayed in charts, bargraphs, analog meters, or digital readouts.
- Show system status including trigger status, errors, alarms, etc.

Software User-Interface

LogView's user-interface uses a control window with toolbar/menus and a spreadsheet model. Similar to other Windows-based programs, LogView's user interface will seem familiar and intuitive. Windows can be sized and placed to best fit your application. Several different meter styles are available to monitor data in real time if so desired.

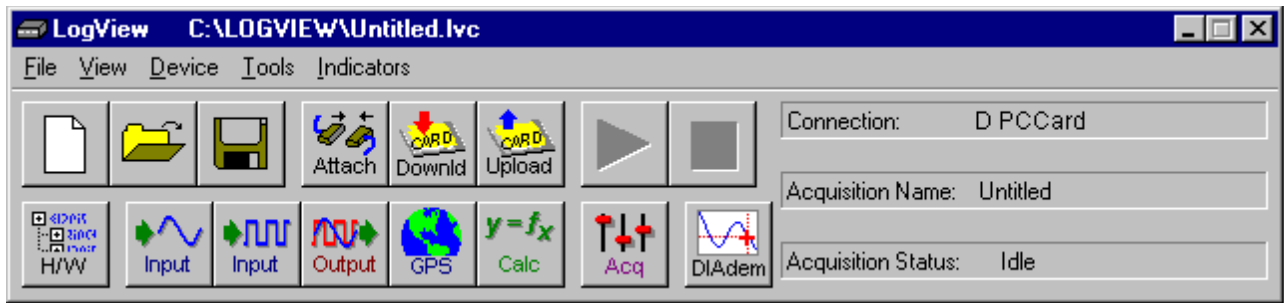
Control Window (Pull-Down Menus and Toolbars)



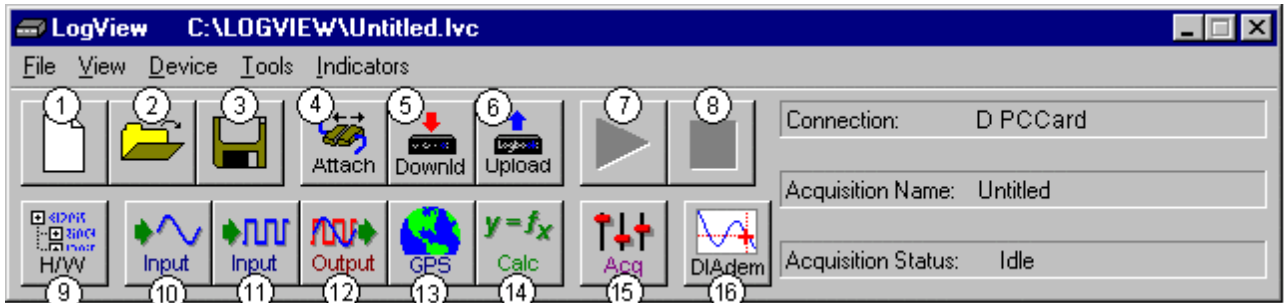
LogView Pull-down Menu Selections

LogView pull-down menus (above) are discussed in the section, *Menu Descriptions*. The following figure shows LogView's control window. Note that two sets of toolbar buttons reside just below the row of pull-down menus.

Toolbar commands can be accessed in two ways: (1) via toolbar, or (2) via pull-down menu selection. Note that the pull-down menus include additional commands that do not have corresponding buttons in the toolbar.



LogView Control Window – LogBook Unattached



LogView Control Window – LogBook Attached

Legend

- | | |
|--|---|
| 1 – New Setup File | 8 – Stop Acquisition |
| 2 – Open Setup File | 9 – Hardware Configuration |
| 3 – Save Setup File | 10 – Analog Input Setup |
| 4 – Break PC from LogBook (Shows when PC is attached), or
– Attach PC to LogBook (Shows when PC is unattached) | 11 – Digital Input Setup |
| 5 – DownLoad to LogBook (Shows when PC is attached), or
– DownLoad to PC-Card (Shows when PC is unattached) | 12 – Output I/O Setup |
| 6 – UpLoad Acquisition Setup & Data to LogBook
(Shows when PC is attached), or
– UpLoad Acquisition Setup & Data to PC-Card
(Shows when PC is unattached) | 13 – GPS (Global Positioning System) Option |
| 7 – Arm (Start) Acquisition | 14 – Calculated Channel Setup |
| | 15 – Acquisition Configuration |
| | 16 – DIAdem |

Spreadsheet Model

LogView's interface uses a **spreadsheet model** of cells in rows and columns (see next figure):

- **Each row is a different channel.** Individually-controlled channels can be hardware-based or calculated; channels can be identified with user-specified labels.
- **Each column is a parameter related to the channel.** Some parameters can be user-set (user label, sample rate, etc); others are read only (physical channel, readings from transducers, etc).

Note: Generally, cells that are “grayed-out” rather than black are not subject to user input (e.g. physical channel, channel type); however, grayed-out Sample Rates under the Storage tab can be changed in the Acquisition Configuration Window.

Channel Configuration

Enter channel label: **P1_CH00**

Storage		DBK Parameters		User Scaling		2-Point Cal					
#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	Sample Rates			
								A	B	C	D
1	P1_CH00	P1_CH00	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
2	P1_CH01	P1_CH01	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No

User-specified channel label. 16 characters maximum. Type in desired label or leave default.

Analog Input Channel Configuration Window, Spreadsheet Portion

LogView's spreadsheet-style setup provides a simple method of both viewing and configuring the parameters of the input, output, and calculated channels. Several spreadsheets are needed to display all the channels' parameters. *LogView's* spreadsheet windows include:

- **Analog Input Channel Configuration** (see page 3-27 for details) - This default-opening window has more parameter columns than will fit in view at one time. Therefore, the left-most (white) columns are shown in every view; these parameters include: Physical Channel, User Label, On/Off, Reading, Range, Units, and Channel Type. The right-most (shaded) columns vary depending on which folder tab is selected. Each tab (Storage, DBK Parameters, User Scaling, and 2-Point Calibration) has tab-specific parameters.
- **Digital and Counter Input Channel Configuration** (see page 3-29) - LogBook has three 8-bit digital ports and one high-speed 16-bit port configurable as inputs or outputs. Digital expansion cards can provide up to 192 digital bits. There are also 4 pulse-input ports that can count pulses for summing and/or frequency measurement.
- **Output-Channels Configuration** (see page 3-31) - This window shows all the currently-available digital and analog output channels. Each output channel is fed by a user-set source channel. Source channels can be chosen from any of the input (hardware) channels or calculated (virtual) channels.
- **Calculated-Channel Configuration** (see page 3-31) - *LogView* can derive virtual channels using standard math operators and functions (<, >, min, max, etc). Virtual channels can be used to create alarms, reduce data statistically, develop sophisticated trigger equations, and manipulate input channel values for more useful output including simple control systems.

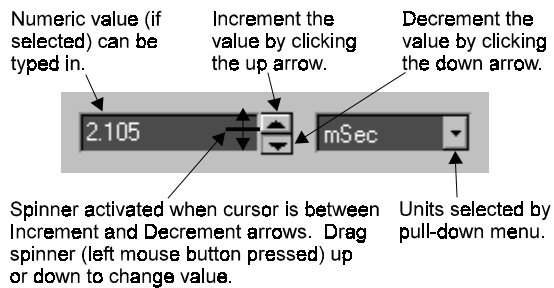
Help Box

The bottom of the spreadsheet contains a context sensitive Help Box for the selected field. As you configure channel parameters, the Help box identifies the field and provides pertinent user information. An example, taken from the previous figure, follows.

Example: In the above figure the User Label cell (of channel 1) is selected. The Help box identifies the field as "User-specified channel label" and states user options. In this case, they are (1) to type in a desired label, i.e., to provide the channel with more meaningful name [not to exceed 16 characters]; or (2) keep the default label of P1_CH00.

User Input

To set up channel parameters, first select the appropriate cell (highlighted in a bold box) with the mouse or keyboard arrow keys (up/down/sideways). Some cells allow you to key-in values from a keyboard (values such as user labels, offsets, etc). When key-in cells are selected, a user-input box will appear where you can type in characters as needed (e.g., channel label in previous figure). Some cells allow you to choose the desired setting from a drop-down list; you select among the options, and the parameter is set. Other cells allow you to set numeric values with "spinner" up/down arrows that change the value incrementally (selecting a point between the spinners changes the mouse action into a virtual scroll bar—as you drag the mouse vertically, the numeric values change accordingly).



User-set parameters can be set individually per channel, or the same value can be “filled down” for an entire column. To apply the same column setting to multiple channels, use the spreadsheet’s **fill-down** feature. Select multiple cells in a column by dragging the mouse with the left mouse button (or using the <Shift> and arrow keys). **Enable the fill-down feature with the right mouse button.**

As a shortcut to toggle channel readings on or off, you can place the cursor in the Reading column and double-click the mouse. Another alternative is to double-click the column title, and every channel value in the column will change to the next value if such a value is list-selectable. Globally, you can switch all channel readings in the Indicators menu as Start All Indicators and Stop All Indicators.

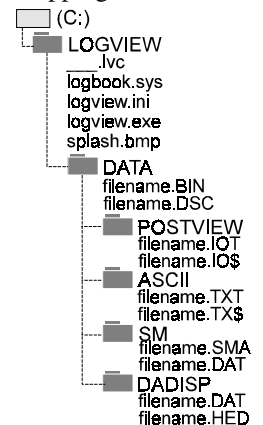


For program windows that exhibit an “Apply” button, note that parameter changes will not be *locked-in* until the Apply button has been pressed (clicked).

File Management

LogView uses various types of files for its operation:

- **System.** The file **logbook.sys** is the system file that operates LogBook. It must reside on the PC-Card in LogBook for the system to power-on and work properly. All PC-Cards used with LogBook should have this file.
- **Setup (Acquisition Configuration).** The filename extension for the acquisition setup file is **.LVC** (from *LogView* Configuration). This file is downloaded to LogBook’s PC-Card. The file contains parameter details for a particular acquisition (as configured in *LogView*). When swapping PC-Cards in a remote LogBook, the new PC-Card should have the same **.LVC** file.
- **Data.** Names for the data files use a long format convention as described below. The Preferences window from the View pull-down menu allows you to customize how your data files will be named.



File Organization

As data is uploaded to the PC, *LogView* first uploads the raw data file(s) and then converts them into the formats specified in the Preferences window. The raw binary files are placed in the DATA directory in the path specified during a configuration save. If the configuration was never saved, the DATA directory will be created in the *LogView* working directory. *LogView* creates a sub-directory within DATA for each file format selected. The figure shows a typical file structure.

Data Filename Generation

Uploading can create one data file or many data files. A simple, completed data collection with one timebase will produce only one data file. More complex conditions will create multiple data files. When these conditions exist, *LogView* creates a *file-set* rather than a single file.

These **configurations** will create multiple data files during an upload.

- With multiple timebases enabled, *LogView* generates a separate file for each rate.
- With Auto Re-arm set greater than 0, multiple trigger blocks will be collected—each in a separate file.

These **events** will generate multiple file-sets.

- When LogBook configuration is re-armed through *LogView* or by cycling LogBook’s power, a new file-set is created.
- When a partial upload takes place with an attached LogBook, a new file-set is created.
- When a partial upload takes place from a PC-Card in the PC’s socket, a new file-set is created.

A partial upload saves part of the data from an active acquisition. Three ways to perform a partial upload:

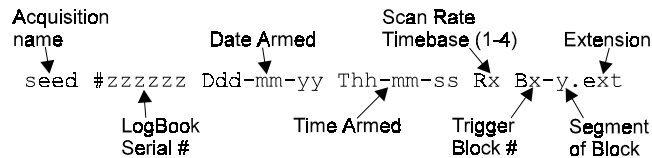
- During an acquisition, connect your PC to LogBook and execute an upload. To make room for additional data, the uploaded data is deleted from the PC-Card.
- During an acquisition, swap the PC-Card in LogBook with a different card. Then insert the card into your PC, and perform an upload.
- Start an upload of any kind; then click Cancel while the upload is taking place.

Naming Format for Data Files

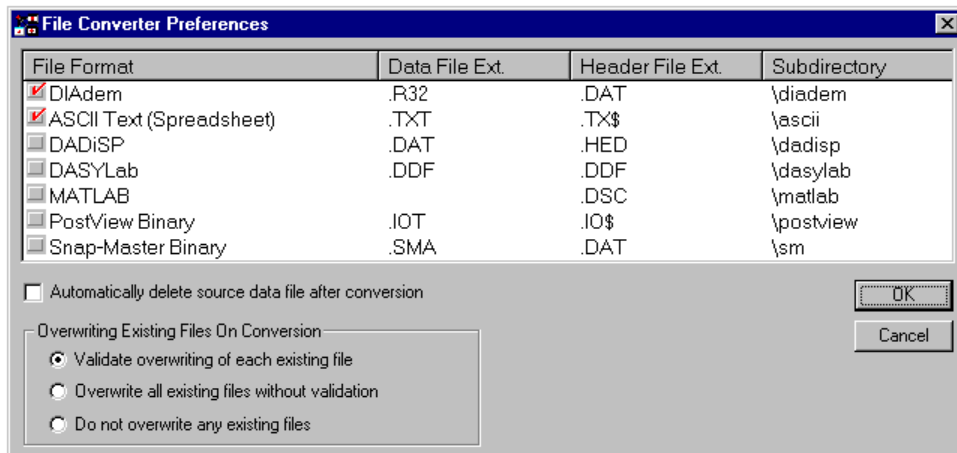
LogView names uploaded data files to make them easy to identify and organize. The File Converter Preferences window (Represented below) allows you to customize *LogView*'s naming process to suit your needs. Navigate as follows to access the window: View Pull-down menu ⇒ Preferences ⇒ File Converter. Preferences can be set so:

- Files will not be accidentally overwritten
- The use of several LogBooks is easy to manage.
- Test times and dates automatically embedded
- It is easy to identify files that are part of the same acquisition

The figure and table below define the full-field format for data files. As described in the next section, you may wish to turn off unneeded fields for simplicity.



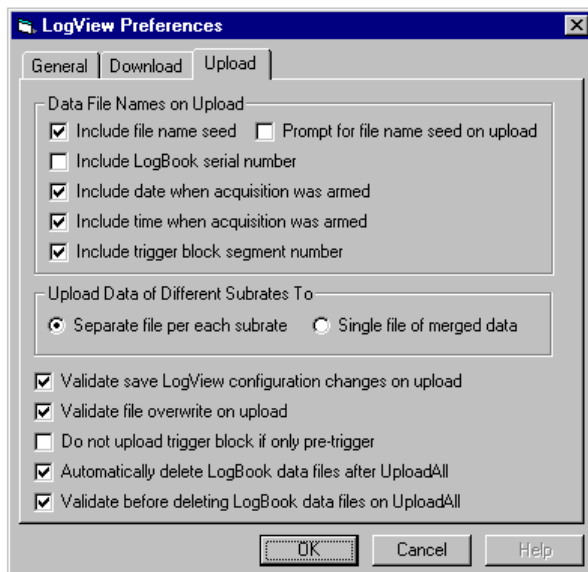
seed	User-supplied identifier string (e.g., TOM1) provides easy identification of files associated with a specific test, person, or device-under-test.
#zzzzzz	When multiple LogBooks are being used, the 6-digit serial number identifies which LogBook was used to collect the data.
Ddd-mm-yy	The Date field represents the date the acquisition was initially armed. This date is not necessarily the date when the data was actually collected. It is possible LogBook was armed on Thursday but did not trigger until Saturday. The file-last-modified date shown as a file attribute in Windows Explorer (not LogView Explorer) is the date the file was uploaded to the PC.
Thh-mm-ss	The Time field represents the time the acquisition was initially armed. This time is not necessarily the time when the data was actually collected. It is possible LogBook was armed at noon but did not trigger until 2:00pm. The file-last-modified time shown as a file attribute in Windows Explorer (not LogView Explorer) is the date the file was uploaded to the PC.
Rx	The Rate field holds a number from 1 to 4 representing the scan rate for the file. If channels are stored at more than one rate, a file is created for each rate.
Bx-y	The Block field holds 2 numbers: x is the trigger block number, and y is the segment of the trigger block. A trigger block is segmented when partial uploads take place. Typically, y will be 1 when the entire trigger block is uploaded at once. The numbers are generated chronologically as they occur.
.ext	The filename extension for the data files and their explanatory header files are shown below



File Converter Preferences Window

This window is reached by navigating as follows: View Pull-down menu ⇒ Preferences ⇒ File Converter

Customizing the File Name



LogView Preferences Window, Upload Tab Selected

This window is reached by navigating as follows: View Pull-down menu ⇒ Preferences ⇒ Upload Tab

Under certain conditions, all filename fields may not be needed. To turn off fields, simply enable or disable the check boxes in the Upload tab of the Preferences window (see figure here and discussion on page 3-40). Be aware that simplifying the filename removes the safeguards to prevent 2 files having the same name and causing an overwrite/lost information condition. If fields are disabled, overwrites are more likely to occur.

The following table suggests when it is safe to turn off various filename fields.

Condition	Recommendation
I want to overwrite old data every time I perform an upload.	No optional fields are required.
I only have one LogBook.	Turn off LogBook serial number field.
I use a new seed every time I upload.	Only the seed option is needed.
I often accumulate multiple acquisitions on the PC-Card and want to upload them at one time.	Make sure at least the time field is enabled; otherwise, acquisitions will be overwritten as they are uploaded.
I never perform partial uploads.	Don't need block number.

Example of all parameters: LAB1 #123456 D03-15-98 T12-04-12 R1 B1-1

SEED (user description string) = "LAB1"

LogBook serial number = 123456

Date armed = March 15, 1998

Time armed = 12:04:12PM

Rate = 1

Trigger block = 1, Segment = 1

Simplest application. If a new acquisition is uploaded, this file will be overwritten: R1 B1-1

Rate = 1

Trigger block = 1, Segment = 1

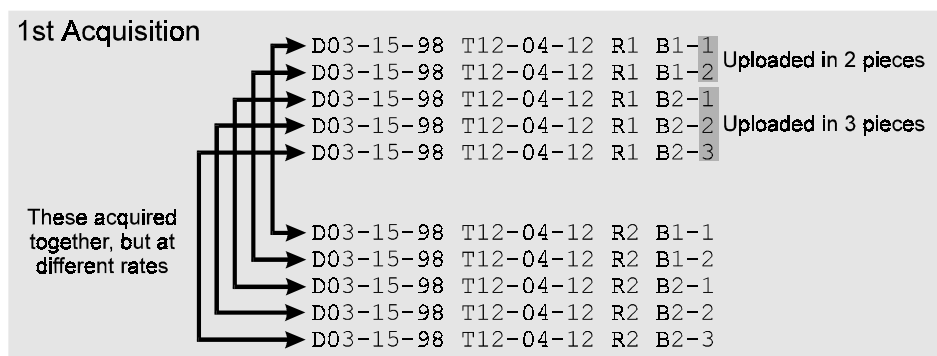
If all acquisitions are performed in the same day, the time can identify the files: T12-04-12 R1 B1-1

Time = 12:04:12pm

Rate = 1

Trigger block = 1, Segment = 1

The example below shows data files from an acquisition with 2 trigger blocks and 2 timebases; the acquisition was uploaded in segments. All the dates and times are the same because these trigger blocks are all part of the same acquisition. The first two files represent a continuous data collection—2 files exist because of partial uploads.



Example of Data Uploaded in Segments

How To... Procedures

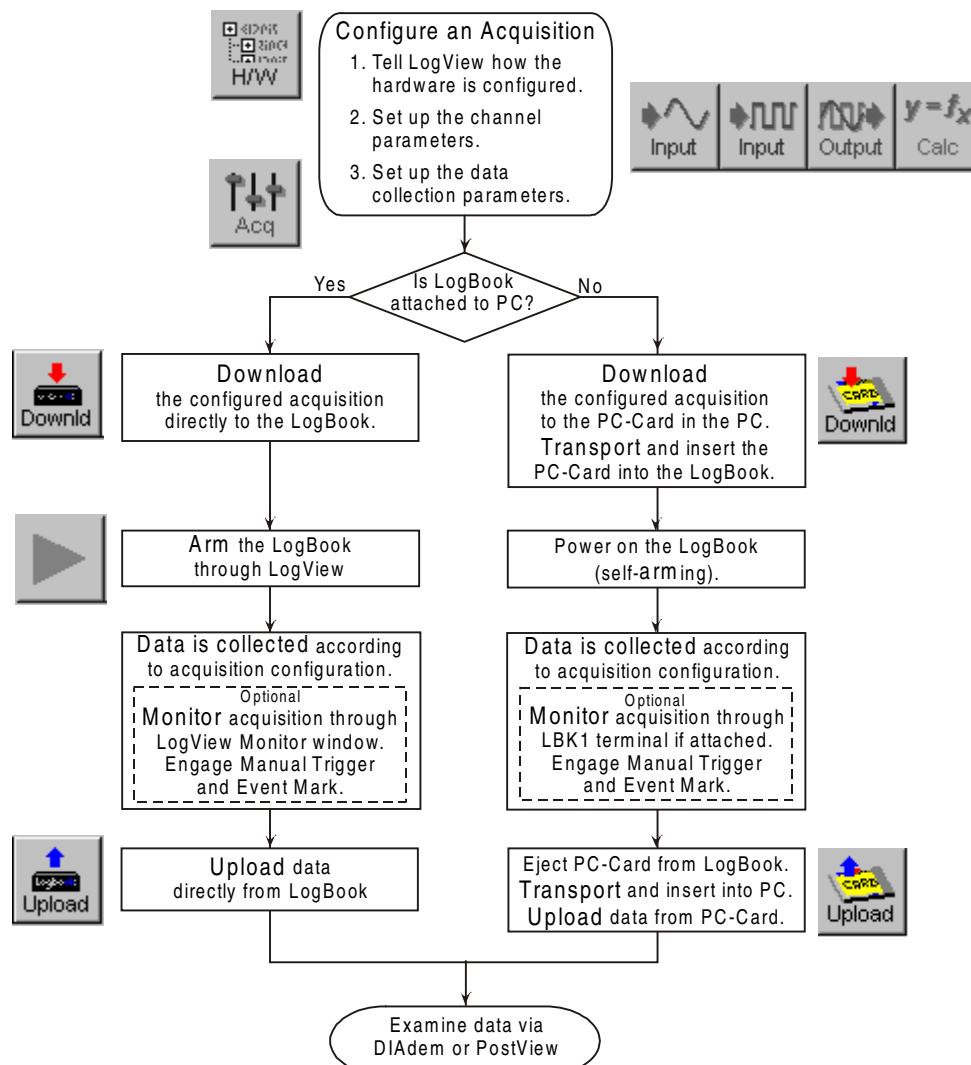
Because of *LogView's* flexibility, this manual can not detail every possible use of the system. Instead, these procedures explain how to perform typical tasks. Understanding these tasks will help you apply the principles to a variety of data acquisition environments. For your particular application, you may need to combine or alter these procedures. For more details, you may need to refer to related Menu Descriptions or procedures.

This section begins with a flowchart of a simple acquisition and then explains the following tasks and operational modes:

- Using an Attached LogBook.....3-11
- Using LogBook "Unattached".....3-13
- Simple Data Logging.....3-13
- Setting Up DBK Cards.....3-15
- Using Multiple Timebases.....3-16
- Using Digital 2-Point Calibration.....3-17
- Using Digital Outputs As Alarms...3-19
- Using Exception Capturing.....3-20

Flowchart of a Simple Acquisition

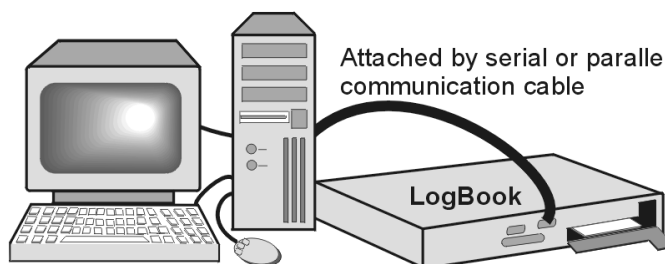
Consider the flowchart of a simple data acquisition. Whether LogBook is attached or unattached, the process is similar except for downloading and uploading. You begin the process in *LogView* by defining the parameters for an acquisition.



Basic Operational Flow of a LogBook Acquisition

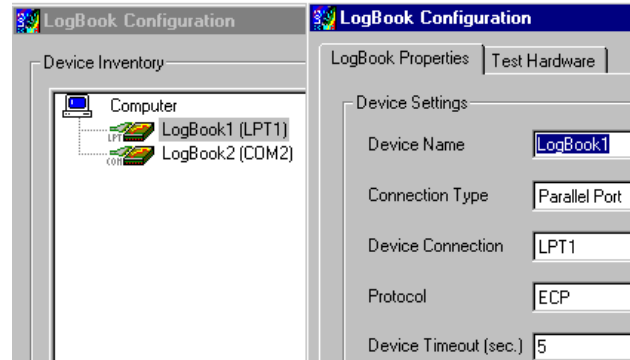
Using an Attached LogBook

When using an attached LogBook, *LogView* communicates directly to the PC-Card in LogBook through the communication interface (serial or parallel).



After *LogView* recognizes the attached LogBook, an acquisition setup file can be downloaded to LogBook. After the acquisition, data can be uploaded from LogBook without handling the PC-Card. Note that steps 1 through 4 are often done during the initial installation.

1. On your PC with *LogView* already loaded, open control panel applet, and check Hardware Configuration. If no LogBook is present in the tree, click Add Device and a LogBook ID; otherwise, select a LogBook in the tree and click Properties.
2. Under LogBook Properties tab, enter or verify device name, the connection type, the protocol, a timeout duration; and then click Apply.
3. (if serial connection) Under Port Settings tab, select baud rate and related parameters; and then click Apply.
4. Verify proper LogBook connection and power-on; then, under the Test Hardware tab after, click the Test button. Testing will verify system parameters and then bench-mark system communication performance.
5. Launch *LogView* from your PC (unless you set up a shortcut, you can find *LogView* in the Programs group in the Start menu). The control window and the Analog Input Channel Configuration window should appear.
6. Under the Device menu in the control window, click Select LogBook. From the drop down list, select LogBook you just configured in the hardware tree; then click the Attach icon to establish a communications link. The Upload and Download buttons in the Control Window should now be enabled (*LogView* recognizes when LogBook is attached and enables the applicable tools as seen by their lettering turning from gray to black).



7. In *LogView*'s Analog Input Channel Configuration (see page 3-27) and Acquisition Configuration (see page 3-37) windows, set up the channels and trigger parameters you wish to use (see *Simple Data Logging*, page 3-13).
8. Download the acquisition setup file just configured to LogBook
9. Click the Arm Acquisition button (▶). LogBook is now armed and ready to collect data when the trigger parameter is satisfied.
10. During the acquisition, you can monitor system status via LogBook Monitor window accessed from the Device pull-down menu. To verify proper operation, such monitoring is recommended for the first run of a new acquisition setup file.
11. After collecting data, click Upload to pull the data into the PC (see page 3-23). Depending on the communication channel and size of data files, uploads take a variable amount of time. Uploads can also be done incrementally during an acquisition.

The next time you launch *LogView*, it will automatically look for the selected LogBook and attempt to attach itself. At this point, *LogView* and LogBook will be in constant communication. If you want to turn off LogBook's power or detach the communication cable, you should first select Break from the Device menu or Exit from the File menu.



PC-Cards purchased with LogBook have been initialized at the factory. PC-Cards purchased elsewhere must be initialized through *LogView*. The initialization procedure is discussed in the following paragraph.

Initializing a PC-Card

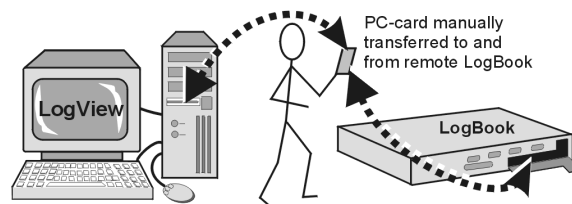
PC-Cards, that were purchased with LogBook, have been initialized. **PC-Cards purchased elsewhere must be initialized.** Initialization is accomplished as follows:

1. Place the PC-Card in the PC's corresponding socket.
2. Select the driver according to your card's documentation.
3. In *LogView*, under the Device menu, click Select PC-Card, then click OK.

LogView will check the card and initialize it as needed.

Using LogBook “Unattached”

When using a LogBook “unattached,” *LogView* does not communicate in real time with LogBook; instead, *LogView* downloads the acquisition setup file to a local PC-Card that can later be manually transferred to LogBook.



After the acquisition is complete, the PC-Card that collected data in LogBook must be manually transferred to the PC where *LogView* can then upload the data. The PC-Card must first be properly initialized :

1. Take any ATA PC-Card memory device, and insert it into a corresponding socket on the PC. If this is the 1st time this type of card has been inserted, Windows may require driver information. Follow the on-screen instructions, or refer to the documentation included with the PC-Card.
2. Launch *LogView* from your PC (unless you set up a shortcut, you can find *LogView* in the Programs group in the Start menu). The control window and the Analog Input Channel Configuration window should appear.
3. Under the Device menu, click Select PC-Card. Use the drop down list to tell *LogView* which drive letter is associated with the PC-Card. Note: as PC-Cards are inserted and removed from the sockets, Windows will arbitrarily assign drive letters. If 2 PC-Cards occupy 2 sockets, the order of their insertion usually dictates the assignment of drive letters. The Attach, Upload, and Download buttons on the Control Window should now be enabled.
4. In *LogView*'s Analog Input Channel Configuration and Acquisition Configuration windows, set up the channels and trigger parameters you wish to use (see *Simple Data Logging* below).
5. Download the acquisition setup file (**logbook.sys** will also be downloaded if not already present).
6. Eject (remove) the PC-Card from the PC socket, and transport it to the remote LogBook site. Insert the PC-Card into LogBook's socket, and power up LogBook. LogBook will automatically load the setup file and arm the system.
7. After the remote LogBook has collected all the data, remove the PC-Card from LogBook's socket, transport it to the PC, and insert it into the PC's socket. If *LogView* is running, it will soon recognize the presence of the card and enable the Upload and Download buttons.
8. Click Upload to pull the data into the PC.



After telling *LogView* which drive letters are associated with PC-Card disks, *LogView* will periodically poll the system for their presence. As cards are inserted and ejected, *LogView* will automatically enable and disable the Upload and Download buttons.



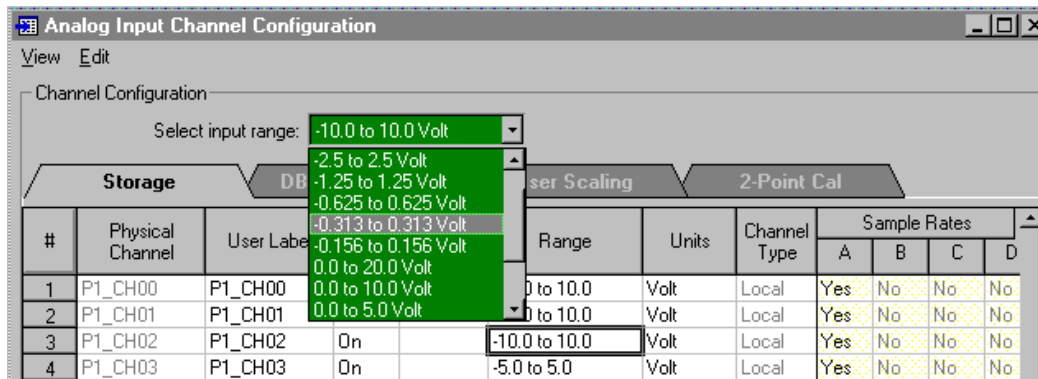
If a large quantity of data will be recorded, you should return to the remote LogBook in time to swap PC-Cards [before the first card is full]. Card swapping is discussed on page 1-7. All PC-Cards to be swapped must first be initialized as discussed in the previous section.

Simple Data Logging

To log data, you need to configure the hardware, set up the channels, and configure the acquisition parameters. The following steps are generic and will vary with different applications.

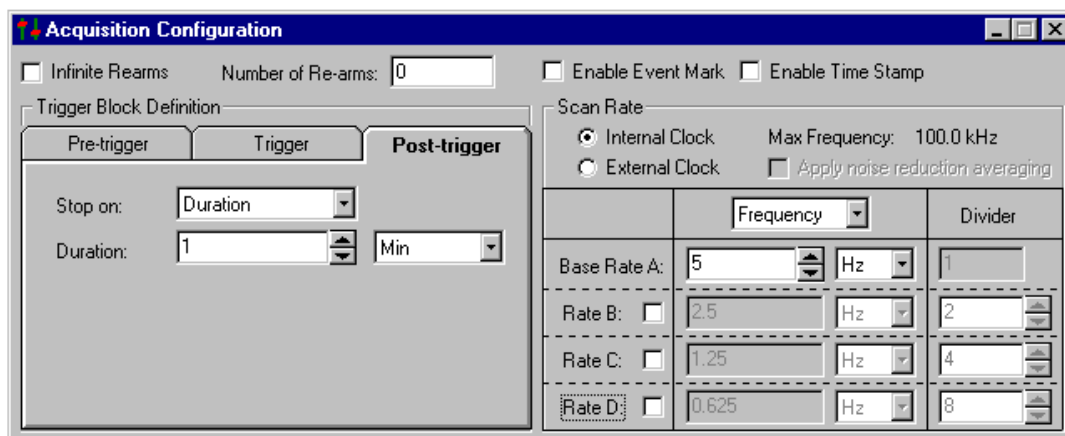
1. Launch *LogView*, and Attach *LogView* to your Logbook if working in an attached mode or to a PC-Card inserted in your PC if working in a remote, unattached mode (see previous 2 procedures if necessary).
2. Select New under the File menu or the “New” button, and give the acquisition setup file a name relevant to your application.
3. Click the Analog Input button to display the setup grid in the Analog Input Channel Configuration window. Turn all but the 1st 4 channels off (or as applicable) by placing the cursor in the On/Off column and double-clicking to toggle the setting on and off (unused channels that are left ON will limit the maximum scan rate possible). To change the Range for a particular channel, click the cursor on the affected and then use the drop down user input box to select an appropriate range (can be bipolar or unipolar).





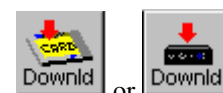
Selecting Input Range for Channel P1-CH02

- Click the Digital Input button. Turn all the digital channels off—or as applicable.
- Click the Acquisition Configuration button or select that submenu from the View pull-down menu, and the Acquisition Configuration window will appear.
- From the Acquisition Configuration window, select all the parameters that define your desired acquisition. Under the Trigger tab, select Immediate as the trigger if you want to start the acquisition the moment the system is armed. Under the Post Trigger tab, select a duration of 1 minute. In the Scan Rate frame, set Base Rate A to 5 Hz (or as applicable) by typing in a value and selecting the proper unit.



Acquisition Configuration Window

- After verifying that all settings are as you desire, select Save under the File menu and associate a name to your acquisition setup file (if not already done so).
- From the main toolbar, click the Download button to send the setup file to LogBook's PC-Card.
- To arm an attached LogBook, click the Arm button.
- To arm a remote LogBook, eject the PC-Card, transport it to LogBook, insert it into LogBook's socket, and then apply power.
- To upload data from an attached LogBook during an acquisition or after the acquisition is complete, click the Upload button.
- To upload data from a remote LogBook after the acquisition is complete or as part of card swapping, eject the PC-Card from LogBook and transport to the PC's socket; then click the Upload button.
- To inspect the data, click the DIAdem button. Note that DIAdem is covered in separate documentation.



or



or



Reference Note: DIAdem users should refer to separate DIAdem documentation. If you choose to use *PostView*, instead of the more versatile DIAdem program, refer to Appendix F.

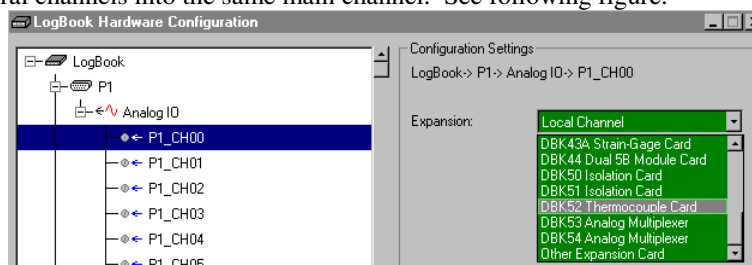
Setting Up DBK Cards

DBK cards and modules provide channel expansion and signal conditioning. For proper operation, you must use *LogView* for software configuration of the DBK cards. All hardware configuration-related parameters can be found in the *LogBook Hardware Configuration Window* (sometimes referred to as a “hardware tree”).



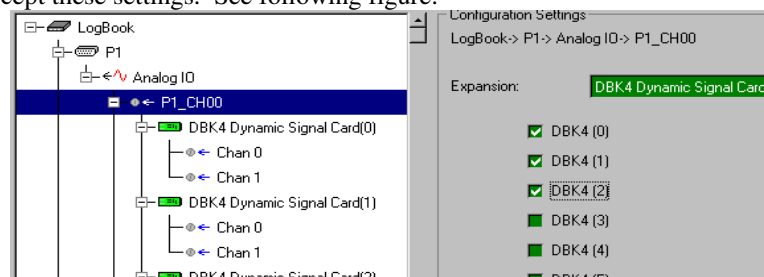
Reference Note: Chapter 5, *DBK Expansion Options*, contains parameter definitions and information as to which parameters are set in hardware and which are set in software.

1. Open the *LogBook Hardware Configuration Window* by clicking the Hardware Configuration button.
2. To add analog input DBKs, select P1 Analog I/O in the tree, and set its property to Single-ended.
3. Select a channel and assign it either a local channel or a specific DBK expansion module that will multiplex several channels into the same main channel. See following figure.



Setting Analog I/O Channel P1_CH00, DBK52 T/C Card Selected

4. Most DBKs have related cards and sub-channels as part of their method to multiplex up to 16 channels into each main channel. Click the appropriate checkboxes to set up the channels; and then OK to accept these settings. See following figure.



Selecting Applicable DBK4 Dynamic Signal Cards

5. Click the Analog Input button to view the newly setup channels in the Analog Input Channel Configuration spreadsheet (see page 3-27). Verify all channel numbers and assign user labels as desired.



Note: In some cases, such as with DBK19, channel values are returned in units of temperature, instead of volts.

6. From the *Analog Input Channel Configuration window*, select the DBK Parameters tab to view specific settings for each DBK channel. Set the DBK parameters at this time. If necessary, refer to the DBK chapter for an explanation of the parameters; for example, DBK4 programmable filter values and DBK7 debouncing times.



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

Channel Configuration									
DBK Filter Cut-Off Frequency: 9.0 kHz									
Storage DB 18.0 kHz 9.0 kHz 4.5 kHz 2.25 kHz 1.125 kHz 562.0 Hz 141.0 Hz									
#	Physical Channel	User Label	Range	Units	Channel Type	DBK Parameters			
						Param.1	Param.2	Param.3	Param.4
1	P1_CH00_0_0	P1_CH00_0	281.0 Hz	99 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=18.0 kHz	Exct=Enable Clk=Enable
2	P1_CH00_0_1	P1_CH00_0	141.0 Hz	99 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=18.0 kHz	Exct=Disable Clk=Disable
3	P1_CH00_1_0	P1_CH00_1_0	On	-3.159 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=9.0 kHz	Exct=Disable Clk=Enable
4	P1_CH00_1_1	P1_CH00_1_1	On	-3.159 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=18.0 kHz	Exct=Enable Clk=Enable

Setting DBK Parameters in the Analog Input Channel Configuration Window

When configuring DBKs, the *LogBook Hardware Configuration Window* provides a means of setting up all manual hardware settings. Once configured, the analog and digital channel setup spreadsheets provide a means of setting up channel-specific, programmable features.



Some DBKs have hardware settings that must be manually set inside the DBK, such as jumpers or DIP switches. For DBK hardware configuration, refer to the applicable DBK in chapter 5. In these cases the parameter setting in *LogView* must match the actual hardware. Setting one does not automatically set the other; in other words, you must make configuration settings in both software and hardware, when applicable.

Using Multiple Timebases

LogBook is capable of storing channels at 4 independent timebases (one base rate and 3 rates that are divisions of the base rate). Two reasons for using multiple timebases are: first, to reduce the amount of storage required by saving slow channels at a slow rate—acquisition can last longer before filling up the PC-Card; and second, to provide noise reduction by averaging and thus enhance the value of the data.

1. Open the Acquisition Configuration window (see page 3-37) by clicking the Acquisition Configuration button.
2. In the scan rate frame at the right of the window, set the Base Rate A to the maximum frequency required for any channel.



	Frequency	Divider
Base Rate A:	18 kHz	1
Rate B: <input checked="" type="checkbox"/>	9000.0 Hz	2
Rate C: <input checked="" type="checkbox"/>	4500.0 Hz	4
Rate D: <input checked="" type="checkbox"/>	2250.0 Hz	8

Acquisition Configuration Window

3. Check all three rate checkboxes B, C, D. Type in a divider for rates B through D to create sub-rate sampling frequencies which are based on Base Rate A. *LogView* will compute and display the corresponding rates in frequency or period units.

Note: The higher the divider (right most column) the slower the scan rate.

4. To reduce noise in sensitive channels like thermocouples, these channels can be sampled at a high rate but stored at a slower rate after mathematically averaging the intermediate values. By checking the Apply Noise Reduction Averaging checkbox, channels stored at a sub-rate will store the average of all of the values collected at the Base Rate A. Extraneous values that are obvious errors will have less effect on the data—it's also possible to set up a calculated channel that only accepts values within a defined range.
5. Close the *Acquisition Configuration Window*.
6. Click the Analog Input button to display the Analog Input Channel Configuration window. Under the Storage tab, note that the newly configured sample rates are enabled. The sample rate columns determine the rate at which each channel's data will be stored. Each enabled (On) channel can have data stored at sample rates A, B, C, D (or a combination, thereof), see following figure.

Analog Input Channel Configuration
View Edit

Channel Configuration

Collect data at rate C: Yes

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

#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	Sample Rates			
								A	B	C	D
1	P1_CH00_0_0	P1_CH00_0_0	On		-3.159 to 3.159	Volt	DBK4	Yes	Yes	Yes	Yes
2	P1_CH00_0_1	P1_CH00_0_1	On		-1.579 to 1.579	Volt	DBK4	Yes	Yes	No	Yes
3	P1_CH00_1_0	P1_CH00_1_0	On		-3.159 to 3.159	Volt	DBK4	Yes	No	Yes	No
4	P1_CH00_1_1	P1_CH00_1_1	On		-0.079 to 0.079	Volt	DBK4	Yes	No	No	No

Setting Sample Rates for Data Storage. Each enabled channel can be assigned up to four rates.

- Set the cells in these four columns to Yes or No, as desired, for all enabled (On) channels. Channels shown as “Off” are not sampled.
- Once configured, download the acquisition setup file, and initiate data collection.

Using Digital 2-Point Calibration



Remote LogBooks can not be calibrated. 2-point calibration can only be performed when LogBook is attached to the PC via a communication interface.

2-point calibration allows you to mathematically “trim out” inaccuracies in the measurement equipment and/or the transducer. By allowing the equipment to measure 2 known points in the measurement range, LogBook can calculate linear constants (the scale and offset) to correct inaccuracies in its analog inputs (see page 3-28). For channels where only one known point can be applied and verified, *LogView* provides offset trimming.

- Click the Attach button to establish communication with LogBook.
- Click the Analog Input button to open the analog input spreadsheet.
- Click the 2-Point Calibration tab to expose the calibration columns. If some columns are obscured, scroll to the right to reveal them or resize the window by dragging the right edge further to the right. Note that the default **Cal Scale** and **Cal Offset** [mathematically applied to each channel] are 1 and 0, respectively (right-most columns).



Analog Input Channel Configuration
View Edit

Channel Configuration

Enter value for the point 2: 1.15 Volt

Storage Rates **DBK Parameters** **User Scaling** **2-Point Cal**

#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	2-Point Calibration							
								Set P1	Actual P1	Get P1	Set P2	Actual P2	Get P2	Cal Scale	Cal Offset
1	P1_CH00	P1_CH00	On		-1.25 to 1.25	Volt	Direct	0.1		Execute	1.15		Execute	1.0	0.0
2	P1_CH01	P1_CH01	On		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
4	P1_CH03	P1_CH03	On		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
5	P1_CH04	P1_CH04	On		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
6	P1_CH05	P1_CH05	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
7	P1_CH06	P1_CH06	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
8	P1_CH07	P1_CH07	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
9	P1_CH08	P1_CH08	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
10	P1_CH09	P1_CH09	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
11	P1_CH10	P1_CH10	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
12	P1_CH11	P1_CH11	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0
13	P1_CH12	P1_CH12	Off		-10.0 to 10.0	Volt	Direct			Execute			Execute	1.0	0.0

Expected value at point x. Type in expected value, then click Execute to get real value. Only available when LogBook is attached.

Analog Input Channel Configuration, 2-Point Cal Tab Selected

2-Point Cal								
Channel Type	2-Point Calibration							
	Set P1	Actual P1	Get P1	Set P2	Actual P2	Get P2	Cal Scale	Cal Offset
Direct	0.1		Execute	1.15		Execute	1.0	0.0
Direct			Execute			Execute	1.0	0.0
Direct			Execute			Execute	1.0	0.0

2-Point Cal Tab, Partial Close-up

4. Apply a voltage to channel 1 near the bottom end of the measurement range.
5. Type the known value into the **Set P1** column for the associated channel.
6. Click the Execute button under the **Get P1** heading. This allows you to read the channel and calculate the required offset. Note that the channel value read is now shown in the **Actual P1** column and the **Cal Offset** column now shows the correction factor.
7. Apply a voltage to channel 1 near the top of the measurement range.
8. Type the known value into the **Set P2** column for the associated channel.
9. Click the Execute button under the **Get P2** heading to read the channel and calculate the required offset and scale. Note that the channel value is now shown in the **Actual P2** column. The **Cal Offset** and **Cal Scale** columns now show the correction factors.



For channels using thermocouples, it may be impractical to provide more than one calibration point. In such cases, apply just one known point in Set P1, and click the corresponding Execute button. This will adjust the offset only, which is typically the source of most transducer error.



For strain gages, use the User Scaling tab to enter the transducers' transfer functions (e.g., volts to pounds), then use 2-point calibration to periodically trim the scale and offset. This eliminates the need to manually adjust sensors using hardware potentiometers.

Analog Input Channel Configuration

View Edit

Channel Configuration

Enter scale value: 2.1

Storage Rates			DBK Parameters		User Scaling		2-Point Cal	
#	User Label	On/Off	Reading	Range	Units	Channel Type	User Scaling	
							Scale	Offset
1	P1_CH00	On		-1.575 to 3.675	Volt	Direct	2.1	1.05
2	P1_CH01	On		-10.0 to 10.0	Volt	Direct	1.0	0.0
3	P1_CH02	On		-10.0 to 10.0	Volt	Direct	1.0	0.0

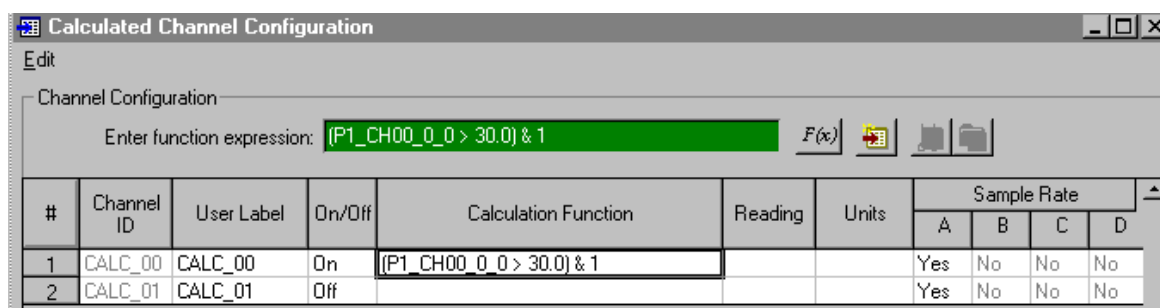
Scale and offset to convert to engineering units. Type in desired values. FinalReading = Scale * RawReading + Offset.

*User Scaling. Final Reading = Scale*RawReading + Offset*

Using Digital Outputs As Alarms

Using LogView's calculated channel capability (see page 3-31), digital outputs can be stimulated by events such as signal levels in analog inputs (e.g., to sound an alarm at a rising temperature before a test system over heats).

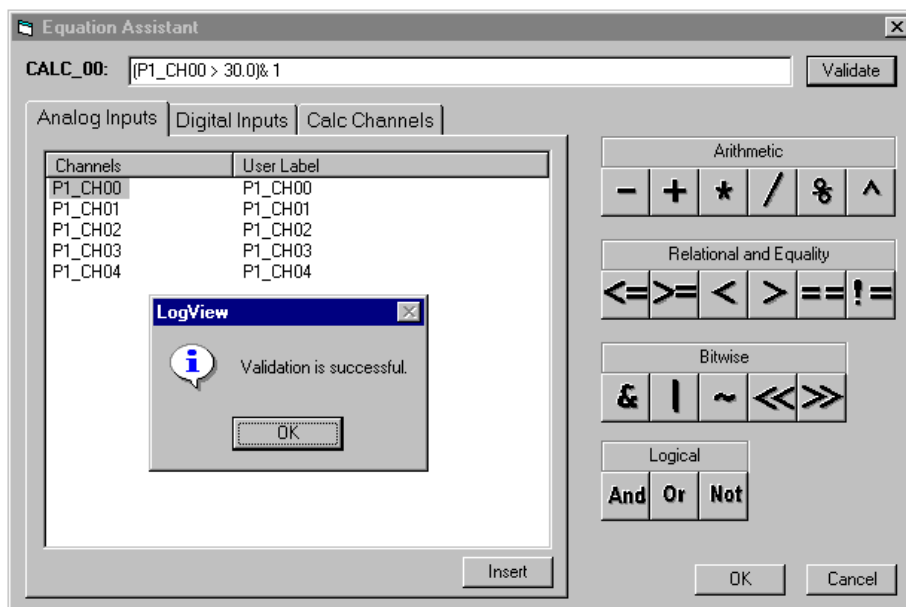
1. Click the Analog Input button to activate the *Analog Input Channel Configuration* window.
2. Turn on the analog input channel that you'd like to use to stimulate a digital output channel.
3. Click the Calculated Channel button to open the Calculated Channel Configuration window.
4. Click the Add New Channel button (located just right of the $F(x)$ button); or select "Add New Channel" from the Edit pull-down menu to activate the first or next calculated channel.
5. In the Calculated Function column, type in the following equation "(P1_CH00 > 30.0) & 1". If you're not using channel 0, replace P1_CH00 with your channel tag. This equation will yield a 1 in its least significant bit when the value of channel 0 is above 30, and 0 when it is below 30.



Entering an Equation (Function Expression)



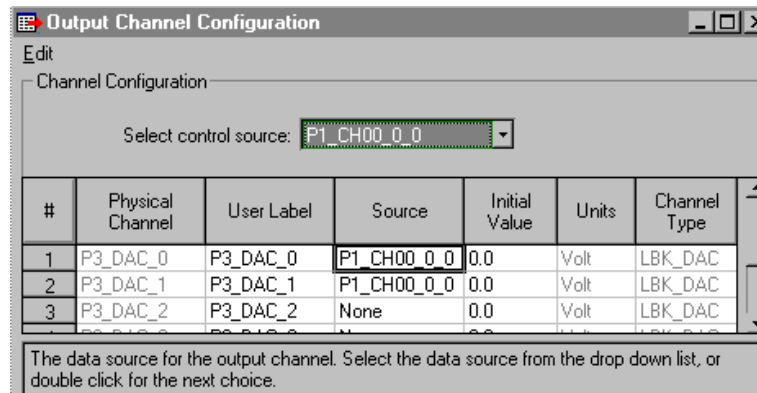
To verify accurate use of syntax, use the Equation Assistant $F(x)$ and the Validate button (see following figure). The Equation Assistant is accessed via the $F(x)$ button. Refer to page 3-33 for detailed information regarding the Equation Assistant.



The Equation Assistant can be used to create and validate equations.

6. In the Calculated Channel setup grid, set the newly configured channel to "On."
7. Close the Calculated Channel grid.
8. Click the Output I/O Setup button. If no digital output rows are present, click the Hardware Configuration button in the main toolbar and add a few digital I/O ports as outputs; e.g., the LBK2 DAC on the P3 port.





Selecting a Control Source

9. Select an output port; then set its Source to the calculated channel that we just configured. Unless you changed the label in the Calculated Channel grid, the source will be CALC_00.
10. Once configured, download the configuration to initiate data collection with the specified alarm output.

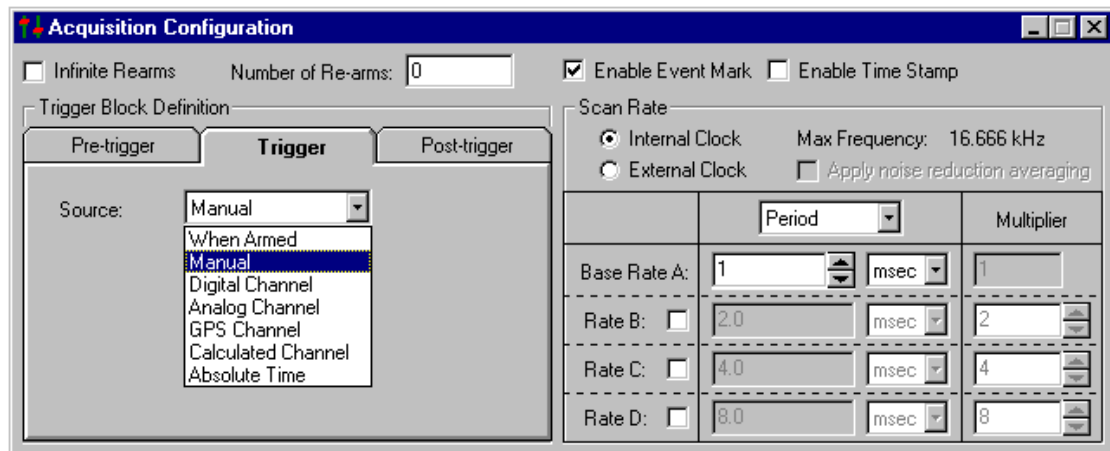
Using Exception Capturing

LogView can be set up to wait for defined events to occur, then capture data until another specified event. The triggering process is controlled through the Acquisition Configuration window (see page 3-37). If Auto Re-arm is used, LogBook will then re-arm itself after each triggering sequence, waiting for the occurrence of the next trigger event. This setup allows LogBook to capture specific events rather than a continuous data stream that may be useless in some applications. Exception capturing is useful where continuous data would soon fill up the PC-Card with low-value data.

1. Click the Acquisition Configuration button to open the Acquisition Configuration window.
2. Set up the trigger parameter as required. The trigger can be set to various parameters including the level of an analog input channel where you can select a threshold and hysteresis with rising or falling edge. Trigger sources include analog input level, digital channel, immediate, absolute time, and manual Event Mark.

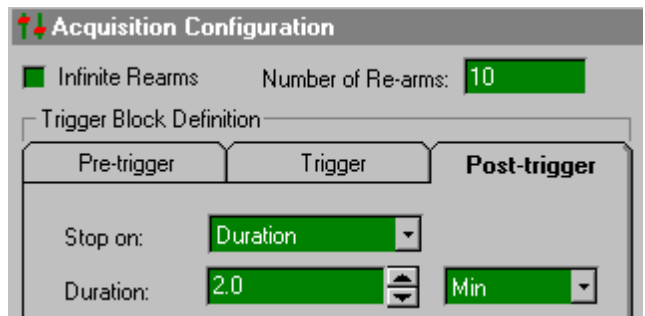
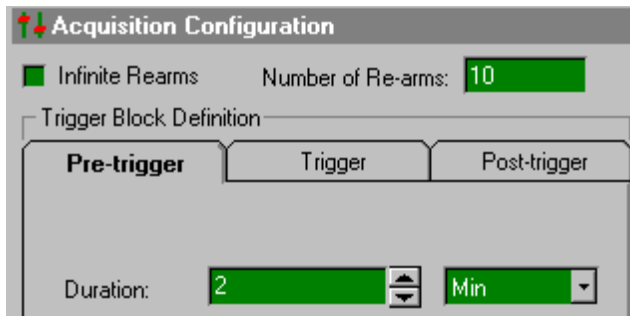


In the manual mode, you must select the Enable Event Mark checkbox so that the Event Mark buttons on LogBook Monitor window and on the LBK1 are activated.



Setting Up the Trigger Parameter

3. In the Pre-trigger tab, set up a duration of time occurring before the trigger event that you would like to save data for. Exception capturing is most effective when you can set trigger parameters to isolate the particular data of interest (e.g., all data 2 minutes before and after a specific event).
4. In the Post-trigger tab, you can set the stop event based on a duration, an analog or digital event, or a manual Event Mark.



5. Enable auto Re-arm by setting the field to 10.
6. Set up input channels as needed in the Analog Input Channel Configuration window.
7. Save the setup file, download it to the PC-Card, and start the acquisition.
8. After the data has been acquired, upload the data files from the PC-Card with *LogView's* Explorer or Upload button. Note that individual trigger blocks for each capture have indexed file names, with each name being unique.

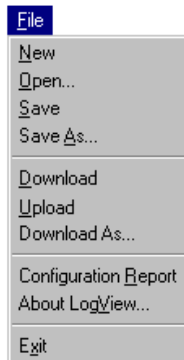


Reference Note: The *File Management* section of this chapter, page 3-7ff, contains detailed information regarding filename structure.

Menu Descriptions

The rest of the chapter describes each menu in detail, including all the related windows and parameters. The menus are presented in the order they appear in the control window and can be referred to as needed.

File Menu



The File menu helps manage your data and configuration files. You can determine the file format, as well as how and where the files are saved in memory. As stated in the previous reference note, The *File Management* section of this chapter, beginning on page 3-7, contains detailed information regarding filename structure.

New

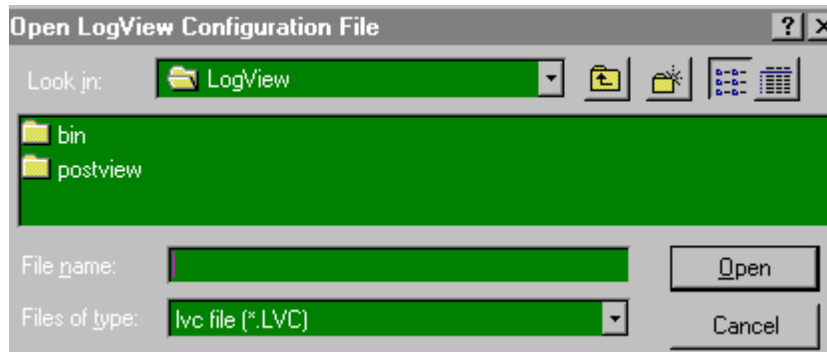


The New command allows you to create a new file. If you try to leave a configuration not yet saved, dialog box asks how “Do you want to save the current configuration?”; select Yes, No, or Cancel. The Save/Save As window will appear. Several icons in the top right of the window offer you help in navigating through files and levels of folders.

Open



The Open command allows you open a previously created configuration file.

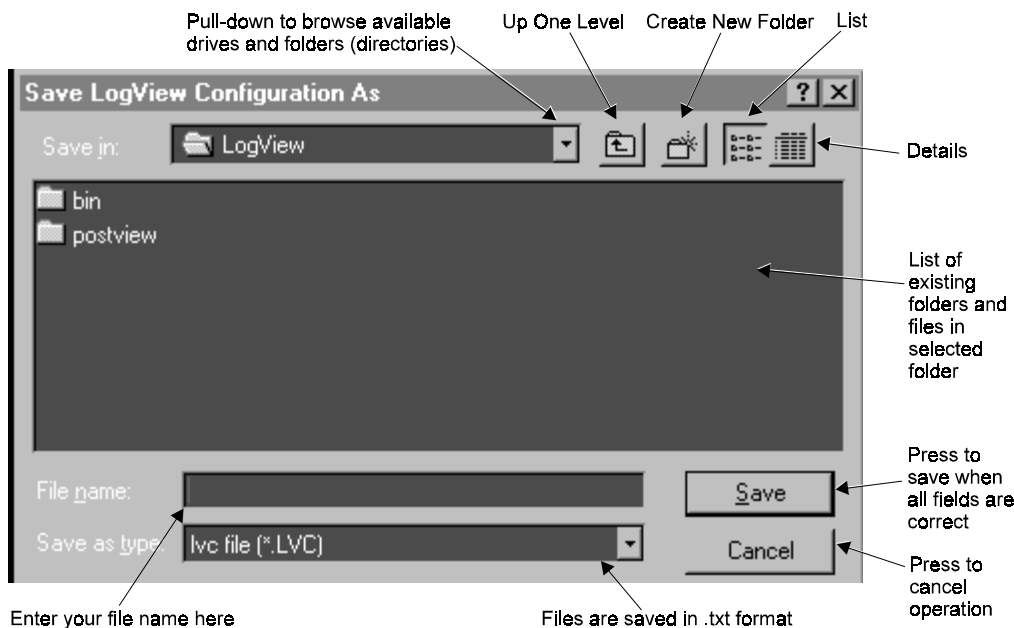


Save



Save As (no toolbar icon)

The Save command allows you to store the configuration file you are currently working on. The Save As command uses the same window as the Save command and allows you to enter a new file name. The current file remains unchanged from its last save.



Upload



or



The Upload command uses *LogView's* Explorer to get data files from a PC-Card. The PC-Card can reside in LogBook if LogBook is attached to the PC or in the PC's card slot if the PC-Card was manually transferred from a remote LogBook.

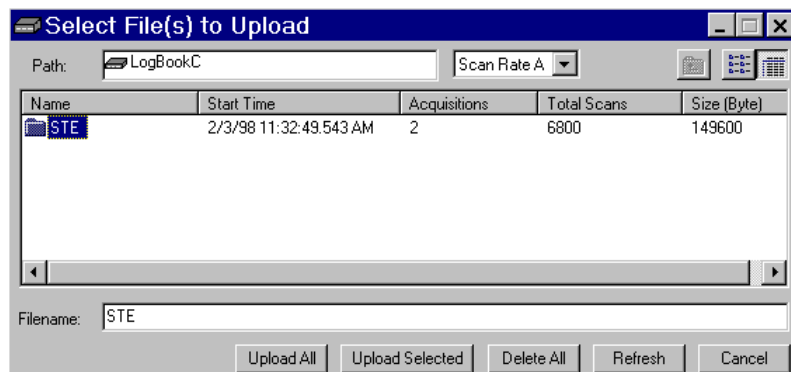
Note: The Upload icon and the Explorer item in the Device menu can upload from both LogBook or the PC's card slot; in either case, the icon looks slightly different as shown at left.

When the Upload button is clicked:

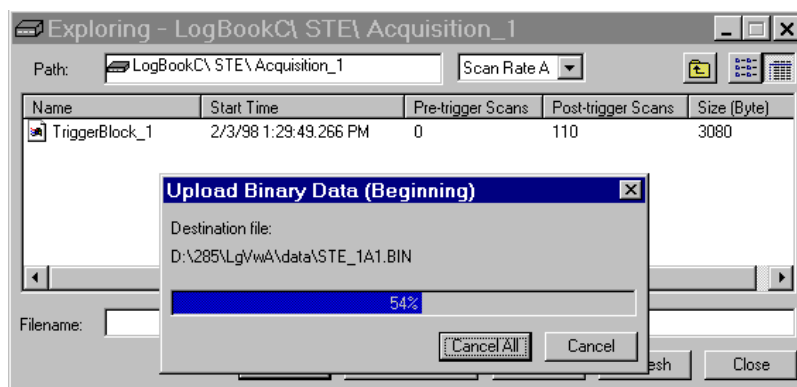
- If only 1 acquisition file (inactive) resides on the PC-Card, all that data is uploaded to the PC's hard drive.
- If more than 1 acquisition file resides on the PC-Card, an exploring window will appear and allow you to select which acquisition files or trigger blocks you may wish to upload.
- (attached mode only) If the only acquisition file on the PC-Card is active, all acquired data will be uploaded. To prevent duplication of records and conserve storage space, data already uploaded is then deleted from the PC-Card.

The buttons at the bottom of the window (see figure) allow you to:

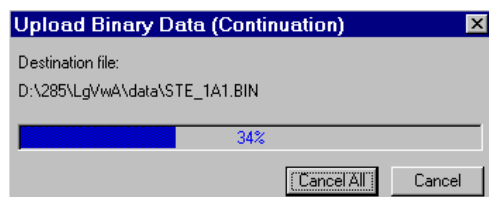
- **Upload All** the files on the PC-Card to your PC's hard drive with the designated Path and delete data on the PC-Card if "Delete on Upload All" is selected in *LogView* Preferences. **Note:** with attached mode and an active acquisition, this is the only way to upload data.
- **Upload Selected** uploads only those files which you select.
- **Delete All** the files on the PC-Card.
- **Refresh** will refresh Explorer with data from an active acquisition.
- **Cancel** will close the dialog box.



If uploading an active file for the first time (using Upload All), the following window appears (here, **Cancel** will stop an upload in progress):



If uploading an active file already partially uploaded, the following window will appear:



Download



or



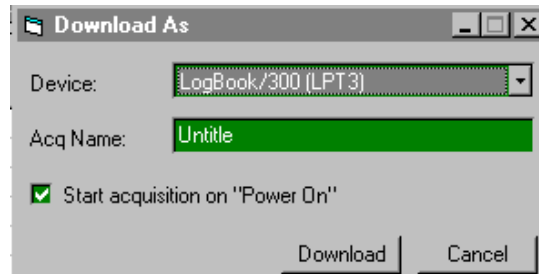
The Download command downloads the current *LogView* setup to LogBook if attached (or a PC-Card if LogBook is unattached) with the same name as the *LogView* setup name. If the current setup is default-named “Untitled”, a dialog box asks “Enter the acquisition name before *LogView* will download current configuration”. Select OK to save, Cancel to stop download process.

Download As...

(no toolbar icon)

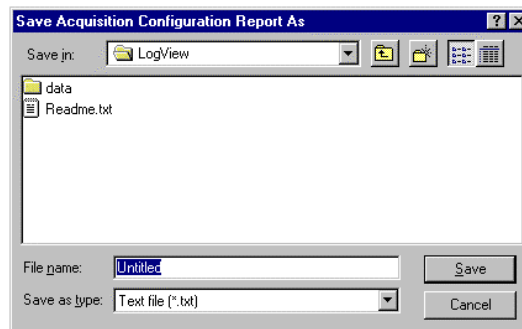
The Download As... command works much like a Save As command and brings up the window shown at left. You can choose your own file name. When fields contain the correct data, select the Download button; or you may Cancel the operation.

The checkbox Start acquisition on “Power On” is default-checked so that a remote LogBook will begin an acquisition as soon as it is turned on. You can uncheck this box if you will be using an LBK1 to arm the acquisition or if you will be applying power to LogBook but not wanting to begin an acquisition immediately.

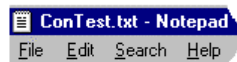


Configuration Report

Configuration Report allows you to save a report of the configuration parameters. An example follows.



Configuration Report Window (selected from File Pull-down Menu)



Untitled Configuration Report
(Created: 3/29/99 10:47:30 AM)

Clock Settings

Type:	Internal Clock
Max Scan Rate:	100.0 kHz (0.01msec period)
Base Rate:	100.0 Hz
Scan Rate1:	100.0 Hz (divider=1)
Scan Rate2:	Off
Scan Rate3:	Off
Scan Rate4:	Off

Trigger Block Settings

Pre-Trigger:	Collect 0 scans
Trigger:	When Armed
Post-Trigger:	Collect 100 scans

Number of Re-arms:	0
Averaging:	On
Mark Input:	Off
Time Stamp:	Off

Analog Inputs
All inputs are turned OFF

Digital Inputs
All inputs are turned OFF

Calculated Inputs
All inputs are turned OFF

Outputs

1. PhysicalName: P3_TimerDivisor0
User Label: P3_TimerDivisor0
Data Source: None
Initial Value: 1 Dec
Output Type: Local (Digital)
2. PhysicalName: P3_TimerDivisor1
User Label: P3_TimerDivisor1
Data Source: None
Initial Value: 1 Dec
Output Type: Local (Digital)

Sample Configuration Report (Condensed Image)

About LogView

Provides the software version number and a statement regarding copyright violations.

Exit

The Exit command closes *LogView*. *LogView* can also be closed by selecting the “X” button at the top right of the Control Window. If entered data has not been downloaded (saved), a dialog box will appear with such a message.

View Menu



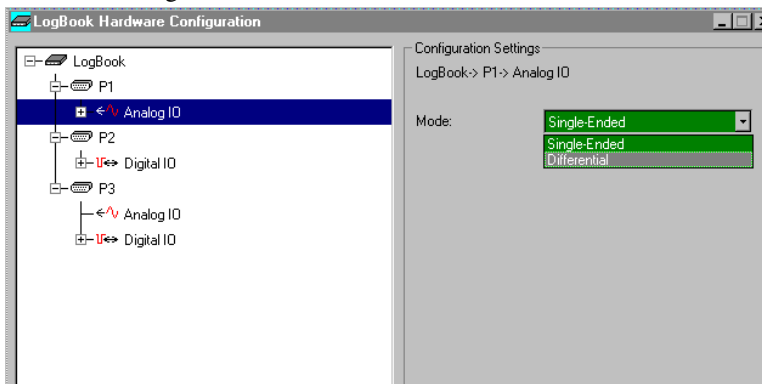
The View menu includes configuration windows, most of them in the spreadsheet format. Descriptions of the View pull-down menu’s selections follow.

Hardware Configuration

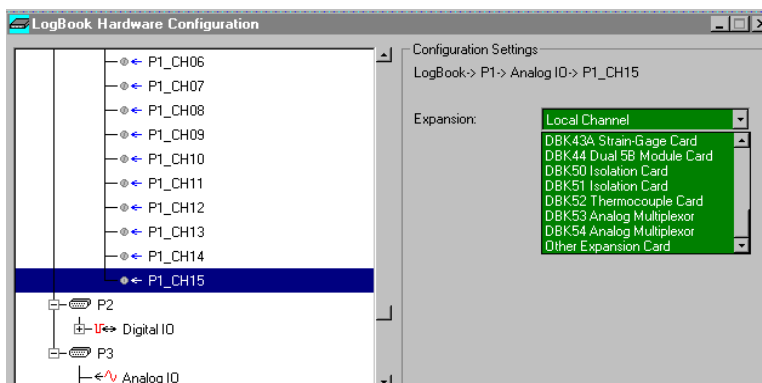


Selecting Hardware Configuration brings up the windows shown below. As you progress through the hardware tree, the window will prompt you for related information as needed. All 3 I/O ports (P1, P2, P3) are set up here.

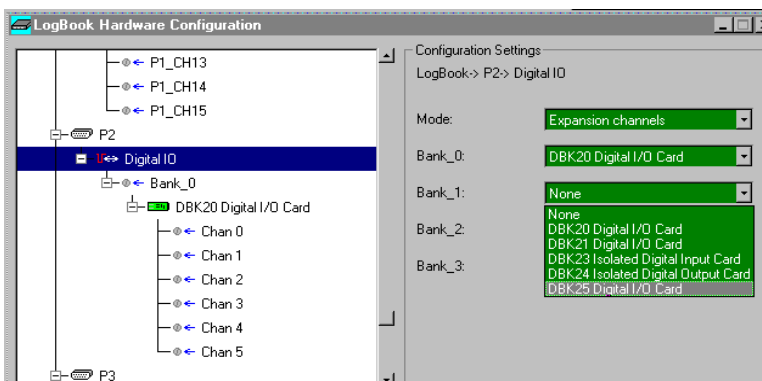
Note: these windows only set up non-programmable parameters to match corresponding hardware settings. *LogView* cannot know these settings unless you enter them here. Some DBKs have programmable settings that must be set under the DBK Parameters tab of the Analog Input Channel Configuration window.



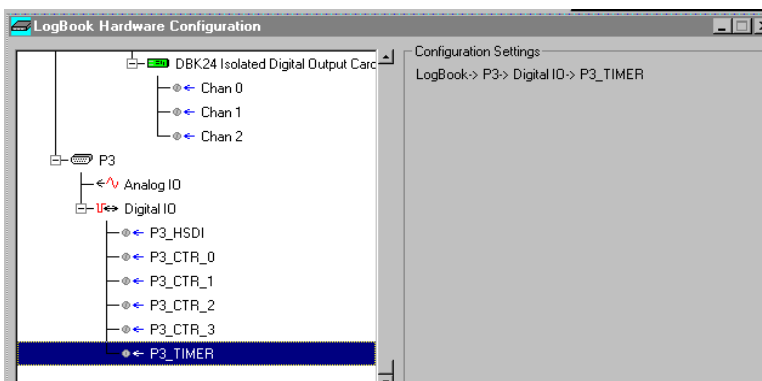
This figure shows user selecting the differential mode of analog input on P1.



This figure shows user selecting a particular DBK to be attached to channel 15 of P1.



This figure shows user selecting a particular DBK as assigned to 1 of 4 banks of channels on P2.



This figure shows user selecting LogBook's timer on P3's Digital I/O line.

Analog Input Channel Configuration



The analog input spreadsheet (see following figure) uses four tabs to group analog input parameters. Always visible are the Physical Channel, User Label, On/Off, real-time Reading, Range, Units, and Channel Type columns. Clicking a tab exposes one of the four sub-windows of parameters including Storage, DBK Parameters, User Scaling, or 2-Point Calibration.



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

#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	Sample Rates			
								A	B	C	D
1	P1_CH00	P1_CH00	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
2	P1_CH01	P1_CH01	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
4	P1_CH03	P1_CH03	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
5	P1_CH04	P1_CH04	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
6	P1_CH05	P1_CH05	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
7	P1_CH06	P1_CH06	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
8	P1_CH07	P1_CH07	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
9	P1_CH08	P1_CH08	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
10	P1_CH09	P1_CH09	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
11	P1_CH10	P1_CH10	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
12	P1_CH11	P1_CH11	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No

Physical analog input point.

Help box explains the use the current window, field, or cursor position

Channel List (1 per row - read channel's parameter values across the row)

Parameter Column Labels (all columns cannot be displayed at the same time)

Tabs to sub-windows to view related parameters

In the **User Label** column, use the default channel labels or insert your own labels of up to 16 characters (the column width is flexible). Labels are saved with the data so more meaningful channel names will appear in your post acquisition display-and-analysis software. For example, a calculated channel that controls an alarm can be so named; several channels that are combined for a calculated channel can be so named, etc.



When possible, use User Label names that closely resemble the Physical Channel names. This practice makes channel identification easier to remember and helps avoid confusion.
Example: If Physical Channel P1_CH01 was being used for an alarm, a User Label of P101Alarm would be logical.

In the **On/Off** column, use On to enable or Off to disable channels. System performance for the enabled channels is improved by disabling (not sampling) the channels not in use.

The **Reading** column displays the real-time channel value in the user's units. The immediate feedback by this column allows you to optimize range settings, verify scaling, or validate sensor calibration.

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

The next figure shows the columns accessible with the **Storage** tab selected (default). If channels are sampled only to derive calculated channels or stimulate outputs, they do not need to be stored. For example, a channel can be sampled at a high rate to prevent aliasing while a calculated channel is used to derive and save its maximum every 10 seconds. In this case, only one sample every 10 seconds is saved, rather than thousands. The **Sample Rates** columns in read-only mode are set up in the Acquisition Configuration dialog box where up to 4 timebases can be defined. For applications with slow and fast signals, slow signals can be sampled at a slower rate, optimizing the system's storage capacity. The base rate A can be divided by 3 divisors for rates B, C, and D (see page 3-39)

Storage		DBK Parameters			User Scaling		2-Point Cal				
#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	Sample Rates			
								A	B	C	D
1	P1_CH00	P1_CH00	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
2	P1_CH01	P1_CH01	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Local	Yes	No	No	No

Analog Input Channel Configuration, Storage Tab Selected

Storage		DBK Parameters		User Scaling		2-Point Cal					
#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	DBK Parameters			
								Param.1	Param.2	Param.3	Param.4
1	P1_CH00_0_0	P1_CH00_0_0	On		-3.159 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=18.0 kHz	Exct=Enable	Clk=Enable
2	P1_CH00_0_1	P1_CH00_0_1	On		-3.159 to 3.159	Volt	DBK4	Filter=Bypass	maxFq=18.0 kHz	Exct=Enable	Clk=Enable
3	P1_CH01	P1_CH01	On		-10.0 to 10.0	Volt	Local				

Analog Input Channel Configuration, DBK Parameters Tab Selected

The above figure shows the **DBK Parameters** tab used to configure channels with programmable DBK parameters. Depending on the DBK, values must be entered in the **Param.1** to **Param.4** columns. One such example is the DBK4 that requires filter settings; some other DBK cards also have programmable parameters.

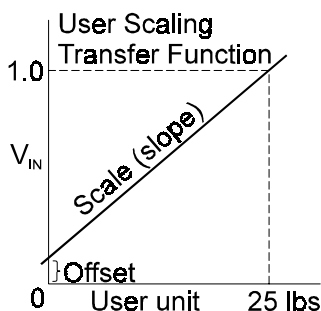


Some DBKs have hardware switches and jumpers for configuration. When using such DBKs, corresponding parameters must be set in the *LogBook Hardware Configuration* window.

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	

Analog Input Channel Configuration, User Scaling Tab Selected

The **User Scaling** tab shown above has **Scale** and **Offset** columns. In User Scaling, you create a **transfer function** so *LogView* will display units that are useful for your application. Here, you can arbitrarily define your **Units** (apples, oranges, whatever) based on the raw input value, typically Volts. To do so, type your new unit name in the Units column and select an appropriate range (e.g. unipolar). Then, enter its linear scale relation to the Volt (e.g. 25 pounds per Volt) and any offset from 0 (e.g. the empty basket measures 0.1 V). The reading and range columns change accordingly.

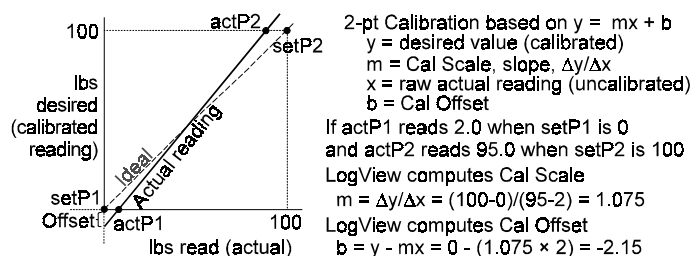


Storage		DBK Parameters		User Scaling		2-Point Cal									
#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	2-Point Calibration							
								Set P1	Actual P1	Get P1	Set P2	Actual P2	Get P2	Cal Scale	Cal Offset
1	P1_CH00	P1_CH00	On		0.1 to 500.1	lbs	Local	0.0	2.0	Execute	100.0	95.0	Execute	1.075	-2.15
2	P1_CH01	P1_CH01	On		0.0 to 2000.0	apples	Local			Execute			Execute	1.0	0.0
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Local			Execute			Execute	1.0	0.0

Analog Input Channel Configuration, 2-Point Cal Tab Selected

Calibration. The above figure shows the columns in the **2-Point Calibration** tab. To fine tune the accuracy of the value coming from a linear sensor, *LogView* provides both 1- and 2-point calibration. **One-point calibration** can be used to zero a channel—as in a thermocouple, which is usually more accurate in scale than offset. You might place the thermocouple in an ice bath and set just the 0°C point. **2-point calibration** determines the scale and offset factors to convert the raw readings into accurate calibrated readings. 2 points of known (set) values must be compared with 2 sensor (actual) readings.

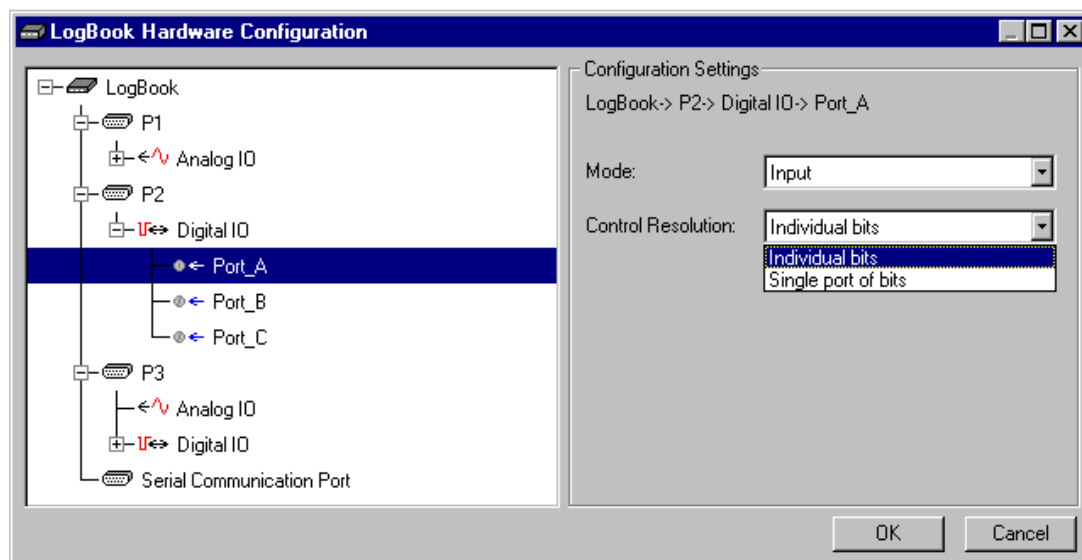
For example, to calibrate a strain-gage scale, unload the scale, type 0.0 into the Set P1 column, then click the Get P1 Execute button to read the actual sensor value (2.0). Place a known 100 lb weight on the scale; type 100 into the Set P2 column; then click the Get P2 Execute button to read the actual sensor value (95.0). *LogView* automatically computes the **Cal Offset** factor (near 0) and **Cal Scale** factor (near 1). From now on, *LogView* automatically applies the $y = mx + b$ calculation to the incoming reading to produce the calibrated reading.



Digital and Counter Input Channel Configuration



The basic *LogBook* system has three 8-bit digital ports and one high speed 16-bit port configurable as inputs or outputs in the *LogBook Hardware Configuration* window (see following figure). When configured as inputs, these ports appear in the Digital and Counter Input Channel Configuration spreadsheet. Also, 4 pulse input ports can count pulses for summing and/or frequency measurement. Adding digital expansion cards provides up to 192 digital bits.



Configuring Digital I/O Port A as Input, and with Control Resolution as Individual Bits

Input

Digital & Counter Input Channel Configuration

Edit

Channel Configuration

Enter channel label: P2_Port_A_0

#	Physical Channel	User Label	On/Off	Reading	Format	Channel Type	Sample Rate			
							A	B	C	D
1	P2_Port_A_0	P2_Port_A_0	On		Hex	Local	Yes	No	No	No
2	P2_Port_A_1	P2_Port_A_1	On		Hex	Local	Yes	No	No	No
3	P2_Port_A_2	P2_Port_A_2	On		Hex	Local	Yes	No	No	No
4	P2_Port_A_3	P2_Port_A_3	Off		Hex	Local	Yes	No	No	No
5	P2_Port_A_4	P2_Port_A_4	Off		Hex	Local	Yes	No	No	No
6	P2_Port_A_5	P2_Port_A_5	Off		Hex	Local	Yes	No	No	No
7	P2_Port_A_6	P2_Port_A_6	Off		Hex	Local	Yes	No	No	No
8	P2_Port_A_7	P2_Port_A_7	Off		Hex	Local	Yes	No	No	No

User-specified channel label. 16 characters maximum. Type in desired label or leave default.

Digital & Counter Input Channel Configuration Screen, Channels Configured for Individual Bits

Digital & Counter Input Channel Configuration

Edit

Channel Configuration

#	Physical Channel	User Label	On/Off	Reading	Format	Channel Type	Sample Rate			
							A	B	C	D
1	P2_Port_A	P2_Port_A	On		Hex	Local	Yes	No	No	No
2	P2_Port_B	P2_Port_B	On		Hex	Local	Yes	No	No	No
3	P2_Port_C	P2_Port_C	On		Hex	Local	Yes	No	No	No
4	P3_HSDI_0	P3_HSDI_0	On		Hex	Local	Yes	No	No	No

Physical digital input point designator. Go to Hardware Configuration dialog to set.

Digital & Counter Input Channel Configuration, Each Channel as a Port of Bits

The **Physical Channel** column identifies the actual hardware port of the physical channel.

In the **User Label** column, you can use the default channel names or type in a more suitable label up to 32 characters in length. These labels are saved with the collected data.

The **On** column can enable (On) or disable (Off) individual channels. To maximize system performance, only channels that are enabled are sampled.

The **Reading** column displays the read-time value of the digital port in the format specified in the **Format** column.

Analog, digital, and pulse samples are all sampled together in LogBook. This makes time correlation possible. In the Acquisition Configuration dialog box, up to four timebases can be specified. A digital or pulse channel can be sampled at any or all of these timebases.



Tip Channels sampled only to derive calculated channels, or to simulate outputs do not need to be stored.

Output Channels Configuration



The Output spreadsheet shows all of the currently available digital and analog output channels. Each output channel requires a source channel to feed it. Source channels can be chosen from an analog input for an analog output or from a digital input for a digital output.

#	Physical Channel	User Label	Source	Initial Value	Units	Channel Type
1	P3_TimerDivisor0	Timer-PortA	P2_Port_A	1	Dec	Local
2	P3_TimerDivisor1	P3_TimerDivisor1	P2_Port_B	1	Dec	Local

User-specified channel label. 16 characters maximum. Type in desired label or leave default.

Output Channel Configuration Window

The (physical) **Channel** column identifies the hardware channel assignment.

The **User Label** column allows you to enter a more suitable channel name of up to 32 characters

The **Source** column designates the input or calculated channel used as the source of data for this output channel. An entry of None disables the output channels.

The **Initial Value** column allows you to initialize the output to a specified value.

The **Units** column indicates units for Initial Value. This column can not be edited. The default is Decimal.

GPS Channels (LogBook/360 Only)



LogBook/360 can store latitude, longitude, and altitude coordinates along with the analog and digital data from the attached transducers, providing it is connected to a Global Positioning System (GPS) receiver. LogView software provides an easy method for setting up the GPS channels. No programming, character string parsing, or protocol decoding is necessary.

LogBook/360 can provide direct support for any GPS receiver that conforms to the NMEA 0183 protocol standard. **GPS support is not provided for LogBook/300.**

GPS receivers must be purchased separately, and are available from a variety of sources. If purchasing a GPS make sure it conforms to the NMEA 0183 protocol standard.



Reference Note: Refer to the GPS section of chapter 4 for detailed information.

Calculated-Channel Configuration



LogBook can derive virtual channels from real and/or virtual channels using math operators and functions. The resulting virtual channels can be used to:

- Create alarms based on any combination of signal levels from real channels and logical or mathematical functions of virtual channels
- Reduce data through statistical operations, comparisons, etc.
- Develop sophisticated trigger equations using a series of averaging, comparing of other real and virtual channels
- Manipulate input channel values for a more useful output (perhaps the quantity of interest cannot be measured directly but depends on a complex derivation from several measurements)
- Control external devices via digital output signals (like a simple Programmable Logic Controller)

Note: Calculated channels can have numeric values such as analog channel values. Calculated channels can also have digital values of 0 or 1. These channels can be stored in any one (or all 4) timebases set up in the *Acquisition Configuration Window*, in the same manner as other input channels.

Calculated Channel Configuration Windows with Calculation Function Examples

#	Channel ID	User Label	On/Off	Calculation Function	Reading	Units	Sample Rate		
							A	B	C
1	CALC_00	calcthis	On	P1_CH00_0 0 + P1_CH00_0 1		Volt	Yes	No	No
2	CALC_01	CALC_01	On				Yes	No	No
3	CALC_02	CALC_02	On				Yes	No	No

#	Channel ID	User Label	On/Off	Calculation Function	Reading	Units	Sample Rate		
							A	B	C
1	CALC_00	Temp14_23	On	P1_CH00_14 > 23	1.0		Yes	No	No
2	CALC_01	CALC_01	On	CALC_00 And (P1_CH00_15 > 24)	0.0		Yes	No	No
3	CALC_02	CALC_02	On	P1_CH01 + P1_CH02	5.393	Volt	Yes	No	No
4	CALC_03	CALC_03	On	P1_CH01 * 2	0.797	VoltX2	Yes	No	No

Calculated Channel Configuration Windows with Calculation Function Examples

You can access the Calculated Channel Configuration window from the control window's View pull-down menu, or by using the Calc (fx) button. The window contains several columns which are easy to understand because of their labels, and their similarity with columns previously discussed. The Calculation Function column is a noted exception which is discussed during the following four examples.

Note: Channel ID and Physical Channel nomenclature appear in the Calculation Function column. User Labels will not appear in the function column unless they are identical to a Channel ID, or a Physical Channel label.

Refer to the above screen shots for the examples which follow.



In addition to understanding the equation aspect of the following examples, you should also note the differences between the two types of configuration screens; i.e., an actual (real) channel and the calculated (virtual) channel.



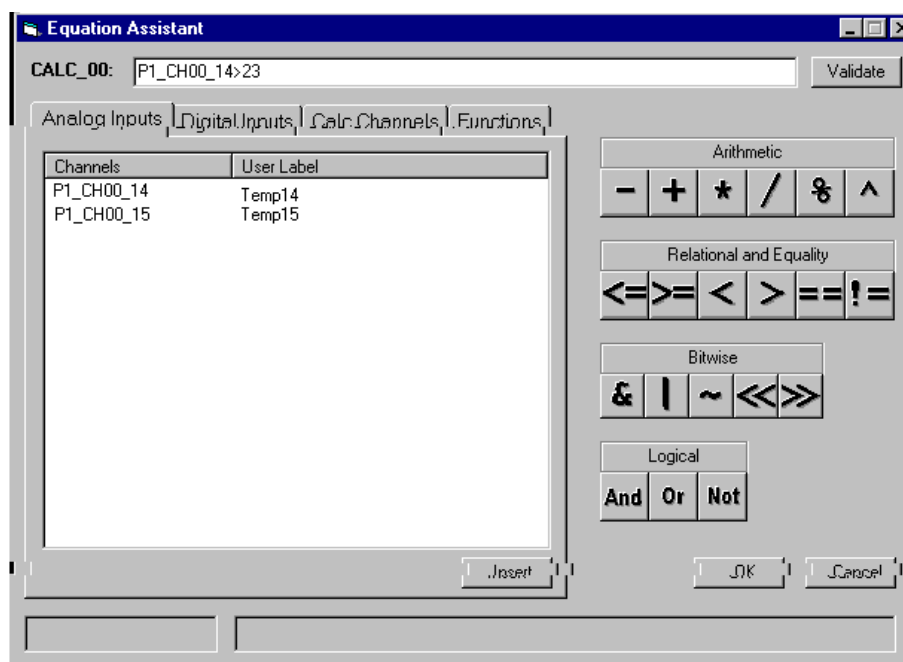
Reference Note: You may wish to refer to math or programming books to derive calculation functions that suit your specific application. Beside the examples at the end of this section, a wide variety of calculation functions can be created.

Equation Assistant

The following window is opened by the F(x) button on the Calculated Channel Configuration window. The Equation assistant helps to ensure that the proper syntax is used in the Calculation Function column. Selecting the corresponding math and logic operators will enter the corresponding commands (these commands can also be typed in, but using the equation assistant can minimize syntax mistakes).



No recursion. A calculated channel cannot refer to itself directly or indirectly by creating a loop of inter-related calculations.



Equation Assistant Dialog Box

Equation Assistant Function Buttons					
Arithmetic					
-	+	*	/	%	^
(subtraction)	(addition)	(multiplication)	(division)	(modulus) ¹	(exponentiation)
Relational and Equality					
< =	> =	<	>	= =	! =
(less than or equal to)	(greater than or equal to)	(less than)	(greater than)	(equal)	(not equal)
Bitwise Note: Bitwise functions are briefly discussed in the text which immediately follows this table.					
&		~	<<	>>	
(Bitwise And)	(Bitwise Or)	(Bitwise Not)	(Shift Left)	(Shift Right)	
Logical Note: Logical functions are briefly discussed in the related text which follows this table.					
And	Or	Not			

¹ **Note:** Modulus has several possible meanings. As used in the equation assistant, modulus is the remainder which results when the first operand is divided by the second. For example: the modulus for 3 % 3 is 0; the modulus for 3.257 % 3 is 0.257; and the modulus for 5 % 2 is 1.0.

Bitwise Operators

The bitwise operators perform bitwise-AND (&), bitwise-OR (|), and bitwise-Not (~) operations.

Syntax

AND-expression & equality-expression

OR-expression | Not-expression

Not-expression ~ AND-expression

The operands of bitwise operators must have integral types, but their types can be different. These operators perform the usual arithmetic conversions; the type of the result is the type of the operands after conversion.

& The bitwise-AND operator compares each bit of its first operand to the corresponding bit of its second operand. If both bits are 1, the corresponding result bit is set to 1. Otherwise, the corresponding result bit is set to 0.

Example: $10110000 \& 10010000 = 10010000$

| The bitwise-OR operator compares each bit of its first operand to the corresponding bit of its second operand. The operator is inclusive in that, if either bit is 1, the corresponding result bit is set to 1. Otherwise, the corresponding result bit is set to 0.

Example: $10110000 | 10010000 = 10110000$

~ The bitwise-NOT operator creates a bitwise complement of its operand. Thus, a 0 switches to 1, and a 1 switches to 0.

Example: $\sim 10110000 = 01001111$

Bitwise Left Shift and Right Shift Operators: <<, >>

Syntax:

shift-expression << additive-expression

shift-expression >> additive-expression

The bitwise shift operators shift their first operand left (<<) or right (>>) by the number of positions the second operand specifies.

Example: $10110000 \ll 2 = 11000000$

Logical Operators

The logical operators perform logical AND, logical OR, and logical NOT operations.

Logical operators do not perform usual arithmetic conversions. Instead, they evaluate each operand in terms of its equivalence to 0. Thus, the result of a logical operation is either 0 or 1.

AND The logical-AND operator produces the value 1 if both operands have nonzero values. If either operand is equal to 0, the result is 0. If the first operand of a logical-AND operation is equal to 0, the second operand is not evaluated.

OR The logical-OR operator performs an inclusive-OR operation on its operands. The result is 0 if both operands have 0 values. If either operand has a nonzero value, the result is 1. If the first operand of a logical-OR operation has a nonzero value, the second operand is not evaluated.

The operands of logical-AND and logical-OR expressions are evaluated from left to right. If the value of the first operand is sufficient to determine the result of the operation, the second operand is not evaluated. This is called "short-circuit evaluation."

NOT The logical-negation (logical-NOT) operator produces the value 0 if its operand is true (nonzero) and the value 1 if its operand is false (0). The operand must be an integral, floating, or pointer value.

Examples of Calculated Channels

Example 1: **P1_CH00_14 > 23**

Look at row 1 in the Calculated Channel Configuration screen (previous figure). You will see that the user created a calculation function of **P1_CH00_14 > 23** for the calculation channel labeled CALC_00. In this example the user wants to use CALC_00 as a logic indicator based on the state of physical channel P1_CH00_14; thus channel CALC_00 will read 1 or 0, depending on the value of the physical channel's reading. The top screen shows P1_CH00_14 to have a reading of 26.13. Since 26.13 is greater than 23 (from the calculation function), CALC_00's reading appears as 1.0. If the physical channel's reading drops to 23 or lower, CALC_00 will read 0.0. Note that CALC_00 can be used in additional equations, and is used in the second example.

To obtain a calculation channel, select the Calculated Channel Configuration window's Edit pull-down menu, then select Add Channel. In regard to the calculation function column, the following steps highlight how to enter the function which was used in this first example, **P1_CH00_14>23**.

1. Ensure the physical channel to be referenced is enabled. For the first example, this was channel P1_CH00_14.
2. Use the Calc (y = fx) button in the toolbar or Calculated Channels from the View pull-down menu to access the Calculated Channel Configuration Window.
3. Select the Edit pull-down menu (located on the Calculated Channel Configuration window).
4. Select Add New to add a calculation channel. In our first example this is CALC_00.
5. Click on the cell in the Calculation Function Column. A **F(x)** button appears by the Enter Function Expression dialog box.
6. Use the **F(x)** button to access the Equation Assistance dialog box (illustrated following example 4).
7. In the Equation Assistant box, double-click on the desired reference channel. P1_CH00_14. This entry will appear in the equation box, located just below the title bar. Note that you may type the channel, and other equation entries in this box, if desired.
8. From the Relational and Equality buttons, select the "greater than" symbol (>). This entry will appear in the equation box.
9. With the cursor placed after the greater than symbol, type 23.
10. Verify that your function appears correctly, then select the OK button. This closes the Equation Assistant.

Though these ten steps pertain to the first example, the method is essentially the same for the remaining three examples, despite the function differences. A figure and table have been placed after the examples to identify various button options available with the Equation Assistant.

Example 2: **CALC_00 And (P1_CH00_15>24)**

Look at row 2 in the Calculated Channel Configuration screen (previous figure). You will see that the user created a calculation function of **CALC_00And(P1_CH00_15 > 24)** for the calculation channel having the channel ID of CALC_01. In this example the user wants to use CALC_01 as a logic indicator based on the state of both CALC_00 and physical channel P1_CH00_15.

In this example, channel CALC_01 will read 1 if both of the following are true:

- a) CALC_00 has a value of 1.0
- b) P1_CH00_15 has a value greater than 24

Although the first condition is satisfied, we can see that the second is not, since P1_CH00_15 has a reading of 21.81. Because both conditions are not satisfied, CALC_01 reads 0.0. Note that CALC_01 can be used in additional equations.

Example 3: **P1_CH01+P1_CH02**

Look at row 3 in the Calculated Channel Configuration screen (previous figure). You will see that the user created a calculation function of **P1_CH01+P1_CH02** for the calculation channel having the channel ID of CALC_02. In this example the user wants to use CALC_02 to indicate to sum of two physical channels, i.e., P1_CH01 and P1_CH02.

In this example, channel CALC_02 reads 5.393 volts because:

- a) P1_CH01 reads 0.398 volts, and
- b) P1_CH02 reads 4.995 volts

Note that CALC_02 can be used in additional equations.

Example 4: **P1_CH01*2**

Look at row 4 in the Calculated Channel Configuration screen (previous figure). You will see that the user created a simple calculation function of **P1_CH01*2** for calculation channel CALC_03. In this example the user wants CALC_03 to read twice the value of physical channel P1_CH01.

Note that CALC_03 can be used in additional equations.

Acquisition Configuration

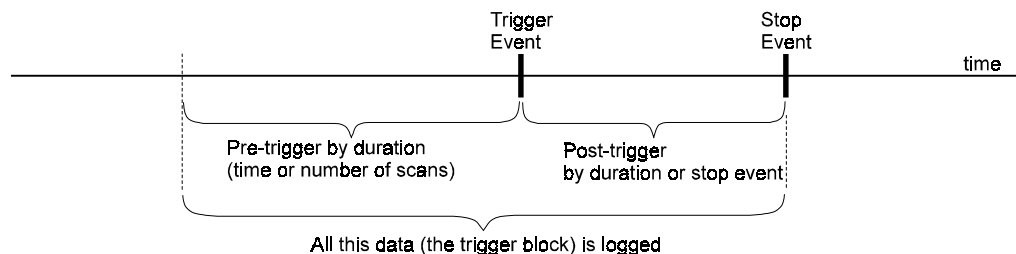


The Acquisition Configuration dialog box allows you to define trigger conditions including various parameters for pre-trigger, trigger, post-trigger, scan rate and timebase.

LogBook data can be collected in two basic ways depending on the trigger setup:

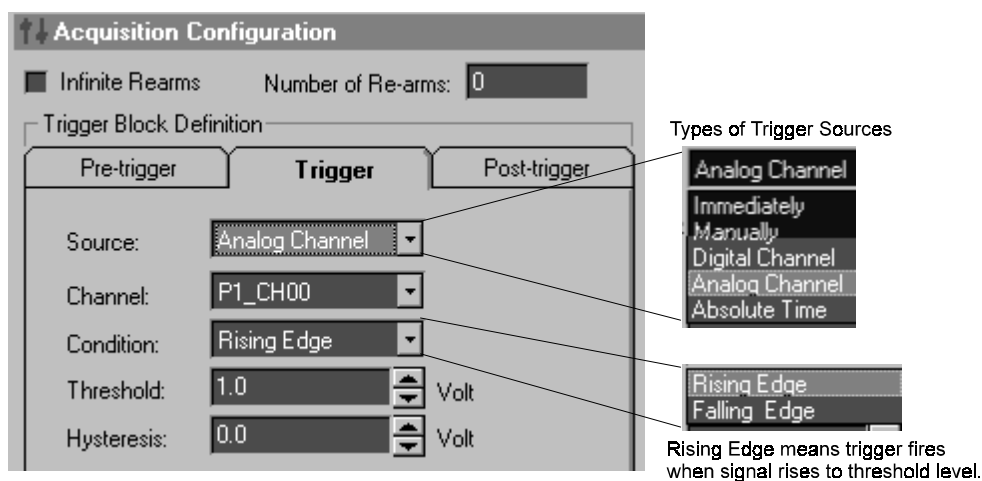
- Continuous. As a simple data logger in a strip chart mode, all data collected is then saved. The trigger source can be set to immediate and the post-trigger scan count set to infinite.
- Exception-only. As an exception-capturing system, collected data is saved only under specified conditions. Pre-trigger, post-trigger, and re-arm parameters allow you to collect only data around specified events, just the data of interest, nothing more. Thus memory is conserved, and post-analysis is easier.

The next figure shows a time line with data being collected continuously, but only the trigger block is logged to memory (the pre-trigger and post-trigger data combined is called a trigger block).



Trigger Parameters Setup

The next figure shows the basic trigger parameters (channel, condition, threshold, and hysteresis) for an analog channel as the trigger source (the other sources are also listed).



LogBook can be triggered by several types of sources including analog and digital triggering, multi-step triggering, multi-channel triggering, time-of-day triggering, and manual trigger. The manual trigger can be implemented in the following ways:

- With a PC attached, you can trigger LogBook from *LogView's* LogBook Monitor window in the Device menu.
- Without a PC, you can use LogBookK1's manual trigger button.

The auto re-arm feature allows for a large number of acquisitions to take place automatically, with each acquisition using the same settings. As soon as the previous trigger block is terminated, the system immediately re-arms itself, waiting for the trigger condition to be satisfied. The Number of Re-arms field allows you to specify how many triggered acquisitions to capture. For exception-capturing, specify the number of trigger blocks that should be collected before data logging is terminated. For continuous data logging, specify 1 trigger block.

If Absolute Time is selected for the trigger source, the window changes as shown in the figure at right. The parameters include the date and time as well as options for retriggering after a specified duration.

A wide variety of trigger sources and stop events provide great flexibility in exception-capturing. If data collection is desired only under specific conditions, appropriate trigger conditions can be so specified. Besides the trigger event, you can define a pre-trigger and post-trigger for the trigger block. A common example of exception-capturing would be to collect 100 pre-trigger scans and 1000 post-trigger scans every time a particular channel measures a certain temperature.

The 'Acquisition Configuration' window shows the 'Trigger Block Definition' section. The 'Source' is set to 'Absolute Time'. The 'Date' is set to 'March 17, 1998' and the 'Time' is '4:02:16 PM'. The 'Retrigger each:' section has '1' Days, '0' Hours, '0' Minutes, and '0' Seconds. The 'Infinite Rearms' checkbox is checked, and 'Number of Re-arms' is set to '0'.



To conserve memory when collecting high-speed data, use the trigger to take snapshots of information only during the appropriate periods.

When using a trigger to start the acquisition, a pre-trigger count can be supplied so that information just before the trigger can be collected and saved (LogBook's buffer allows pre-trigger data to be stored temporarily until saved in a trigger block). The post-trigger definition specifies when the data collection activity should end.

The 'Acquisition Configuration' window shows the 'Pre-trigger' tab. The 'Duration' is set to '0' and the unit is 'Scans'. A dropdown menu is open showing options: 'Scans', 'Hour', 'Min', 'Sec', and 'mSec'.

The 'Acquisition Configuration' window shows the 'Post-trigger' tab. The 'Stop on:' dropdown is set to 'Duration'. The 'Duration' dropdown is open showing options: 'Duration', 'Manually', 'Digital Event', and 'Analog Event'. The unit is set to 'Scans'.

You can also use a calculated channel as a trigger source, but you must use an analog output or digital channel as an intermediary. The calculated channel can be based on real channels and user logic to create an analog output channel or a digital output channel which could then be the input for the trigger event or stop event. A calculated channel can describe virtually any combination of channel conditions. For example, you can develop a calculated channel called TRIG and specify it as the trigger channel. If the channel's equation is $TRIG = (Temp1 - Temp2) > 50.0^\circ$, the data collection process will be triggered when the difference between the 2 channels is greater than 50.0° .

Scan Rate Setup

The Scan Rate block is the right half of the *Acquisition Configuration* window (see following figure). To set the scan rate, you can use LogBook's "internal" clock, or an "external" clock.

The screenshot shows the 'Acquisition Configuration' window. The 'Scan Rate' section is on the right. It includes checkboxes for 'Internal Clock' (selected) and 'External Clock'. There is a 'Max Frequency' field set to '100.0 kHz' and an 'Apply noise reduction averaging' checkbox. Below these are four rows for scan rates: 'Base Rate A' (5 Hz, divider 1), 'Rate B' (2.5 Hz, divider 2), 'Rate C' (1.25 Hz, divider 4), and 'Rate D' (0.625 Hz, divider 8). Each rate has a checkbox and a 'Frequency' dropdown set to 'Hz'. The 'Post-trigger' section on the left shows 'Stop on: Duration' and 'Duration: 1 Min'.

Scan Rate Setup. Accomplished on the right-half of the Acquisition Configuration Window.

- **Internal Clock.** The scan-to-scan timing may be set by a fixed-frequency pacer clock. LogBook's time-of-day clock has 1/16-second resolution for data-logging applications where acquisitions must be performed at specific times during the day. The time of occurrence for each acquisition and its trigger are recorded with the data. The internal clock can be reset in the *LogBook Monitor* window in the Device menu.
- **External Clock.** Each scan may be individually started by an external trigger to allow the scan rate to track an external, variable-speed event (such as engine revolutions).

Note: The scan-to-scan time is not recorded when tracking variable-speed events.

For applications with both slow and fast phenomena, sampling slow signals at a slower rate while maintaining high rates for fast signals will conserve memory. For example, channel 1 may read fast signals like vibration and can be sampled at the high (base) rate; channel 2 may read slow signals like thermocouples and can be sampled at a lower rate. A Base Rate A and up to 3 more rates (B, C, D) can be configured; but only one base rate can be defined for the entire system and it should be set for the fastest scan required. The B, C, D rates must be integer (whole number) divisions of the base rate. It is also possible to scan the same channel at several rates.

Note: A separately indexed data file is created for each scan rate.

The checkbox "**Apply noise reduction averaging**" refers to auto-averaging for scan rates B, C, and D. All channels are scanned at the base rate; but they may also be scanned at divisions of the base rate. Two advantages to averaging are noise reduction by limiting the effect of extraneous readings and storage savings since fewer values are stored.

- **Averaging.** Checking this box, the readings from the base rate will be averaged, and the average value will be entered for the derived rate scan. If the scan rate B is $\frac{1}{4}$ of the base rate A, then four A readings will be averaged for each B reading.
- **No averaging.** Not checking this box, the readings at the derived scan rates will be exactly the same for that time-point as the base rate.

Event Marking/Time Stamping

The top right side of the Acquisition Configuration window allows you to manually mark events and/or insert an absolute time reference for each scan:

- **Enable Event Mark** sets up the acquisition for an operator to press the Event Mark button in the *LogBook Monitor* window or on the LBK1 remote operation terminal. Whenever the button is pressed, that data point is added to the data file; when viewing the data file from *PostView* (discussed in Appendix F) you can see all the event marks in relation to the corresponding data.
- **Enable Time Stamp** sets up the acquisition to automatically add the time (to ms) and date to the data file for every scan.

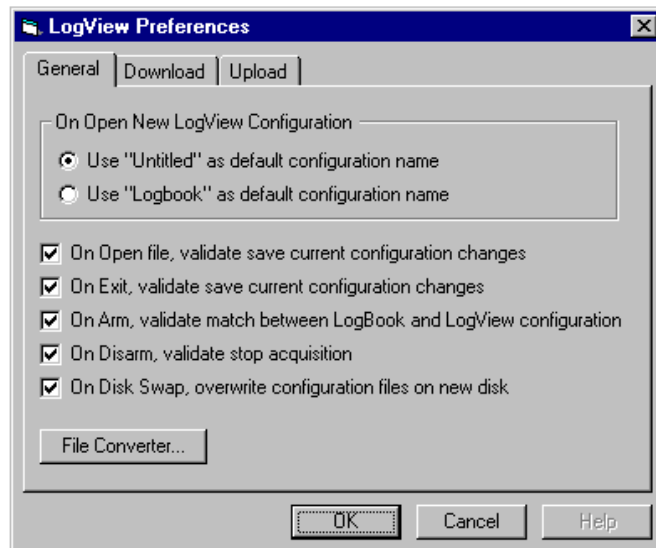
Preferences

(no toolbar icon)

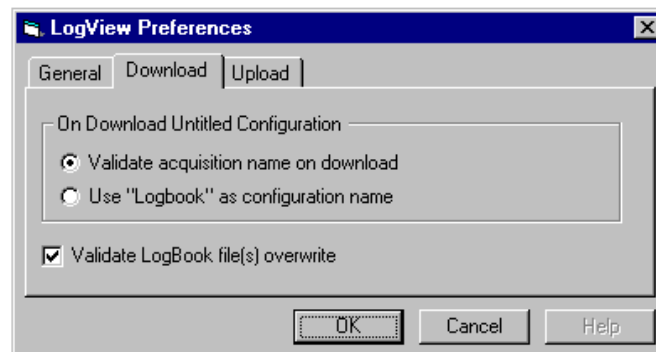
LogView allows you to set various parameters to make your application more useful and convenient. These preference settings are divided into 4 tabs as shown in the figures on the right.

Most of the options cover default use of filenames and validating changes to files.

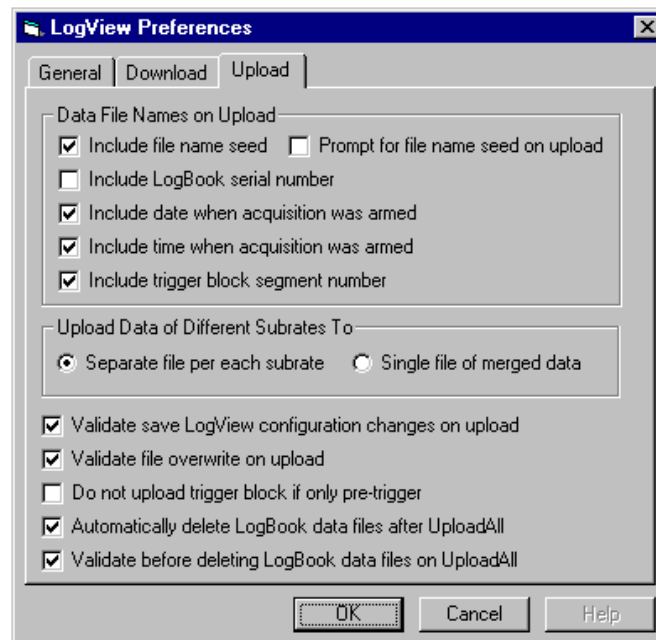
As explained in the *File Management* section (see page 3-7ff), *LogView* can generate multiple data files for an acquisition and then automatically name them. These names have a long format with several fields (seed, serial number, date armed, time armed, trigger block/segment). Unless you need the long-format name to prevent file overwrites, you can uncheck the fields you don't need. For example, if only using one LogBook, the serial number is not needed.



LogView Preferences, General Tab Selected



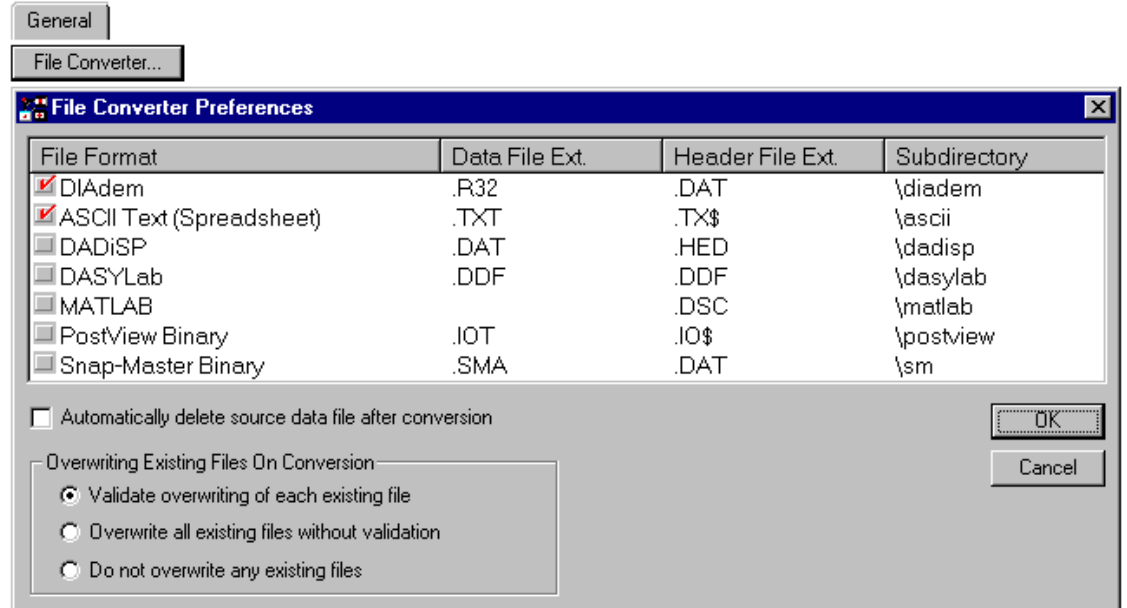
LogView Preferences, Download Tab Selected



LogView Preferences, Upload Tab Selected

For data conversion:

- 1) Select the *LogView* Preferences “General Tab.”
- 2) Click on the “File Converter” button. The *File Converter Preferences* dialog box appears.
- 3) Select the formats you want to save your data in.
- 4) If desired, check to automatically delete the source data file after conversion. The default avoids automatic deletion of the source data file.
- 5) Select the overwriting-related preference you desire. The default is to “Validate overwriting of each existing file.”

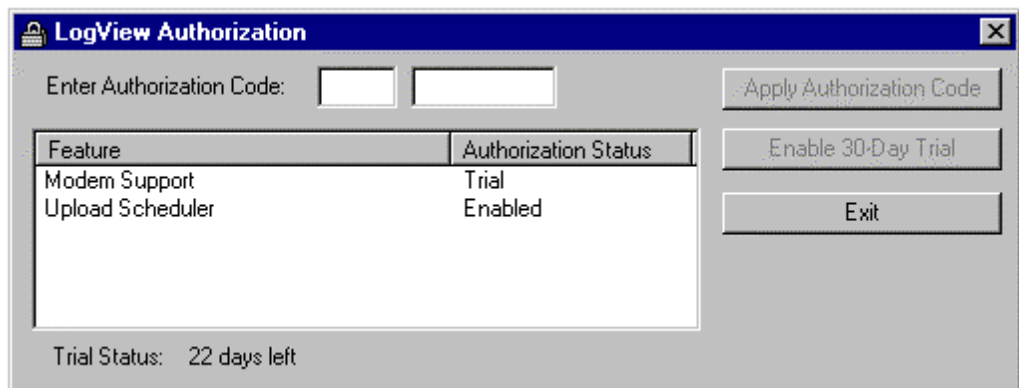


File Converter Preferences Dialog Box

LogView Authorization

(no toolbar icon)

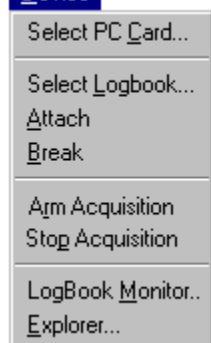
The View Pull-Down menu includes a *LogView Authorization* dialog box. If you have the Modem Support or Upload Scheduler feature, you must enter your authorization code to enable the applicable feature. If you do not have an authorization code you can obtain one from your service representative, or can enable a 30-day trial period.



LogView Authorization Dialog Box

Device Menu

Device



The Device menu allows you to choose devices in your system, attach or break connection to the system, and to start and stop an acquisition.

Select PC-Card

(no toolbar icon)

Select PC-Card allows you to choose which drive on your computer you wish to make active for uploading and downloading—especially relevant if your computer has more than one PC-Card slot.

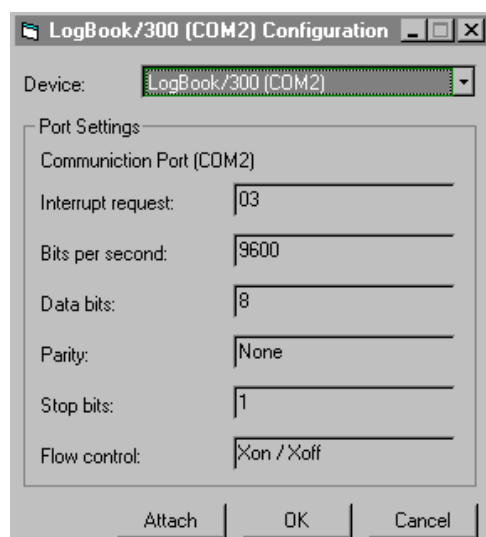


Select PC-Card

Select LogBook

(no toolbar icon)

Select LogBook allows you to choose devices from your system and then verify or change the communication port settings.



Select LogBook



Attach allows you to establish connection with a LogBook. If no LogBook is connected, *LogView* will automatically attach to a PC-Card in the user-specified PC-Card drive (specified in the “Select PC-Card” dialog box).



Break allows you to break the connection with an attached LogBook.



Arm Acquisition Arms the acquisition for the selected device. The scan will begin when the selected trigger condition is met.



Stop Acquisition will disarm the acquisition for the selected device. No data will be collected despite trigger conditions until the acquisition is armed (started).

LogBook Monitor

(no toolbar icon)

The LogBook Monitor provides a system status report on the current acquisition (if in progress). The window allows provides access to manual-trigger and chart-marking functions. You can access LogBook's Explorer by clicking the button in the lower right-hand corner of the screen. The Explorer allows you to search the PC-Card for acquisition files and the indexed trigger blocks within the acquisition files (see following section for more Explorer information).

Acquisition Settings	
Name:	DONTW2
Status:	Pre-Trigger Acq
Acquired Scans:	281203
Trigger Block #:	1
Number re-arms:	Infinite
Base scan rate A:	80.0 Hz
Trigger Type:	Channel Value
Stop Event Type:	Duration
<input type="button" value="Event Mark"/> <input type="button" value="Manual Trigger"/>	

LogBook115K Settings	
Clock:	02/17/1999 3:32:45 PM
Max Swap Time:	50 min 58 sec
Error:	0, "No Error"
Dynamic Memory:	16 MB
Disk free space:	101,622 KB
Disk used space:	1,185 KB
<input type="button" value="Reset Clock"/> <input type="button" value="Show Error"/> <input type="button" value="Clear Error"/> <input type="button" value="Explorer..."/>	
<input type="button" value="Close"/>	

LogBook Monitor

The acquisition status is only updated every 1 or 2 seconds; the status for scans at a faster rate may not be updated before the scan is finished.

Whenever you select the Event Mark during an acquisition, *LogView* notes the exact time to time-correlate the marked instant with data collected then. This function is like marking a strip chart to draw attention to a particular time frame. These marks can be seen later while reviewing the data in *PostView* (see Appendix F).



The Enable Event Mark (in the Acquisition Configuration window) must be checked in order for the LogBook Monitor to be enabled. This event-marking feature is also accessible via LBK1.



Max Swap Time (Maximum Disk Swap Time) is the estimated amount of time that the user has to remove and replace LogBook's PCMCIA card without interruption to LogBook's active acquisition.

The Manual Trigger button is available here and will activate the trigger or post-trigger event immediately when selected (also accessible via the LBK1).

Under LogBook Settings, you can read the current time of LogBook's clock. You can reset LogBook's clock to the PC's clock by selecting the Reset Clock button.

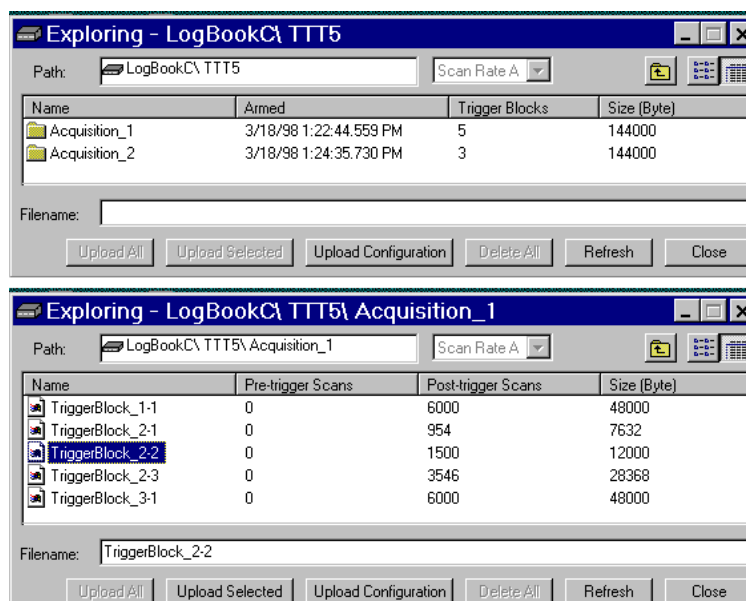
The Error box contains an error number and brief description of the error. These errors are listed in Appendix B. Not all errors are fatal to the acquisition.

Explorer

(no toolbar
icon)

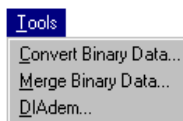
The Explorer window can be reached from the Device menu or from its button in the *LogBook Monitor window*. Explorer allows you to search the PC-Card for acquisition files and the indexed trigger blocks within the acquisition files. The Exploring windows look first at the acquisitions saved to disk and then deeper into each trigger block within an acquisition.

The convention for naming files is described on page 3-8. In the example shown at the right, TriggerBlock_2-2 uses “TriggerBlock” as the seed and “2-2” to indicate the 2nd segment of the 2nd trigger block. The binary data file ends with the .bin extension understood in the *LogView Explorer*.



LogBook Explorer Window, Two Examples

Tools Menu



The Tools menu provides three selections:

- **Convert Binary Data** - allows you to convert raw binary data (*.bin files) into other formats that you may find more useful.
- **Merge Binary Data** – allows you to *merge Rate files* and to *concatenate Trigger Block segments*.
- **DIAdem** – Accesses the independent DIAdem program for graphing and analysis of previously recorded data.

Convert Binary Data

(no toolbar icon)

The Convert Binary Data menu option allows you to convert raw binary data (*.bin files) into other formats that you may find more useful. You must first select an existing binary file to be converted. The filename can be typed in or selected by the Browse button that leads to a folder/file search window. After a file is selected (or multiple files), you can toggle check-boxes on/off for each format type. When ready to begin the conversion, select the Convert button and set up the destination folder/filename.

Data collected with LogBook can be uploaded to your PC's hard disk in any or all of several data formats for post-acquisition analysis. Some of the available file formats include Snap Master, DADiSP, Matlab, and ASCII (Excel) which is compatible with most software for analysis. *LogView* creates the necessary header files for each data format so that the software can use the channel labels, the timebase information, and other parameters.

Converted data files are placed in format-specific subdirectories of the binary source file directory.

Rates, Trigger Blocks, and Segments

LogBook has the capacity to save channel data at four independent rates. For each enabled rate, a file is created. For example, if all four rates are being used, four files will be present after an upload. Depending on the *Upload Preference* settings (as discussed in Preferences, page 3-40), the file names will look similar to the following.

TEST R1 B1-1.BIN
TEST R2 B1-1.BIN
TEST R3 B1-1.BIN
TEST R4 B1-1.BIN

“TEST” is the name of the acquisition configuration.
“Rn” shows the rate number. R1 through R4 is Rate1 through Rate 4.
“Bn-m” shows the trigger block and segment numbers.
For example, B1-1 indicates “Block1, Segment 1.”

Note: Files with high rates take up more memory than files with slow rates.

Auto Re-arm is used when multiple trigger events need to be captured. When the auto re-arm feature is enabled, LogBook will arm itself, wait for a trigger, collect the pre- and post-trigger, then re-arm itself and repeat the process.

The pre- and post-trigger data surrounding a *trigger point* is called a *Trigger Block*. A new file is created for each Trigger Block. If only one *rate* is used and three *Trigger Blocks* are collected, the file names would look similar to the following.

TEST R1 B1-1.BIN
TEST R1 B2-1.BIN
TEST R1 B3-1.BIN

In each case, R1 indicates Rate 1. B1, B2, and B3 indicate Trigger Blocks 1, 2, and 3, respectively. The “-1”, in each case, indicates Segment 1.

Uploads can be performed while data is being collected. For applications that require continuous acquisition, uploads can be performed periodically to make space for additional data. **Each uploaded portion of a single *Trigger Block* is called a *Segment*.** If one rate is used and a Trigger Block was uploaded in five *Segments*, the file names would look similar to the following.

TEST R1 B1-1.BIN
TEST R1 B1-2.BIN
TEST R1 B1-3.BIN
TEST R1 B1-4.BIN
TEST R1 B1-5.BIN

In each case, R1 indicates Rate 1. B1 indicates Trigger Block 1, and “-1” through “-5” indicates Segment 1 through Segment 5.

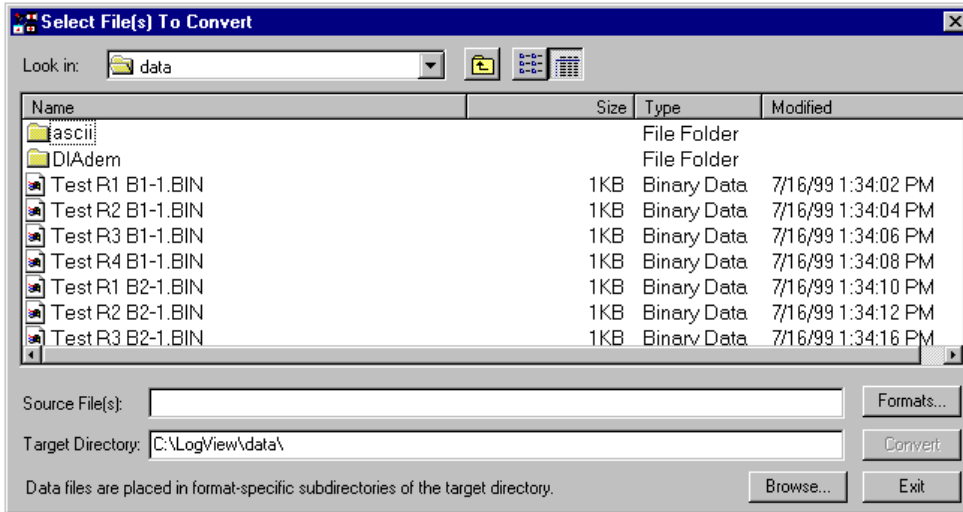
Merging and Concatenating

LogView's **raw binary format** can not be used by other programs; however, LogView can convert its data files into popular file formats used by other display and analysis packages. The conversion can be performed automatically during an upload, or manually after the upload using the *Convert Binary Data* utility (found under the **Tools** pull-down menu).

In addition to providing for file format conversion, the *Convert Binary Data* utility also has the ability to *merge Rate files* and to *concatenate Trigger Block segments*. Examples follow shortly.

- When *merging Rate files*, the utility takes the appropriate rate files and combines them into one file.
- When *concatenating segments*, the utility joins the appropriate segment files, making one continuous Trigger Block file.
- When both *Merge* and *Concatenate* are enabled, Trigger blocks with multiple rates (that were uploaded in segments) can all be consolidated into one file.

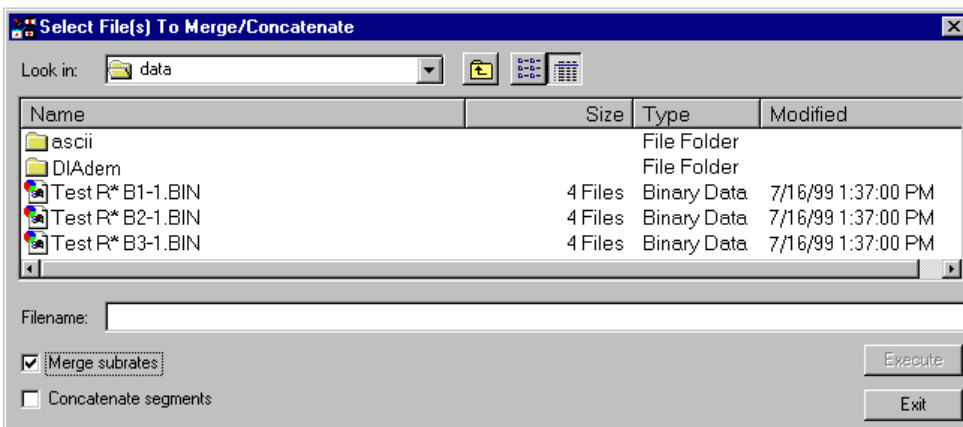
The *Convert Binary Data* utility lists all the raw binary files in the DATA directory. Select the desired file(s) and click Convert to initiate the process. In this way, any Trigger Block, Segment, or Rate file can be individually converted.



Sample Screen from the Convert Binary Data Utility

Merging Binary Data

(no toolbar icon)



Preparing to Merge Subrates

A screen similar to that shown in the above figure appears when the “Merge Binary Data” is selected from the Tools pull-down menu. On this window, when the **Merge Subrates** box is checked, the *Convert Binary Data* utility groups the related Rate files together and displays a single item. In the example below this single item is:

TEST R* B1-1.BIN.

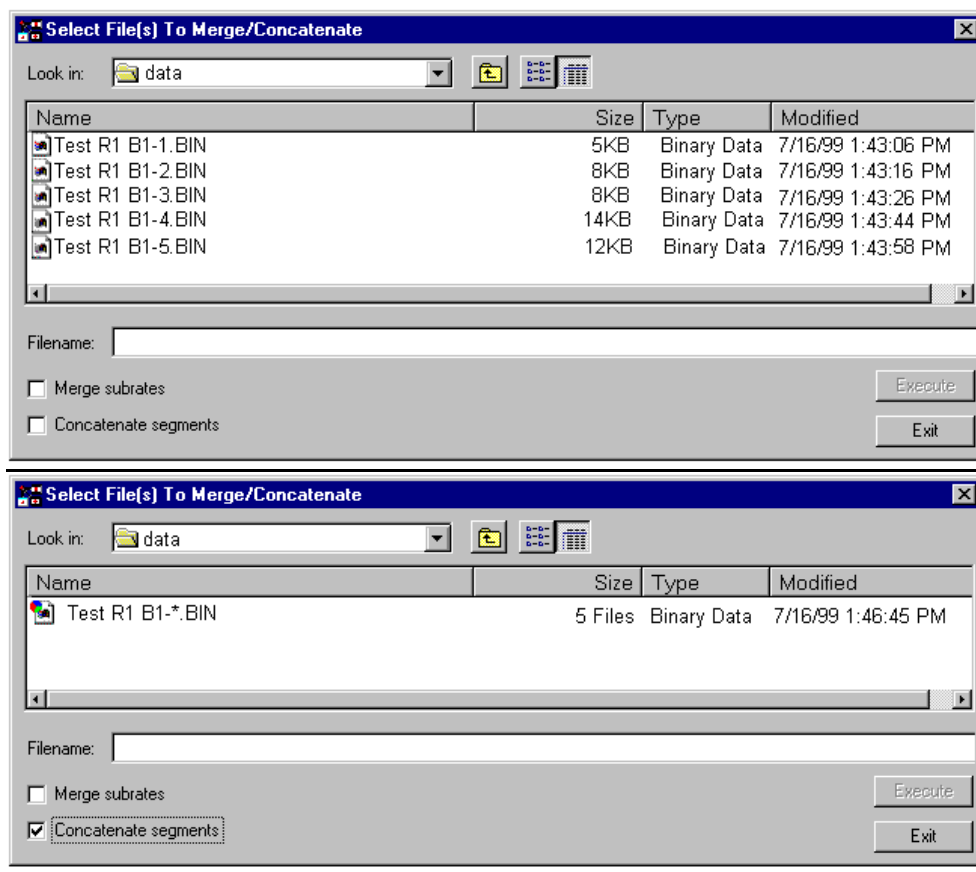
The number of files that this item describes is now shown in size column of the list box (4 files). Selecting **TEST R* B1-1.BIN** and then clicking the *Execute* button (lower right) will convert and merge the files.

```

TEST R1 B1-1.BIN -----> TEST R* B1-1.BIN
TEST R2 B1-1.BIN |
TEST R3 B1-1.BIN |
TEST R4 B1-1.BIN |_|

```

Concatenating (Linking) Segments



File Convert Utility Screen Shown Both Before and After Selecting “Concatenate Segments”

When the *Concatenate Segments* box is checked, the File Convert utility groups the Segment files together and displays a single item. In the example, the single item is **TEST R1 B1-*.BIN**. The number of files that this item describes is now shown in size column of the list box (5 files). Selecting **TEST R1 B1-*.BIN** and then clicking the *Execute* button (lower right of utility) will both convert and concatenate the files.

```

TEST R1 B1-1.BIN -----> TEST R1 B1-*.BIN
TEST R1 B1-2.BIN |
TEST R1 B1-3.BIN |
TEST R1 B1-4.BIN |
TEST R1 B1-5.BIN |_|

```

Note: For applications that require continuous data collection, the *Upload Scheduler* (discussed in chapter 4, *LBK Options*) can periodically upload the data to a local PC, creating new space on the LogBook’s PC-Card.

DIAdem

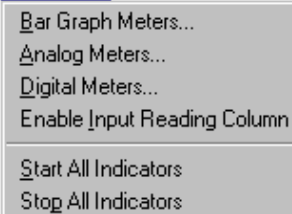


DIAdem is an independent program that allows you to view waveforms recorded by *LogView* (and many other data acquisition programs (including *DaqView*, *TempView*, *ChartView*, and *WaveView*). Refer to the separate DIAdem documentation for detailed information regarding this post acquisition program.

Note: PostView, a less versatile post-acquisition program, is detailed in Appendix F.

Indicators Menu

Indicators



Along with displaying channel data in real time in the setup spreadsheets, *LogView* also provides auxiliary real-time indicators.

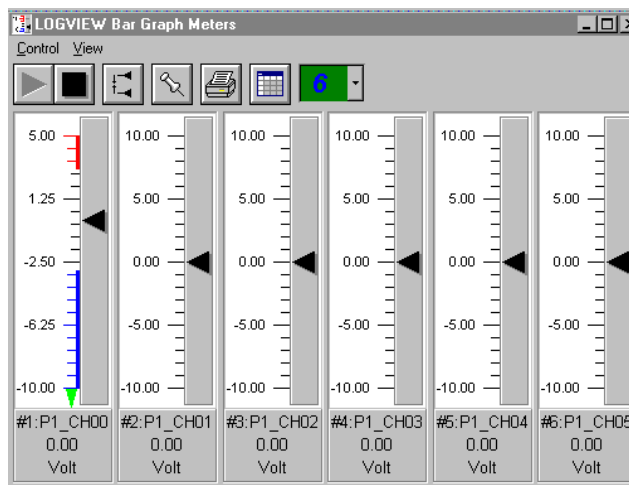
The meter windows simulate the look of popular meter types: the bar graph, the analog dial, and the digital readout. Within each meter type, you can adjust their display properties to fit your needs. Such properties include number of channels, high/low limits, peak hold, trend indicator, etc.

Next, each meter type is shown; and then, their configuration is discussed (they all work in a similar way).

Bar Graph Meters

(no toolbar icon)

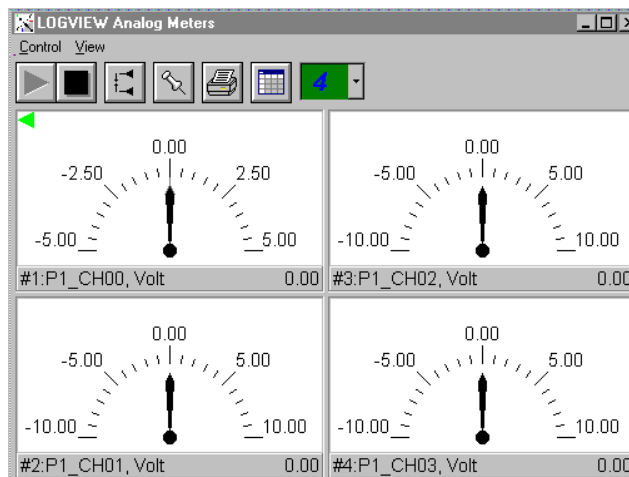
Selecting the Bar Graph Meter icon brings up the Bar Graph window to display several channels in bar graph format. To activate the display, select the Start button on the left side of the toolbar (or Start All Indicators in the pull-down menu or in the toolbar). You can vary the number of channels (32 max) displayed by selecting the input box at the end of the toolbar. The Grid button (next to last item on toolbar) is used to arrange the display for convenient reading. The pushpin icon in the center of the toolbar locks this window on top of other windows until you unlock it by selecting the pushpin again.



Analog Meters

(no toolbar icon)

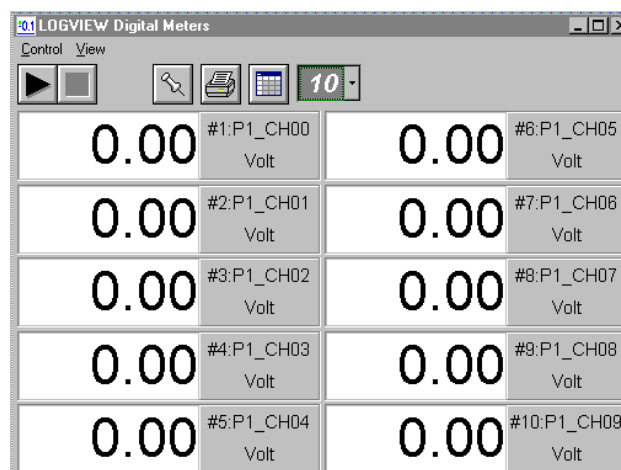
Selecting the Analog Meter icon brings up the Analog Meters window to display several channels in a dial/gage format. To activate the display, select the Start button on the left side of the toolbar (or Start All Indicators in the pull-down menu or in the toolbar). You can vary the number of channels (32 max) displayed by selecting the input box at the end of the toolbar. The Grid button (next to last item on toolbar) is used to arrange the display for convenient reading. The pushpin icon in the center of the toolbar locks this window on top of other windows until you unlock it by selecting the pushpin again.



Digital Meters

(no toolbar icon)

Selecting the Digital Meters icon brings up the Digital Meters window to display several channels in numeric format. To activate the display, select the Start button on the left side of the toolbar (or Start All Indicators in the pull-down menu or in the toolbar). You can vary the number of channels (32 max) displayed by selecting the input box at the end of the toolbar. The Grid button (next to last item on toolbar) is used to arrange the display for convenient reading. The pushpin icon in the center of the toolbar locks this window on top of other windows until you unlock it by selecting the pushpin again.



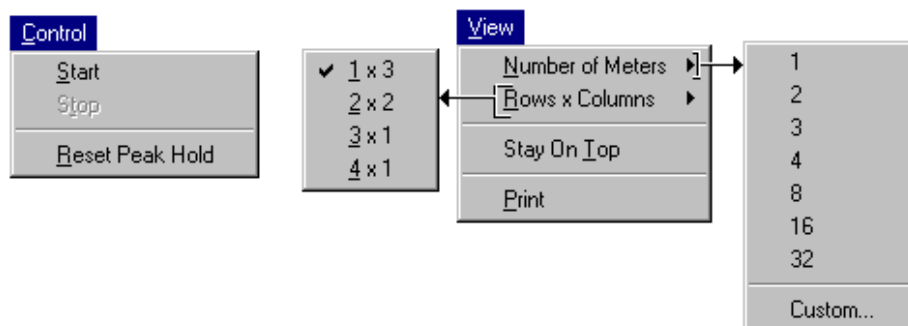
Meters Configuration

The toolbars and pull-down menus for the three meter types are identical except that Digital Meters does not have a Reset Peak Hold icon.



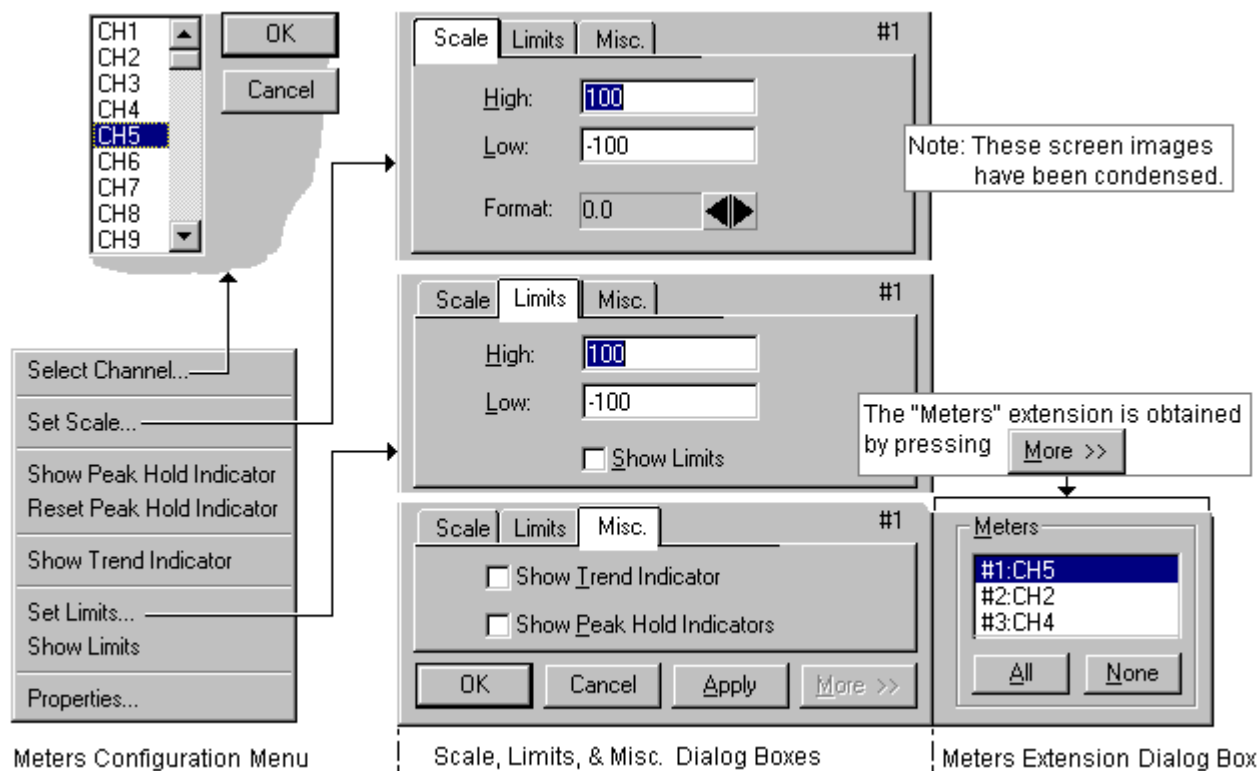
Meters Toolbar Icons		
Item	Name	Function
	Start	Starts meters.
	Stop	Stops meters.
	Reset Peak Hold Indicator	Resets the floating markers. Upon reset, the markers will instantly adjust to indicate the highest and lowest values reached since the time of the reset. This feature does not apply to the Digital Meters.
	Stay On Top (Push pin)	Locks or unlocks the meter window on top of other windows.
	Print	Sends the meter(s) display image to connected printer.
	Rows x Columns	Opens a small menu with "row x column" arrangement options. <i>Example:</i> When the number of meters is 6 the grid options will be: 6x1, 3x2, 2x3, and 2x4 with the first number being the number of rows. If you then select 3x2 you will have 3 rows of meters with 2 meters per row.
	Number of Meters	Specifies the number of meters to appear on the screen. Up to 32 meters can be selected.

The meters windows each have a Control and View pull-down menu, as indicated by the following figure. These menu items correspond to the toolbar icons described above.



A meters configuration menu (lower left corner of figure) will appear when you place the mouse pointer over a meter and click the right mouse button. This menu allows you to access various dialog boxes for changing parameters for meters. The steps for configuring a meter are detailed below.

Note: The *Show Peak Hold Indicator / Reset Peak Hold Indicator* selections are not an option for Digital Meters and do not appear on the configuration window for digital meters.



Meter Configuration Menu and Related Dialog Boxes

Configuring a Meter

1. Bring up the desired meter group (Bar Graph, Analog, or Digital).
2. Place the mouse cursor over the meter to reconfigure.
3. Click on the right mouse button. A Meters Configuration Menu will appear (see figure above).
4. Select the desired option from the meter configuration menu.
5. If a dialog box is required, for example, to change a limit, enter in the new value in the appropriate parameter box and press "Apply" or "OK." Pressing "Apply" implements your changes, but keeps the dialog box open, allowing you to make additional changes. Pressing "OK" implements your changes and closes the dialog box.

The previous figure and the next table and the previous figure serve as a quick reference to meters configuration.

Configure Meter Settings, Function Descriptions	
Function	Description
Select Channel	Select a new channel for display. The selected channel will replace the one currently seen in the meter. Note that double-clicking the left mouse button in the meter region will also bring up a dialog box which allows you to select a new channel.
Set Scale	Set the high and low points of the scale as well as define the decimal place format.
Show Peak Hold Indicator	Places high and low uni-directional floating markers on the scale to indicate the highest and lowest values reached up to the present time. This feature does not apply to the Digital Meters selection.
Reset Peak Hold Indicator	Resets the floating markers. Upon reset, the markers will instantly adjust to indicate the highest and lowest values reached since the time of the reset. This feature does not apply to the Digital Meters selection.
Show Trend Indicator	Displays a pointer to indicate the direction of the trend. Note that during rapid meter fluctuations the increase and decrease pointers will appear to blink simultaneously.
Set Limits	Provides a way of establishing high and low limit set-points.
Show Limits	Displays limits by adding color (red for high, blue for low) to the scale regions which equal and exceed the set limit values. For Digital Meters the limits are indicated by red numbers and an upper red bar for hitting or exceeding the high limit; and blue numbers and a lower blue bar when reaching or exceeding the low limit.
Properties	Allows setting and showing limits, as well as opening the Scale dialog box.

You can access a different dialog box from the one initially selected. For example, from the Set Scale dialog box you can select Limits to access the Set Limits/Show Limits display, as well as select “Misc.” which allows you to “Show Trend Indicator” and “Show Peak Hold Indicators.”

Mouse buttons

- Left: Double-clicking the left mouse button in a meters scale area brings up a channel selection pop-up menu.
- Right: Single-clicking the right mouse button in a meters scale area brings up a configuration pop-up menu.

Enable Input Reading Column

(no toolbar icon)

This command enables/disables the “Reading” column of the Analog Input Channel Configuration spreadsheet to provide a numeric view of incoming data. This function toggles on and off when the menu item is repeatedly selected.

Note: With the input reading columns ON, no modifications to program parameters may be performed.

Start (or Stop) All Indicators

(no toolbar icon)

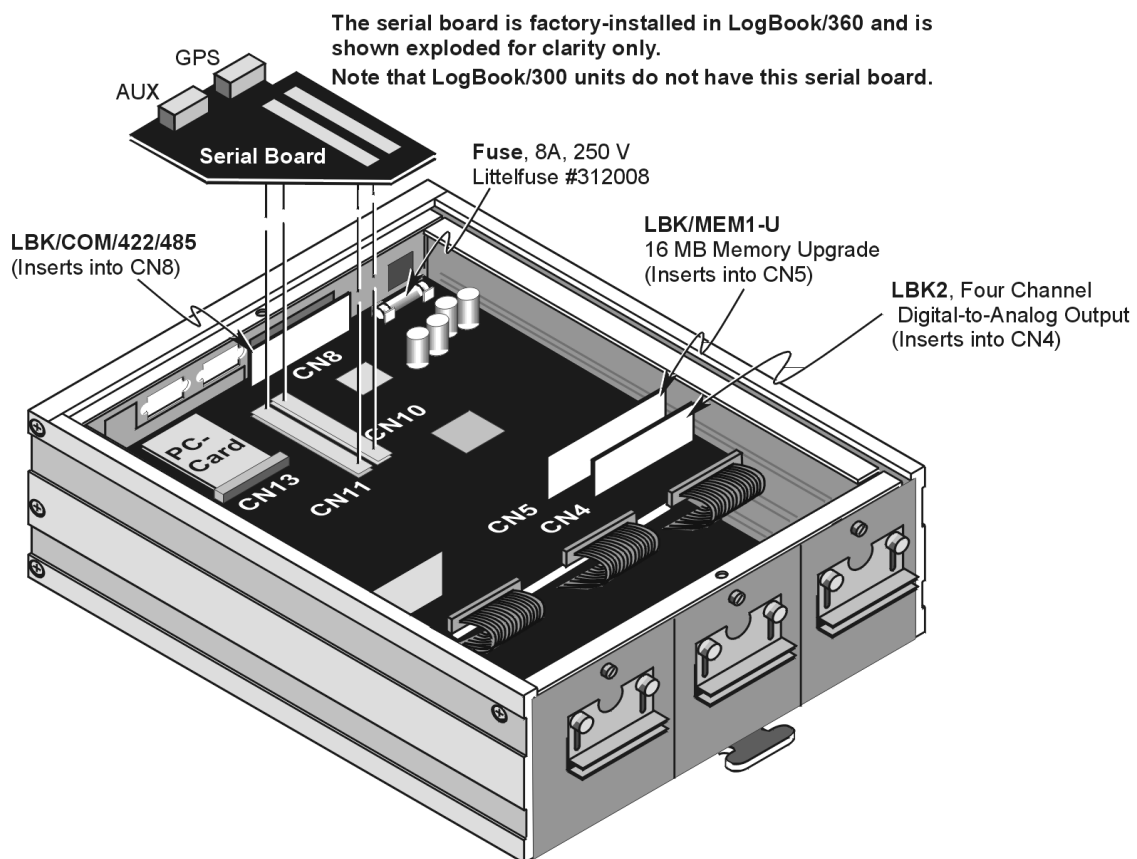
Starting or Stopping all indicators affects several windows if open, including: Reading column, Charts, Bar Graph Meters, Analog Meters, and Digital Meters. **Note:** you can start or stop any of these active windows separately using their own Start or Stop (Pause) buttons.



LBK Options, Location Reference	4-1
LBK/COM/422/485	4-2
LBK/MEM1-U, Expanded Memory (16 MB Upgrade)	4-3
LBK1, Remote LogBook Terminal	4-4
LBK2, Four Channel, Digital-to-Analog Output	4-8
GPS and Serial Device Data Collection (LogBook/360 Only).....	4-9
LogBook/Modem, with Upload Scheduler.....	4-21

LBK Options, Location Reference

The following location reference applies to hardware aspects of LogBook's LBK options. Since the LogBook/GPS and LogBook/Modem options are primarily software related, they do not appear in the illustration. Additional items of importance to the user, such as the fuse and PC-Card are also called out. Although the following drawing is based on LogBook/360, it can be used for LogBook/300 motherboard reference. The remainder of this chapter discusses the installation of each option, and includes a board layout.



Component Location Reference

- Notes:**
- (1) Information regarding LBK1 (the remote LogBook Terminal) begins on page 4-4.
 - (2) The actual LogBook motherboard, depicted above for LogBook/360, also applies to LogBook/300.
 - (3) The AUX/GPS Serial Board is *factory-installed* in LogBook/360.
 - (4) The AUX/GPS Serial Board is not used in LogBook/300.

The standard LogBook communications board supports RS-232 only; but as an option, the LogBook can be purchased with the additional capability for RS-422 and RS-485. These optional boards (p/n LBK/COM/422/485) have circuitry for all three communication protocols on the same board. If your communication board has the RS-422/485 option, you can switch between RS-232 and RS-422/485 by switching the board's orientation in the CN8 slot.

WARNING



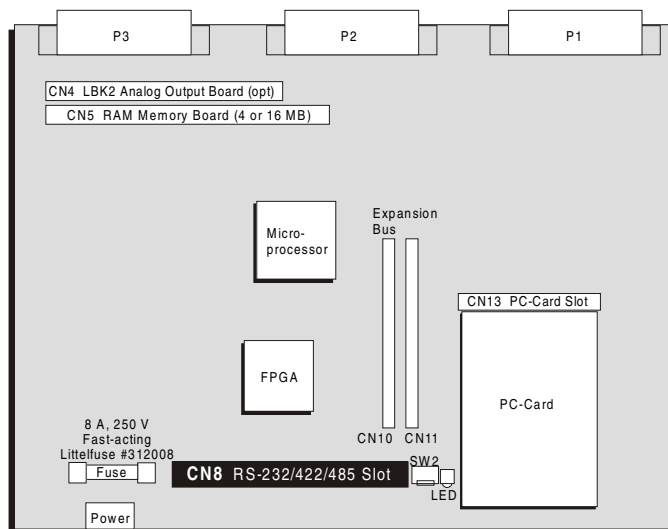
Electric shock hazard. Turn off power to all system-connected devices prior to connecting or disconnecting cables, or setting hardware configurations. Failure to do so could result in electric shock or death, and equipment damage, even under low-voltage conditions.

CAUTION



Perform the following procedure using ESD tools, containers, and procedures. One or more related components are sensitive to damage from electrostatic discharge.

1. Turn off system power.
2. Remove the LogBook's top cover and locate CN8 (see figure for location).
3. Remove the RS-232/485 board from CN8. Note that CN8 has two release clips.
4. Rotate the RS-232/485 board to a relatively upside-down position, and insert back into CN8. Note that onboard text indicates which end should be up for a given communication (RS-232 ↑ UP ↑, or RS-485 ↑ UP ↑).
5. For RS-485 applications, ensure the address setting on rotary switch SW2 is unassigned; and change the address if needed. See note.
6. Replace the top cover and screws.
7. Turn on system power.



LogBook Motherboard, CN8 Location Reference

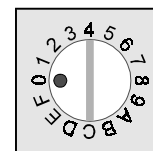
Notes:

- (1) The CN8 slot has two release clips that must be depressed to release the COM card.
- (2) The COM Card has onboard text, indicating orientation, as follows:
“RS-232 ↑ UP ↑”
“RS-485 ↑ UP ↑”

The LBK/COM/422/485 Card inserts into the CN8 slot on LogBook's Motherboard.



For RS-485 applications, rotary switch SW2 sets the address. SW2 is located next to CN8, just inside the PC-Card door. Use a small flat-head screwdriver to set a particular address (1 of 16) in a multi-drop RS-485 network. Rotate the switch so the black dot aligns with the desired, *previously unassigned*, address.



LBK/MEM1-U, Expanded Memory (16 MB Upgrade)

The standard 4-MB RAM can be user-replaced with a 16 MB board (LBK/MEM1-U). The expanded memory creates a larger data buffer, allowing more time to swap PC-Cards. This is convenient when using fast scan rates. Note that the 16 MB memory option can also be installed at the factory (LBK/MEM1).

WARNING



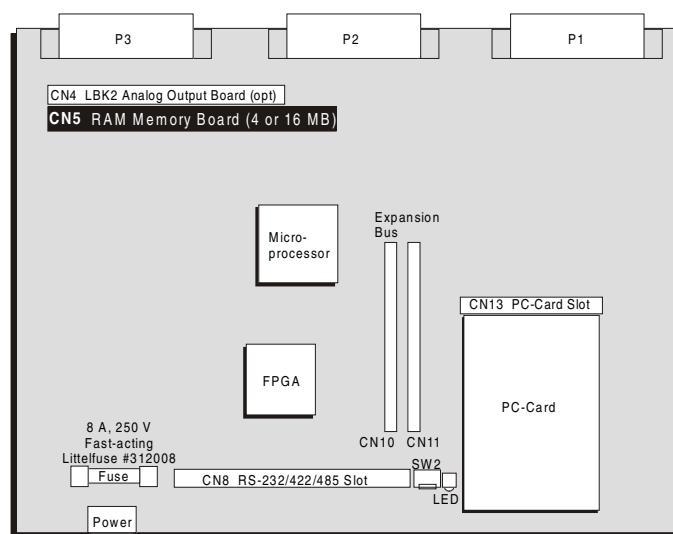
Electric shock hazard. Turn off power to all system-connected devices prior to connecting or disconnecting cables, or setting hardware configurations. Failure to do so could result in electric shock or death, and equipment damage, even under low-voltage conditions.

CAUTION



Perform the following procedure using ESD tools, containers, and procedures. One or more related components are sensitive to damage from electrostatic discharge.

1. Turn off system power.
2. Remove LogBook's top cover and locate SIMM socket CN5 (see figure). The CN5, 72-pin socket, holds the RAM Memory Board.
3. Using ESD precautions, depress CN5's two release clips and remove the 4-MB board.
4. Using ESD precautions, insert a 16 MB board (LBK/MEM1-U) into CN5. Note that the board and socket are keyed to mate *one-way-only*, and will lock together when properly mated.
5. Replace the top cover and screws.
6. Turn on system power.



LogBook Motherboard, CN5 Location Reference

Note:

The CN5 slot has two release clips that must be depressed to release the memory card.

The LBK/MEM1-U Memory Board inserts into the CN5 slot on LogBook's Motherboard.

LBK1, Remote LogBook Terminal

Hardware Description

The LBK1 remote-operation terminal connects to LogBook and provides control of the LogBook *with no computer attached*. With the LBK1, the basic LogBook operations can be controlled with a push of a button; and acquisition data can still be monitored.



LogBook can operate without an LBK1 and with no PC attached. However, such operation requires the use of a programmed PC-card.

Physical Features of LBK1.

- The control panel has a 16-line \times 40-character back-lit LCD display (4.25 \times 2.25 in.).
- The keypad has 29 membrane switches. Six “soft-keys” are located under the LCD display; their programmed function is shown in the bottom row of the LCD display. Numeric keys are available for entering various parameters in a signed, decimal format. Other keys are used to initiate the manual trigger, mark events, navigate the menu, enter/cancel settings, and turn the system on and off.
- The LBK1 has a beeper to confirm keystrokes; there are no LEDs.
- The LBK1 has one connector (an RJ11) that attaches to the LogBook’s DB9 connector via the supplied cable. The supplied cable is 2 ft long. Cable options include: a coiled, retractable cable (6 ft max) and a shielded 3 ft cable to comply with CE standards. Cable lengths up to a maximum of 100 ft from LogBook can be used.
- No batteries are required; LBK1 power comes from the LogBook.
- An optional LBK1 mount can be attached to LogBook for convenient mounting of the LBK1 module.
- The size of the LBK1 is 7.875 \times 4.375 \times 1.125 in. (200 \times 111 \times 29 mm).

Capabilities



LBK1’s capabilities and limitations are highlighted in the following table. Note that, although LBK1 provides many LogBook functions, it does not provide the degree of control that can be obtained by using a PC and LogView.

Capabilities. The LBK1 can:	Limitations. The LBK1 cannot:
Indicate LogBook power status, acquisition state, and system errors. Provide the user with control to start/stop an acquisition, to initiate a manual trigger, and to mark events. Display channel values numerically: Any measured input channel may be displayed in real time during acquisitions. Any enabled, displayable channel may be displayed if the acquisition is halted. Monitor disk status, showing what percentage of the disk is full. Set LogBook time.	Set up a new acquisition configuration. View charts and graphs. Perform mathematical functions with virtual channels. Run LogView. Internally store data.

LBK1 Installation

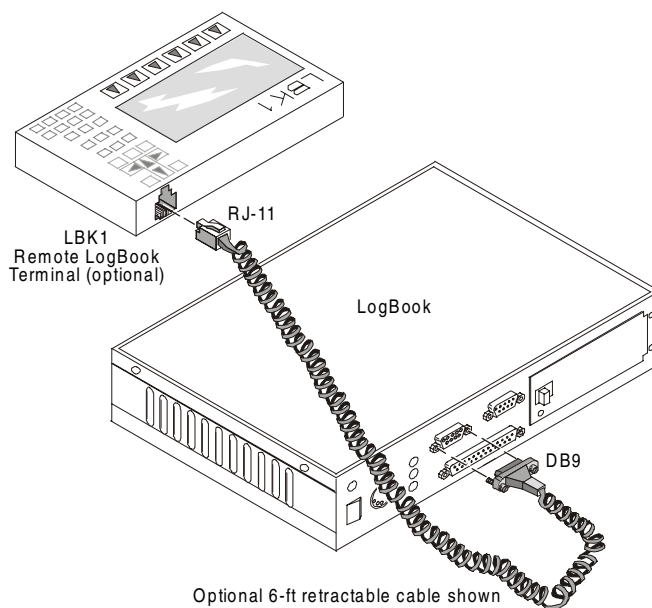
System Connection

1. Connect the supplied cable's DB9P connector to the LogBook's DB9S connector and tighten the locking screws.

On **LogBook/300** the connector is labeled "FROM CONTROLLER".

On **LogBook/360** the connector is labeled "TERMINAL (TO LBK1)".

2. Connect the cable's RJ-11 connector to the LBK1's corresponding socket.



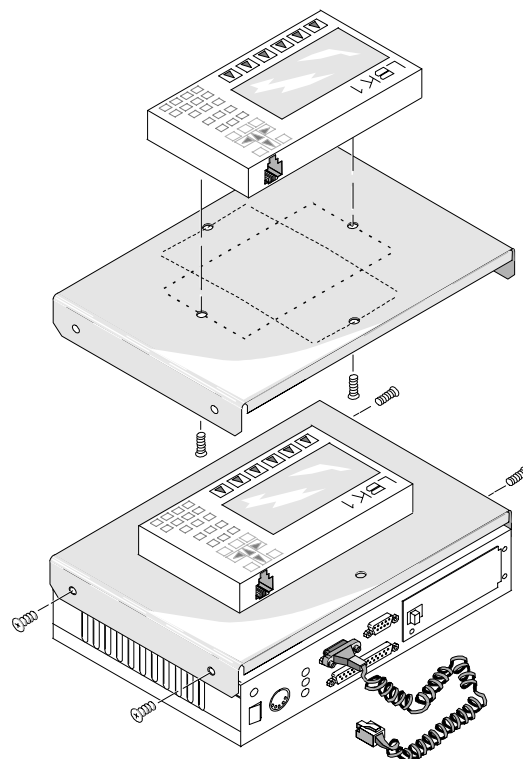
LBK1 with Early-Style LogBook/300

Mounting Rack

An optional mounting rack (p/n Mount1) can be used to hold the LBK1 securely to the LogBook. For convenience, you can mount the LBK1 length-wise or width-wise on the rack (see figure).

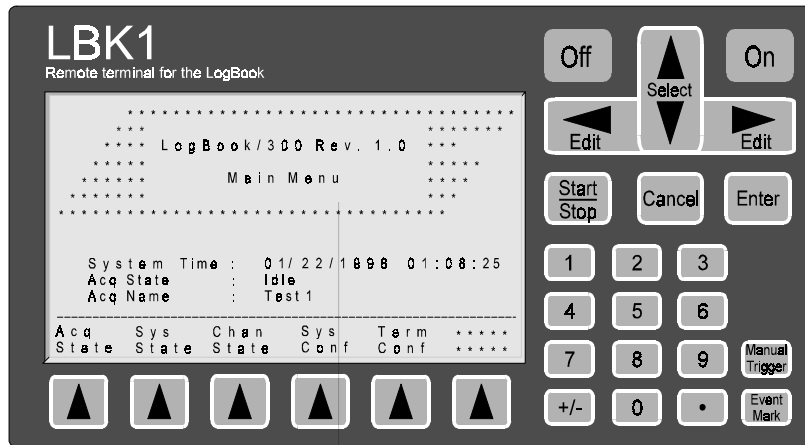
1. Mount LBK1 on the rack in the desired orientation, and attach 2 screws through the rack to the LBK1.
2. Mount rack onto the LogBook, and attach 4 screws to hold the rack to the LogBook.
3. Attach cable, RJ-11 side to the LBK1 and DB9 side to the LogBook.

Note: The mounting rack can be attached to other equipment, racks, shelves, or other support structures.



LBK1 and Rack (p/n Mount1) Shown both Assembled (bottom) and Disassembled (top)
Note: Early-Style LogBook Depicted

Control-Panel Functions



LBK1, Remote Terminal

Menu Select Keys (▲) – Located just below the display screen, these keys access the various menus.

On - Turns power ON to the LogBook. As an indication of power status, legible characters or the LCD backlight shows that LogBook power is on.

Off - Turns power OFF to the LogBook. To prevent accidental shutdown, the user must confirm the “off” request if so configured in the Terminal Configuration submenu.

Select/up/down - Moves the cursor up and down menu to select a particular parameter or function.

Edit/left/right - Views and selects among pre-programmed parameter values; Increases (right) or decreases (left) the numeric quantity.

Enter - Resets parameter values as shown; performs current operation.

Cancel - Discards current operation and restores previous state as last saved.

Start/Stop - Starts an acquisition from idle, or stops an on-going acquisition.

Numeric keypad - Allows entry of signed (+/-) decimal (*) numbers for setting various parameters.

Manual Trigger - Generates a manual trigger to begin a scan sequence.

Event Mark - Generates an event marker. LogBook records the exact time (to the nearest scan) at which the operator presses the Event Mark button. These marks can be viewed through **PostView** on the user's PC.

LBK1 Menu Map

The following table describes the LBK1 menus that become available via the soft-keys below the LCD display panel. In general, you can scroll through menu parameters by using the Select-up/Select-down keys and through parameter values by using the Edit-left/Edit-right keys. Selections are finalized by using the Enter key; selections are discarded by using the Cancel key or by selecting another parameter.

Menu ID	Name/Type/Description	Fields and Parameters
Main Menu	Opening screen with soft-key options for other menus on the bottom line. Other screens can return here by selecting Main Menu at bottom right corner.	System Time - reports time registered by LogBook's internal timer Acquisition Status - status can be idle , armed , or triggered .
ACQ STATE	Acquisition Status (Read Only) Shows settings from LogView's Acquisition Configuration window. Defines basic trigger parameters using 3 submenus.	
	Scan Rate	Clock Source - can be internal or external Base Rate A (Hz) - can be off or set by LogView Base Rate B (Hz) - can be off or set by LogView Base Rate C (Hz) - can be off or set by LogView Base Rate D (Hz) - can be off or set by LogView
	Acquisition Configuration	Acquisition Name - name of the configuration file (*.lvc) that is currently loaded Number of Re-arms - infinite or number of repetitions until acquisition is stopped
	Pre-Trigger Configuration	Scans - the number of scans before the trigger event that will be saved
	Trigger Configuration	Source - can be immediately, manually, analog channel, digital channel Date - to set Absolute Time Time - to set Absolute Time Retrigger - under absolute Time, set duration to next trigger Channel - user label for analog and digital channels Condition - can be rising or falling edge for analog or digital channel source Threshold - a voltage value for analog channel source Hysteresis - a voltage value for analog channel source
	Post-Trigger Configuration	Stop On - can be manually, analog channel, digital channel Channel - user label for analog and digital channels Scans - the number of scans before the trigger event that will be saved Condition - can be rising or falling edge for analog or digital channel source Threshold - a voltage value for analog channel source Hysteresis - a voltage value for analog channel source
SYS STATE	System Status (Read only) Shows system status and resources.	Start Time - lists the date and time of current acquisition Acquisition - status can be idle , armed , or triggered . Pre-Trig Scans - lists the number of pre-trigger scans already completed. Post-Trig Scans - lists the number of post-trigger scans already completed Trigger Blocks - lists the number of trigger blocks already completed and stored with current configuration file. Error Count - lists the number of errors during current acquisition. Disk Space Available - lists the number of bytes available on the PC-card. Disk Space Used - list the number of bytes saved to the PC-card.
CHAN STATE	Channel Status (Read Only) All channels are listed with their values and units. If multiple pages are used to list channels, each page is numbered in the format "page (1) of (3)".	Channel Name - lists channel by user-assigned name/number Reading - lists the latest reading received from that channel Units - lists the dimensional units of the reading; e.g., PSI, DegC The soft-keys in this menu are used as follows: AnIN Chans - to display active analog channels and their current readings DigIN Chans - to display active digital channels and their current readings Calc Chans - to display calculated channels and their current values Next Page - to display next page for more channels Prev Page - to display previous page of channels Main Menu - to return to main menu
SYS CONF	System Configuration (Set Time) (Read/Write)	Time - reports time registered by LogBook's internal timer Month - sets LogBook timer to current month Year - sets LogBook timer to current year Hour - sets LogBook timer to current hour Minute - sets LogBook timer to current minute Second - sets LogBook timer to current second
TERM CONF	Terminal Configuration Allows the user to set parameters for the LBK1 terminal. These values are saved in the LBK1's non-volatile memory.	Contrast - sets display contrast from 1 to 25 Brightness - sets display brightness from 1 to 25 Key Sound - can be yes or no to confirm keystroke Back Light - can be yes or no (not using the back light can conserve battery life) Verify Power Off - can be yes (when off key is selected, a confirmation screen will ask "power Off" with yes and no soft-keys) or no (selecting the Off key will immediately turn off the LogBook) Baud Rate - can select communication speed from listed options

LBK2, Four Channel Digital-to-Analog Output Option

The optional D/A output board contains four 16-bit, voltage-output, digital-to-analog converters with a maximum update rate of 100 kHz per channel. The board is intended for waveform generation, UUT stimulus, and signal feedback. Each converter has a fixed, full-scale output of ± 10 VDC. The board's operation must be programmed through LogView.

The D/A output board has been designed for operation into loads of $>2000\ \Omega$ resistance with <100 pF of parallel capacitance. The D/A board is stable with all capacitive loads; however, increased capacitive loading will result in longer settling times.

Name: Analog Output Board

Output Voltage Range: ± 10 VDC.

Voltage Resolution: (1 LSB): $305\ \mu\text{V}$

Offset Error: $\pm 0.0045\ \text{V}$

Full Scale Error: $\pm 0.01\%$

Settling Time For 20 Volt Step: $<10\ \mu\text{s}$

The D/A output board is an edge-card design and plugs into a 30-pin SIMM socket. If not factory-installed, the D/A board can be easily installed by the user as follows:

WARNING



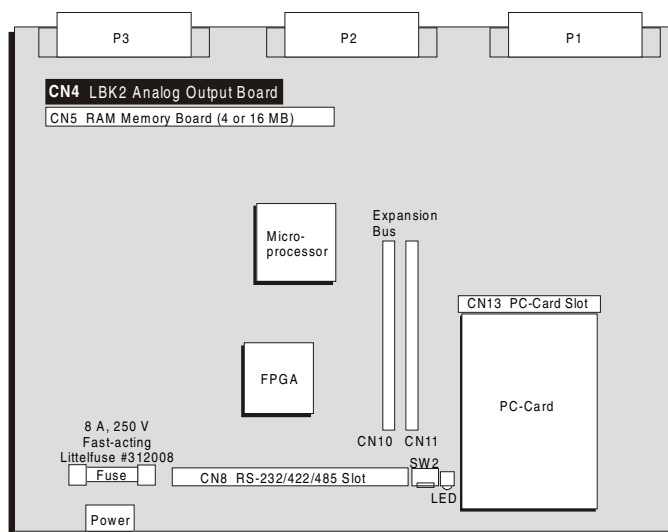
Electric shock hazard. Turn off power to all system-connected devices prior to connecting or disconnecting cables, or setting hardware configurations. Failure to do so could result in electric shock or death, and equipment damage, even under low-voltage conditions.

CAUTION



Perform the following procedure using ESD tools, containers, and procedures. One or more related components are sensitive to damage from electrostatic discharge.

1. Turn off system power.
2. Remove the LogBook's top cover and locate CN4 (a 30-pin SIMM socket), see following figure.
3. To gain access to CN4, first remove the RAM memory board from CN5.
4. Using ESD precautions, remove the bypass board from CN4.
5. Using ESD precautions, insert the LBK2 analog output board into CN4. Note that the board and socket are keyed to mate *one-way-only*, and will lock together when properly mated.
6. Using ESD precautions, replace the RAM memory board into CN5.
7. Replace the top cover and screws.
8. Turn on system power.



LogBook Motherboard, CN4 Location Reference

Notes:

CN4 and CN5 slots each have two release clips that must be depressed in order to release cards.

The LBK2 Analog Output Board inserts into the CN4 slot on LogBook's Motherboard.

GPS & Serial Device Data Collection (for LogBook/360 Only)

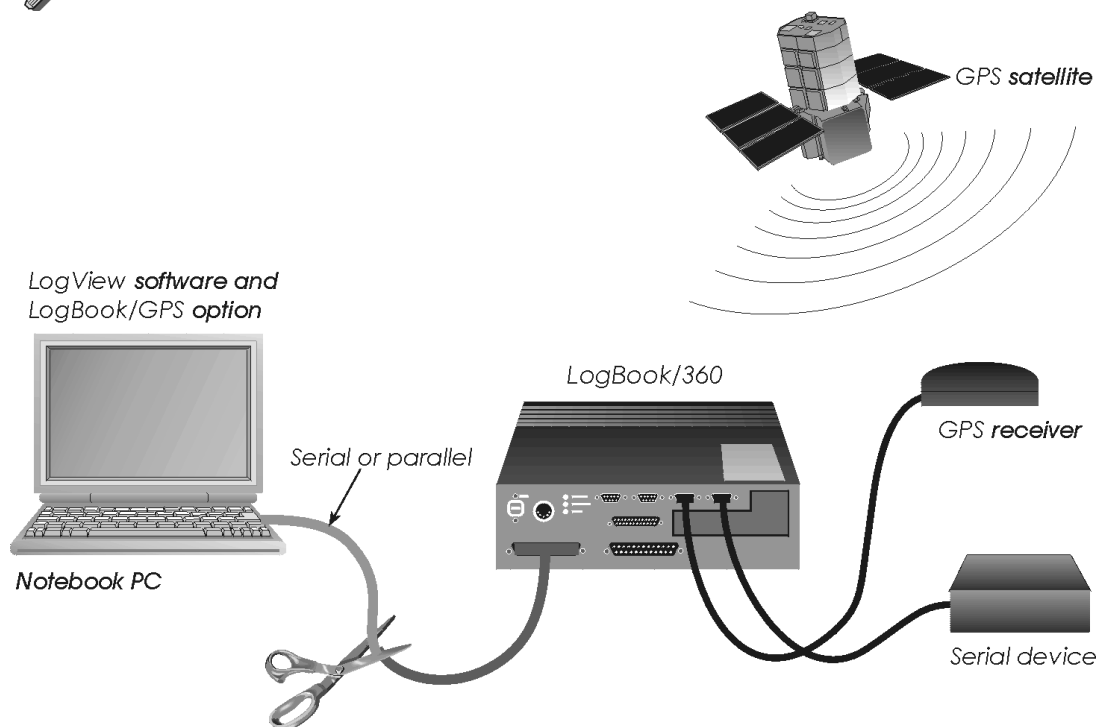
Introduction

The LogBook/360 has two serial ports to which RS-232 devices can be attached. Using the LogView interface, serial data channels can be described that allow the LogBook to collect data from the devices, convert them to channel values, and store them synchronously with its analog and digital inputs.

Although the auxiliary serial ports are standard in the LogBook/360, the serial input software is sold separately as option *LogBook/GPS*. When this option is purchased, an authorization code is provided from the factory that enables the option.



LogBook/300 does not support serial device input.



LogBook/360 Connected to GPS Receiver and a Serial Device

Virtually any serial device that sources continuous ASCII data, including Global Positioning System (GPS) devices, gas flow meters, and scales, is compatible. GPS devices conforming to the NMEA 0183 standard are supported directly in the LogView interface, so no knowledge of the data format is necessary. The GPS receiver must be purchased separately and is available from a variety of sources. For ease of operation, make sure the receiver complies with the NMEA 0183 protocol standard.

Serial Input Fundamentals

Every LogBook input and output is called a channel. When an input channel is enabled, the LogBook will sample and save it at the specified frequency. To collect and save numeric data from serial devices, a *serial channel* must be defined. Each serial channel defines a single number embedded in the ASCII *serial input string* sourced by the serial device. Each serial channel has an associated *format string* that provides the parsing and converting instructions to the LogBook. Up to 16 serial channels can be defined within the LogView software application.

Terms

<i>Serial channel</i>	A serial channel is a LogBook data element, like an analog input channel, that can be collected and stored with the other analog and digital input data. A serial channel defines a single numeric field within the serial data stream sourced by the serial device.
<i>Serial input string</i>	A serial input string is the ASCII data being transmitted by the serial device. Typically, the serial input string contains several numeric and character fields, and is terminated by carriage return (CR) and/or line feed (LF) characters.
<i>Format string</i>	A format string is a user-created character string that contains the instructions necessary for the LogBook to parse out the desired field in the serial input string.

Capabilities and Limitations

Interface type	RS-232 devices.
Data types	The device must supply an ASCII sentence, an ASCII data string terminated by a CR and/or LF. The device must transmit its data without any inducement.



Devices that require a data request command from the controller are not supported.

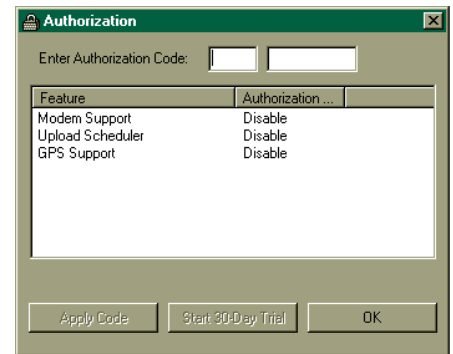
Serial input string size	The size of a terminated sentence cannot exceed 255 characters.
Number types	Integers (+/-32,768), floats (3.4E+/-38 with 6 digits of decimal precision), and character (+/-128) types are accepted.
Serial channel usage	Like all other input channels in the LogBook system, serial channels can be used in equations defining <i>calculated channels</i> and/or used in the definition of the <i>trigger or stop events</i> .
Serial baud rate	1200, 2400, 4800, 9600, 38400, 57600, 115200.
GPS port	General serial devices can be attached to either port 1 and/or 2, but a GPS device can only be attached to Port 1.
Synchronicity	<p>The LogBook's analog and digital input channels are synchronously sampled at the specified rate(s) using an internal or externally supplied sample clock. Serial devices provide data to the LogBook asynchronously to its sample clock. When a serial input string is parsed and converted, its value is placed in temporary storage. When the sample clock <i>fires</i>, the current value in temporary storage is scanned along with the analog and digital input channels and written to the LogBook's non-volatile PC-Card memory.</p> <p>If the sample rate associated with the serial channel is slow relative to the transmission speed of the serial device, the temporary storage may be updated several times between recorded samples. If the sample rate of the associated serial channel is fast relative to the transmission speed of the serial device, the temporary storage may be sampled and stored many times without any new updates from the serial device.</p>
Data validity	When the system is first armed the serial channel data may be invalid for an undetermined number of scans. Until the serial device provides that which is required by the serial channel definition, the associated serial channel will be invalid. For high sample rates, many scans may be executed before valid data is present on the serial channels.

Installation and Setup

Installing a New System

For new LogBook systems, perform the following steps to install.

- Step 1** Follow the general instructions included with your LogBook for installing your hardware and software.
- Step 2** Launch LogView.
- Step 3** Select *File/Authorization...*
- Step 4** Enter the Authorization Code supplied by the factory, then click *Apply Code*. This code is only supplied when the LogBook/GPS option is purchased. If you haven't purchased the option, but would like to try it out for 30 days, click *Start 30-Day Trial*.
- Step 5** Connect your serial device(s).
- Step 6** Close and re-launch LogView.



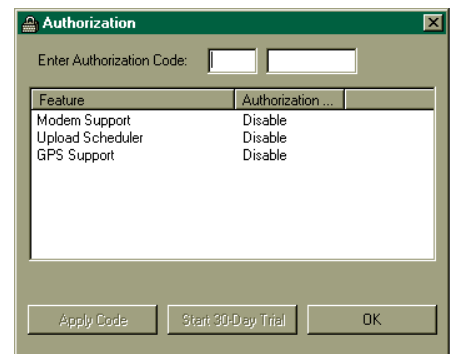
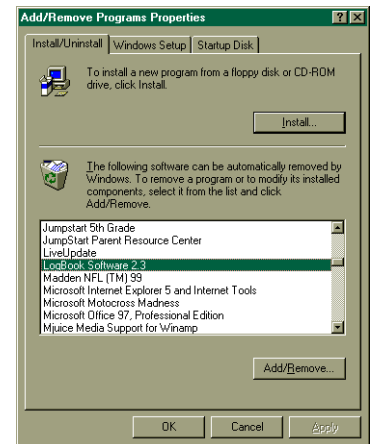
Upgrading an Older System

When adding the GPS/Serial Input option as an upgrade to an older LogBook system, perform the following steps:

- Step 1** Use the *Add/Remove Programs* utility in the *Windows Control Panel* to uninstall your current version of LogView.
- Step 2** Insert the upgrade CD. If Autorun is enabled, the setup program will launch automatically. If it's disabled, run SETUP.EXE from the root directory of the CD.
- Step 3** In the opening window, select LogBook support and click OK.
- Step 4** Follow the on-screen instructions to complete the installation.

Note: It may be necessary to restart your computer when the setup program is complete.

- Step 5** After restarting your computer, launch LogView.
- Step 6** Select *File/Authorization...*
- Step 7** Enter the authorization code supplied by the factory then click *Apply Code*. This code is only supplied when the LogBook/GPS option is purchased. If you haven't purchased the option, but would like to try it out for 30 days, click *Start 30-Day Trial*.
- Step 8** Connect your serial device(s).
- Step 9** Close and re-launch LogView.



Configuring an Acquisition

What you need to know about your non-GPS device

To successfully capture data sourced by a non-GPS device, you'll need intimate operational knowledge about the device. Use the Operator's Manual shipped with the device to collect information about the following:

Baud rate, parity, stop bits, and data bits	To successfully communicate with the serial device, the LogBook's serial port(s) must be set up to match the RS-232 parameters of the serial device.
Data transmission rate	Typically, serial devices send a block of ASCII data or an ASCII sentence (terminated by CR LF) on a periodic basis—once per second, for example. Knowing this rate will allow you to set up your sample rate for the serial channel(s) intelligently. To capture every value transmitted by the serial device, set the sample rate for the serial channel at about twice the rate of the serial data transmission rate.
Data string	To successfully parse and convert fields within the serial data string, complete knowledge of the string format must be known. For each serial channel, a format string must be created which perfectly describes the expected message. The Windows' Hyperterminal application is sometimes helpful for inspecting the serial strings sourced by a device.

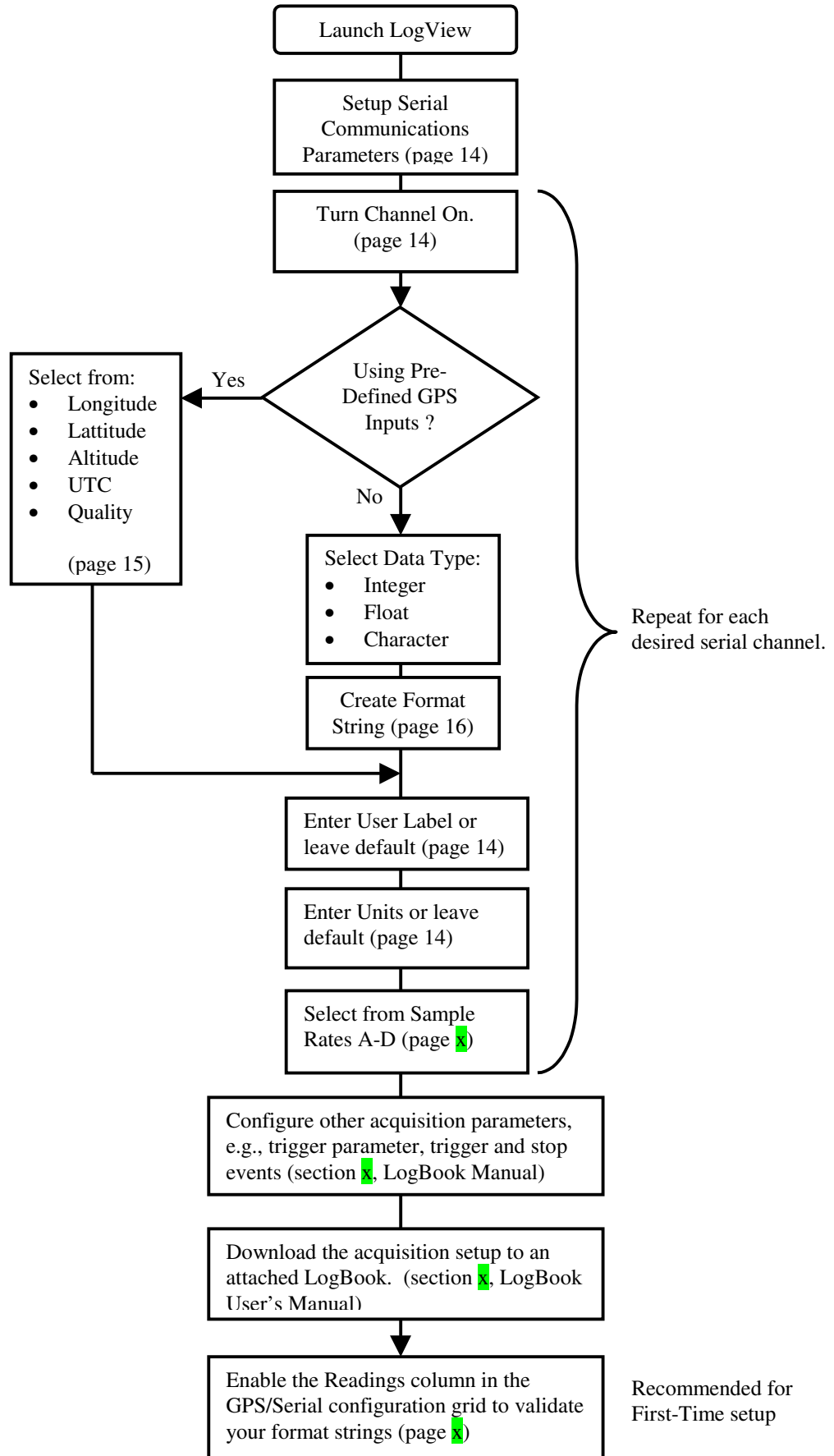
What you need to know about your GPS

The LogBook has direct support for all GPSs that conform to the NMEA 0183 protocol. A GPS of this kind can be connected and operated without any knowledge of the communication or protocol parameters. The included GPS support makes use of the NMEA 0183's *GGA* message, yielding Longitude, Latitude, Altitude, UTC time, and Quality of fix.

If additional GPS parameters are desired, serial channels can be defined to capture them, just like parameters from general, non-GPS devices. To maximize flexibility, user-defined serial channels and pre-defined GPS channels can be used concurrently on the same GPS device. For example, the GPS Longitude channel can be enabled concurrently with a user-defined serial channel that captures the *heading* data from the same GPS.

To capture user-defined parameters from the GPS, intimate knowledge of the GPS data strings is required.

Configuration Setup Overview



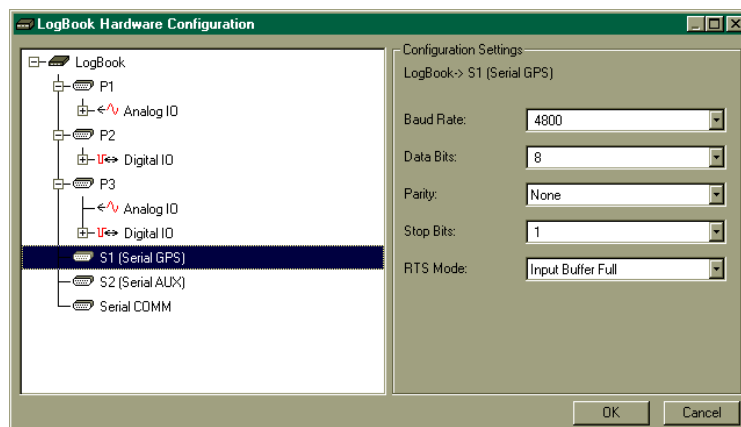
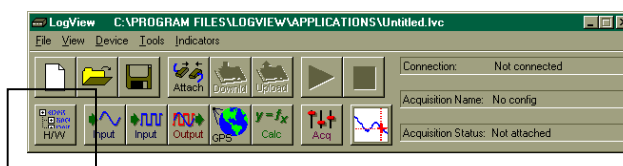
Setting up Serial Communication Parameters

To setup the serial communication parameters of either or both RS-232 ports, open the Hardware Configuration Window.

This window exposes the hardware configuration tree used to configure DBK expansion cards and hardware settings.

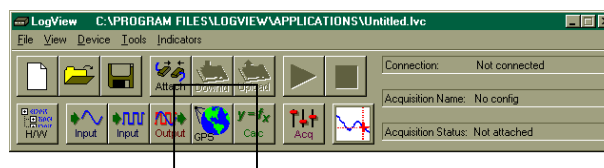
Selecting any of the 3 Serial ports at the bottom of the tree exposes their settings on the right. The bottom-most serial port is the LogBook communication port used to connect the LogBook to a PC or modem. The items labeled S1 and S2 are the 2 serial device input ports. On the LogBook connector panel, the connectors for S1 and S2 are marked “Serial GPS” and “Serial AUX”, respectively. The 1st port is labeled GPS because, if used, a GPS should only be connected to this port. If a GPS is not being used, any serial device can be connected to S1 and/or S2. The default configuration settings for S1 and S2 are designed for standard GPS receivers. If you’re using a GPS on S1, leave the settings in their default states. For general serial devices, the baud rate, data bits, parity, and stop bits settings should all be set to match the serial device. The RTS Mode setting regulates the RS-232 handshaking. The *Input Buffer Full* setting enables hardware handshaking. The *Always On* setting disables handshaking.

Once the settings for S1 and S2 have been entered, click **OK** to close the window.

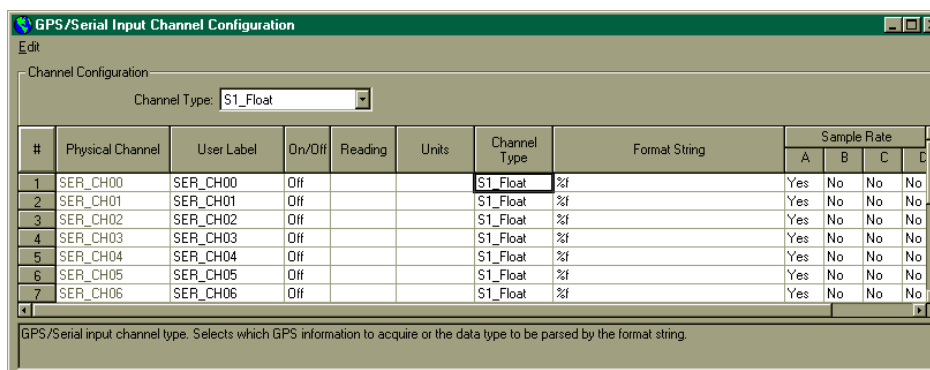


GPS/Serial Input Channel Configuration

To configure a serial input or GPS channel, click the GPS/Serial Input tool in the toolbar. This action will expose the channel grid used to set up the desired serial input channels.



Each row of the grid represents a serial input channel. Up to 16 serial input channels can be defined. As channels are needed, enable them in the On/Off column, then select the channel type from the drop down list. The “Units” and “User Label” columns hold a user-entered string that is stored with the data for data readability, but have no effect on the acquisition.



The “Channel Type” and “Format String” columns define what will be read from the serial device and stored in the associated LogBook channel. In the “Channel Type” column, both the serial port and data type are specified. When an integer, character, or floating point input is selected, LogView will automatically insert the required directive into the format string. The user can then add additional, optional formatting parameters, but *the format string must always end with the directive initially inserted by LogView or a directive of the same number type.*

The following table describes the available settings for Channel Type:

Parameter type	Setting	Description
GPS-specific (on S1 only)	Latitude Degrees	Latitude Degrees is an integer that varies from +/- 90 degrees. A positive number represents the northern hemisphere while a negative number represents the southern hemisphere.
	Latitude Minutes	Latitude Minutes varies from 0 to 60 minutes with 4 digits of decimal precision providing a distance resolution of 0.02 meters.
	Longitude Degrees	Longitude Degrees is an integer that varies from +/- 180 degrees. A positive number represents the western hemisphere while a negative number represents the eastern hemisphere.
	Longitude Minutes	Longitude Minutes varies from 0 to 60 minutes with a variable number of digits of decimal precision, providing a distance resolution of 0.02 meters.
	Altitude	Altitude varies from -11,000 to 21,767 meters with 0.5 meter resolution.
	UTC Time	UTC Time varies from 0 to 86,399 seconds.
	Quality of Fix	The Quality of Fix, provided by the receiver, varies from 0 to 8, providing feedback as to the dependability of the fix information. 0 indicates an invalid fix.
General purpose serial device	Integer	Any integer embedded in a string of ASCII serial data.
	Float	Any floating point number embedded in a string of ASCII serial data.
	Character	Any single character embedded in a string of ASCII serial data.
Time-of day parameters for the LogBook's internal real-time clock	mSeconds	Real-time clock milli-seconds ranging from 0 to 875.
	Seconds	Real-time clock integer seconds ranging from 0 to 59.
	Minutes	Real-time clock integer minutes ranging from 0 to 59.
	Hours	Real-time clock integer hours ranging from 0 to 23.
	Days	Real-time clock integer days ranging from 0 to 32767.

Each serial channel represents one and only one number or character. To acquire both Longitude *and* Latitude, for example, two channels must be enabled and set, respectively. When collecting data from a non-GPS device, each desired parameter in the data sent by the serial device must occupy a unique channel. If the serial device supplies three parameters and all three are to be collected, then three serial channels must be configured.

When a GPS or time-of-day (TOD) parameter is required, simply select the associated cell in the Channel Type column of the grid, then select the desired parameter from the drop down list. When an integer, float, or character is to be parsed from a serial input string, a format string must be formulated.

#	Physical Channel	User Label	On/Off	Reading	Units	Channel Type	Format String	Sample Rate			
								A	B	C	D
1	SER_CH00	SER_CH00	On		Degrees	S1_LatDeg	<Not Applicable>	Yes	No	No	No
2	SER_CH01	SER_CH01	On		Minutes	S1_LatMin	<Not Applicable>	Yes	No	No	No
3	SER_CH02	SER_CH02	On		Minutes	TOD_Min	<Not Applicable>	Yes	No	No	No
4	SER_CH03	SER_CH03	On		Hours	TOD_Hour	<Not Applicable>	Yes	No	No	No
5	SER_CH04	SER_CH04	On		Days	TOD_Day	<Not Applicable>	Yes	No	No	No
6	SER_CH05	SER_CH05	Off			S1_Float	%f	Yes	No	No	No
7	SER_CH06	SER_CH06	Off			S1_Float	%f	Yes	No	No	No
8	SER_CH07	SER_CH07	Off			S1_Float	%f	Yes	No	No	No

The simplest format string can be used if the serial device simply sends one parameter terminated by a CR and/or LF. For example, a scale might send the following:

```
+12.32<CR><LF>
+13.23<CR><LF>
+13.44<CR><LF>
+12.65<CR><LF>
```

In this case, the simple format string %f would instruct the LogBook to start at the 1st character in the serial input string sentence. It would then begin the conversion to a floating point number until a character was encountered that could not be converted. If a %I, for integer, was used instead of %f, the LogBook would record +12 instead of +12.32.



Reference Note:

For complete instructions on developing format strings, see the Format String Reference below.

Format String Reference

The format string provides instructions to the LogBook's internal parser allowing it to parse, then to convert numerically a specified section of an ASCII string from a serial device. The format string contains directives for accepting and rejecting parts of the string. Only one section of each ASCII string can be accepted and converted for each serial channel.

The parsing and converting process begins when the LogBook senses the serial input string sentence, a string from the serial device that is terminated by a CR and/or LF. Each enabled Serial Channel will attempt to parse the entire serial input string. To successfully parse and convert a number or character in a string, all of the characters up to the desired field must be accounted for in the format string. The first character encountered that does not match the format string will cause the parsing operation to fail with no conversion process. The serial channel associated with a failed parsing operation will remain unchanged.

Each format string contains directives to ignore all the characters except those of interest. A format string can contain several optional "ignore" directives, but must contain one and only one "accept and convert" directive. The "accept and convert" directive must be the last item in the format string. A format string can contain any or all of the following:

Format directive	Description	Example	Comment
%Xy	The "%" character signifies the beginning of a conversion directive. "X" is a decimal integer specifying the maximum length of the desired field, while "y" is a character that specifies the conversion type.	%3i %c %6f	Convert 1-3 character integer. Convert 1 character. Convert 1-6 character float.
%*Xy	The "%" followed by the "*" character signifies the beginning of a <i>rejecting</i> directive. "X" and "y" are the same as above.	%*7c%i %*i,%i	Reject 7 characters, convert an integer. Reject 1 integer and a comma, convert 2 nd integer.
White space	Tabs or spaces to be taken literally then rejected.	%*i %f	Reject 1 integer and a space, convert a float.
Regular characters	Literal characters that are to be matched exactly in the serial input string, then rejected	\$GPGGA,%f	Match and reject "\$GPGGA," exactly, convert a float.

Format string examples:

LOAD:%f

Match the literal "LOAD:" then start converting a float.

%*14c%i

Ignore the 1st 14 characters, then start converting an integer.

%*i,%*i,%*i,%f

Ignore 3 integers followed by commas, then start converting a float.

The following table of examples shows how each format string operates on a series of serial input strings:

Serial input string from device	Format Strings Associated with three Serial Channels		
	LOAD:%f	%*14c%i	%*i,%*i,%*i,%f
LOAD:+12.345<CR><LF>	+12.345	Failed. After rejecting 14 characters, none were left.	Failed attempting to match 1 st integer in format string.
12,45,23,453.234<LF>	Failed attempting to match "LOAD:".	34. After skipping 14 characters, the last 2 numbers were converted.	+453.234. Three integers separated by commas rejected.
11.1 22.2 33.3 44.4 55.5<CR>	Failed attempting to match "LOAD:".	44. Converted first integer after ignoring 1 st 14 characters.	Failed after the 1 st decimal point was encountered. The decimal point is neither an integer nor a comma.

Valid Conversion Type Specifiers

- c** Any sequence of characters in the input stream of the length specified by the field width, or a single character if no field width is specified, is matched.
- d** A decimal integer, consisting of an optional sign, followed by one or more decimal digits, is matched. Leading white-space characters are skipped.
- e, f, g** A floating-point number, consisting of an optional sign ("+" or "-"), followed by one or more decimal digits. The **e** specifier accepts scientific notation (i.e., 1.234E+12), while the **f** specifier accepts non-scientific notation values (i.e., 1.1234). The **g** specifier accepts either. Leading white-space characters are skipped.
- i** An optional sign, followed by an octal, decimal, integer, or hexadecimal constant is matched. An octal constant consists of "0" and zero or more octal digits. A decimal constant consists of a non-zero decimal digit and zero or more decimal digits. A hexadecimal constant consists of the characters "0x" or "0X" followed by one or more (upper- or lowercase) hexadecimal digits. Leading white-space characters are skipped.
- o** An octal integer, consisting of an optional sign, followed by one or more (zero or non-zero) octal digits, is matched. Leading white-space characters are skipped.
- s** A sequence of non-white-space characters is matched. Leading white-space characters are skipped.
- u** An unsigned decimal integer, consisting of one or more decimal digits, is matched. Leading white-space characters are skipped.
- x** A hexadecimal integer, consisting of an optional sign, followed by an optional prefix "0x" or "0X," followed by one or more (upper- or lowercase) hexadecimal digits, is matched. Leading white-space characters are skipped.
- %** A conversion type specifier of "%" is treated as a single ordinary character that matches a single "%" character in the input data.

Channel Type Selection Table

The following table shows the required channel type selection for each valid conversion type specifier. This table does not apply to format directives using the *reject* indicator ("*"). The Sx in the table represents serial ports S1 or S2.

Conversion Type Specifier	Description	Required Channel Type	Value Range
c	character	Sx_Char	-128 to 127
d	signed decimal integer	Sx_Int	-32,768 to 32,767
e	scientific notation floating point	Sx_Float	3.4E +/- 38 (7 digits)
f	non-scientific notation floating point	Sx_Float	3.4E +/- 38 (7 digits)
g	either e or f formats	Sx_Float	3.4E +/- 38 (7 digits)
i	optional signed octal, hexadecimal, or decimal integer	Sx_Int	-32,768 to 32,767
o	octal integer	Sx_Int	-32,768 to 32,767
s	string (reject only)	N/A	N/A
u	unsigned decimal integer	Sx_Int	0 to 65535
x	hexadecimal integer	Sx_Int	-32,768 to 32,767
%	N/A	N/A	N/A

GPS Examples

The following block of characters is an example of typical GPS receiver data:

```
$GPRMC,011855,V,4022.1990,N,08249.1990,W,000.0,000.0,150470,006.7,W*6C
$GPGGA,011855,4022.1990,N,08249.1990,W,0,00,,M,M,,*44
$GPGSA,A,1,,,,,,,,,,,,,*1E
$GPGSV,3,1,12,12,00,000,,14,00,000,,15,00,000,,16,00,000,*7D
$GPGSV,3,2,12,17,00,000,,18,00,000,,19,00,000,,20,00,000,*7E
$GPGSV,3,3,12,21,00,000,,22,00,000,,23,00,000,,24,00,000,*7E
```

The following example demonstrates how to retrieve information from the first few fields of the Global Positioning System Fix Data (GGA) line:

```
$GPGGA,011855,4022.1990,N,08249.1990,W,0,00,,M,M,,*44
```

Field Name	Field Description
Start of Sentence	\$
Address Field	“aacc” where “aa” is the talker identifier mnemonic (GP for Global Positioning System) and “cc” is the sentence formatter mnemonic (GGA for Global Positioning System Fix Data)
Universal Time Coordinated (UTC)	“hhmmss.ss” where “hh” is hours (0 to 23), “mm” is minutes (00 to 59) and “ss.ss” is seconds (00.00 to 59.99)
Latitude	“ddmm.mm” where “dd” is degrees (0 to 89) and “mm.mm” is minutes (00.00 to 59.99)
Latitude N/S	N=North, S=South
Longitude	“dddmm.mm” where “ddd” is degrees (0 to 179) and “mm.mm” is minutes (00.00 to 59.99)
Longitude E/W	E=East, W=West

The format string of all serial input channels parsing information from the GGA line should start with “\$GPGGA,” so that all other serial input strings fail to match and are ignored.

One method of parsing the UTC is to create a single channel that parses the entire UTC. In this case, the channel type would be set to “Sx_Float” and the format string would be set to “\$GPGGA,%f”. The value of the channel for the example line above would be 11855. When parsing the UTC with this method, the channel value can jump when the minutes or hours change (i.e. 11859 to 11900). In this case, “Sx_Int” cannot be used because the UTC can be greater than 32767.

Another method to parse the UTC is to create individual hours, minutes, and seconds channels. The hours and minutes channels would be configured as “Sx_Int” with format strings of “\$GPGGA,%2u” and “\$GPGGA,%*2u%2u” respectively. Notice that the hours channel parses the first two characters while the minutes channel throws the first two characters away by using the assignment suppression character (“*”), and parsing the next two characters. The second channel would be configured for Sx_Float, so that fractions of seconds could be read, and would use a format string of “\$GPGGA,%*4u%f”. Notice the seconds channel throws away the four characters that make up the hours and minutes, and parses the remaining characters as a floating point number.

The ASCII value of a single character can be read using the %c format specifier. So the latitude hemisphere character “N” would be read as a decimal 78 (the ASCII value of N). If the channel type is set to “Sx_Char”, the value of the channel would be 78 but the LBK1 would display “N”.

The following table demonstrates various ways to parse the information contained in the GGA line.

Format String	Comments
\$GPGGA,%f	Converts the UTC to a float. The value may jump when minutes and hours change.
\$GPGGA,%2u	Convert UTC hours only.
\$GPGGA,%*2u%2u	Ignore UTC hours and convert UTC minutes.
\$GPGGA,%*4u%f	Ignore UTC hours and minutes and convert seconds.
\$GPGGA,%*f,%f	Ignore UTC time and convert Latitude value. This value is in “ddmm.mm” format. Channel value may jump when degrees change, and channel resolution may be large.
\$GPGGA,%*f,%2u	Ignore UTC time and convert Latitude degrees only.
\$GPGGA,%*f,%*2u%f	Ignore UTC time and Latitude degrees, convert floating point minutes.
\$GPGGA,%*f,%*f,%c	Ignore UTC and Latitude, convert N/S character. The value will be recorded as decimal equivalent of the ASCII “N” (XX decimal) or “S” (XX decimal).
\$GPGGA,%*f,%*f,%*c,%f	Ignore UTC, Latitude, N/S character, convert Longitude in the format “ddmm.mm”.
\$GPGGA,%*f,%*f,%*c,%3u	Ignore UTC, Latitude, N/S character, convert Longitude degrees only.
\$GPGGA,%*f,%*f,%*c,%*3u,%f	Ignore UTC, Latitude, N/S character, Longitude degrees, convert floating point Longitude minutes only.
\$GPGGA,%*f,%*f,%*c,%*f,%c	Ignore UTC, Latitude, N/S character, Longitude, convert E/W character. The value will be recorded as decimal equivalent of the ASCII “E” (XX decimal) or “W” (XX decimal).



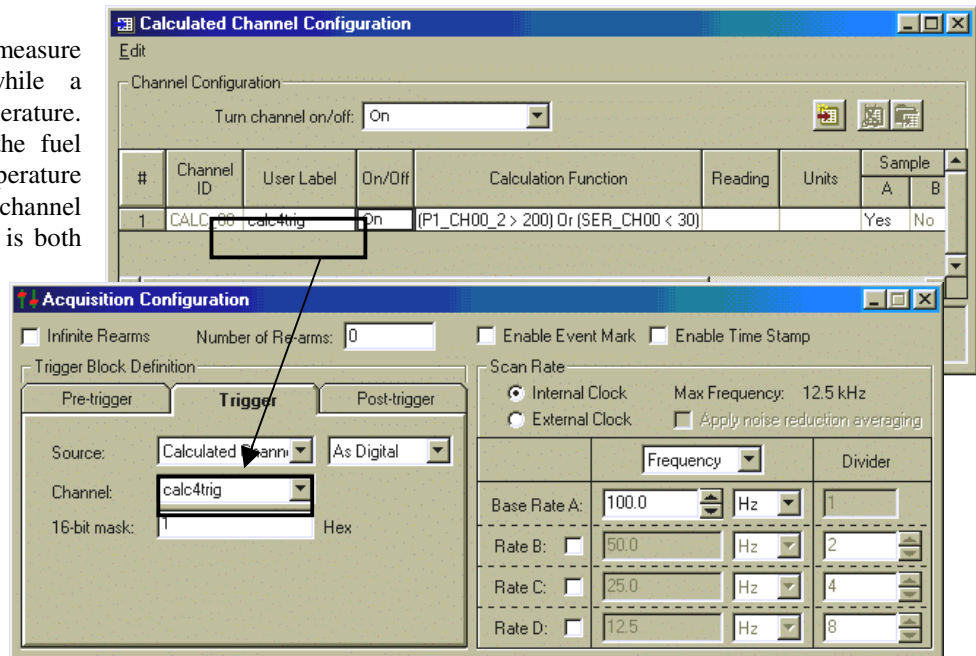
If the serial input data is in fixed length format, the format string can be simplified by throwing a number of characters away, rather than whole fields. For example, the Longitude Hemisphere could be parsed using a format string of \$GPGGA%*31c%c

Using Serial Channels in Calculated Channels

Calculated channels and the LogBook's ability to use them to define trigger and stop events is a very powerful feature. This feature extends to the serial channels, which provide time-of-day data plus information from GPS and general serial devices.

Example Application #1

An RS-232 scale is being used to measure the weight of a liquid fuel while a thermocouple measures engine temperature. The LogBook is to trigger when the fuel weight is less than 30Kg or the temperature exceeds 200F. The calculated channel shown yields a true/false output that is both recorded and used as the trigger source.

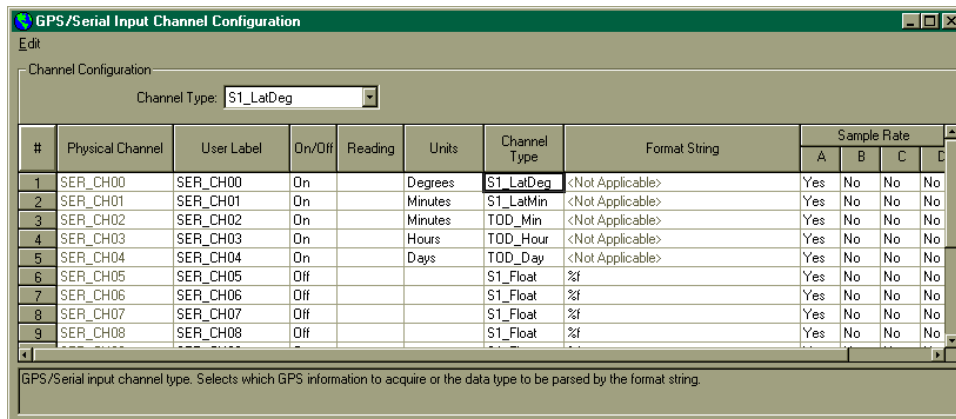


Example Application #2

An oven is being monitored by several thermocouples attached to a LogBook. The LogBook is to trigger whenever the temperature of the oven exterior is above 50C or at 9:00AM each day. The following calculate channel equation yields a true/false output that is both recorded and used as the trigger source.

$(P1_CH00_2 > 50) \text{ Or } (SER_CH03 > 9)$

The serial channel, SER_CH03, is assigned the Channel Type, TOD_Hour



Example Application #3

A GPS receiver is attached to the LogBook to record the present fix of the vehicle under test. The LogBook is to trigger whenever the altitude is above 1000 meters and the fix quality is equal to 3. The following calculate channel equation yields a true/false output that is both recorded and used as the trigger source.

$(SER_CH02 > 1000) \text{ And } (SER_CH03 == 3)$

SER_CH02 is the altitude from the GPS and SER_CH03 is the fix quality from the GPS.

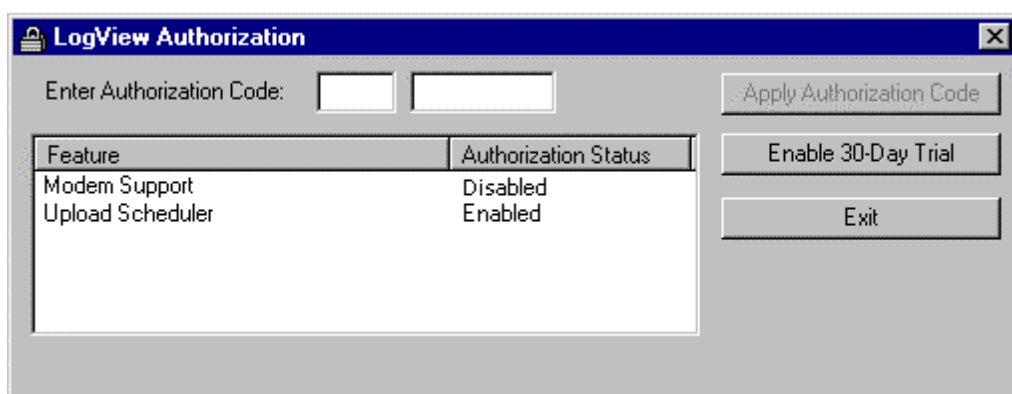
LogBook/Modem, with Upload Scheduler



If the modem [connected to LogBook] has a DTR switch, it should be set to DTR Override. Check the modem for DIP switches on the front or rear. If a DIP switch is present, refer to the modem user's manual. If the DIP switch is for DTR, set it to DTR Override. When DTR Override is set, the DR (Data Ready) LED will light up after turning the modem on.

You must enter a valid authorization code prior to using LogBook's modem support for the first time. To enter the code:

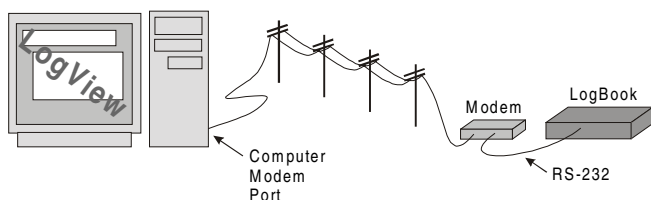
1. Open *LogView*.
2. From *LogView's Control Window*, select the *View Pull-Down* menu.
3. Select *Authorization*. The *LogView Authorization* dialog box appears.
4. Enter your authorization code to enable Modem Support. If you do not have an authorization code you can obtain one from your service representative, or can enable a 30-day trial period.



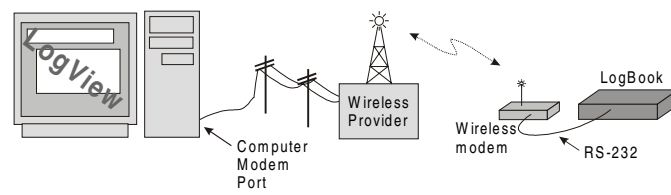
LogView Authorization Dialog Box

Overview

A modem-connected PC can communicate with LogBook virtually anywhere in the world. Any Hayes-compatible modem can be attached to the LogBook's serial port. Both standard desktop and wireless modems are supported.



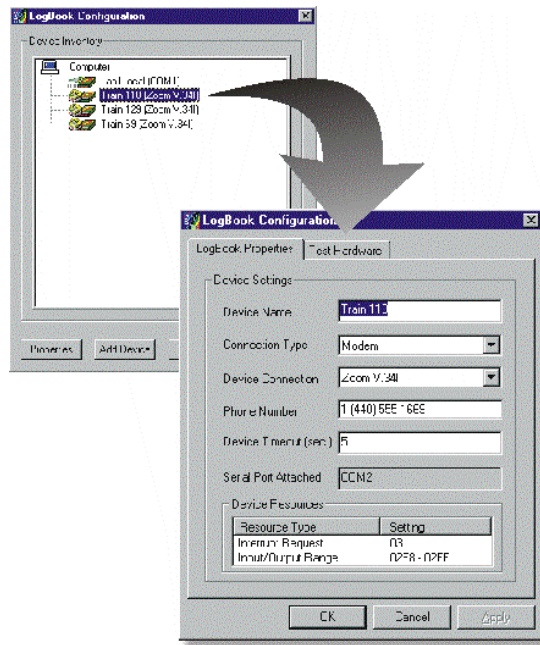
Desktop LogBook System Using A Standard Modem



Mobile LogBook System Using A Wireless Modem

When LogView "attaches" to a remote LogBook, the remote LogBook automatically assumes the baud rate setup by the local and remote modems. This ensures reliable communication at the maximum possible rate. At power-up, LogBook commands the modem to prepare for incoming calls. Operator interaction at the LogBook site is not required to initialize the remote modem. If power to the modem or LogBook is interrupted, when power returns, LogBook will automatically re-initialize the modem.

LogView provides a Windows Control Panel applet for configuring communication attributes of LogBook field units. A virtually unlimited number of connections can be described, each with its own communications attributes and user-assigned name.



Use the Control Panel applet to create LogBook connections

Along with the standard interface choices of serial and parallel port, the applet also allows you to select a modem option and specify an associated telephone number of a remote LogBook.

Within LogView, select a configured LogBook, by name, from the list provided. While engaged with a LogBook (remote or local), LogView can: query the present channel values, check the acquisition status, query the PC-Card status, configure and download a new acquisition configuration, arm and/or trigger the system, and upload collected data. LogView makes no distinction between locally connected LogBooks and those that are attached via modem. For instance, LogView can upload data from a LogBook four feet away (via serial port), or from a LogBook 2000 miles away (via modem).

When attached to a wireless phone modem, a LogBook in a mobile application can be accessed at any time. After LogView attaches to a remote LogBook, collected data can be uploaded from a moving vehicle such as a car, train, bus, truck, or boat. In addition to data uploads, LogView can configure LogBook, report present channel values, and the system status while the device under test is rolling down the road.

With modem support comes an application designed to automate the task of uploading data from one or several LogBooks. This is the *Update Scheduler* (discussed in the next main section).

LogBook, PC, and Modem Systems

LogBook uses two modems: one connected to a host PC with LogView software, and the other to LogBook via an RS-232 connection.

Modems should be connected to analog phone lines. Transfer is always performed at the maximum speed negotiated between the modems when connecting. The Host side of the TAPI interface handles the modem and the connection.

Configuration Utility

LogBook's **LogCpl configuration utility** provides the interface for creating a device with the following properties:

- **Device Name** (user-defined name for the modem-connected LogBook).
- **Connection Type**. From choices of Parallel Port, Serial Port, and Modem, **select Modem**.
- **Device Connection**. Set to the applicable modem. This can be selected from the list of modems detected on the system.
- **Phone Number** (the number used to call the modem).
- **Device Timeout**. This is a timeout for the Send/Receive attempts. For this application the call timeout is 30 seconds.

Host PC

LbkTapi.dll is used to service the modem connection. It is called through **Lbk.dll** and **LbkXport.dll**.

Exported functions are the same as for the other connection types and include:

- **lbkTAPIOpen** - opening the device.
- **lbkTAPIClose** - closing the device.
- **lbkTAPIOutput** - sending data.
- **lbkTAPIEnter** - receiving data.
- **lbkTAPIOnline** - verify device is online.

Opening the device includes following steps:

1. Showing connection status dialog box.
2. Verifying system is TAPI compatible (**tapi.dll** is part of the installation).
3. Checking modem present and ready.
4. Calling the remote modem.
5. Waiting for the ring back.
6. Negotiating connection speed and other parameters.
7. Setting the connection handle and returning connection status.
8. Closing the connection status dialog box.

Note: Connection dialog will display text corresponding to each status phase.

Note: At any time during the connection process, you can terminate the call by clicking the Cancel button (in the Connection Status dialog box). In this case, the **lbkTAPIOpen** function will return the corresponding error: **ERR_TAPIOPEN_CANCELED_BY_USER**.

In addition to cancellation by the user, a connection could fail because of the following:

- ◇ busy signal
- ◇ no dial tone
- ◇ modem offline
- ◇ wrong number
- ◇ remote modem not in auto-answer mode
- ◇ remote LogBook offline

In these cases, the error is indicated by connection dialog, and returned to the calling application.

Note: Closing the device includes dropping the call and freeing all modem resources.

LogBook and Modem States

When LogBook is powered-on, software checks for a powered modem attached to the serial port. If a modem is not detected, the check is repeated once a minute until either: the modem is detected, or a serial connection is established.

Modem Detected

If the modem is detected, LogBook sends a series of AT commands to the modem. These set the modem to the initial *auto-answer* state. Once each minute, LogBook checks to see if the modem is in the auto-answer mode. This check continues until a connection is established. This provides for modem recovery, if it was powered-off, then on again.

LogBook software processes messages received from the modem until **RING** and then **CONNECT** messages are received. This means the connection with the Host has been established. The session is terminated when the Host hangs up and LogBook receives the message, **NO CARRIER**. At this point, the initialization procedure is scheduled with a five-second delay. This delay gives the modem time to drop the connection and return to its idle state. LogBook checks for the *auto-answer* state once a minute, waiting for the next session.

Modem Not Detected, Serial Connection Established

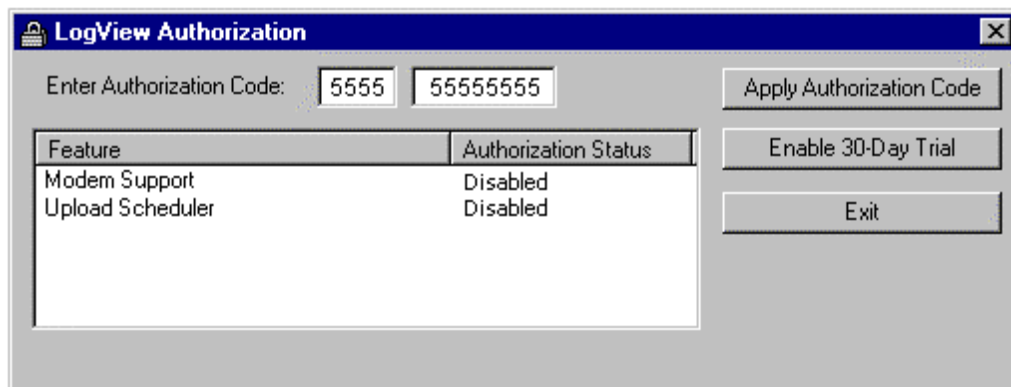
In the case where a modem is not detected, but a serial connection established, all modem activities are suspended; and do not take any of the system's processing time.

Upload Scheduler

The Upload Scheduler is an independent application that allows the user to configure upload events on one or more LogBooks. To avoid waiting for a lengthy upload to complete, the Scheduler can be configured to perform the upload during unattended off-hours. For example, three upload events could be configured in the Scheduler, each for an upload of data at different hours. The Upload Scheduler can save valuable time by performing unattended uploads; especially in cases where modem-connected LogBooks are operating at slow baud rates.

Before using the Upload Scheduler for the first time, you must enter a valid authorization code. To enter the code:

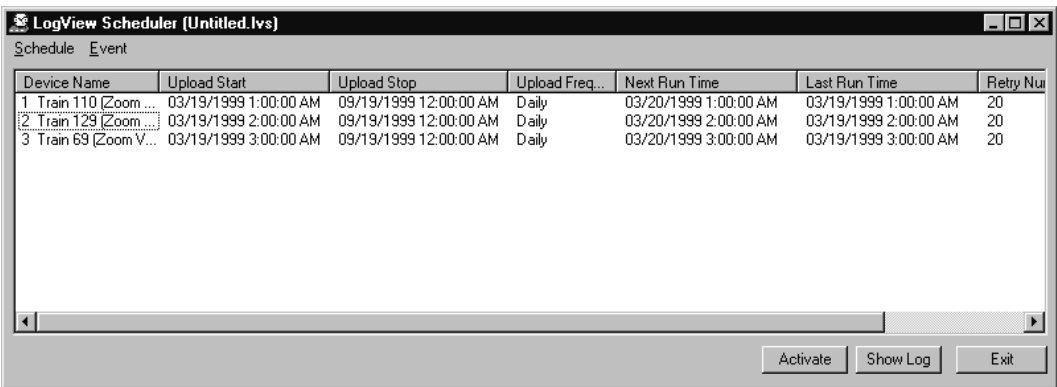
1. Open LogView.
2. From LogView's Control Window, select the View Pull-Down menu.
3. Select Authorization. The *LogView Authorization* dialog box appears.
4. Enter your authorization code to enable the Upload Scheduler. If you do not have an authorization code you can obtain one from your service representative, or can enable a 30-day trial period.



LogView Authorization Dialog Box

For applications that require continuous data collection, the Upload Scheduler can periodically upload the data to a local PC, making space on the LogBook's PC-Card memory for more data. For a continuous acquisition, each upload creates a new file called a *data segment*. LogView contains a utility to merge

segments, or to concatenate (link) them in one continuous file. Merging and concatenating are discussed in Chapter 3, *Using LogView*.



The screenshot shows the 'LogView Scheduler (Untitled.lvs)' window. It has a menu bar with 'Schedule' and 'Event'. Below is a table with the following data:

	Device Name	Upload Start	Upload Stop	Upload Freq...	Next Run Time	Last Run Time	Retry Nu
1	Train 110 (Zoom...	03/19/1999 1:00:00 AM	09/19/1999 12:00:00 AM	Daily	03/20/1999 1:00:00 AM	03/19/1999 1:00:00 AM	20
2	Train 129 (Zoom...	03/19/1999 2:00:00 AM	09/19/1999 12:00:00 AM	Daily	03/20/1999 2:00:00 AM	03/19/1999 2:00:00 AM	20
3	Train 69 (Zoom V...	03/19/1999 3:00:00 AM	09/19/1999 12:00:00 AM	Daily	03/20/1999 3:00:00 AM	03/19/1999 3:00:00 AM	20

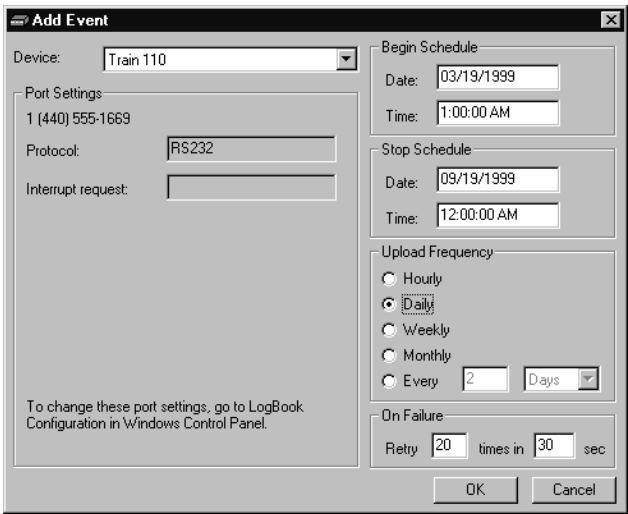
At the bottom right are buttons for 'Activate', 'Show Log', and 'Exit'.

The Upload Scheduler automates the process of uploading data from one or many LogBooks.

In the above example, the Scheduler automatically initiates a session with each LogBook at the specified time and uploads the available data. When the user arrives in the morning, all the data is immediately available for inspection on the PC's hard drive.

A scheduled event can be configured to execute only one time, or periodically from Begin Schedule time to Stop Schedule time. Periodic configurations can be made for uploads every hour, day, week, or month, without operator intervention.

If the scheduled upload should fail for any reason, LogView will retry the upload the number of times indicated in the *Retry* field. These attempts are initiated at the duration indicated in the *time in* field. The following figure shows that there will be 20 retry attempts. A retry will occur every 30 seconds (until the upload is successful).



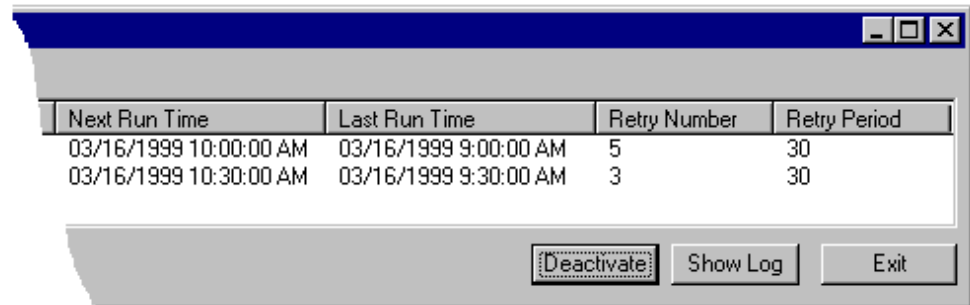
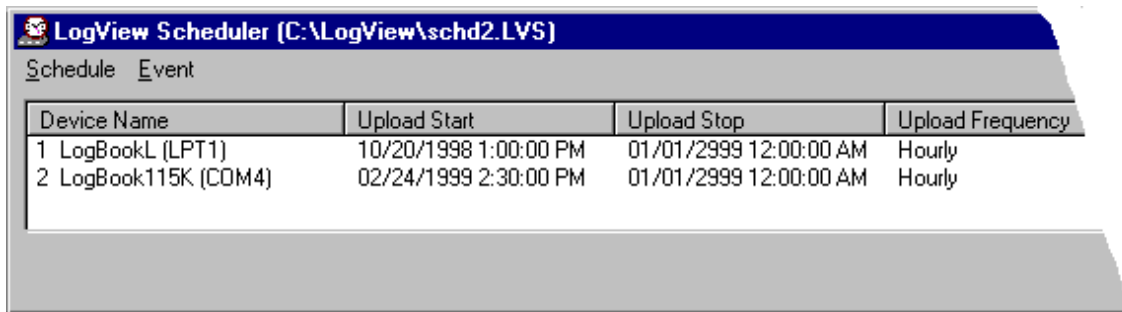
The 'Add Event' dialog box contains the following fields and options:

- Device:** Train 110
- Port Settings:** 1 (440) 555-1669
- Protocol:** RS232
- Interrupt request:** (empty)
- Begin Schedule:** Date: 03/19/1999, Time: 1:00:00 AM
- Stop Schedule:** Date: 09/19/1999, Time: 12:00:00 AM
- Upload Frequency:** Radio buttons for Hourly, ☒ Daily, Weekly, Monthly, and Every (with a value of 2 and a dropdown set to Days).
- On Failure:** Retry 20 times in 30 sec
- Buttons:** OK, Cancel

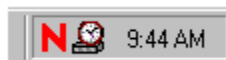
At the bottom, a note reads: 'To change these port settings, go to LogBook Configuration in Windows Control Panel.'

Upload events can execute once or periodically

An “active” Scheduler window is represented below. The image has been split so it could be shown in its entirety at its present scale.



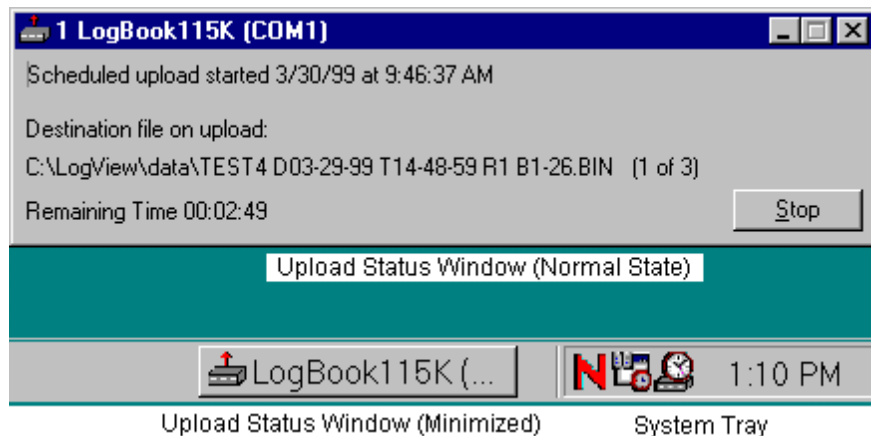
Active Upload Scheduler (split for complete image)



System Tray

When the Upload Scheduler is activated, a Clock/LogBook icon appears in the Windows Desktop System Tray, as shown in the figure at the left.

Note: If the Upload Scheduler is active upon computer shutdown, it will automatically activate when the computer is restarted.



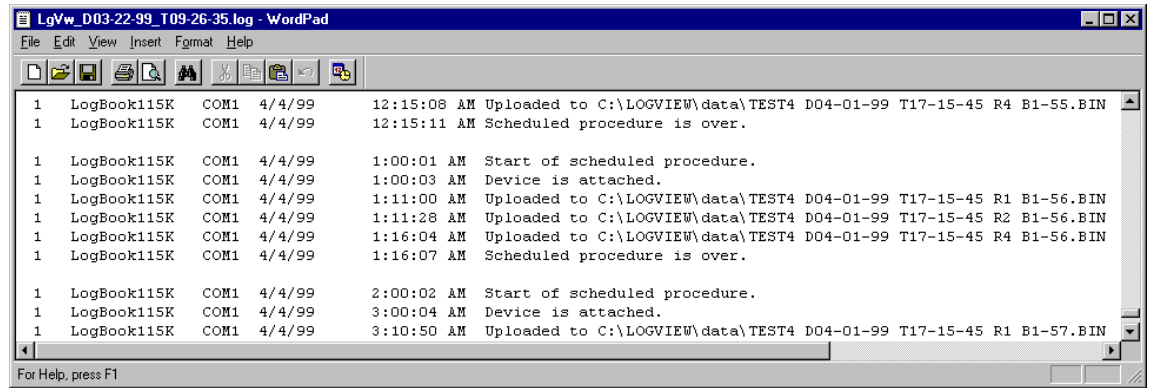
Upload Status Window (Minimized)

System Tray

*Section of Desktop Showing:
Upload Status Window (normal and minimized states) and the System Tray*

Each time the Upload Scheduler initiates an upload from LogBook, the application creates a minimized Upload Status window (see previous figure). The Upload Status window provides schedule-related information, such as upload start time, file destination, and time remaining. This window also states when an upload fails; and when a “retry” will be attempted.

The Upload Scheduler saves a report of all its activities to the log file. You can view the log file by clicking Upload Scheduler’s “Show Log” button, or by selecting “Show Log” menu item in the Schedule pull-down menu.



Log File in WordPad Default

By default, the Upload Scheduler opens the log file in WordPad. You can choose to open the log file in other applications using the Schedule pull-down menu, Set LogViewer menu item.

The log file will be located in the **\log** subdirectory of the LogView install directory. The Upload Scheduler will generate another log file as soon as the size of the current log file reaches 1MB. The Upload Scheduler will delete the oldest log file from the **\log** directory when the number of log files exceeds 10.

The Upload Scheduler uploads all binary data to the subdirectory **\data** in the LogView installation directory.



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Depending on your system's use of power, you may need to add auxiliary power supplies. The misuse of power can cause equipment damage; so, it is important to read this and related sections of the manual carefully. Chapter 2, *System Power*, explains how to calculate your system's use of power.



Reference Note: The following power-related DBK options are discussed in Chapter 2, *System Power*.

- **DBK30A** – Rechargeable Battery Module
- **DBK32A** – Auxiliary Power Supply Card
- **DBK33** – Triple Output Power Supply Card
- **DBK34** – Vehicle UPS Module

Overview

The DBK series of cards and modules perform various data acquisition functions including signal conditioning, analog output, digital I/O, expansion, and power supply. The DBKs work with boards from other manufacturers, but DBK performance is best when used with dynamic channel programming as in a LogBook. The ability to select both channel and gain/range is crucial for obtaining high channel-to-channel scan rates with a variety of transducers. The sequencer uses DRAM memory to hold channels and gains for up to 256 data input channels. The 100 kHz channel-to-channel scan rate is maintained even with a fully loaded system of DBKs.

This chapter begins with common installation, configuration for both hardware and LogView, and power management concepts for typical DBKs. Much of this setup information applies to many DBKs; however, special cases are detailed as needed.

The DBKs are presented in numerical order for easy access. (In the page footer, the DBK number is just inside the page number with the chapter title.) Each DBK is described in detail under the following headings (some DBKs vary from this general outline):

- **Overview** (usually with a block diagram) describes the basic features and operation of the DBK.
- **Hardware Setup** describes configuration and connections for both the DBK and LogBook.
- **Hardware Function** describes special hardware concerns if beyond the scope of the *Overview*.
- **Specifications** are given at the end of each DBK section and in the *Specifications* chapter.



Reference Note: This chapter describes DBKs available as this manual goes to print. DBK-specific setups are described in their respective sections. Since new DBKs are constantly being developed, you may have a DBK not described in this section. If this is the case, or if you need a new DBK-type capability, please contact your sales agent.

The DBK product line offers the LogBook user a variety of cards and modules, allowing for system expansion and signal conditioning for all types of transducers. The following table organizes DBKs by function.

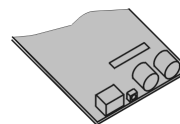
DBK Option Cards and Modules		
Product	Name/Description	Capacity
Analog Signal Conditioning. These DBKs attach to transducers and condition their outputs into analog voltages that the LogBook's A/D Converter can measure. There are many signal conditioning solutions available (and more are in development). DBK high-capacity modules require more circuitry than can fit on a compact card.		
DBK4	Dynamic Signal Input Card	2 channels
DBK7	Frequency-to-Voltage Input Card	4 channels
DBK8	High-Voltage Input Card	8 channels
DBK9	RTD Measurement Card	8 channels
DBK12	Low-Gain Analog Multiplexing Card	16 channels
DBK13	High-Gain Analog Multiplexing Card	16 channels
DBK15	Universal Current/Voltage Input Card	16 channels
DBK16	Strain-Gage Measurement Card	2 channels
DBK17	Simultaneous Sample & Hold Card	4 channels
DBK18	Low-Pass Filter Card	4 channels
DBK19	High-Accuracy Thermocouple Card	14 channels
DBK42	5B Isolated Signal-Conditioning Module	16 channels
DBK43A	Strain-Gage Measurement Module	8 channels
DBK44	5B Isolated Signal-Conditioning Card	2 channels
DBK45	SSH and Low-Pass Filter Card	4 channels
DBK50	Isolated High-Voltage Input Module	8 channels
DBK51	Isolated Low-Voltage Input Module	8 channels
DBK52	Thermocouple Input Module	14 channels
DBK53	Low-Gain Analog Multiplexing Module	16 channels
DBK54	High-Gain Analog Multiplexing Module	16 channels
Digital I/O / Control		
DBK20	General-Purpose Digital I/O Card (Screw Terminals)	48 channels
DBK21	General-Purpose Digital I/O Card (DB37 Connectors)	48 channels
DBK23	Optically Isolated Digital-Input Module	24 channels
DBK24	Optically Isolated Digital-Output Module	24 channels
DBK25	Relay Output Card	8 channels

Expansion and Connection. These DBKs offer expansion and connection options. For just a few DBKs, you can use the stackable 3-slot DBK10 low-profile enclosure. For more DBKs, you can use the 10-slot DBK41. Multiple DBK41s can be daisy-chained to accommodate many DBKs within a single system. Connections are provided for screw terminals and BNC connectors.		
DBK1	16-Connector BNC Adapter Module	16 connectors
DBK10	3-Slot Expansion Enclosure	3 cards
DBK11A	Screw-Terminal Option Card (DB37 to Screw Terminal Block)	Component sockets
DBK40	BNC Interface Module	18 connectors
DBK41	10-Slot Expansion Module	10 cards
Power Supply. These DBKs offer power options for laboratory, automotive, and field use. Input power can come from any 10 to 20 VDC source or an AC source by using the included AC-to-DC adapter. The DBK30A rechargeable power supply can power DBK modules where AC mains are not available (the DBK30A outputs 28 V for powering transducers). For a large number of DBK cards, the DBK32A or DBK33 can be installed into an expansion slot. The DBK33 is used when +5 V is required in addition to ± 15 VDC. The DBK34 provides a steady 12 or 24 VDC while working with vehicle electrical systems that may be turned on or off during testing.		
DBK30A	Rechargeable Battery/Excitation Module	+12-14, 24-28 VDC (3.4 A-hr @ 14 VDC)
DBK32A	Auxiliary Power Supply Card	± 15 V @ 500 mA
DBK33	Triple-Output Power Supply Card	± 15 V @ 250 mA; +5 V @ 1 A
DBK34	Vehicle UPS Module	12/24 VDC (5 A-hr @ 12 VDC)

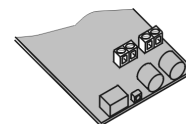
As we release enhanced versions of our DBK products, you are likely to notice the following:

- Several DBK boards now have terminal blocks, in addition to the previous connectors. Both connectors are still usable, and board functions have not been changed. Note that terminal block sizes and locations may differ, depending on the DBK board. Regardless of the board type, the terminal blocks are clearly visible, and the connection slots are easy to identify. You can use the terminal blocks as an alternate method of making your connections, should this method prove more convenient.

DBK cards with terminal blocks include: DBK2, DBK7, DBK8, DBK17, DBK18, DBK32A, DBK33, and DBK45.



**Early Boards
(No Terminal Blocks)**



**Enhanced Boards
(with Terminal Blocks)**

- For convenience, certain DBK boards now have bias resistors pre-installed between channel low and analog common. Bias resistors are described in the DBK12/13 and DBK15 board descriptions of this chapter.
- The enhanced DBK16 has additional jumpers that allow you to select *internal* or *external* as the channel excitation regulator's power source. This feature is described in the DBK16 board section of this chapter.

LogView Setup

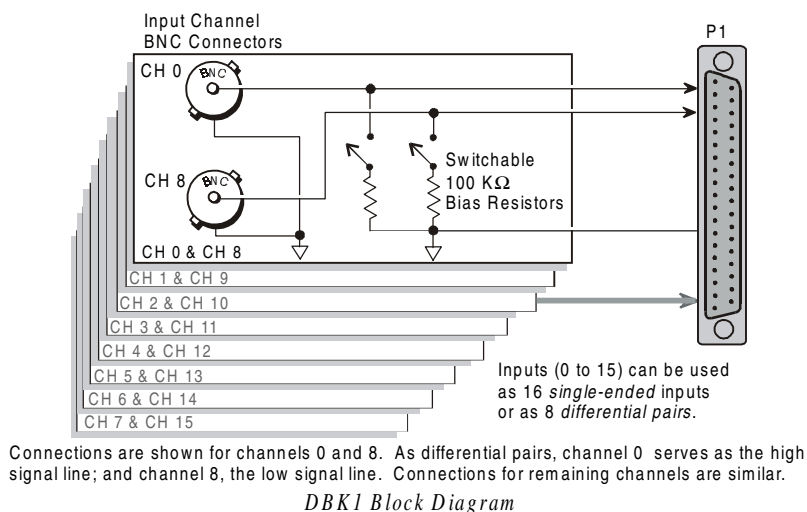
You must set up LogView for the particular DBKs in your system (you may wish to refer to the *LogView* chapter for further details and screen captures.) Generally, you begin from LogView's main window by selecting Hardware Configuration from the View pull-down menu (or the Hardware Configuration icon). Then you select the signal I/O port (P1 for analog, P2 for digital, P3 for pulse/frequency). The right side of the window has configuration settings with drop down options that change accordingly as you progress through the configuration process. When configuring a DBK that requires specific settings, you must select the settings from the options presented. These options are discussed in the DBK sections that follow.

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

DBK1 16-Connector BNC Adapter Module

Overview

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



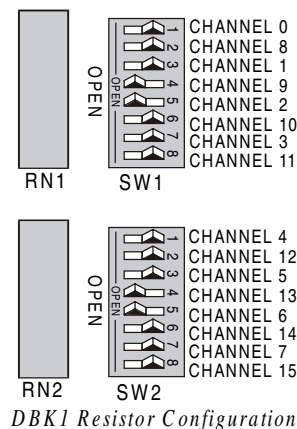
Hardware Setup

Configuration

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

As shown in the figure and silk-screened on the board,

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



DBK1 - Specifications

Name/Function: 16-Connector BNC Adapter Module

Connectors:

- DB37 male, mates with P1
- BNC connectors for signal input


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

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

Weight: 1.3 kg (3 lb)

DBK4 2-Channel Dynamic Signal Input Card

DBK4 Power Notice — Determining System Power Requirements

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

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

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

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

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

The following two charts provide information regarding available power.

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

Auxiliary Power Supplies	
Product	Available mW
DBK32A	15000**
DBK33	7500
CDK10	4500

** DBK32A only provides ± 15 VDC output.

Power-Requirement Worktable					
Quantity x milli-Watts = power required					
Option	Qty.	x	mW	=	power
DBK1		x	0	=	0
DBK2		x	565	=	
DBK4		x	2750	=	
DBK5		x	135	=	
DBK7		x	420	=	
DBK8		x	455	=	
DBK9		x	560	=	
DBK11A		x	0	=	0
DBK12		x	455	=	
DBK13		x	455	=	
DBK14		x	485	=	
DBK15		x	485	=	
DBK16		x	1040	=	
DBK17		x	905	=	
DBK18		x	1085	=	
DBK19		x	200	=	
DBK20		x	50	=	
DBK21		x	50	=	
DBK23*		x	10	=	
DBK24*		x	10	=	
DBK25		x	10	=	
DBK35		x	0	=	0
DBK40		x	0	=	0
DBK41		x	0	=	0
DBK42		x	35	=	
DBK43A*		x	35	=	
DBK44		x	330	=	
DBK45		x	1565	=	
DBK50*		x	35	=	
DBK51*		x	35	=	
DBK52		x	200	=	
DBK53		x	455	=	
DBK54		x	455	=	
Total Power Required J					

*Asterisk indicates a module with internal power supply, powered separately.

Note: CDK10 or DBK33 required when using DBK options with Daq PC-Cards.

Overview

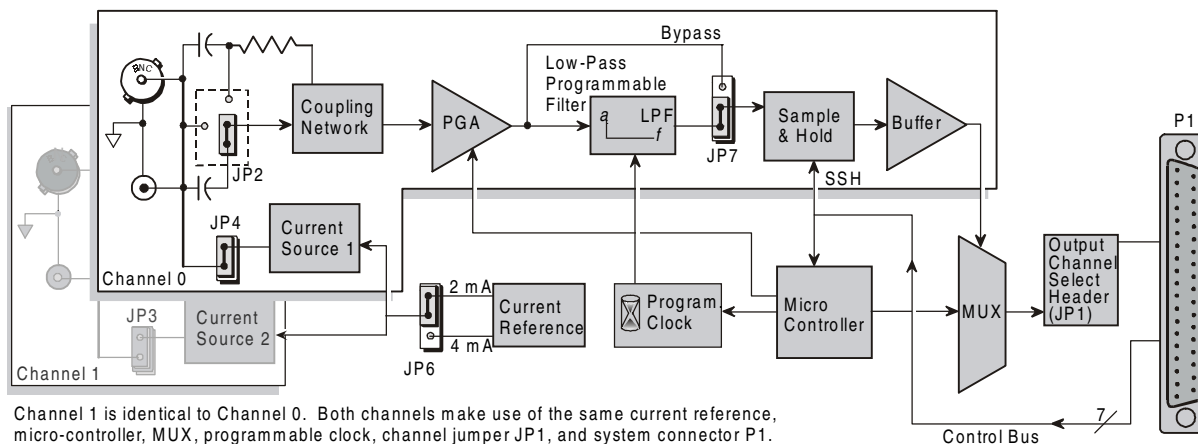
DBK4 is a 2-channel signal conditioner for dynamic signals. The unit provides a means of interfacing the data acquisition device with piezoelectric transducers that include, but are not limited to: accelerometers, microphones, and force/pressure transducers. The DBK4 interfaces with the LogBook's P1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



Reference Note: Refer to chapter 2, *System Power*, for information regarding power-related DBKs.



Reference Note: Appendix C, an Accelerometer Tutorial, contains information that may be helpful to DBK4 users.



DBK4 Block Diagram

Hardware Setup

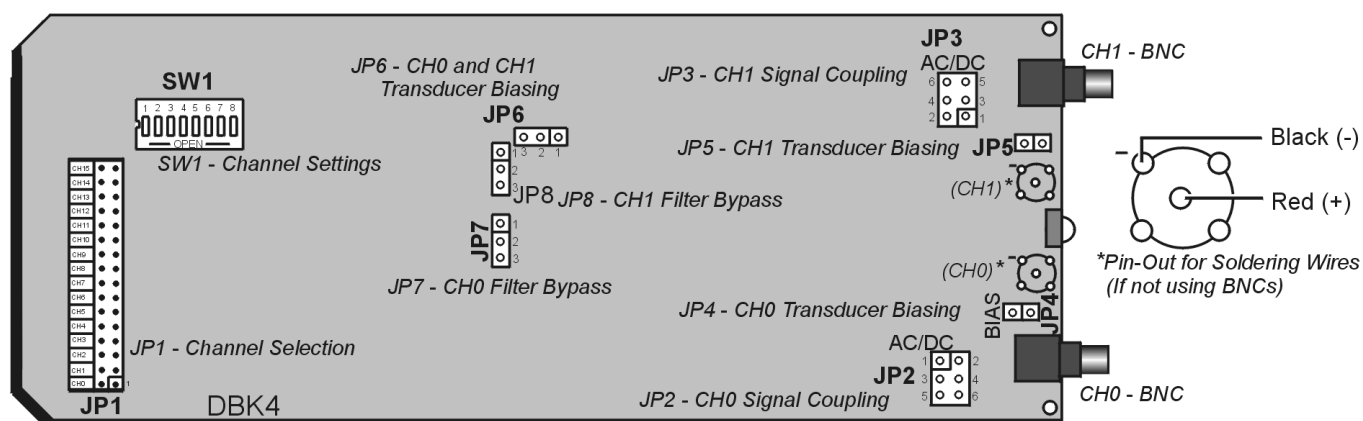


Software calibration for each DBK4 requires a set of unique constants supplied on a diskette identified by a serial number matching the DBK4 card. To install these constants, follow instructions on the “readme” file included on the calibration disk.

Card Configuration

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

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



DBK4, Board Layout (not to scale)

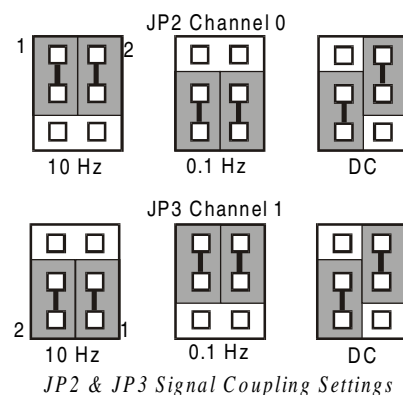
Signal Coupling (JP2 & JP3)

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

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

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

Note: For JP2 and JP3, 0.1 Hz is the default.



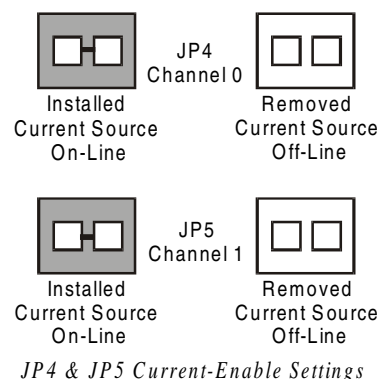
CAUTION



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

Current Source (Transducer Biasing) (JP4 & JP5)

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



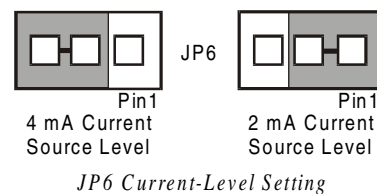
CAUTION



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

Current Level (Transducer Biasing) (JP6)

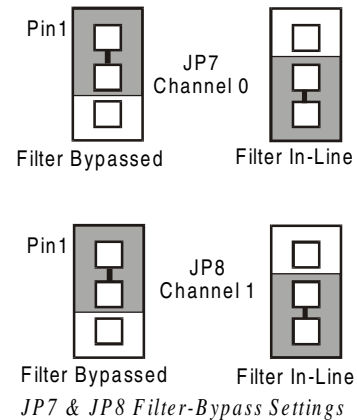
Current level is not channel-specific. The level selected applies to both channels. The figure shows the JP6 jumper settings for current level. Most transducers operate with either 2 or 4 mA of bias current. However, biasing at 4 mA allows the transducer to drive longer cables.



Reference Note: For more information, refer to the *Cable Driving* section of Appendix C, *Accelerometer Tutorial*.

Filter Bypass (JP7 & JP8)

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



Main Channel and Sub Channel Selection

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

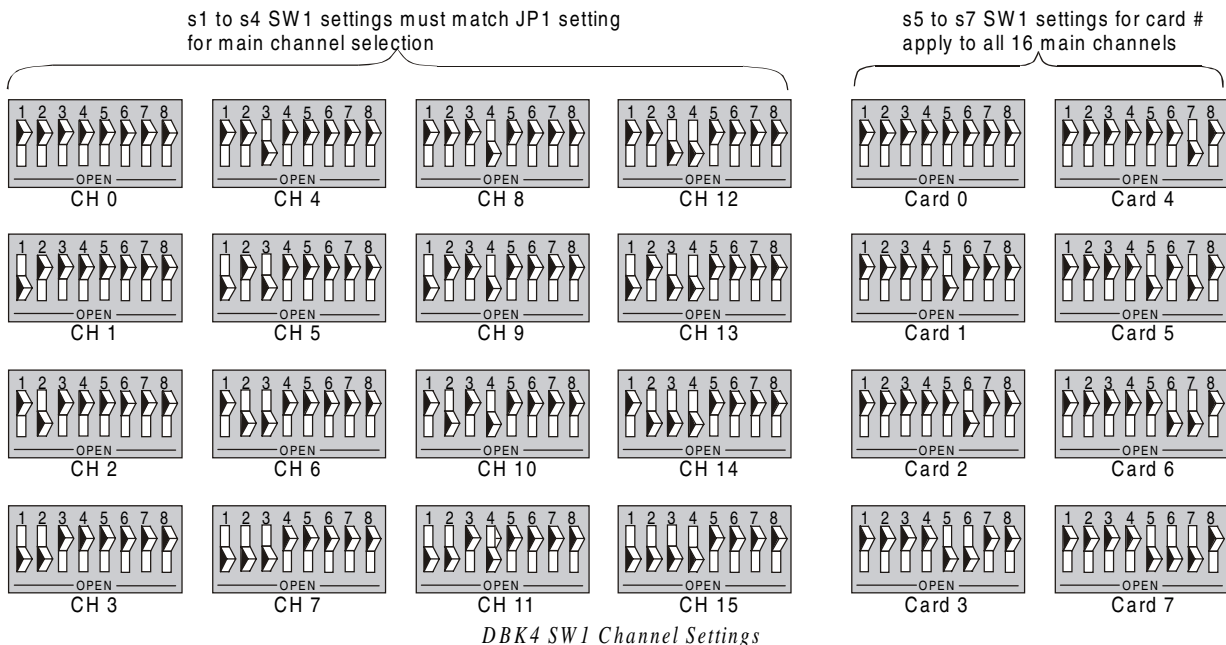
The DBK4 uses JP1 and SW1 for channel and sub-channel selection. (Position s8 on SW1 is not used.) The DBK4 card or a group of DBK4 cards (0-7) must have a dedicated main channel. Do not intermix DBK4 cards with other types of DBK cards in a channel. LogBook will not function properly if channel settings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



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

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

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



Card Connections

The DBK4 connects to the LogBook's P1 port or a P1 port on a DBK Expansion Module as described at the beginning of this chapter.

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

Hardware Description

Current Source (Transducer Biasing)

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

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

Signal Coupling

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

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

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

CAUTION



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

Amplifier

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

Low-Pass Filter

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

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



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

Sample and Hold

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

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

Power Management

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

DBK4 - Specifications

Name/Function: 2-Channel Dynamic Signal Input Card

Physical Specifications

Channels: 2

Signal Connection: 1 BNC connector per channel

Dimensions: 8.28" W × 3.25" H

Operating Specifications

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

Current Source:

Output Impedance: >1.4 MΩ

Compliance: 27 VDC

Current Levels: 2 & 4 mA

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

Input Impedance: 150 kΩ

Gain:

Bypass Mode: ×1.583 ×15.83 ×158.3

Filter Mode: ×1 ×10 ×100

Input Ranges: ±5 V ±500 mV ±50 mV FS

Coupling: AC, DC

AC: 1-pole, 10 Hz HPF

1-pole, 0.1 Hz HPF

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

Filter(Typical):

Distortion

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

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

Cut-off(Fc):

18 kHz 9 kHz 4.5 kHz 2.25 kHz

1125 Hz 562.5 Hz 281.2 Hz 141.6 Hz

Flatness DC - 80% Fc: ±0.2 dB

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

Accuracy Passband Center: ± 0.5 dB

DBK7 4-Channel Frequency-To-Voltage Input Card

Overview

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

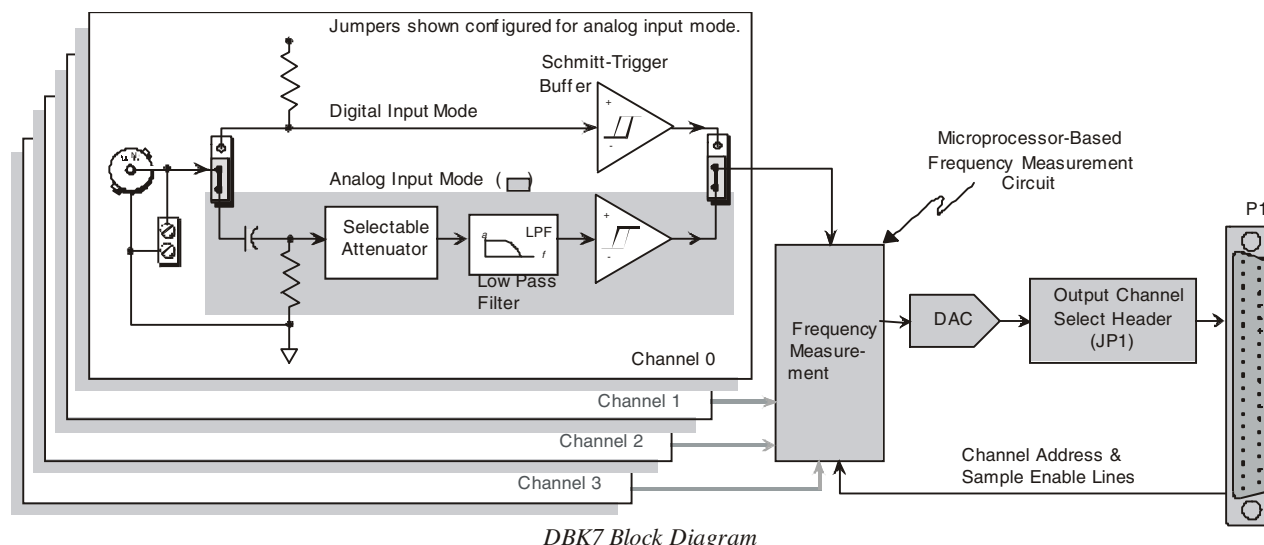
Features of the DBK7 include:

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

The block diagram (see figure) shows the card's basic function. Each channel:

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

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



Hardware Setup

CAUTION

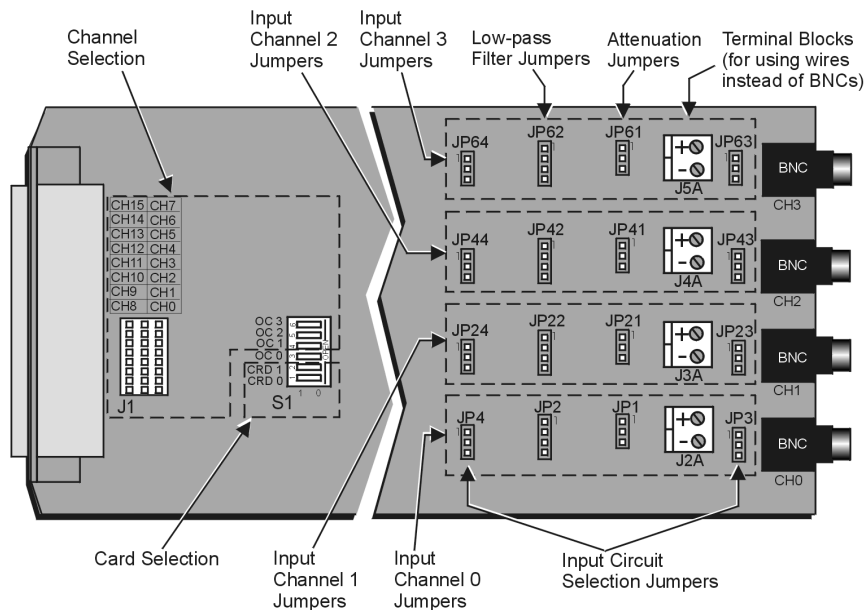
**DBK7 must be configured before connecting the card to inputs and outputs. Failure to do so could result in card damage.**

Hardware-related steps for setting up DBK7 include:

- Configuring onboard jumpers and switches for the application (see previous CAUTION).
- Connecting the input cables to sensors and the output cable to a LogBook.

Card Configuration

Several jumper and switch settings must be made on the DBK7 card to match both the system setup and the signal-conditioning requirements. This section describes a typical configuration. The figure shows the location of jumpers and switches the user must set during card configuration.



DBK7 Board Layout

Channel and Card Selection Configuration

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

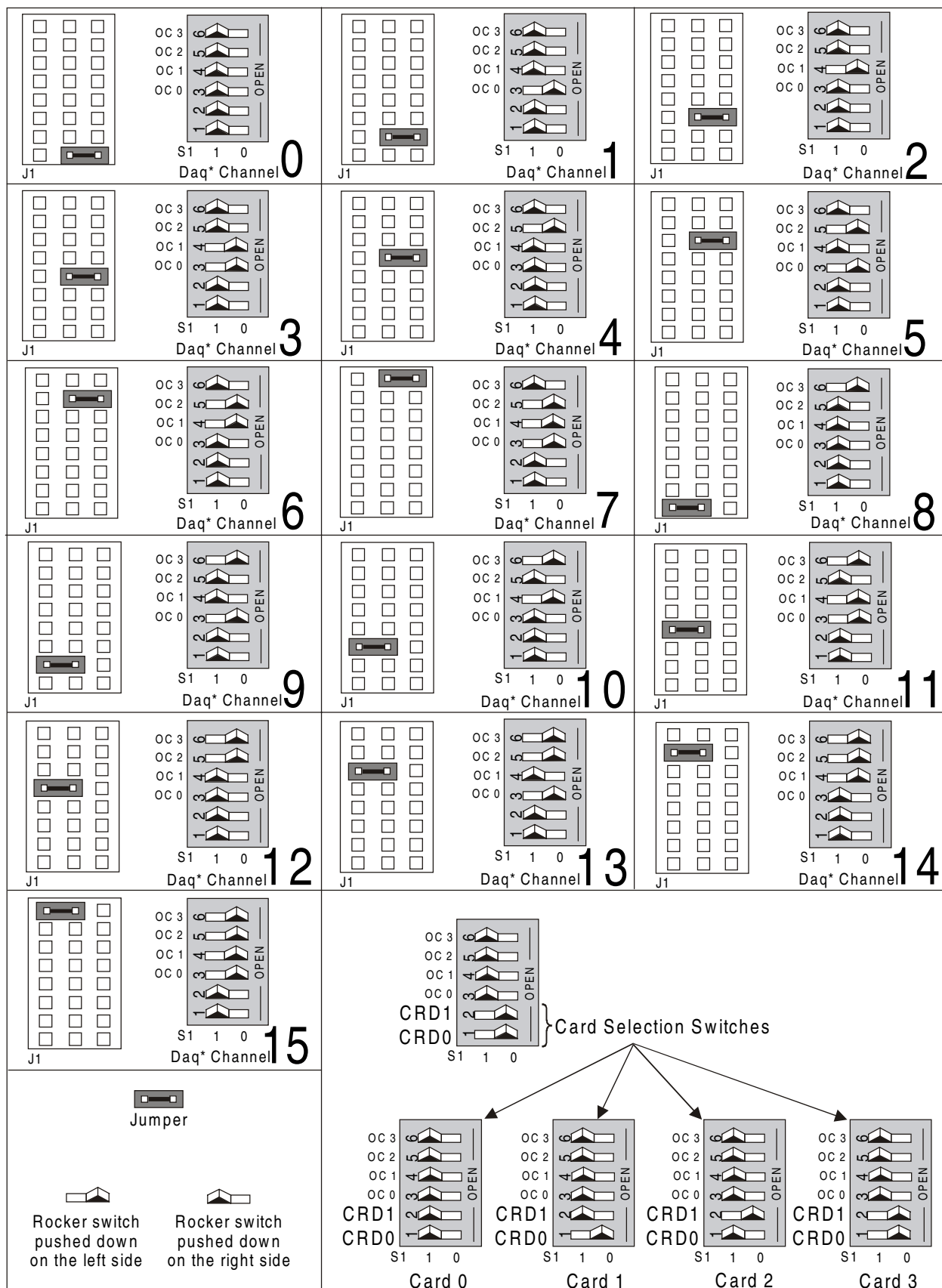
- J1 is a 24-pin (3×8) header requiring two pins in a row to be connected. Up to 4 cards can share the same channel.
- S1 is a 6-position DIP switch (positions 3-6 set the main channel). Each card sharing a main channel can have one of four sub-addresses (card number) as set by S1 (positions 1 & 2).



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

Set the main channel and sub-address as follows:

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



DBK7 Channel Configuration

Input Signal Conditioning Configuration

Hardware settings affect 3 aspects of signal conditioning:

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

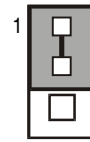
Input Circuit Selection

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

Select the input circuit for each input channel as follows:

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

Analog setting for both input circuit jumpers



Digital setting for both input circuit jumpers



Channel: Jumpers
0: JP4 & JP3
1: JP24 & JP23
2: JP44 & JP43
3: JP64 & JP63

Input Circuit Selection Jumpers

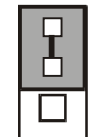
Attenuation Selection (Analog Input Circuit Only)

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

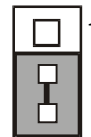
Set the attenuation for each channel as follows:

1. Determine the best attenuation for each channel.
 - Use attenuation and reduced sensitivity if the input signal's peak level exceeds 1 V.
 - Disable attenuation for full sensitivity if the input signal's peak level is less than 1 V.
2. For attenuation, position the jumper across pins 1 and 2. Attenuation is enabled (the default setting). (See figure.)
3. To disable attenuation, position the jumper across pins 2 and 3. The full-strength signal is used.
4. Verify the jumper position for each input channel.
 - JP1 for channel 0
 - JP21 for channel 1
 - JP41 for channel 2
 - JP61 for channel 3

Jumpers/Channels
JP1/0, JP21/1, JP41/2, & JP61/3



Reduced
Sensitivity
Pins
1 & 2



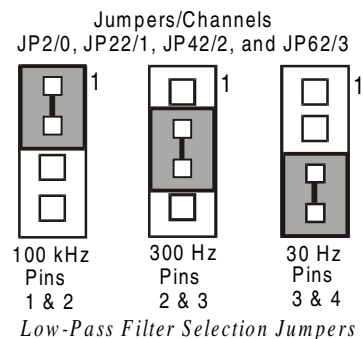
Full
Sensitivity
Pins
2 & 3

Attenuation Selection Jumpers

Low-Pass Filter Selection (Analog Input Circuit Only)

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

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



Card Connection

Note: New versions of the DBK7 have been enhanced by the addition of terminal blocks. The BNC connectors are still usable, and board functions have not been changed.

After the DBK7 hardware is configured, it can be safely connected to the system. On the input side, up to four sensors connect to the card's input BNC connectors. On the DB37 (P1) side, the DBK7 connects to the LogBook (possibly through an expansion module) via a CA-37-x (or CA-131-x) cable.

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 DBK7 damage.

Connect the DBK7 card as follows:

1. Connect each sensor BNC connector to a mating connector on the card. Channel labels (CH0 to CH3) are printed just below the corresponding connector. Tag each sensor with its corresponding LogBook channel, card sub-address, and DBK7 input channel.
2. For a single DBK7 card, connect one end of the P1 cable to the card's male DB37 output connector.
3. Connect the other end of the cable to the P1 port of the LogBook. For multiple DBK7 cards, use a CA-37-x (or CA-131-x) cable to daisy-chain several cards or an expansion module. For example, three DBK7s (or 2 DBK7s and an expansion module) can be connected to LogBook with a CA-37-3.

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

For CE Compliance

To maintain the EMI emission and immunity standards for CE compliance, the DBK7 must be placed in a DBK41/CE 10-slot analog expansion module that is connected to the LogBook by a CA-143-x cable rather than the CA-37-x (refer to the DBK41 section). In the presence of 3 V/m RF fields,

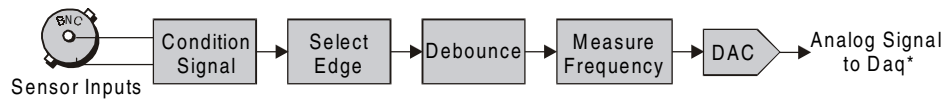
- 500 mVpp signals are required to maintain 0.1% accuracy.
- Metal shells of the BNC connectors must be directly connected to the chassis ground in order to maintain 100 mV sensitivity and 0.1% accuracy.
- The host computer must be properly grounded.
- The host computer and peripheral equipment must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



Reference Note: Appendix D contains additional information regarding CE compliance.

Hardware Function

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



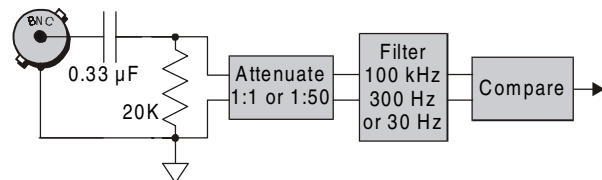
DBK7 Function Diagram

Input Signal Conditioning

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

Analog Input Signal Conditioning

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

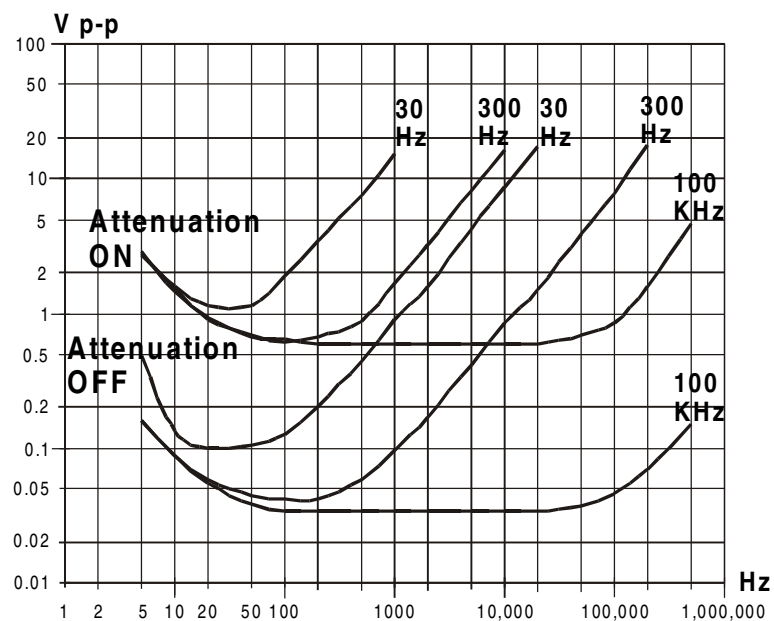


DBK7 Analog Equivalent Input Circuit

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

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

The graph shows typical sine-wave sensitivity in peak-to-peak voltage vs frequency from 5 Hz to 500 kHz. Six combinations of attenuation (on/off) and low-pass filtering (30 Hz, 300 Hz, and 100 kHz) are graphed.

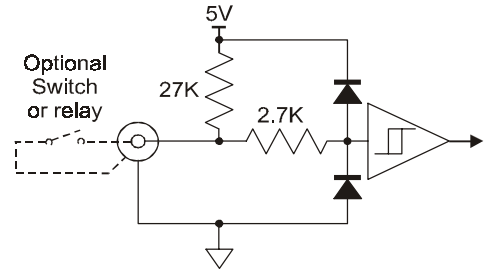


DBK7 Typical Sine-Wave Sensitivity

Digital Input Signal Conditioning

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

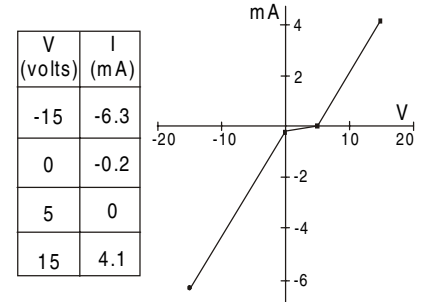
When the input circuit jumpers are set for digital, the outside (shield) conductor of the BNC connector connects directly to ground. The center conductor is pulled up with 27 K Ω to +5 V and then passes through a 2.7 K Ω protection resistor before being detected by a Schmitt-trigger buffer with input-protection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



DBK7 Digital Equivalent Input Circuit

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

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



DBK7 Digital I/V Relationship

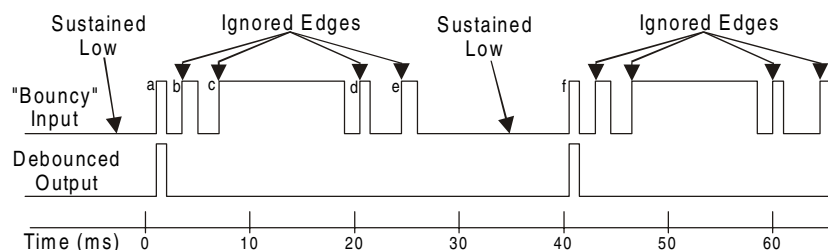
Edge Selection

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

Debouncing

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

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



DBK7 Debouncing Effects

Frequency Measurement

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

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

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

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

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

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

In this equation: 4096 derives from 12-bit precision; $0.5 \mu\text{s}$ is the resolution of the DBK7'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 $4096 \times 0.5 \mu\text{s} \times 61/2 = 62.5 \text{ ms}$, or about 16 measurements per second.
- To measure frequencies from 1 to 61 Hz, the measurement period is at least $4096 \times 0.5 \mu\text{s} \times 61/60 = 2.1 \text{ ms}$. Note that as the DBK7 only measures frequency once per cycle, it would take from 1 to 61 measurements per second.

Thus, measuring frequencies over a narrow range takes longer than over a wide range as the ratio of $F_{\max} / (F_{\max} - F_{\min})$. 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:

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

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 $F_{\max} - 1/4096 (F_{\max} - F_{\min})$.

D/A Conversion

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

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

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

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

Specifications - DBK7

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

Input Channels per Card: 4

Maximum Cards per System: 64

Maximum Channels per System: 256

Input Connector: 1 BNC connector per channel

Connector: DB37 male, mates with P1

Frequency Ranges: (programmable) 0 Hz to 960 kHz

Output Voltage Range: -5 V to +5 V

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

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

Accuracy: 0.1%

Analog Input

Low-level:

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

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

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

15 mV hysteresis.

High-level:

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

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

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

250 mV hysteresis.

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

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

Digital Input

TTL-Level: 0.001 to 960 kHz.

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

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

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

Hysteresis: 400 mV min

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

Maximum Input Voltage: -15 V to +15 V.

DBK8 Eight-Channel High-Voltage Input Card

Overview

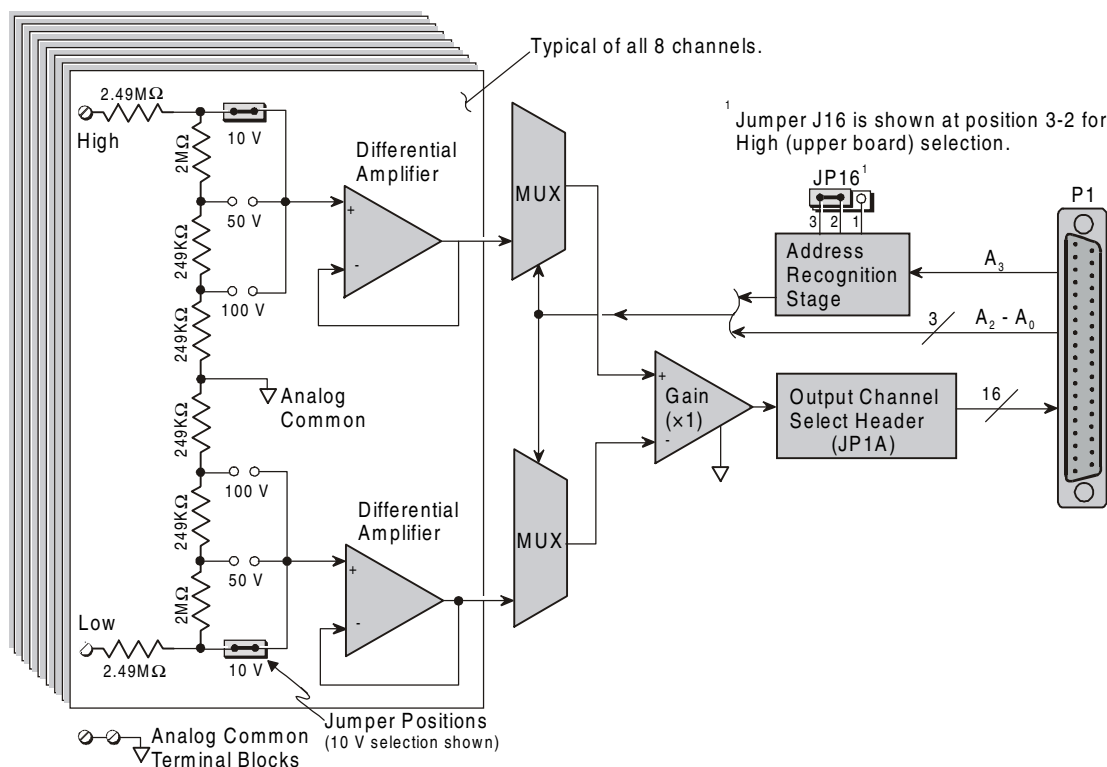
The DBK8 reads voltages up to ± 100 V from DC to 10 kHz. The inputs are balanced differential and referenced to the LogBook analog common. No external biasing resistors are used. The input impedance of each DBK8 channel is $10\text{ M}\Omega$ to minimize loading of the circuit being measured. Two DBK8s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

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

The DBK8 has 3 attenuation factors.

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

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



DBK8 Block Diagram

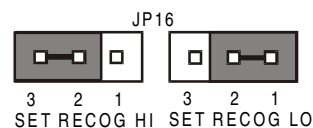
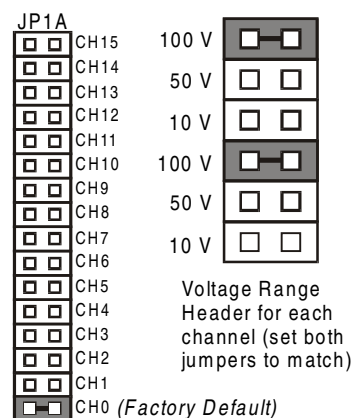
Hardware Setup

Card Configuration

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

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

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



DBK8 Configuration Settings

Card Connection

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



To meet CE safety specifications, an edge guard (kit p/n 232-0806) must be attached to the DBK8 card before insertion into a DBK41 expansion chassis. This guard helps prevent accidental access to high-voltage circuits. See Appendix D for more information.

DBK8 has a footprint on the card to install a DB37 connector to accommodate input signals. The pinouts are the same as P1 for the 16 main channels, but the other pins are not wired. Pins 30 to 37 correspond to channels 7 to 0; pins 11 to 18 correspond to channels 15 to 8 (or low 7 to 0 in differential mode)—see chapter 2, 3, or 4 for P1 pinout locations.

Safe Mounting

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

DBK8 - Specifications

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

Connectors: DB37 male, mates with P1 pinouts; screw terminals and DB37 footprint for signal inputs.

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

Input Impedance: 10 M Ω

Attenuation:

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

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

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

Output Voltage Range: ± 5 VDC

Bandwidth: 15 kHz

Attenuation Accuracy: 0.5%

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

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

DBK9 Eight-Channel RTD Card

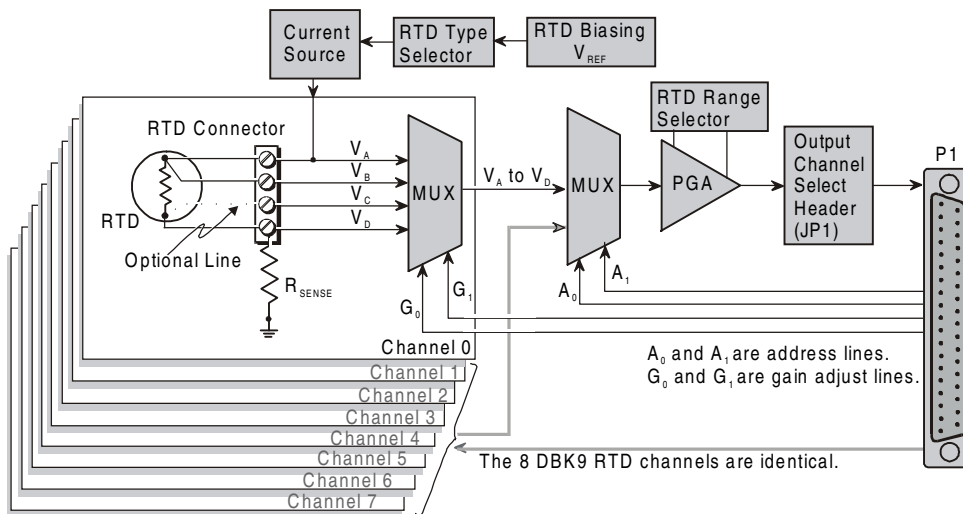
Overview

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

$$RTD = [V_A - V_D - 2(V_A - V_B) R_{sense}] / V_D \quad (\text{Result in Ohms})$$

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

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

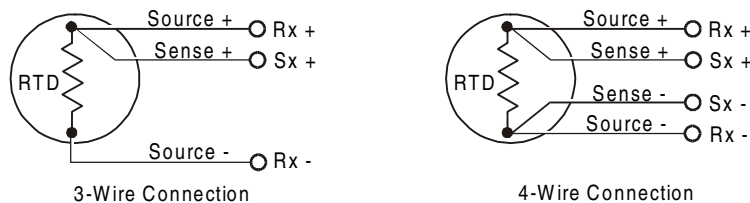


DBK9 Block Diagram

Hardware Setup

Card Connection

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

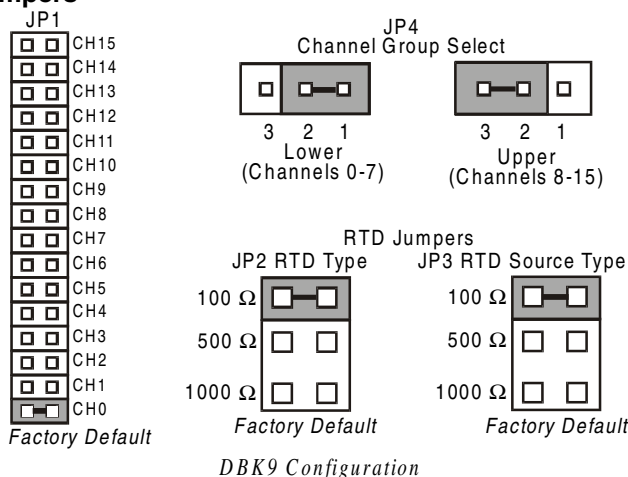


RTD Connections for the DBK9

Card Configuration

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

Channel Address Jumpers



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



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

RTD Type Selection Jumpers

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



JP2 and JP3 must use the same setting.

DBK9 Calibration

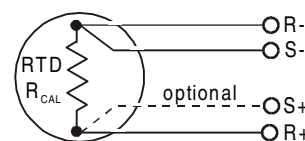
The DBK9 is default-calibrated for a 100 Ω RTD. To use the DBK9 with a 500 Ω or a 1000 Ω RTD, the user must calibrate the card as follows:

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

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

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

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



DBK9 Calibration Setup

DBK9 - Specifications

Name/Function: 8-Channel RTD Measurement Card
Connector: DB37 male, mates with P1 pinout; screw terminals for signal connections
Configurations: 3-wire or 4-wire
Alpha: 0.00385
Inputs: 8 channels
Temperature Ranges: 100, 500, or 1000 Ω: -200 to +850°C

RTD Excitation Current:

100 Ω 500 μA
 500 Ω 227 μA
 1000 Ω 160 μA

Accuracy: ±1.5°C (wide band)

Resolution: 0.3°C

Range and RTD Type Adjustments: Jumpers on circuit board



DBK10 3-Slot Expansion Chassis

Overview

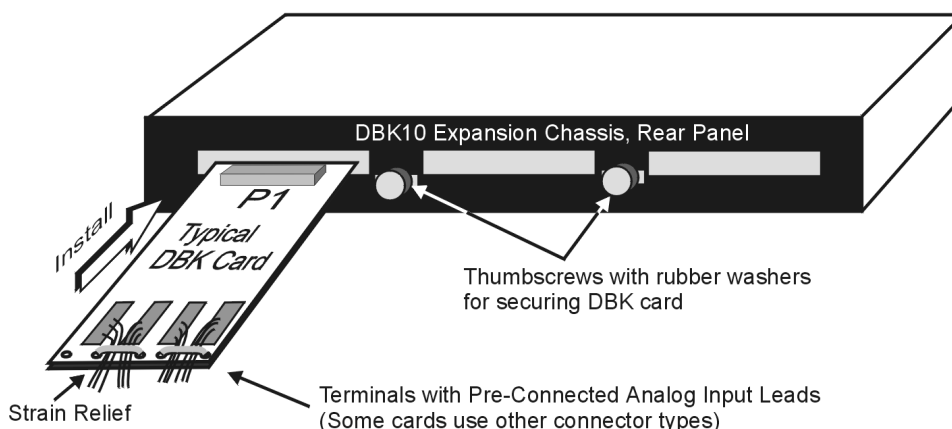
DBK10 is a metal enclosure that holds up to 3 expansion cards. Cards can slide into their slots without removing the signal connections. Two DBK10s are ideal for applications that require 6 or fewer DBK cards. Multiple enclosures can be stacked to accommodate many cards. For applications that require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

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

Hardware Setup

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

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



Installing a Card in a DBK10 Expansion Chassis

DBK10 - Specifications

Name/Function: 3-Slot Expansion Chassis

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

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

Capacity: Accommodates 3 DBK expansion cards

Material: Aluminum

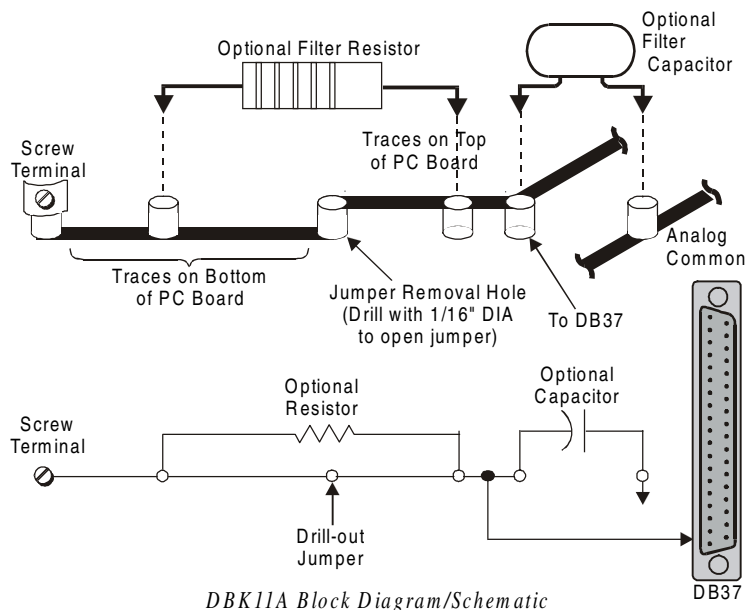
Finish: Black, powder-coated

DBK11A Screw-Terminal Option Card

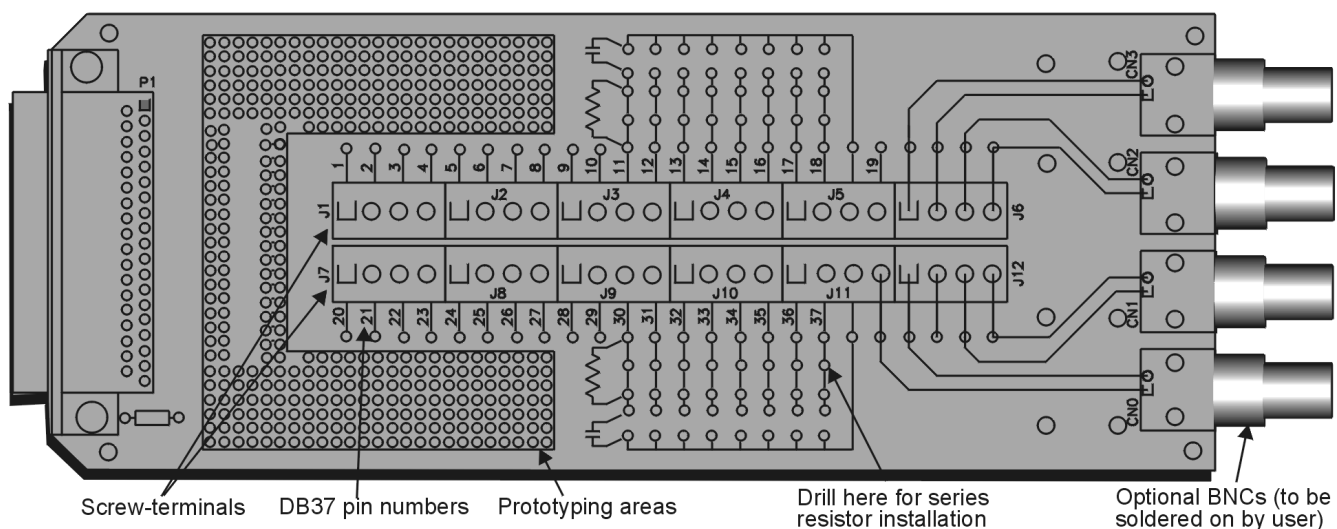
Overview

DBK11A provides access to all pins on a DB37 connector and includes sockets for optional passive-filtering components. DB37 pins connect to screw terminals while passing through an optional prototype area on the PC board. This area can accommodate resistors, capacitors, and custom wiring. The user can choose appropriate values to fit the application.

Note: DBK11A is compatible with P1, P2, P3, DigiBook/72, and any DB37 connector. The DBK11A card has footprints for 4 BNC connectors; and the DBK11A includes 4 BNCs that the user can solder onto the card.



Hardware Setup



DBK11A Board Layout

Card Connection

The DBK11A has screw-terminal connectors for easy access to analog inputs and outputs. The terminal blocks have numbers that relate to pin numbers on the DB37 connector. There are also areas on the board with standard 0.1" hole spacing for the user to install additional circuitry. The optional BNCs are connected to screw terminals on J6 and J12. These screw terminals can be jumpered to the screw terminals for specific P1 pin numbers as needed.

1. Make the appropriate connections to terminal blocks as required for your application.

Note: Wire size for the screw terminals should be in the range of 14 to 26 gage.

2. Once all connections are in place, secure all wires at the end of the DBK11A board. Nylon tie wraps (not included) work well for this purpose.

Card Configuration

There are 2 rows of screw terminals for direct connection to DB37 pins. For additional circuitry such as RC networks, there are 9 spare terminals, several hundred unconnected solder pads and signal paths to the analog input terminals (pins 11-18 and 30-37). The default circuit path is just a straight connection with no options. Before adding components, you must drill out the 1/16" diameter jumper-removal hole (see previous two figures). Note that RC filters (optional) can be located on 16 pins that correspond to the analog input channels.

DBK11A - Specifications

Name/Function: Screw-Terminal Card

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

Wire Size Range: 14 to 26 ga

BNC Option: DBK11A includes 4 BNCs for user-soldered connection

DBK12 and DBK13 Analog Input Multiplexer Cards

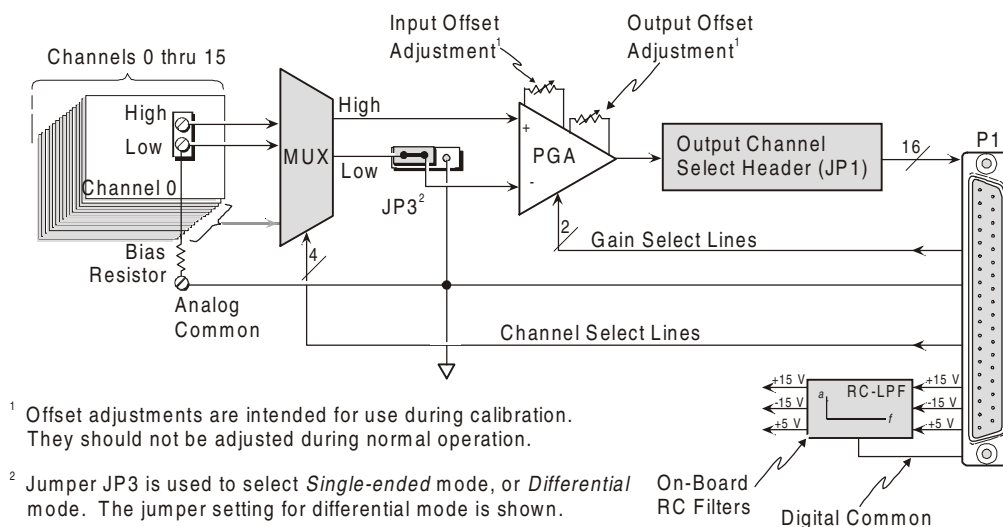
Overview

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

- The DBK12's amplifier offers $\times 1$, 2, 4, or 8 gain (programmable per channel). These gains can be combined with the standard LogBook gains of 1, 2, 4, 8, 16, 32, and 64 to yield gains of 1, 2, 4, 8, 16, 32, 64, 128, 256, and 512.
- The DBK13's amplifier offers $\times 1$, 10, 100, or 1000 gain (programmable per channel). These gains can be combined with the standard LogBook gains of 1, 2, 4, 8, 16, 32, and 64 to yield gains of 1, 2, 4, 8, 10, 16, 20, 32, 40, 64, 80, 100, 160, 200, 320, 400, 640, 800, and 1000.

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

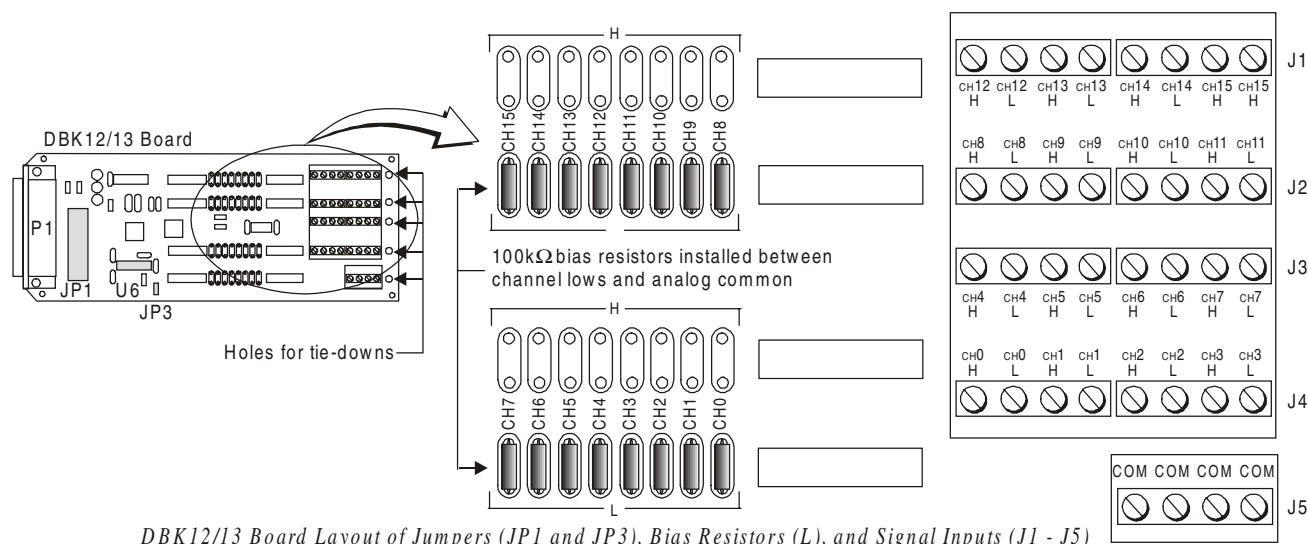
Note: DBK12 and DBK13 use the same printed circuit board and look quite similar. If the label becomes unreadable, you can distinguish them as follows: the U6 integrated circuit is a PGA203 in DBK12; but a PGA202 in DBK13.



DBK12 and DBK13 Block Diagram

Hardware Setup

To set up the card, you may need to refer to the following figure of the DBK12/13 board layout.



DBK12/13 Board Layout of Jumpers (JP1 and JP3), Bias Resistors (L), and Signal Inputs (J1 - J5)

Card Connection

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

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

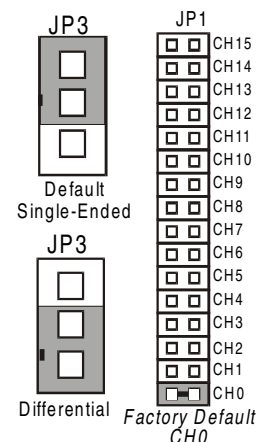


Note! A path to analog common must exist, either by direct connection or through bias resistors.

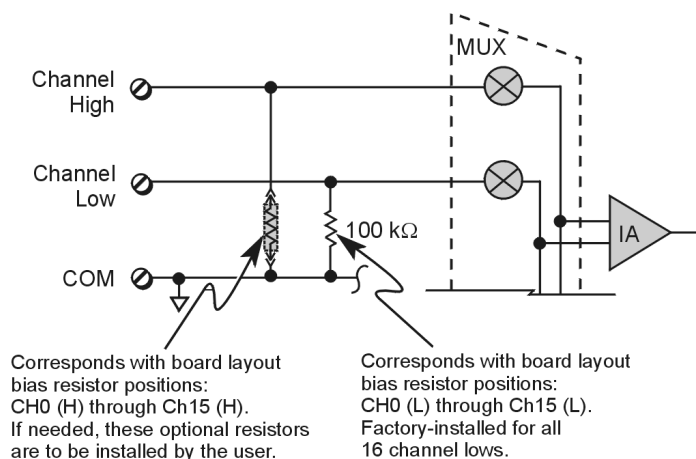
Card Configuration

The two variables of card configuration are input mode to the card and channel output to the LogBook.

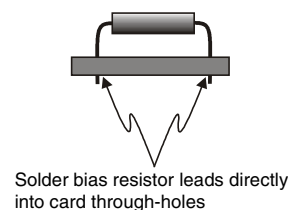
1. Set the signal input mode on jumper JP3 (see figure).
 - For single-ended inputs, find the SE/DIFF Select jumper (JP3) located near the connector and place the jumper in the SE position.
 - For differential inputs, select the DIFF position.
2. To configure the channel, locate the 16x2-pin header near the front of the board labeled JP1. Note the 16 jumper locations on this header labeled CH0 through CH15 to match one of the LogBook's base channels. Place the jumper on the channel you wish to use. Only one jumper is used on a single card; all cards in a daisy-chain must have unique jumper settings. Up to sixteen DBK12s/13s may be connected to your LogBook. (The optional DBK10 enclosure may be used.)



On newer version boards, bias resistors are factory-installed between the channel lows and analog common. If you have an early version board, you can still install the bias resistors. The use of bias resistors is discussed in the *Signal Management and Troubleshooting Tips* chapter.



DBK12/13 Configuration



DBK12 - Specifications

Name/Function: Analog Multiplexing Card (Low Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 2$, $\times 4$, $\times 8$

Inputs: 16 differential or single-ended
(switch selectable as a group)

Voltage Range: 0 to ± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: $\pm 0.05\%$ typ, $\pm 0.25\%$ max

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20 V/ μ s typ, 10 V/ μ s min

Settling Time: 2 μ s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typ, 0.015% max

Bias Current: 150 pA, 0.2 μ A max

Offset Voltage: $\pm(0.5 + 5/G)$ mV typ; $\pm(2.0 + 24/G)$ mV max

Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typ; $\pm(2.0 + 24/G)$ μ V/ $^{\circ}$ C max

DBK13 - Specifications

Name/Function: Analog Multiplexing Card (High Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 10$, $\times 100$, $\times 1000$

Inputs: 16 differential or single-ended (switch selectable as a group)

Voltage Range: 0 to ± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: $\pm 0.05\%$ typ @ $G < 1000$
 $\pm 0.25\%$ max @ $G < 1000$
 $\pm 0.10\%$ typ @ $G = 1000$
 $\pm 100\%$ max @ $G = 1000$

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20V/ μ s typ, 10V/ μ s min

Settling Time: 2 μ s to 0.01% @ $G < 1000$
10 μ s to 0.01% @ $G = 1000$

CMRR: 80 dB @ $G=1$ min
86 dB @ $G=10$ min
92 dB @ $G=100$ min
94 dB @ $G=1000$ min

Non-Linearity: 0.002% typ @ $G < 1000$
0.015% max @ $G < 1000$
0.02% typ @ $G = 1000$
0.06% max @ $G = 1000$

Bias Current: 150 pA typ; 0.2 μ A @ 25 $^{\circ}$ C max

Offset Voltage: $\pm(0.5 + 5/G)$ mV @ 25 $^{\circ}$ C typ;
 $\pm(2.0 + 24/G)$ mV @ 25 $^{\circ}$ C max

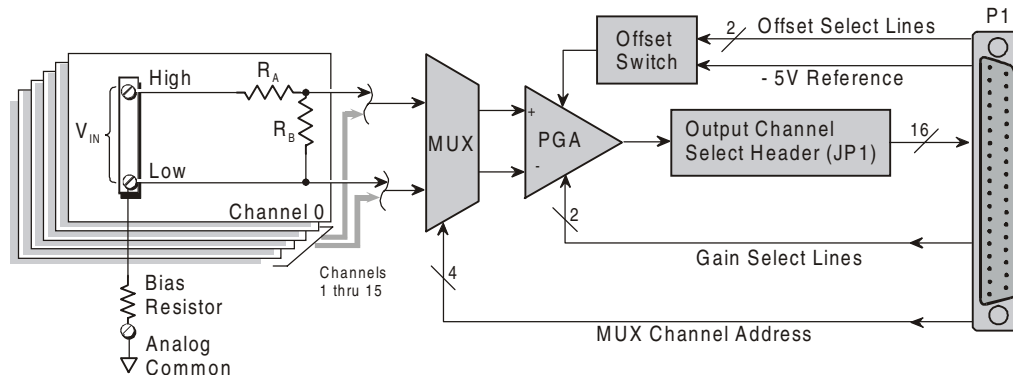
Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typ; $\pm(12 + 240/G)$ μ V/ $^{\circ}$ C max

DBK15 Universal Current/Voltage Input Card

Overview

DBK15 uses a 16-channel multiplexer and a programmable gain input amplifier (PGA). Component sockets accept resistors that configure each channel for current-to-voltage conversion or for voltage attenuation. The differential signal input from the transducer must use 3 leads: high, low, and common.

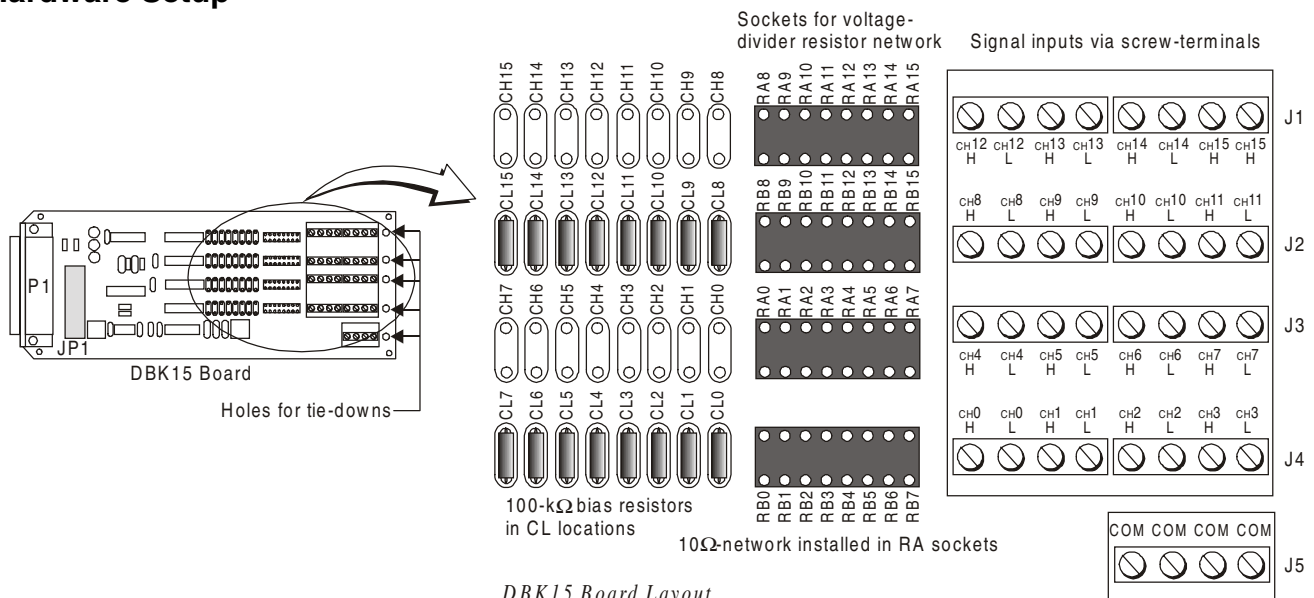
When configured by appropriate resistors, the DBK15 can measure voltages up to 30 VDC or currents up to 20 mA. Each of 16 input channels has a resistor “A” and “B” location. Installing various resistors in these locations yields channel-to-channel flexibility. The DBK15’s input amplifier is software programmable for $\times 1$ or $\times 2$ gain per channel, providing unipolar 0 to +10 V or bipolar -5 to +5 V ranges per channel.



$$V_{OUT} = V_{IN} \left(\frac{R_B}{R_A + R_B} \right) (GAIN) + OFFSET$$

DBK15 Block Diagram

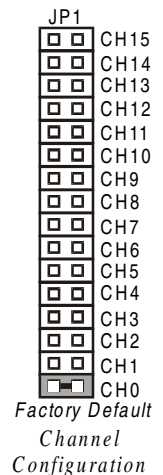
Hardware Setup



DBK15 Board Layout

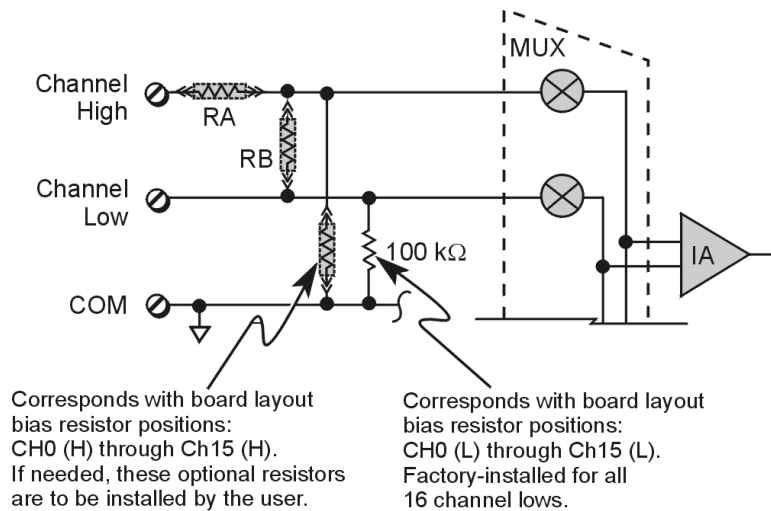
Card Configuration

1. Determine the LogBook's Analog Input Channel for each DBK15 in your system. As few as one or as many as 16 DBK15's may be connected to your LogBook. Since this is a daisy-chain type interface, each card must appear unique. This is accomplished by assigning each card to a different Analog Input on the LogBook.
2. Locate the 16x2 pin header labeled JP1 near the front of the board. Note the 16 jumper locations on this header labeled CH0 through CH15 corresponding to the LogBook's Analog Input Channels.
3. Set JP1 jumper on the pins for your intended output channel (CH0-CH15, see figure). Only one jumper is used on a single card. No two cards in the same system can have the same jumper setting.
4. Determine values for R_A and R_B for each input signal channel. Standard RN55D (¼ watt, 1%, metal film) resistors or 22 ga bare wire (short) plug in pin sockets (see table).
5. Install resistors in R_A and R_B sockets for each channel as desired (see figures).

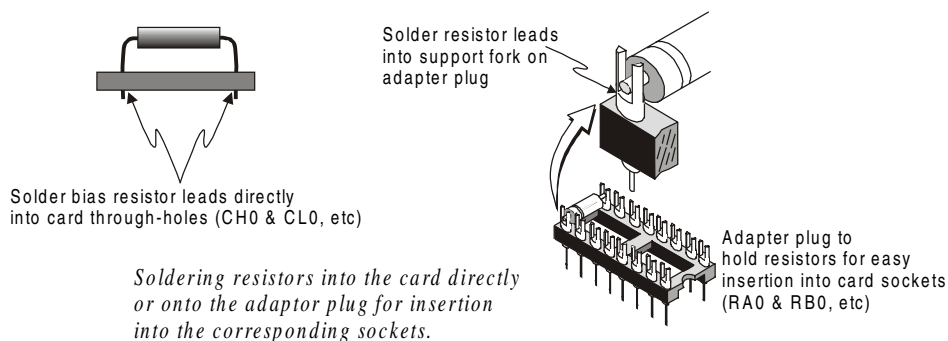


Input Range	R_A	R_B	Gain	Polarity
± 5 VDC	10 Ω Short	Open	$\times 1$	Bipolar
± 10 VDC	2 K Ω	2 K Ω	$\times 1$	Bipolar
± 30 VDC	10 K Ω	2 K Ω	$\times 1$	Bipolar
± 20 mA	Short	249 Ω	$\times 1$	Bipolar
± 20 mA	Short	124 Ω	$\times 2$	Bipolar
± 2 mA	Short	1240 Ω	$\times 2$	Bipolar

Note: A multiplexed input in sampled data systems must have low impedance to allow for accurate measurements. For 12-bit accuracy at 100 kHz, equivalent attenuator impedances should be less than 1 k Ω and signal sources must have impedances less than 1/4000 of the attenuator input impedance. For example, a 2:1 attenuator using 2 K Ω resistors will have 1 K Ω of equivalent impedance; but the source impedance must be less than 1/2 Ω (1/4000 of 2000) for 12-bit measurement accuracy to be attained.



In voltage mode, R_A and R_B (installed by the user) form a resistor divider network. In current mode, R_A is always shorted, R_B is shunted with a resistor. 8 channels can be configured alike with 16-pin, 8-resistor DIP-8 resistor networks. With no resistors, DBK15 provides 16 differential voltage inputs for +5 V full-scale inputs. CL positions are used for bias resistors if necessary. Two differential measurement configurations can be used: floating or referenced differential (refer to the chapter *Signal Management and Troubleshooting Tips* for more information.)



Card Connection

1. Connect the signal input wires to the appropriate screw terminals. The DBK15 is equipped with screw terminal connectors for easy access to inputs and ground access points. Connectors are provided for 16 differential inputs and are labeled by channel number and H and L for high and low analog inputs. On board, there are 100K Ω bias resistors in the CL locations per channel (the CH locations are not used). These resistors can be removed if desired.



The DBK15 card only supports differential inputs (not single-ended). Connect the high end of the signal to the High input and the low end to the Low input of the desired channel. Ground referencing to Analog Common is important for optimum accuracy.

2. Use tie wraps (not included) and the board's edge-holes to secure all wires in a way that will not allow mechanical stress to affect the signal connection. In other words, be sure to provide a degree of slack, or "strain-relief."

DBK15 – Specifications

Name/Function: Universal Current/Voltage Input Card

Input Connectors: Screw terminals for signal connections

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

Attenuation/Shunt Resistor Connector: Machine sockets
accommodate standard 1/4-watt resistors

Gain Ranges: $\times 1$, $\times 2$

Inputs: 16 differential

Voltage Input Ranges: ± 5 VDC max

Current Input Range: ± 20 mA max

Attenuator Resistors:

Accuracy: $\pm 1\%$

Temperature Coefficient: 100 ppm/ $^{\circ}\text{C}$

Gain Accuracy: $\pm 0.05\%$ typ, $\pm 0.25\%$ max

Maximum Input Voltage: ± 35 VDC

Slew Rate: 10 V/ μs

Settling Time: 2 μs to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typ, 0.015% max

Unattenuated Bias Current: 150 pA typ, 0.2 μA max @ 25 $^{\circ}\text{C}$

Offset Voltage:

$\pm(0.5 + 5/G)$ mV @ 25 $^{\circ}\text{C}$ typ

$\pm(2.0 + 24/G)$ mV @ 25 $^{\circ}\text{C}$ max

Offset Drift:

$\pm(3 + 50/G)$ $\mu\text{V}/^{\circ}\text{C}$ typ

$\pm(12 + 240/G)$ $\mu\text{V}/^{\circ}\text{C}$ max

DBK16 2-Channel Strain-Gage Card

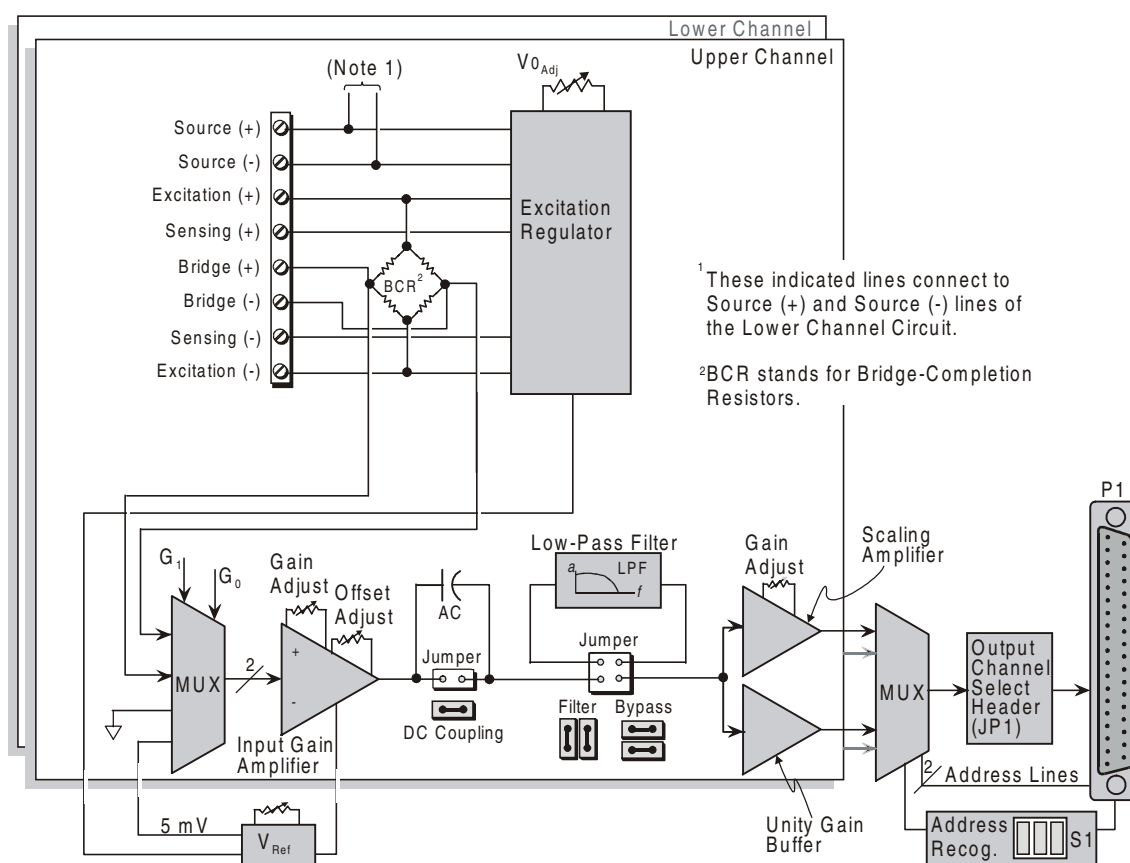
Overview

The DBK16 will condition signals from most types of bridge circuit configuration transducers that have a signal output of less than 50 mV. Strain gages and load cells are common types of these transducers. For half- and quarter-bridge strain gages, the DBK16 can accommodate user-supplied bridge completion resistors that complete the bridge circuit.



The bridge circuit must be complete for the DBK16 to operate correctly.

Each channel of the DBK16 offers a selectable 3-pole, low-pass filter with a user-set cut-off frequency. Up to 8 DBK16 boards can be connected to each of 16 analog Daq* base channels for a maximum of 256 input signals. Remote-sense terminals are used with 6-wire Kelvin connections.



DBK16 Block Diagram

The DBK16 provides an amplifier gain range of $\times 100$ to $\times 12,500$ for use with strain gages having 0.4 to 10 mV/V sensitivities. Most strain gages are specified for a full-scale value of weight, force, tension, pressure, or deflection with an output of mV/V of excitation. For example, a strain gage with a full-scale rating of 1000 lb of tension might output 2 mV/V of excitation at full load. With an excitation of 10 VDC, 1000 pounds of load would produce an output of 20 mV.

The card's 0 to 5 VDC offset and output-scaling permit nulling of large quiescent (inactive or motionless) loads and expansion of the dynamic range for maximum resolution. Typically, the quiescent output is non-zero. Prior to a force being applied, a mounted strain gage can be in a state of partial deflection resulting in an output. In the case of a tension gage, this output may be due to the weight of a hook or empty container.

A wide-range excitation regulator is adjustable from 1.5 to 10.5 VDC with a current limit of 50 mA. The DBK16 requires a 12 to 15 VDC external excitation voltage that can be supplied from the DBK30A battery module or other user-supplied source.

Hardware Setup

CAUTION



Each regulator has a maximum current of 50 mA. The maximum amount of excitation that can be provided by the DBK16 excitation regulator is represented by the following equation:

$$V_{\text{EXC}[\text{MAX}]} = 0.05 \times R_{\text{GAGE}}$$

Where R_{GAGE} = the resistance of 1 element in the bridge circuit.

Exceeding the maximum allowed excitation can cause the DBK16 to fail.

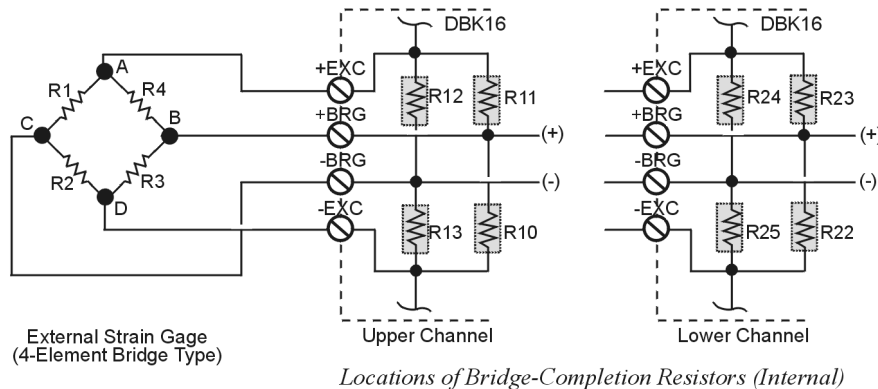
Card Connection

For DBK16s, the strain gage is configured as a 4-element bridge. There are 4 legs in a bridge circuit; the *quarter*, *half* or *full* designation refers to how many elements in the bridge are strain-variable. A quarter bridge has 1 strain-variable element; a half bridge has 2; and a full bridge has 4. Each DBK16 channel has locations for bridge completion resistors. These resistors of fixed values are necessary to fill out the bridge configuration.

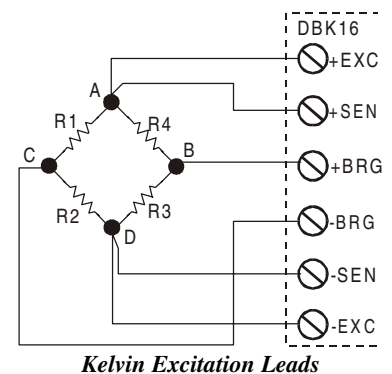
In the following diagram, a 4-element bridge-type strain gage is referenced to the upper and lower channel bridge completion resistor designations for the DBK16.



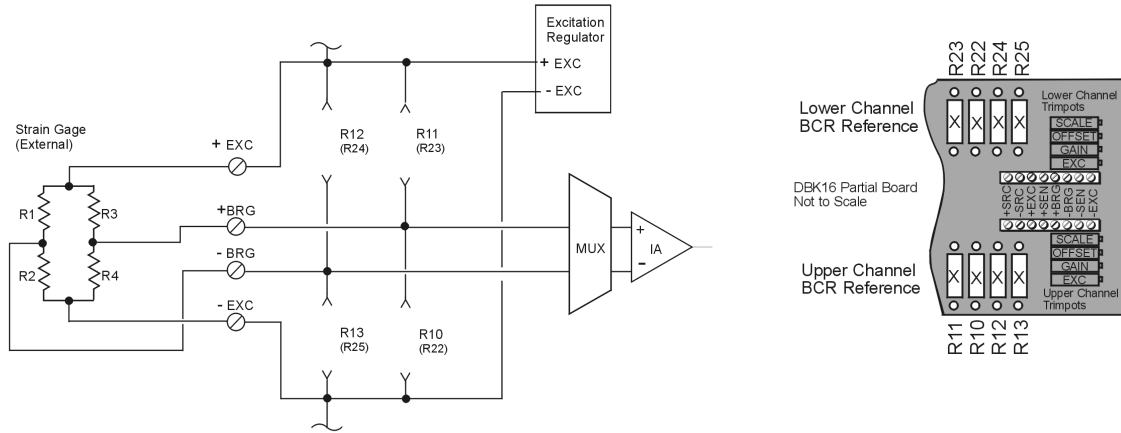
Bridge resistors are used in either the DBK16 or the strain gage, but not in both at the same time.



Connections are provided for Kelvin-type excitation. The excitation regulators stabilize the voltage at the points connected to the on-board sampling dividers. Unless you run separate sense leads to the excitation terminals of the strain gage, the voltage regulation is most accurate at the terminal blocks on the DBK16. In a Kelvin-type connection, six wires run to a 4-element strain gage, and the excitation regulation is optimized at the strain gage rather than at the terminal blocks. For high accuracy, this can be a worthwhile connection for as little as 10 feet of 22 gauge lead wire.



Examples of strain-gage configurations follow.

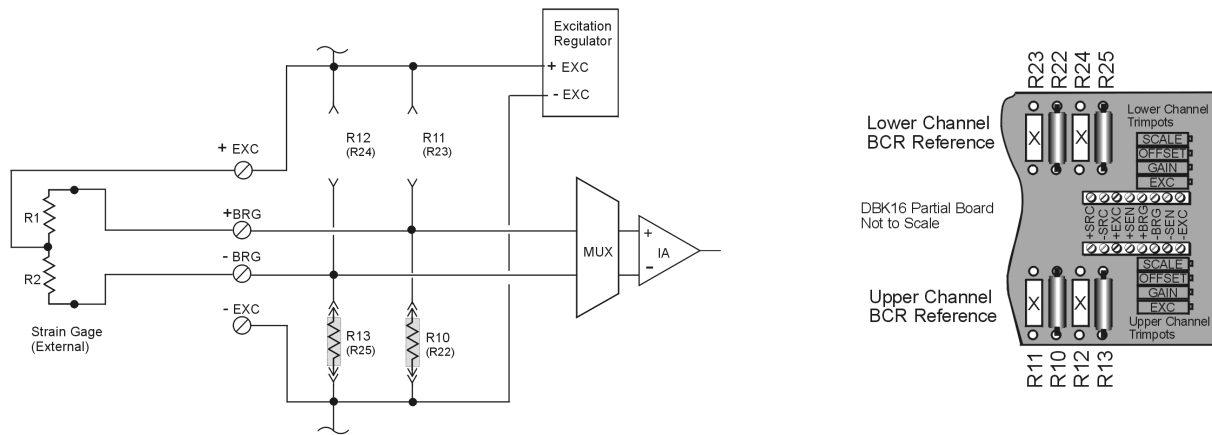


Full Bridge, Resistor Configuration for DBK16

The full bridge configuration makes use of all four elements of the strain gage. When using a full bridge external strain gage (all four elements), the following applies to the DBK16 on board resistor configuration:

Upper Channel – R10, R11, R12, and R13 are not installed.

Lower Channel – R22, R23, R24, and R25 are not installed.



**Half Bridge, ($\Delta R1\downarrow$ and $\Delta R2\uparrow$) $\Rightarrow \Delta E_{OUT}\uparrow$)
Resistor Configuration for DBK16**

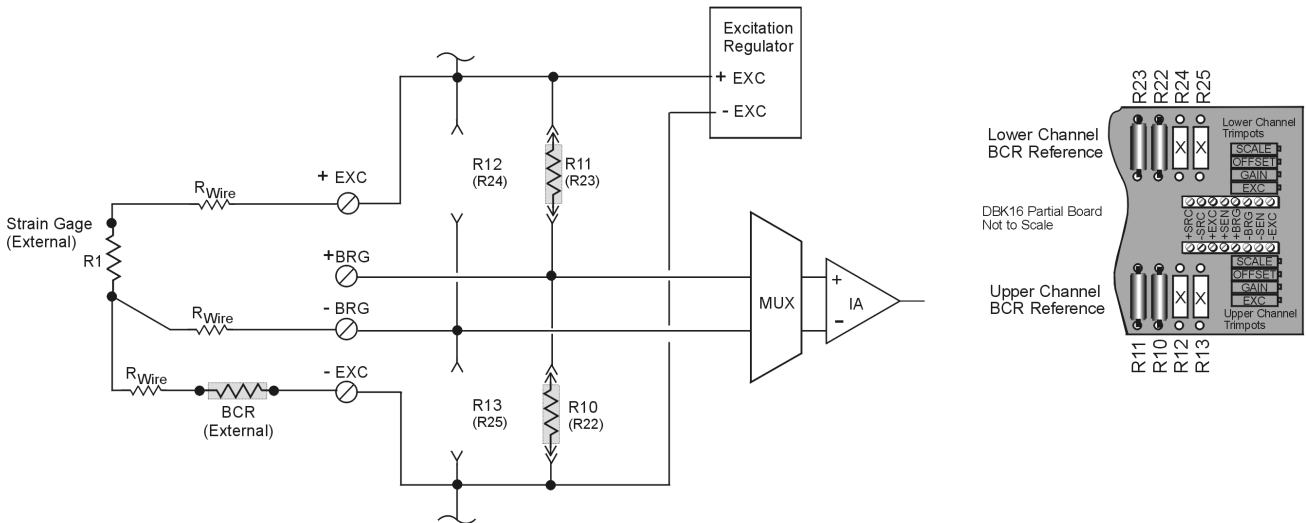
The half bridge configuration makes use of two elements of the strain gage. When using a half bridge external strain gage (two of four elements), the following applies to the DBK16 on board resistor configuration:

Upper Channel – R10 and R13 are to be installed.

Lower Channel – R22 and R25 are to be installed.

Note that other Half Bridge scenarios exist. The one illustrated applies to the equation:

$$\Delta R1\downarrow \text{ and } \Delta R2\uparrow \Rightarrow \Delta E_{OUT}\uparrow$$



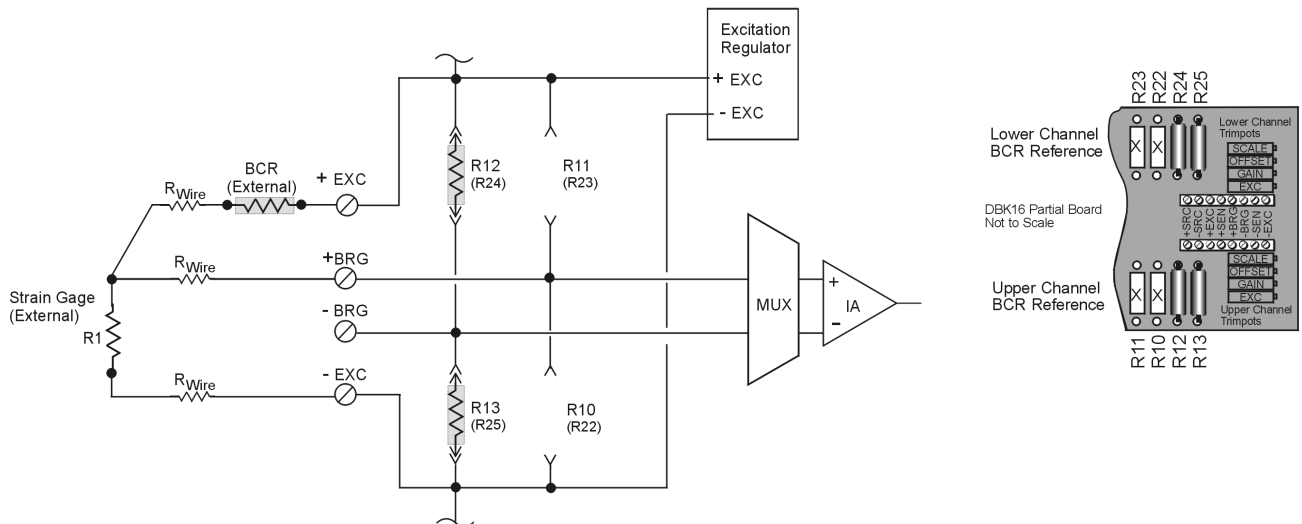
3-Wire, Quarter-Bridge, Negative ($\Delta R \uparrow \Rightarrow \Delta E_{OUT} \uparrow$) for DBK16

The quarter-bridge configuration makes use of one element of the strain gage. The three-wire, quarter-bridge can be configured as “positive” or “negative.” The above figure represents the negative (minus) configuration. In this setup, the magnitude of voltage out is directly proportional to the change in resistance ($\Delta R \uparrow \Rightarrow \Delta E_{OUT} \uparrow$). When using a quarter-bridge external strain gage in the “negative” configuration, the following applies:

Upper Channel – R10 and R11 are to be installed.

Lower Channel – R22 and R23 are to be installed.

An external BCR is to be placed in the –EXC to R1 line (see previous figure).



3-Wire, Quarter-Bridge, Positive ($\Delta R \downarrow \Rightarrow \Delta E_{OUT} \uparrow$) for DBK16

The quarter-bridge configuration makes use of one element of the strain gage. The three-wire, quarter-bridge can be configured as “positive” or “negative.” The above figure represents the positive (plus) configuration. In this setup, the magnitude of voltage out is inversely proportional to the change in resistance ($\Delta R \downarrow \Rightarrow \Delta E_{OUT} \uparrow$). When using a quarter-bridge external strain gage in the “positive” configuration, the following applies:

Upper Channel – R12 and R13 are to be installed.

Lower Channel – R24 and R25 are to be installed.

An external BCR is to be placed in the +EXC to R1 line (see previous figure).

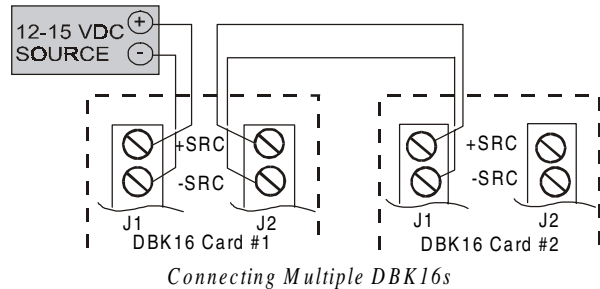
Excitation

To supply excitation voltage to a single DBK16:

Connect J1 (terminals SRC+ and SRC-) to a source of filtered (not necessarily regulated) DC between 12 and 15 V.

To supply excitation to multiple DBK16s:

1. Connect J1 (terminals SRC+ and SRC-) to a source of filtered (not necessarily regulated) DC between 12 and 15 V.
2. Connect J2 of the powered DBK16 to J1 of the next DBK16 (see figure). The excitation power terminals are wired in parallel to *daisy-chain* multiple DBK16s (in systems with more than 2 transducers).



The user-supplied excitation source is attached to a voltage regulator in the DBK16 circuitry. This regulator provides the excitation to the actual transducer (there is a separate regulator for each transducer, hence two regulators per DBK16). Each regulator has a maximum current of 50 mA. The maximum amount of excitation that can be provided by the DBK16 excitation regulator is represented by the following equation:

$$V_{\text{EXC}[\text{MAX}]} = 0.05 \times R_{\text{GAGE}}$$

Where R_{GAGE} = the resistance of 1 element in the bridge circuit.

The user-supplied excitation source should provide adequate current levels for all the DBK16s that are powered. The minimum current required for the user-supplied excitation source for each transducer (2 per DBK16) is:

$$I_{\text{MIN}} = \text{Excitation voltage}/R + 5 \text{ mA} \quad (\text{where } R = \text{the resistance of 1 element in the bridge circuit})$$

The user-supplied excitation source must be 12 to 15 VDC and connected with the proper polarity.

Enhanced DBK16 cards contain two additional jumpers (JP6 and JP7). Their configuration determines whether the channel excitation regulator's power source is *external* (default) or *internal*. Review the following **note** and **CAUTION** prior to selecting the *internal power source*.

- **JP6** – Selects the upper channel's source. Default is *external*.
- **JP7** – Selects the lower channel's source. Default is *external*.



It is possible to power excitation regulators from an internal +15 V on Daq*'s P1 if no other DBKs are being used. On enhanced DBK16 cards, two 3-pin headers (JP6 for upper channel and JP7 for lower channel) are set by default to use an *external* power source. Moving the jumpers to the *internal* position connects the excitation terminals to the +15 VDC rail from P1. Jumper locations are indicated on page 5-39.

CAUTION



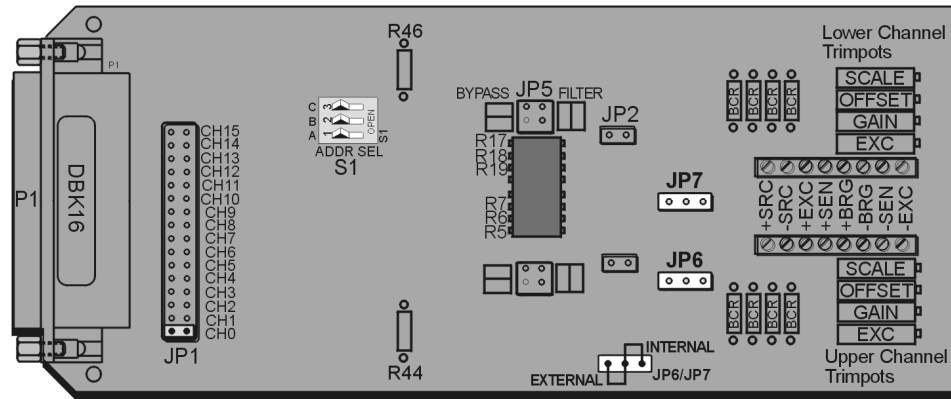
Avoid overloading LogBook's +15 VDC power supply. The power supply can be overloaded if DBK16 jumpers JP6 and/or JP7 are set to "Internal" and one or more of the following conditions exist:

- Additional DBKs are being used.
- 120 Ω bridge-completion resistors are being used in the strain gage configuration.

Card Configuration

The next few sections explain several configuration options on the DBK16:

- AC Coupling and Low-Pass Filter Options
- Channel and Card Address Selection
- Hardware and Set-up



DBK16 Board Layout

AC Coupling, DC Coupling, and Low-Pass Filter Options

Headers on the board accommodate the coupling and low-pass filter options and the output channel selection (see above figure). Resistors can be removed to lower filter gain from $\times 2$ to $\times 1$. A filter frequency determining resistor network can be inserted into an IC socket.

The **AC or DC coupling** choice (on each channel) is set by the presence or absence of a **shunt jumper** on a two-pin header. If the shunt jumper is in place, the coupling is DC. If the shunt jumper is absent, the coupling is AC. **JP3** is used to configure the upper channel's coupling; **JP2** is used to configure the lower channel.

The choice of **using or bypassing the low-pass filter** (for each channel) is made by the orientation of shunt jumpers on a 2x2-pin header. When the shunt jumpers are oriented in the same way as the "bypass" symbol (horizontal, parallel with labels on card), the filter is bypassed. When the shunt jumpers are oriented in the same way as the "filter" symbol (vertical), the filter is in the signal path. **JP4** is used to configure the upper channel; **JP5** is used to configure the lower channel.

The **corner frequency of the low-pass filters** is determined by three resistor values in each filter circuit. Located in the center of the card, the **lower channel resistors** are **R17-R18-R19**; and the **upper channel resistors** are **R5-R6-R7**. These resistor locations are arranged to allow the use of an 8-position DIP network (as a convenient means of changing all 6 resistors at once). The machined-pin socket allows you to insert individual resistors (should the two filter sections have different corner frequencies). The table to the right lists common frequencies, nominal resistance values, and Bourns part numbers.

Frequency	Resistance (Ω)	Bourns Part Number
10 Hz	27,000	4606X-102-273
20 Hz	12,000	4606X-102-123
50 Hz	5600	4606X-102-562
100 Hz	2700	4606X-102-272
200 Hz	1200	4606X-102-122
500 Hz	560	4606X-102-561
1,000 Hz	270	4606X-102-271
2,000 Hz	120	4606X-102-121
5,000 Hz	56	4606X-102-560
10,000 Hz	27	4606X-102-270
20,000 Hz	12	4606X-102-120



DBK16's active low-pass filters have an inherent gain of $\times 2$. You must factor this gain into your setup calculations. To change the gain to $\times 1$, remove the following 10 K Ω resistors: R44 for the upper channel, R46 for the lower channel.



Reference Note: Refer to Appendix A for instructions on calibrating DBK16.

Channel and Card Address Selection

The lower and upper channels on the DBK16 are multiplexed into one of the LogBook base channels (0 to 15). The base channel (that the DBK16 is multiplexed into) is set by the shunt jumper on the 16x2 header designated **JP1** (see previous figure, DBK16 Board Layout).

Each base channel can have up to 16 expansion channels multiplexed into it. Since the DBK16 represents two expansion channels, eight DBK16 cards can be multiplexed into each base channel. To distinguish channels, there is a card address bank of three switches on each DBK16. These switches are binary-weighted with eight possibilities (0-7).

DIP Switch Setting			Card Channels (n)	
C	B	A	Upper	Lower
Open	Open	Open	1	0
Open	Open	Closed	3	2
Open	Closed	Open	5	4
Open	Closed	Closed	7	6
Closed	Open	Open	9	8
Closed	Open	Closed	11	10
Closed	Closed	Open	13	12
Closed	Closed	Closed	15	14

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

The switch settings are: **open = 0, closed = 1 (enabled)**. The weights (when closed) are: **A = 1, B = 2, C = 4**. The table above shows the switch settings. The table to the right lists card channels (n) with respect to the base channel.

Since LogBook has sixteen base channels, up to 128 DBK16s can be used, providing a maximum of 256 channels. To keep track of all base and expansion channels, the base channels are designated 0 to 15 and the expansion channels are designated

16 to 271. Channel 16 is the first channel on the first expansion board (lower channel on card address 0 with JP1 set to CH0). Channel 271 is the last channel on the last expansion board (upper channel on card address 7 with JP1 set to CH15).

To calculate the actual input channel, use the above tables and add the applicable “N” and “n.” The result is the expansion channel number. This number is needed when writing a program to read from that particular channel. For more information on multiplexing, refer to chapter 6, *Signal Management and Troubleshooting Tips*.

DBK16 - Specifications

Name/Function: 2-Channel Strain-Gage Input Card

Input Connectors: Screw terminals for signal connections

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

Number of Channels: 2

Excitation Voltage Range: 1.50 to 10.50 VDC @ 50 mA (on-board adjustment for external source)

Gain Range: x100-1250

Types of Bridges Accommodated:

- Full Bridge, Kelvin Excitation (6-wire)
- Full Bridge (4-wire)
- Half Bridge (3-wire)
- Quarter Bridge (2-wire)

Bridge Resistors: On-board provisions for 4 bridge-completion resistors per channel.

Type Input: Differential DC

Input Impedance: 100 MΩ (in parallel with 150 pF)

CMRR: 115 dB

Excitation Voltage Source: External 13-18 VDC @ 50 mA/circuit

Excitation Current Output: 50 mA max, current limited at 60 mA

Excitation Sensing: Local or Remote

Excitation Regulation:

Line Regulation: 0.025%

Load Regulation: 0.05%

Reference Voltages: 2.500 VDC

Reference Accuracy: 0.05%

Reference Drift: 3 ppm/°C

Gain Calibration Reference: 5.00 mVDC

Reference Accuracy: 0.2%

Reference Drift: 20 ppm/°C

Committed instrumentation amplifier for each section with gain adjust from x100 to x1250 via externally-accessed 15-turn trimpot.

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, 0-5.00 VDC (15-Turn trimpot)

Full-Scale Sensitivity Range:

At 5.00 VDC Excitation: 0.8 to 10 mV/V

At 10.00 VDC Excitation: 0.4 to 5 mV/V

Scaling Amplifier Gain Range: x1 to x10 (15-Turn trimpot)

Low-Pass Filter:

3 pole Butterworth, User By-Passable; -9dB @ User-set Corner Frequency

DBK17 Simultaneous Sample and Hold Card

Overview

Each DBK17 simultaneous sample-and-hold (SSH) card provides 4 channels of voltage input to a LogBook system. Each of the 16 analog input channels can accept 4 DBK17 cards, for a maximum of 256 analog input channels. The simultaneous sample-and-hold function is activated at the beginning of each channel scan and freezes all signals present on DBK17 inputs for the duration of the scan, allowing for non-skewed readings of all channels.

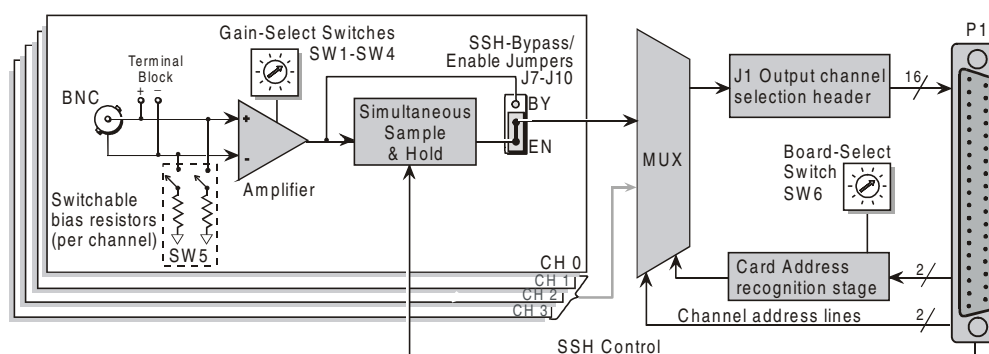


A DBK17 channel should never be the first channel in a scan due to timing of the SSH line.

DBK17 features an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a user-selected gain resistor for custom gain selection instead of the unity gain ($\times 1$) setting.

Four separate sample-and-hold stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled-output MUX allows up to 4 DBK17s to share a common LogBook analog input channel.

The input connectors are BNC type connectors. The differential inputs are provided with switchable 100 K Ω bias resistors to analog common. User gain can be set to any value between unity and $\times 500$ by installing a resistor in the user-location of each channel.



DBK17 Block Diagram

Hardware Setup

Card Connection

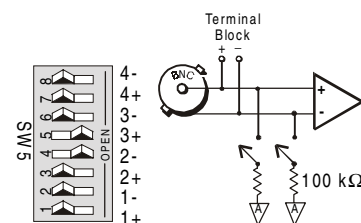
The DBK17 is equipped with BNC connectors for easy access to all of the analog inputs. Connections are provided for four differential inputs.

Note: New versions of DBK17 include a terminal block as a connection option. The BNC connectors can still be used, and board functions have not been changed.

Card Configuration

Input Termination

DBK17 provides two 100 K Ω bias resistors for each analog input. For balanced 200 K Ω input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The input circuit and switch positions are shown in the figure. The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required.



Input Impedance/Termination


SSH Configuration

Each channel's Simultaneous-Sample-and-Hold circuit can be enabled (EN) or bypassed (BY) by placement of the jumper on J7 for channel 0, J8 for channel 1, J9 for channel 2, or J10 for channel 3. The factory-default setting is **enabled (EN)** for each channel.

Gain Settings

On the card, each channel has a gain-set switch labeled GAIN 1 (SW1) to GAIN 4 (SW4) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the card. The value of the gain resistor is determined by the formula:

$$R_{\text{GAIN}} = [40,000 / (\text{Gain} - 1)] - 80 \, \Omega$$

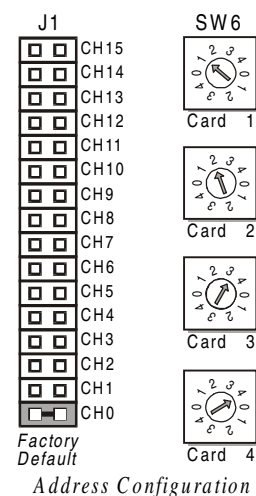
Gain Values	Gain Switch
0 x1	
1 x10	
2 x100	
3 x200	
4 x500	
<i>Setting Channel Gains</i>	

Address Configuration

As many as four DBK17s can be connected to each LogBook analog channel. With sixteen channels (and four inputs per DBK17) 256 inputs are possible. Since this is a daisy-chain interface, each card must have a unique address (channel and card number).

To configure the card, locate the 16 × 2-pin header (labeled J1) near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card. Four cards in the daisy-chain can have the same channel number as long as their card number is unique.

Set switch SW6 for each of four DBK17s on a single channel. Verify that only one card in the system is set to a particular channel *and* card number.



DBK17 - Specifications

Name/Function: Simultaneous Sample-Hold Card

Number of Channels: 4

Input Connections: 4 BNC connectors

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

Number of Cards Addressable: 64

Input Type: Differential

Voltage Input Ranges:

0 to ±5000 mVDC

0 to ±500 mVDC

0 to ±50 mVDC

0 to ±25 mVDC

0 to ±10 mVDC

Input Amplifier Slew Rate: 12 V/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, ×500 and User-Set

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 × 10¹² 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

Gain vs Temperature:

×1 @ ±20 ppm/°C

×10 @ ±20 ppm/°C

×100 @ ±40 ppm/°C

×200 @ ±60 ppm/°C

×500 @ ±100 ppm/°C

Non-Linearity:

×1 to ±0.015% full-scale

×10 to ±0.015% full-scale

×100 to ±0.025% full-scale

×200 to ±0.025% full-scale

×500 to ±0.045% full-scale

Common-Mode Rejection Ratio (CMRR):

70 dB minimum @ ×1

87 dB minimum @ ×10

100 dB minimum @ ×100

100 dB minimum @ ×200

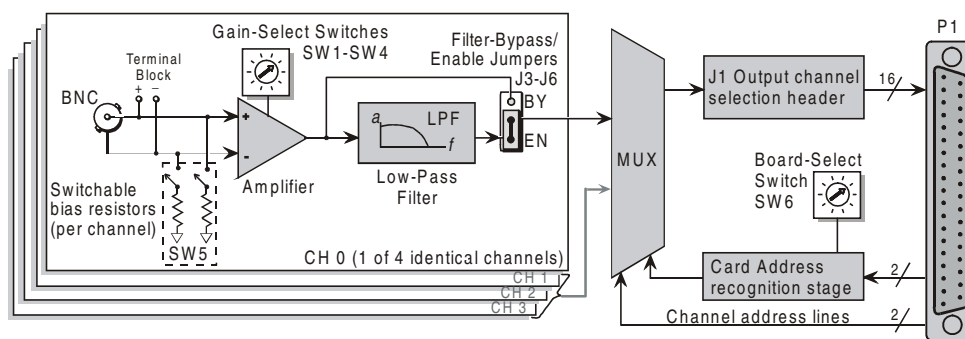
100 dB minimum @ ×500

DBK18 Low-Pass Filter Card

Overview

Each DBK18 low-pass filter (LPF) card provides 4 input channels to a LogBook system. Each of sixteen channels can accept four DBK18 cards for a maximum of 256 analog inputs. The input connectors are BNC type connectors. The differential inputs are provided with switchable 100 K Ω bias resistors to analog common.

The DBK18 features an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a gain resistor for custom gain selection instead of unity gain ($\times 1$). Gain for any channel can be set to any value between unity and $\times 500$ by installing an appropriate resistor. Four separate filter stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled output MUX allows up to four DBK18s to share a common LogBook analog base channel.



DBK18 Block Diagram

Hardware Setup

Card Connection

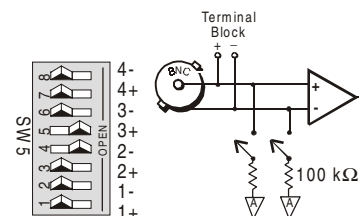
The DBK18 is equipped with BNC connectors for easy access to all of the analog inputs. Connections are provided for 4 differential inputs.

Note: New versions of DBK17 include a terminal block as a connection option. The BNC connectors can still be used, and board functions have not been changed.

Card Configuration

Input Termination

DBK18 provides two 100 K Ω bias resistors (one for each analog input). For balanced 200 K Ω input impedance, both resistors should be switched in. An 8-position DIP switch (SW5) can selectively engage the bias resistors. The input circuit and switch positions are shown in the figure. The switches must be in the closed position to engage the termination resistors. For unbalanced high input (single-ended), only the (-) resistor should be used. If neither resistor is used, some external bias current path is required.



Input Impedance/Termination

Gain Settings

On the card, each channel has a gain-set switch labeled GAIN 1 (SW1) to GAIN 4 (SW4) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the card. The value of the gain resistor is determined by the formula:

$$R_{\text{GAIN}} = [40,000 / (\text{Gain} - 1)] - 80 \, \Omega$$

Gain Values	Gain Switch
0 $\times 1$	
1 $\times 10$	
2 $\times 100$	
3 $\times 200$	
4 $\times 500$	

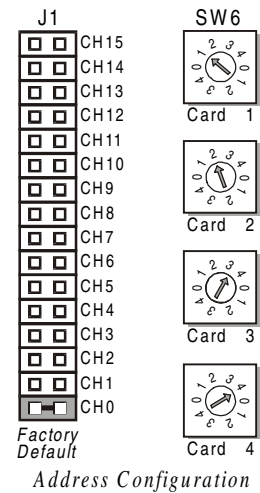
Setting Channel Gains

Address Configuration

Up to 4 DBK18s can be connected to each LogBook analog channel. Since this is a daisy-chain interface, each card must have a unique address (channel number and card number).

To configure the card, locate the 16 × 2-pin header labeled JP1 near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card. Four cards in the daisy-chain can have the same channel number as long as each card number is unique.

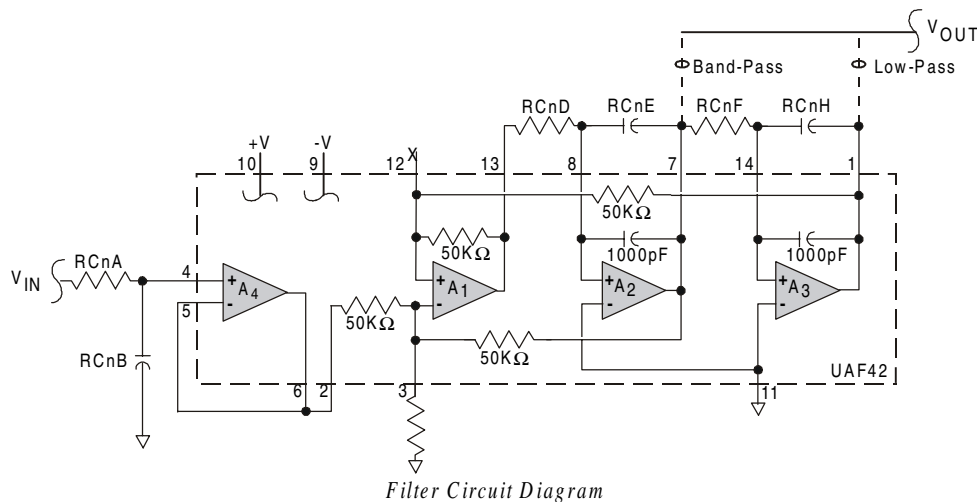
Set switch SW6 for each of the 4 DBK18s on a single channel. Verify that only one card in a system is set to a particular channel and card number.



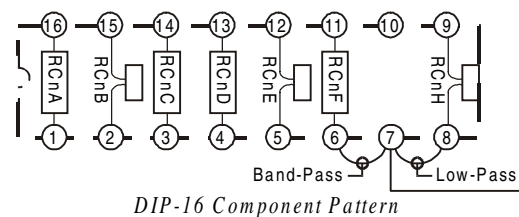
Configuring DBK18 Filter Sections

There are 4 low-pass, 3-pole active filters on the DBK18. Each filter can be enabled (EN) or bypassed (BY) by placement of the jumper on J3 for channel 0, J4 for channel 1, J5 for channel 2, 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 circuit diagram shows the active filter IC in a typical section of the DBK18. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is the channel number; and the 4th character corresponds to the socket position (A-H).



The figure shows the DIP-16 component pattern typical of the 4 filter sections. A machined-pin IC socket in each filter RC location can accept resistors and capacitors that plug directly into the socket. A better approach is to install these components on plug-in headers. This allows solder connections to the components and gold-to-gold, plug-in connections between the header and the sockets. **Note:** no part or “n” means open circuit.



Pin 7 of the DIP-16 socket:

- connects to pin 8 for low-pass filtering
- connects to pin 6 for band-pass filtering

The next table lists values of components for common corner frequencies in Butterworth filters. If you wish to design your own filter, software from Burr-Brown provides the component values to create the desired filter. (The design math is outside 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	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	none	none	3.16 MΩ	none	3.16 MΩ	none	none
100*	1.58 MΩ	none	none	1.58 MΩ	none	1.58 MΩ	none	none
200	787 KΩ	none	none	787 KΩ	none	787 KΩ	none	none
500*	316 KΩ	none	none	316 KΩ	none	316 KΩ	none	none
1000*	158 KΩ	none	none	158 KΩ	none	158 KΩ	none	none
2000	78.7 KΩ	none	none	78.7 KΩ	none	78.7 KΩ	none	none
5000	31.6 KΩ	none	none	31.6 KΩ	none	31.6 KΩ	none	none
10000	15.8 KΩ	none	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.

DBK18 - Specifications

Name/Function: Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors

Output Connector: DB37 male,
connects to P1 with a CA-37-x cable

Number of Cards Addressable: 64

Input Type: Differential

Voltage Input Ranges:

0 to ±5000 mVDC

0 to ±500 mVDC

0 to ±50 mVDC

0 to ±25 mVDC

0 to ±10 mVDC

Input Amplifier Slew Rate: 12 V/μs minimum

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

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} 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

Gain vs Temperature:

×1 @ ±20 ppm/°C

×10 @ ±20 ppm/°C

×100 @ ±40 ppm/°C

×200 @ ±60 ppm/°C

×500 @ ±100 ppm/°C

Non-Linearity:

×1 to ±0.015 % full-scale

×10 to ±0.015 % full-scale

×100 to ±0.025 % full-scale

×200 to ±0.025 % full-scale

×500 to ±0.045 % full-scale

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 20 kHz

The frequency is set by installation of 4-6 resistors and/or capacitors in sockets.

Default Frequency: 1 Hz

Other frequencies may be implemented by soldering resistors and/or capacitors to locations on the 4 blank plug-in headers provided. Values for common frequencies and their component values are provided with the blank headers.

DBK19 Thermocouple Card

Overview

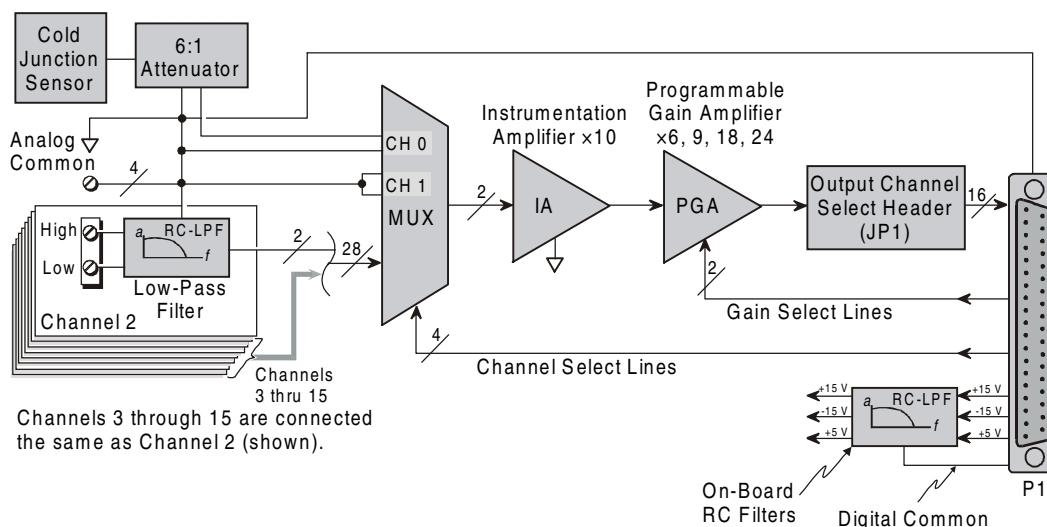
The DBK19 can attach to 14 thermocouples (T/C) for temperature measurements. The DBK19 features an on-board cold junction sensor and a programmable-gain amplifier for measuring type J, K, T, E, N28, N14, S, R, or B thermocouples. The table shows the temperature range for each thermocouple type.

T/C Type	J	K	T	E	N28	N14	S	R	B
Temperature Range °C	-200 to 760	-200 to 1260	-200 to 400	-270 to 1000	-270 to 400	0 to 1300	0 to 1780	0 to 1780	0 to 1820
Temperature Range °F	-328 to 1400	-328 to 2300	-328 to 752	-454 to 1832	-454 to 752	32 to 2372	32 to 3236	32 to 3236	32 to 3308

True differential measurements of thermocouples require a bias current referenced to analog common; therefore, resistors connect each input terminal to the analog common. Filter capacitors across each input operate with input protection resistors to form single-pole RC low-pass filters.

Each DBK19 includes a cold-junction compensation circuit wired to channel 0. Channels 2 through 15 accept external thermocouples. The DBK19s can be used with other analog expansion cards and feature screw terminals for direct connection. Up to 16 DBK19s can be attached to a single LogBook to measure up to 224 (16 × 14) temperatures.

Note: LogView software includes functions for the conversion and linearization of thermocouple readings into temperature data. Each DBK19 card is shipped with a calibration disk with constants used to correct gain and offset errors inherent in the hardware. This calibration is done automatically by LogView when the file, LOGBOOK.CAL, exists in the /LOGVIEW folder and is configured with the calibration constants for each card. See the DBK19 readme.txt file on the disk shipped with the board for details on creating this file.



DBK19 Block Diagram

Hardware Setup

Card Connection

Connect the T/C input wires to the proper terminal. The DBK19 uses screw terminals to connect different types of thermocouples as well as several analog ground access points. Connections are provided for 14 thermocouples.

Thermocouples have polarities that must be observed. Thermocouple types J, K, T, E, N28, N14, S, R and B can be connected to DBK19 channels CH2 through CH15.

- CH0 is reserved for the cold-junction compensation sensor (factory installed).
- CH1 is permanently shorted to common to allow software-driven auto-zero to compensate for temperature drift.

Thermocouple wire is standardized and color-coded as shown in the table. T/Cs have a very small output. Long T/C leads can pickup lots of noise. Use shielding as needed, and average several readings in software to minimize noise effects.

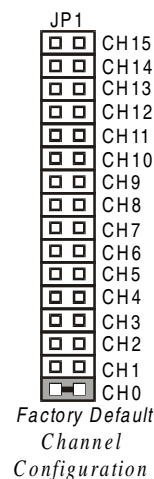
After all connections are in place, secure wires to captive areas (pre-drilled holes) at the rear edge of the board. Nylon tie wraps (not included) work well for this purpose.

T/C Type	(+) Lead to Channel-Hi	(-) Lead to Channel-Lo
J	White	Red
K	Yellow	Red
T	Blue	Red
E	Violet	Red
N28	Orange	Red
N14	Orange	Red
S	Black	Red
R	Black	Red
B	Gray	Red

Card Configuration

Assign a LogBook channel number to the DBK19 card. Up to 16 DBK19s can connect to a LogBook. (Optional DBK10 expansion card enclosure may be used.) Since this is a daisy-chain interface, each card must have a unique channel address.

To configure the card, locate the 16x2-pin header (labeled JP1) near the front of the board. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used on a single card; each card in the system must have a unique jumper setting.



DBK19 - Specifications

Name/Function: High-Accuracy Thermocouple Card

Connector: DB37 male mates with P1 pinouts. Thermocouples attach to on-board screw terminals.

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: x60, x90, x180, x240

Inputs:

- 14 differential thermocouples
- 1 cold-junction compensation
- 1 auto zero

Cold Junction Sensor Output: 100mV/°C

Voltage Ranges Gains:

- 0 to 80 mV @ x60
- 0 to 50 mV @ x90
- 0 to 25 mV @ x180
- 0 to 20 mV @ x240
- 0 to ±10 mVDC

Input Impedance: 20 KΩ

Input RC Filter: -3 dB Frequency: 15.9 kHz

Gain Accuracy:

Uncalibrated: 0.15%

Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Type/Range/Accuracy/Resolution: see table

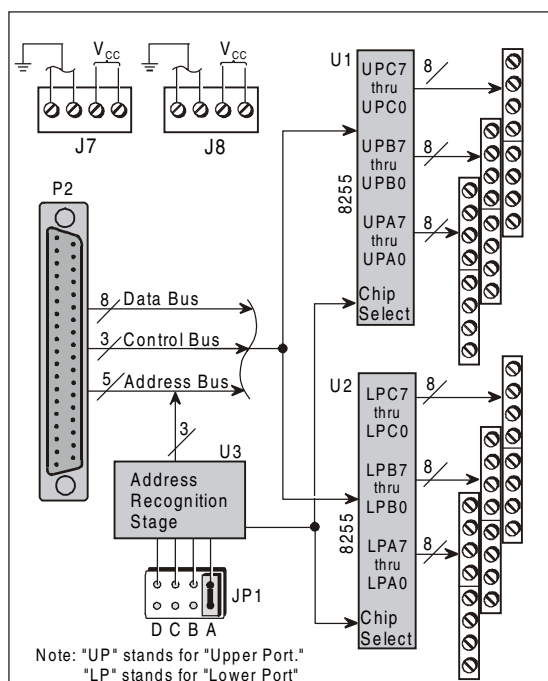
Type	Range		Accuracy		Resolution			
	Min	Max	(<0°C)	(>0°C)	12-bit <0°C	12-bit >0°C	16-bit <0°C	16-bit >0°C
J	-200°C	760°C	0.6°C	0.6°C	1.2°C	0.5°C	0.1°C	0.1°C
K	-200°C	1260°C	1.6°C	1.0°C	1.1°C	0.8°C	0.1°C	0.1°C
T	-200°C	400°C	1.4°C	0.8°C	0.8°C	0.3°C	0.1°C	0.1°C
E	-270°C	1000°C	1.4°C	0.9°C	1.6°C	0.7°C	0.1°C	0.1°C
N28	-270°C	400°C	0.8°C	0.8°C	1.0°C	1.0°C	0.1°C	0.1°C
N14	0°C	1300°C	—	1.0°C	—	5.0°C	—	5.0°C
S	0°C	1780°C	—	1.6°C	—	1.3°C	—	0.1°C
R	0°C	1780°C	—	1.6°C	—	1.7°C	—	0.1°C
B	0°C	1820°C	—	1.8°C	—	1.5°C	—	0.1°C

DBK20 & DBK21 Digital I/O Cards

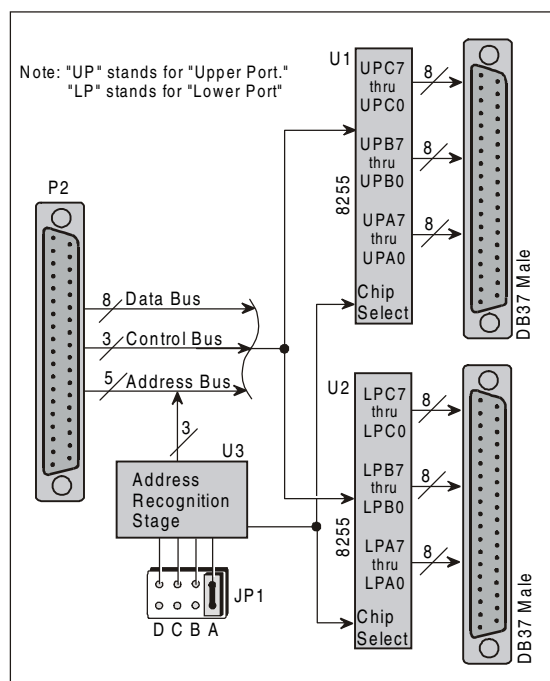
Overview

The DBK20 and DBK21 are general purpose digital I/O cards that can increase available digital I/O lines by 48 per card. The DBK20 uses screw terminals; the DBK21 uses DB37 connectors. Both cards connect to the P2 digital I/O port via the interface cable (CA-37-x).

Up to 4 DBK20s or DBK21s can be attached for a maximum of 192 lines (4x48). The local I/O lines cannot be used while expansion cards are attached. Thus, the first expansion card increases the number of usable digital I/O lines from 24 to 48, and subsequent cards each add 48 additional lines of programmable digital I/O.



DBK20 Block Diagram



DBK21 Block Diagram

Hardware Setup

Card Connection

1. Connect wire leads to terminal blocks (if using a DBK20) or ribbon cable(s) terminated in 37-pin female connectors (if using a DBK21).
2. Once all connections are in place, secure wires to the board at captive areas at the end of the card. Nylon tie wraps (not included) work well for this purpose.

Card Configuration

The header shunt must be set on the proper JP1 position for the intended address. The table shows the 4 choices available.

Note: In multiple card systems, only 1 card at a time can have any given setting.

Set JP1 header for the desired base address by placing the shunt jumper in one of the positions noted in the table (A to D). JP1 is labeled ADDRESS SELECT and is located at the card's lower left side.

Address Select	Bank
A	0
B	1
C	2
D	3

LogBook Connection

The DBK20 or DBK21s attach to the LogBook's P2 digital I/O connector.



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

1. If using the optional DBK10 enclosure, slide the DB37 end of the board into a rear opening, and secure with hold-in screw-washer at rear panel.
2. Connect an accessory ribbon cable (with -x indicating the number of cards to be connected) from the digital I/O port (P2) of the LogBook to the DB37 connector at the end of the option card.

Note: A series of interface cables is available for connection of up to four DBK20 or DBK21 option cards.

DBK20 - Specifications

Name/Function: General Purpose Digital I/O Card

Number of Channels: 48 I/O channels

Connector: Screw terminals

Device: 82C55 x 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 μ A

DBK21 - Specifications

Name/Function: General Purpose Digital I/O Card

Number of Channels: 48 I/O channels

Connector: DB37 male, corresponds to P2 pinout & to DigiBook
P1, P2, P3 pinouts

Device: 82C55 x 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 μ A

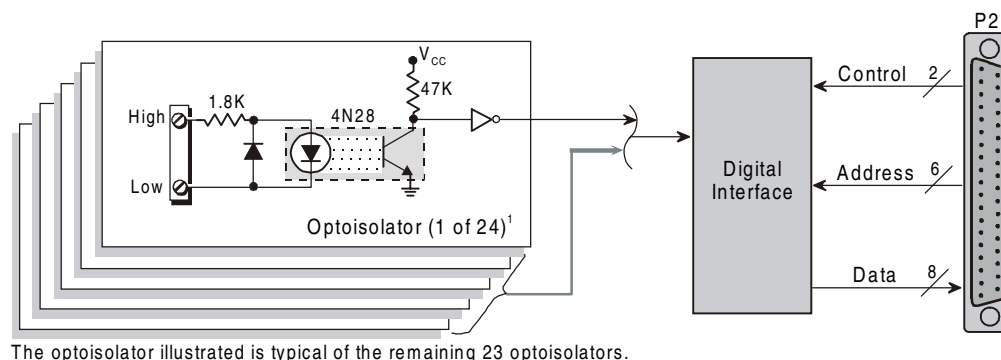
DBK23 Isolated Digital Input Chassis

Overview

The DBK23 is a 3-port by 8-bit digital input chassis that connects to the LogBook's P2 Digital I/O Port. The DBK23 provides 500 V isolation from the LogBook system and from channel-to-channel. Up to 8 DBK23s can attach to the LogBook, offering up to 192 bits of isolated digital input.

The DBK23 provides screw terminal access to each of its 24 isolated inputs. A slide-out PCB allows easy access to the controls and connectors. The input circuitry allows input voltages ranging from 0 to 30.0 V.

Note: The local digital I/O cannot be used while any DBK23s are attached.



DBK23 Block Diagram

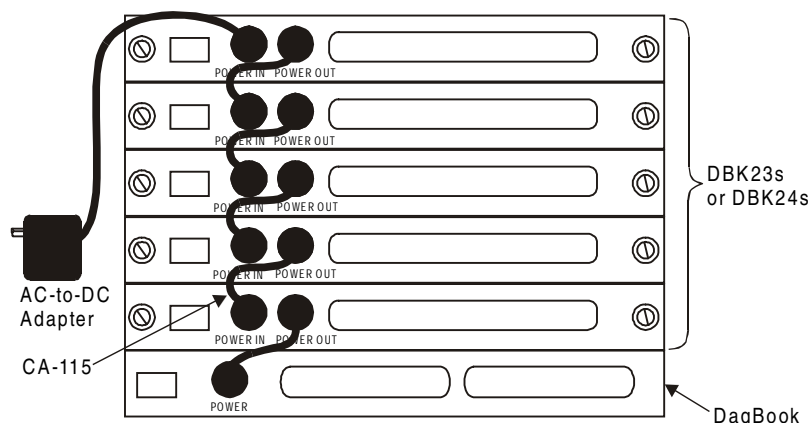
Power Requirements

The DBK23 can be powered by an included AC adapter, a standard 12-V car battery, or an optional rechargeable nickel-cadmium battery module (DBK30A). This power flexibility makes the DBK23 ideal for field and remote data acquisition applications.

Power supplied to the DBK23 powers the on-board regulator. Connect the power supply (AC adapter) to the 5-pin DIN (labeled POWER IN) located on the front panel of the DBK23 chassis. Note the two power indicators on the rear panel of the DBK23. Check that both SYSTEM and LOCAL power LEDs are on at all times during operation. The second 5-pin DIN connector (labeled POWER OUT) can be cascaded to another accessory. A single power source can supply multiple DBK23 units.

CAUTION

Excessive power consumption can cause equipment damage. Calculate system power requirements prior to daisy-chaining. Refer to chapter 2, *System Power*, as needed.

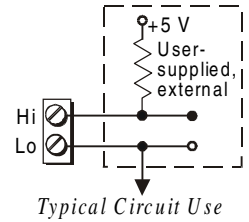


Daisy-Chaining Power to DBK23/24s

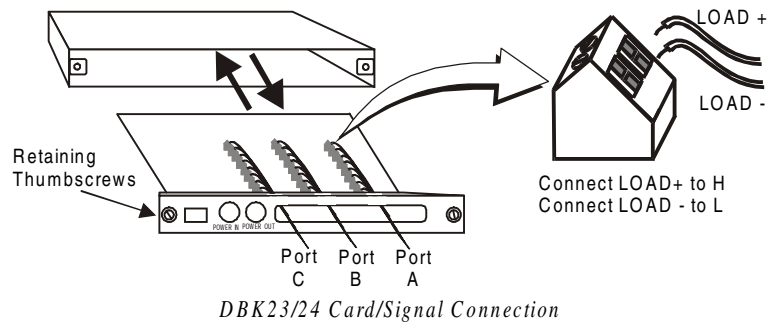
Hardware Setup

Card Connection

Open the DBK23 case by loosening the two retaining screws on the chassis front panel. Slide out the DBK23 board in order to connect wires to terminal blocks. Each input channel (or bit) is equipped with a discrete two-pole screw terminal block for isolated HI and LOW termination. The terminals accept 12 to 22 AWG wire. Insulated wire types selected should meet or exceed 500 V isolation specifications.



Strip insulation from the ends of wires (no more than 1/4"). Insert wire into the screw terminal receptacle so that only the bare portion of wire extends into the opening. Bare wire should not extend more than 1/16" beyond the receptacle. These steps are essential to maintaining proper voltage isolation. Once the wire ends are in place, turn the slot head screw at the top of the block until the receptacle grips the wire firmly. Do not over tighten. Captive holes have been placed in appropriate locations to secure groups of wires to the board. Nylon lock ties (not included) work well for this purpose.



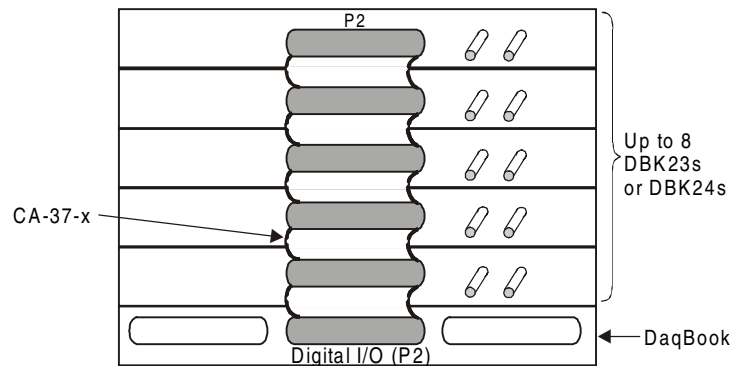
Card Configuration

The LogBook can support up to eight DBK23s in a daisy-chain configuration using an accessory cable (see figure). Each unit is then configured via the on-board DIP switch (S1) for its unique base address. No more than one unit in a common chain may have the same S1 setting. The table shows possible switch settings and addresses.

Bank	Card No.	S1 Configuration		
		C	B	A
0	0	0	0	0
	1	0	0	1
1	2	0	1	0
	3	0	1	1
2	4	1	0	0
	5	1	0	1
3	6	1	1	0
	7	1	1	1

LogBook Connection

Connect the P2 digital I/O port of the LogBook to the P2 connector of the DBK23 using an accessory cable. Select up to 8 positions for a total of 192 programmable isolated inputs.



Connecting Multiple DBK23/24s

DBK23 - Specifications

Name/Function: General Purpose Optically Isolated Digital Input Module

Channels: 24 I/O channels

Connector: Screw terminals for signal outputs

Input Voltage Levels:

Range: 3 to 30 VDC

Input Current: 1.5 to 15 mA

Operating Voltage Range: 9 to 24 VDC

Module Power Requirements: 0.25 W; AC adapter included

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

Channel Address: Set by DIP switch

DBK24 Isolated Digital Output Chassis

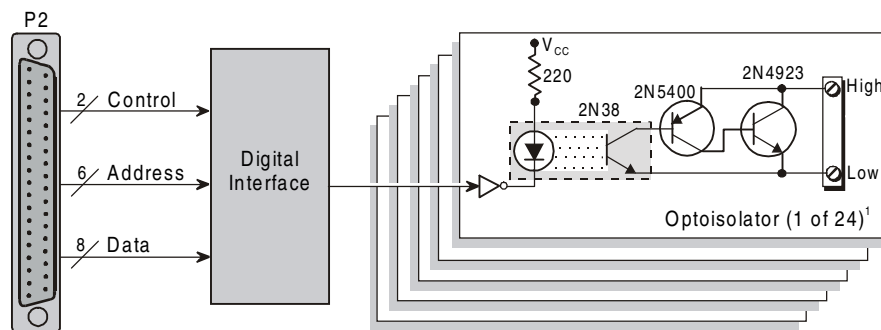
Overview

The DBK24 is a 3×8-channel digital output chassis that connects to the LogBook's P2 Digital I/O Port. The DBK24 provides 500 V isolation from the system and from channel-to-channel. Up to 8 DBK24s can attach to the LogBook, offering up to 192 bits of isolated digital output.

The DBK24 provides screw-terminal access to each of its 24 isolated outputs. A slide-out PCB allows easy access to the controls and connectors. The output circuitry allows output voltages as high as 60 V at currents up to 1 A.



The local digital I/O cannot be used while any DBK24s are attached.



The optoisolator illustrated is typical of the remaining 23 optoisolators.

DBK24 Block Diagram

Power Requirements

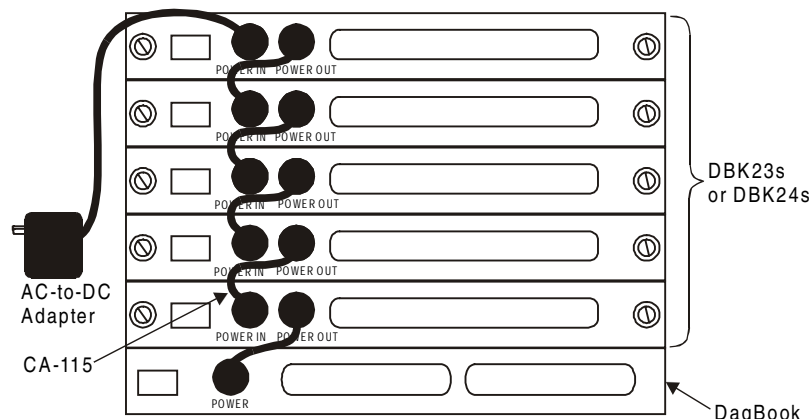
The DBK24 can be powered by an included AC adapter, a standard 12-V car battery, or an optional rechargeable nickel-cadmium battery module (DBK30A). This power flexibility makes the DBK24 ideal for field and remote data acquisition applications.

Power supplied to the DBK24 powers the on-board regulator. Connect the power supply (AC adapter) to the 5-pin DIN (labeled POWER IN) located on the front panel of the DBK24 chassis. Note the two power indicators on the rear panel of the DBK24. Check that both SYSTEM and LOCAL power LEDs are on at all times during operation. The second 5-pin DIN connector (labeled POWER OUT) can be cascaded to another accessory. A single power source can supply multiple DBK24 units.

CAUTION



Excessive power consumption can cause equipment damage. Calculate system power requirements prior to daisy-chaining. Refer to chapter 2, *System Power*, as needed.

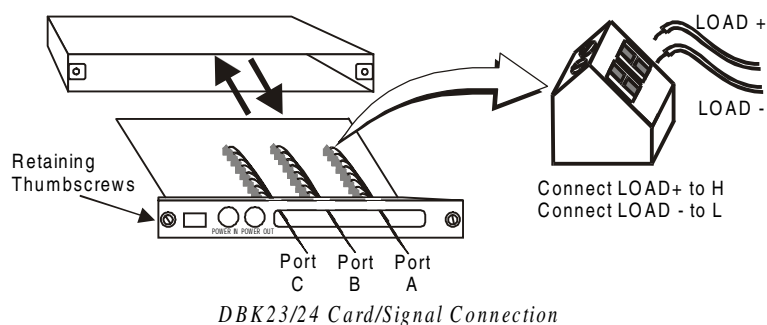
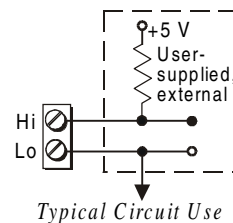


Daisy-Chaining Power to DBK23/24s

Hardware Setup

Card Connection

Open the DBK24 case by loosening the two retaining screws on the chassis front panel. Slide out the DBK24 board in order to connect wires to terminal blocks. Each input channel (or bit) is equipped with a discrete two-pole screw terminal block for isolated HI and LOW termination. The terminals accept 12 to 22 AWG wire. Insulated wire types selected should meet or exceed 500 V isolation specifications.

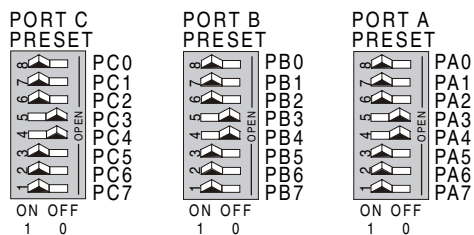


Strip some insulation from the ends of the wires (no more than 1/4"). Insert wire into the screw terminal receptacle so that only the bare portion of wire extends into the opening. Bare wire should not extend more than 1/16" beyond the receptacle. These steps are essential to maintaining proper voltage isolation. After the wire ends are in place, turn the slot-head screw at the top of the block until the receptacle grips the wire firmly. Do not over tighten. Captive holes have been placed in appropriate locations to secure groups of wires to the board. Nylon lock ties (not included) work well for this purpose.

Card Configuration

Presetting the Outputs

Each of the 24 outputs of the DBK24 can be configured to be ON or OFF at system power-on time. Each port has an 8-pole DIP switch. Before applying power to the LogBook or the DBK24, locate the DIP switch for the bit you wish to preset. Move the switch to the desired state for the output when powered on. First power on the DBK24, then the LogBook. All outputs will be operating in accordance with their corresponding DIP switch as shown in the figure. **Note:** The first write command received by the DBK24 will override the switch settings until the unit is again power-cycled. Subsequently, until the first write command is received, the switches may also be used to control the outputs.



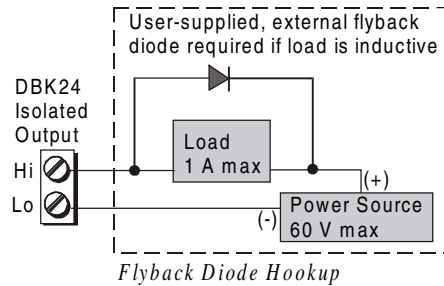
Setting DBK24 DIP Switches

User Output Configuration

The outputs of the DBK24 are designed to switch levels as high as 60 V at 1 A. The next figure shows a typical output hookup with a protective flyback diode in parallel with the load. When driving inductive loads without built-in flyback protection, you must provide this diode.

CAUTION

Failure to provide adequate flyback protection may result in damage to DBK24's output stage.

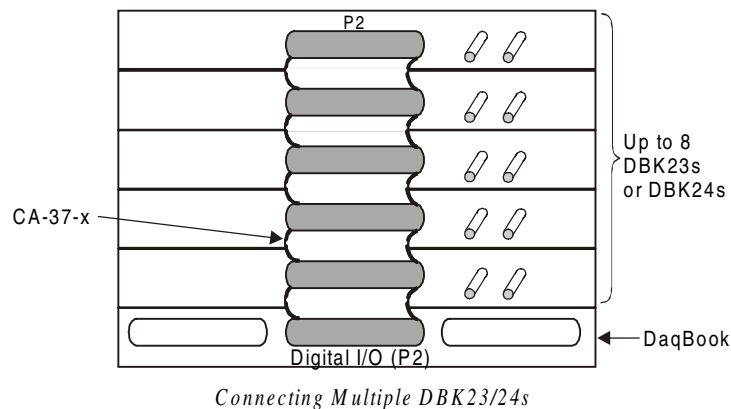


Each unit is then configured via the on-board DIP switch (S1) for its unique base address. No more than one unit in a common chain may have the same S1 setting. Below is a table of possible switch settings.

Bank	Card No.	S1 Configuration		
		C	B	A
0	0	0	0	0
	1	0	0	1
1	2	0	1	0
	3	0	1	1
2	4	1	0	0
	5	1	0	1
3	6	1	1	0
	7	1	1	1

LogBook Connection

Connect the P2 digital I/O port of the LogBook to the P2 connector of the DBK24 using an accessory cable (with -x indicating the number of expansion units to be connected). Select up to 8 positions for a total of 192 programmable isolated inputs.



DBK24 - Specifications

Name/Function: General Purpose Optically Isolated Digital Output Module

Channels: 24 I/O channels

Connector: Screw terminals for signal outputs

Output Channel Ratings:

Maximum current/channel: 1 A

Voltage drop @ 1 A and 25°C: 1 V

Maximum open circuit voltage: 60 VDC

Off-state leakage: 10 μ A

Module Power Requirements: 1.5 W

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

Channel Address: Set by DIP switch

Maximum Module Power Dissipation:

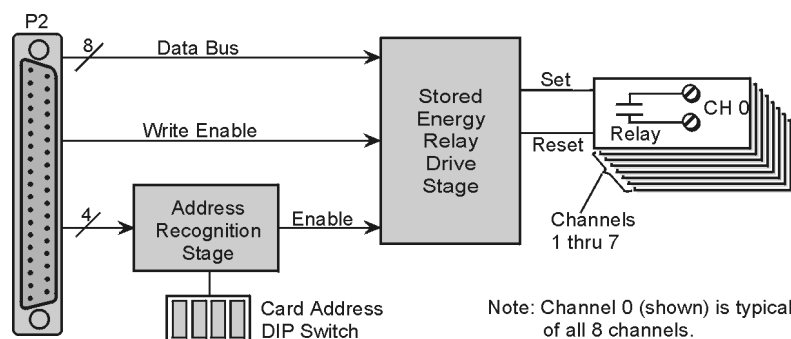
@ 25°C 12 W

@ 50°C 6 W

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Overview

DBK25 provides 8 normally-open relay contacts for isolated switching of AC or DC loads or signals via the LogBook's P2 digital port or via the Daq device's or adapter's P2 digital port. The P2 port operating in the expanded-I/O mode can address up to 32 DBK25s (256 relays max). The DigiBook/72 with 3 P2 ports can address 96 DBK25s for up to 768 relay contacts. The relays are 2-coil sub-miniature latching relays and do not require continuous current to stay closed. Such bi-stable relays can act as an 8-bit non-volatile write-only memory byte.



DBK25 Block Diagram

The steady-state power drain of the DBK25 is very low, less than 1 mA at 5 VDC. It is practical, even operating on a battery, to have hundreds of relay contacts. The stored-energy operation of the DBK25 does limit the practical on/off speed (or the ability to generate 50% duty cycles) to about 10 Hz. The relay's operating time is less than 15 ms.

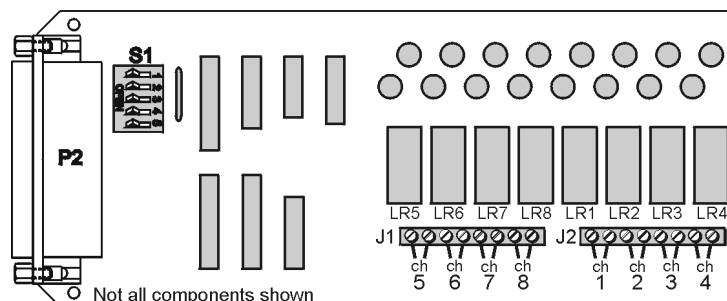
Hardware Setup

Card Connection

There are 16 screw terminals on the DBK25 to connect to 8 separate pairs of output contacts:

- J1 for channels 5 through 8
- J2 for channels 1 through 4

The board contains holes for use of wire ties.



DBK25 Board Layout

Card Configuration

You must set DIP switch S1 to a 5-bit address to correspond to the desired card address. (S1 is located next to the DB37 connector.) The following table lists the switch settings for 32 system card numbers. The XI/O addresses can be used in custom programming to access specific cards.

System Card #	XI/O Address	S1 Position OPEN = OFF					System Card #	XI/O Address	S1 Position OPEN = OFF				
		1	2	3	4	5			1	2	3	4	5
0	H60	OFF	OFF	OFF	OFF	OFF	16	H70	OFF	OFF	OFF	OFF	ON
1	H61	ON	OFF	OFF	OFF	OFF	17	H71	ON	OFF	OFF	OFF	ON
2	H62	OFF	ON	OFF	OFF	OFF	18	H72	OFF	ON	OFF	OFF	ON
3	H63	ON	ON	OFF	OFF	OFF	19	H73	ON	ON	OFF	OFF	ON
4	H64	OFF	OFF	ON	OFF	OFF	20	H74	OFF	OFF	ON	OFF	ON
5	H65	ON	OFF	ON	OFF	OFF	21	H75	ON	OFF	ON	OFF	ON
6	H66	OFF	ON	ON	OFF	OFF	22	H76	OFF	ON	ON	OFF	ON
7	H67	ON	ON	ON	OFF	OFF	23	H77	ON	ON	ON	OFF	ON
8	H68	OFF	OFF	OFF	ON	OFF	24	H78	OFF	OFF	OFF	ON	ON
9	H69	ON	OFF	OFF	ON	OFF	25	H79	ON	OFF	OFF	ON	ON
10	H6A	OFF	ON	OFF	ON	OFF	26	H7A	OFF	ON	OFF	ON	ON
11	H6B	ON	ON	OFF	ON	OFF	27	H7B	ON	ON	OFF	ON	ON
12	H6C	OFF	OFF	ON	ON	OFF	28	H7C	OFF	OFF	ON	ON	ON
13	H6D	ON	OFF	ON	ON	OFF	29	H7D	ON	OFF	ON	ON	ON
14	H6E	OFF	ON	ON	ON	OFF	30	H7E	OFF	ON	ON	ON	ON
15	H6F	ON	ON	ON	ON	OFF	31	H7F	ON	ON	ON	ON	ON

The full-page table on the following page shows all possible relay settings and their associated binary and hex values.

DBK25, pg. 3

DBK25 – Specifications

Name/Function: 8-Channel Relay Output Card

Connectors: Screw terminals for signal outputs

Max Number of Cards: 32

Contact Rating:

2 A @ 28 VDC; 0.6 A @ 120 VAC

Isolation:

Channel-to-System: 250 V

Channel-to-Channel: 150 V

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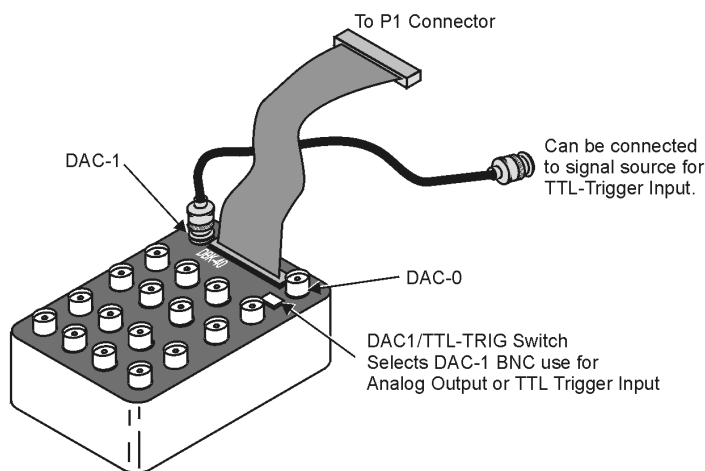
Overview

The DBK40 is a termination panel consisting of 18 BNC connectors. The unit provides an easy means of attaching analog signals from BNC cables to a DB-37 connector, such as P1 on a LogBook, a Daq device, or a DBK module.

The panel includes:

- 16 analog input channels
- 2 analog output channels (DAC-0 and DAC-1)
- a slide switch (DAC1/TTL-TRIG Switch)
- a male DB37 connector

The DAC1/TTL-TRIG Switch is used to select the mode of the DAC-1 BNC connector. DAC-1 can be used as an analog output channel, or as a TTL Trigger Input.



DBK40

Hardware Setup

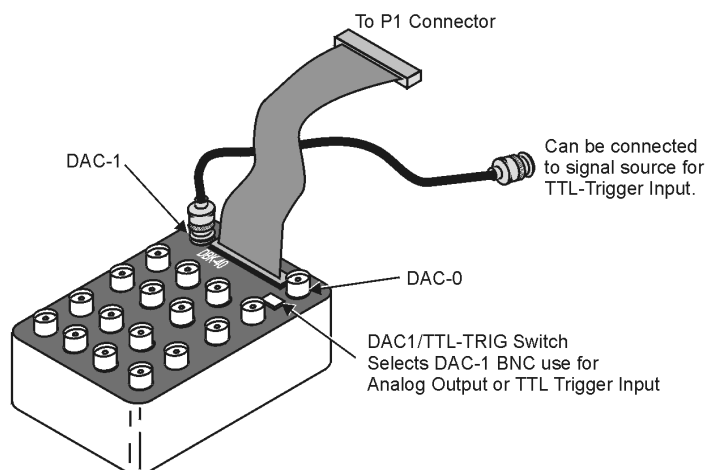
The DBK40 has a male DB37 connector that is pin-compatible with the P1 port. Typically a 6-foot ribbon cable is provided to attach the DBK40 to the P1 connector of the primary acquisition device, e.g., a LogBook or DaqBook.

CAUTION



Connecting the DBK40 to a port other than P1 may result in damage to the system.

Connect one end of the ribbon cable to the DB37 connector of the DBK40 and the cable's other end to the Analog I/O Port (P1) of the primary data acquisition device.



Using the DBK40

The DBK40 is equipped with BNC connectors for 16 single-ended or 8 differential inputs. Also provided are BNC terminals for DAC0 and DAC1 analog outputs.

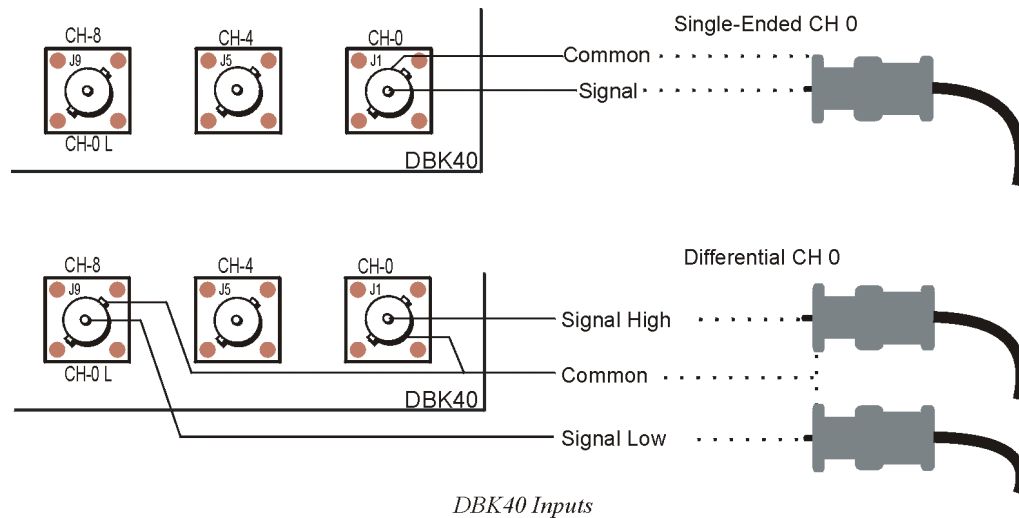
The DAC-1 connector may be used for access to the LogBook or Daq Device Analog I/O TTL trigger input. The position of the DBK40 slide switch determines the use of DAC-1, as indicated in the following table. Verify that this switch is in the correct position for your application.

Switch Setting	Description
TTL/TRIG	Allows the connector to be used for TTL trigger input.
DAC-1	Allows the connector to be used DAC-1 output.

The collars of all of the BNC connectors are common to each other and analog ground. When the TTL trigger input is selected (via the slide switch), the isolated ground plane of the TTL-TRG/DAC1 connector is referenced to digital or TTL ground. Most of the top area of the DBK40's PC board is ground plane that provides excellent low-impedance, low-noise signal interfacing.

Connect your analog signals to the unit as you would to any other BNC connector. The outer shell is ground; the center pin is the signal.

The figure below shows connections for single-ended and differential inputs. In the differential mode, channels 0 to 7 are high; 8 to 15 are low (0 & 8, 1 & 9, 2 & 10, etc).



DBK40 - Specifications

Name/Function: BNC Analog Interface Module

Connection: Male DB37 mates with P1.

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

Single-Ended Mode: Center conductor carries signal, outer conductor carries signal ground.

Differential Mode: Center conductor of two adjacent BNC connectors carries high and low input signals; the outer conductors of both are attached to system ground.

Analog Output Connection: One BNC connector for each of 2 analog output channels; center conductor carries signal, outer conductor carries signal ground.

TTL Trigger Input Connection: One analog output BNC connector can be switched to provide a TTL trigger input connection; in TTL mode, the second analog output channel is unavailable on the BNC connector.

Size: 6.8" wide x 5.3" long x 2.3" high

Weight: 21 oz

Length of Supplied Cable: 6 ft



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Overview

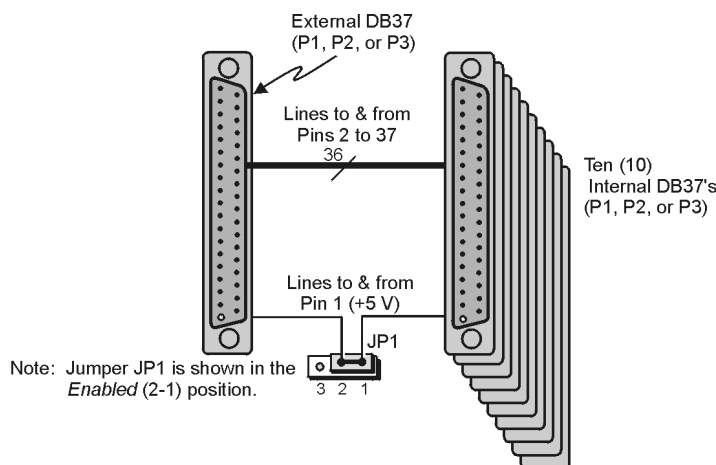
The DBK41 is a metal enclosure that holds up to 10 DBK cards. The exterior front panel has a male DB37 connector that leads to the LogBook or Daq device or further expansion via a CA-37-x cable. On the inside of the front panel, a backplane printed circuit board (PCB) uses 10 female DB37s with their pins connected in parallel to distribute the P1 interface (can also be used with P2 or P3). From the rear panel, the DBKs' signal input lines exit to their respective transducers.

An optional EMI kit provides shield plates for the rear panel to make the DBK41 CE-compliant and prevent EMI from DBKs entering the test environment (or vice-versa). The EMI kit also functions as an electrical safety barrier.

Some DBK cards require a lot of power, in relation to other cards, and the use of power is an important concern. DBK cards can obtain power externally from a LogBook, DaqBook, DaqBoard; or internally from a DBK32A or DBK33 card. (See chapter 2, [Power Management](#) and the power card modules)



A power card in any slot (other than the slot leftmost from rear view) will power the other cards via the backplane. A front panel LED will light whenever power from any source is on the backplane. DBK41's JP1 jumper can be positioned to disable the +5 V power line from the external DB37. This prevents a DBK33 power supply from interfering with other devices.



DBK41 Block Diagram

Hardware Setup

Setup concerns include card and power configuration, proper card insertion, the use of [EMI shields](#) for CE compliance, and mounting [or stacking] of hardware components.

In regard to mounting: metal splice plates can be used to rigidly mount a LogBook or DaqBook on top of a DBK41 or other device that shares the same footprint. For applications in which temporary mounting is convenient: a LogBook, DaqBook or notebook PC can be temporarily mounted to a DBK41 with the use of industrial-strength *dual-lock* pads or strips.

Card Configuration

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

Power Configuration

Power must be configured to prevent multiple power supplies from interfering with each other via the P1 interface. DBK41, LogBook/360, DaqBook, and ISA-type DaqBoards each have JP1 jumpers that must be properly configured in regard to power. Details for each follow.

JP1 in the DBK41

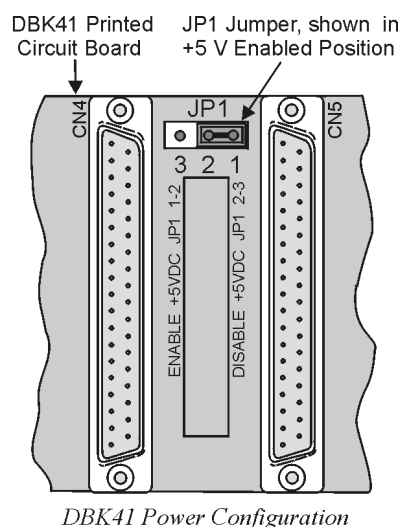
On the DBK41 backplane, JP1 is a 3-pin jumper positioned between DB37 connectors for card number 4 (CN4) and card number 5 (CN5). Two settings are possible, as follows:

ENABLE +5 VDC JP1 1-2

When JP1 pins 1 and 2 are jumpered, the +5 VDC line to the external P1 connector is enabled. The 5 V (VCC) is externally supplied to pin 1 for cards 1 through 10 (CN1 through CN10). The +5 VDC power can come from a LogBook, DaqBook, or DaqBoard through a CA-37-x cable on pin 1 of P1. If not using a DBK33, JP1 should be enabled.

DISABLE +5 VDC JP1 2-3

When JP1 pins 2 and 3 are jumpered, the +5 VDC line to the external P1 connector is disabled. When using a DBK33 power card in the DBK41, the JP1 jumper must be set on pin 2 and 3. The JP1 2-3 setting prevents the DBK33's +5 V from interfering with external devices via the P1 interface.

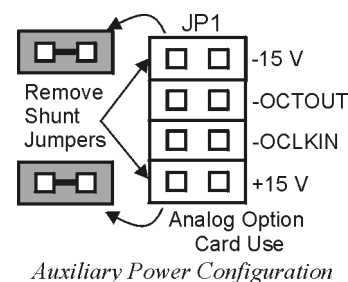


JP1 in the DaqBook and DaqBoard [ISA type]

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

If a DBK32A or DBK33 is used, you must remove the shunt jumpers from the JP1 header located inside the DaqBook or DaqBoard [ISA type]. DaqBooks and DaqBoards [ISA type] are shipped with these shunts positioned to deliver ± 15 V analog power to P1.

Note: The jumpers can be placed on the -OCTOUT and -OCLKIN pins but should be removed if there is interference with card operation (counter-timer).



JP1 and JP2 in LogBook/360

Proper jumper configuration limits LogBook/360's P1 bus to one power source. There should never be more than one power source. The jumpers are located inside the chassis, on the unit's *P1 Interconnect Board*.

JP1. Only remove LogBook/360's JP1 jumper if a DBK33 is used with the system.

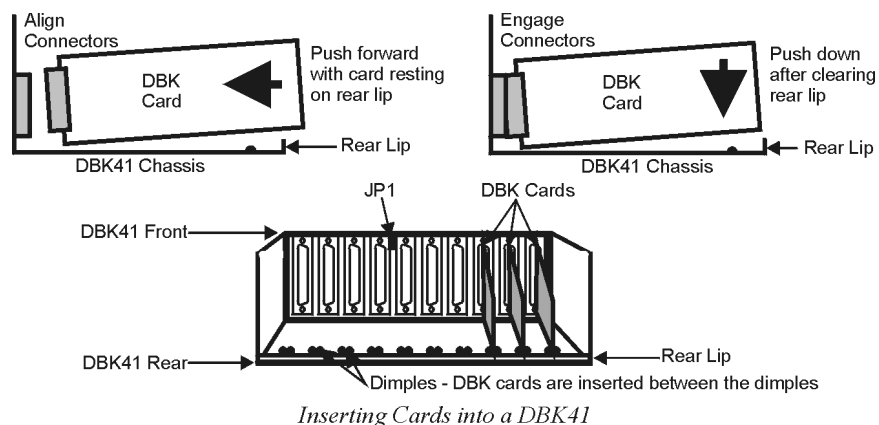
JP2. Only remove the LogBook/360's JP2 jumper if DBK cards are to be powered from LogBook/360's internal PCB.

Card Insertion

Each DBK card has a DB37 male connector which mates with the DB37 female connectors inside the DBK41 chassis. To insert DBK cards into the DBK41 chassis, refer to the figure and perform the following steps.

Note: Cards using screw-connectors for signal input lines must be wired before insertion.

1. Disconnect power from all units to be connected.
2. Place the DBK41 on a flat surface; loosen the two thumbscrews on rear of the case; and remove the top cover by sliding it off.
3. Align the DBK card with the DBK41 connector to be used (CN1 to CN10). The first slot must always be occupied; however, a DBK32A or DBK33 power card may not occupy the first slot. Any of the remaining 9 slots can be used or unused.
4. To clear the lip on the rear panel, tilt the rear of the card upward. Engage the P1 connectors of the card and chassis, and press together gently to avoid damage to the pins.
5. Press down the rear of the card, aligning it within the metal dimples at the rear of the DBK41.
6. After cards are in place, reassemble the DBK41's top cover and attach optional shield plates (described next); then re-connect and power up the system.



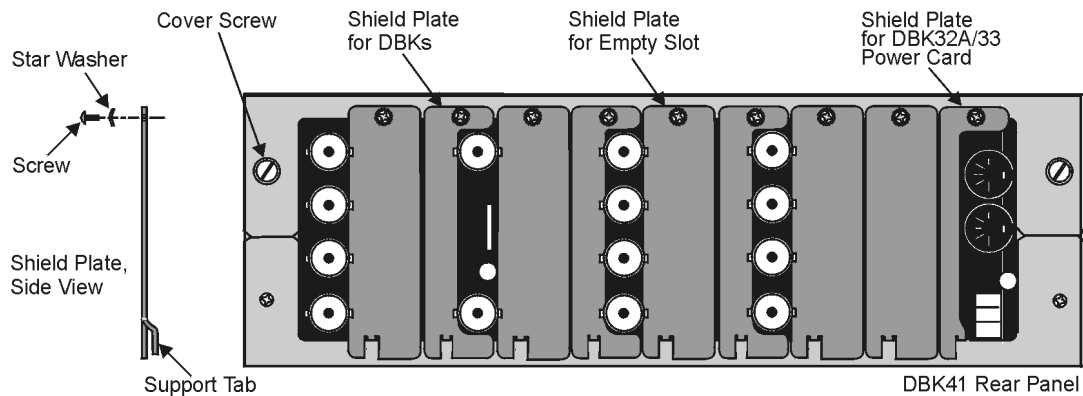
EMI Shield Plates for CE Compliance

To reduce electro-magnetic interference (EMI) escaping from (or entering into) the enclosure, a CE kit provides shield plates that attach to the rear of the DBK41. The kit also functions as an electrical safety barrier. With shield plates attached (a combination of 3 types supplied), the system meets CE standards. The kit includes:

- Full shield plates to cover empty (unused) slots
- Partial shield plates to surround DBKs in a slot (except a power card)
- Partial shield plates to surround a DBK32A or DBK33 power card
- Screws and star washers to secure the shields to the chassis

Note: The CE kit is included with the DBK41/CE and an optional accessory for a DBK41.

The shields have a support tab that slides over the edge of the bottom plate and a screw hole for attachment to the top plate. When tightened, the screws cause the washers to pierce the surface coating into the metal to make a good contact with chassis ground.

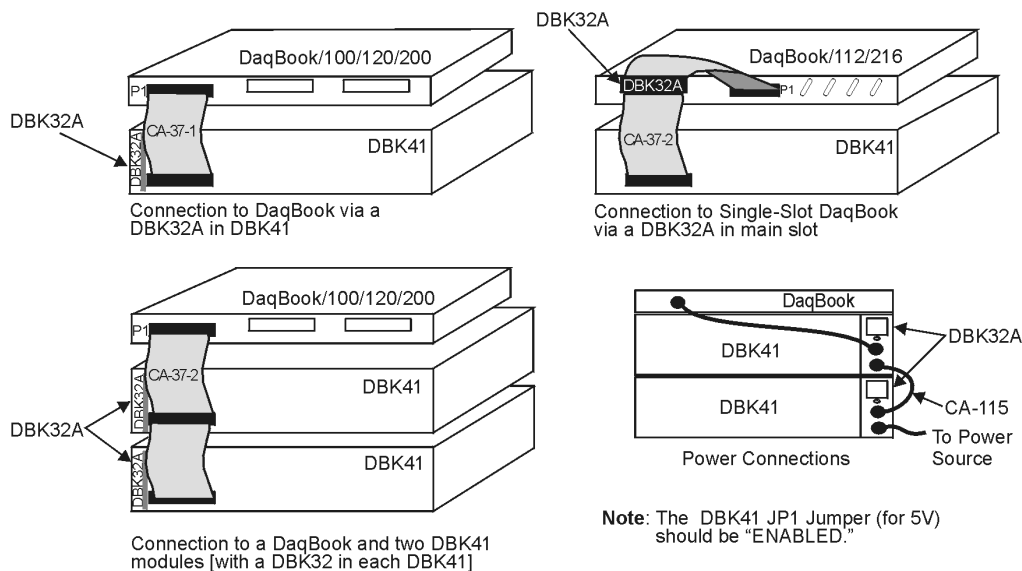


EMI Shield Plates on DBK41 Rear Panel

System Connection

A short ribbon cable (CA-37-x) attaches the DBK41 to the main unit. Connecting the DBK41 to any port other than P1 may damage devices in the system. Likewise, only analog expansion cards may be installed in the DBK41.

Note: For CE compliance, the CA-37-x cable must be replaced with a CA-143-7 or CA-143-18. Multiple chassis require a “T” connector (part # CN-143) for branching.



Examples of DBK41 Connections [with DBK32A] and Cascading Power

DBK41 - Specifications

Name/Function: 10-Slot Analog Expansion Module

Card Capacity: 10 slots to hold standard DBK option cards

Weight: 4 lb (with no cards installed)

Cable (optional): 8" ribbon with DB37 female to DB37 female (CA-37-x)

Power Indicator: LED powered by external device's 5 VDC

Connection: Male DB37, mates via CA-37-x cable with P1



Overview 1**Hardware Setup 2**

DBK42 Connection 2

DBK42 Configuration 2

5B Module Connection 2

Power Considerations 3

Terminal Block Connections 3

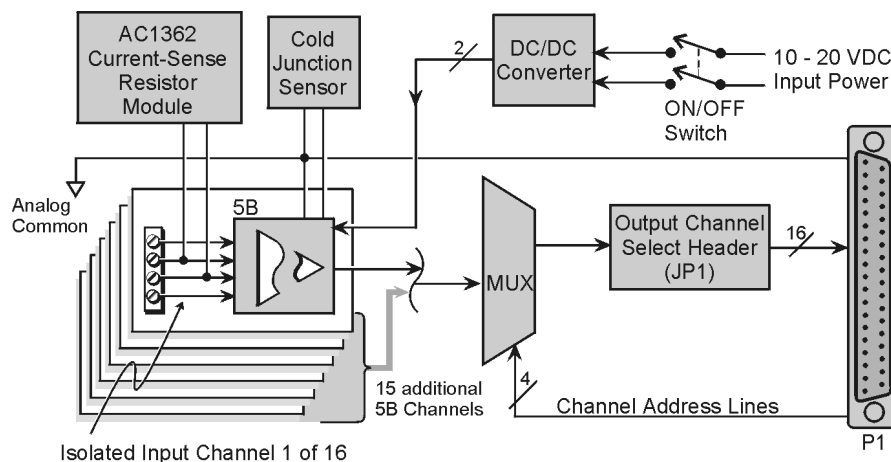
mx+b Values for 5B Modules 5**DBK42 – Specifications 6**

Overview

The DBK42 allows LogBook or Daq device systems to work with up to 16 5B signal conditioning modules. Modules are available for various signal types (e.g., low-level thermocouple signals, strain-gage signals, etc). The DBK42 offers 500 V isolation from the system and between channels. The DBK42 is compatible with all 5B output modules, and the configuration is very flexible. You can select the type of signal attached to each channel.

An accessory cable connects the DBK42's output to the P1 analog input connector. One LogBook or Daq device can support up to 16 DBK42 units with a maximum of 256 isolated analog input channels. The LogBook or Daq device scans the DBK42 channels at the same 10 μ s/channel rate as other DBKs (256 scans in 2.56 ms in a full system).

The DBK42 can obtain power from an included AC adapter, an optional DBK30A rechargeable battery module, or directly from a 12 VDC source (such as a car battery). The built-in power supply can serve a fully-configured system using bridge excitation.

*DBK42 Block Diagram*

For DaqBoard/2000 Series applications, DBK42 is typically powered from an included AC adapter. The unit's built in power supply can serve a fully-configured system using bridge excitation.

Each terminal block contains 4 terminals (per channel) for access to input and excitation features of 5B modules.

The optional CN-71 and CN-72 signal connection blocks provide a convenient way of connecting analog signals to the DBK42.

- **The CN-71 is for non-thermocouple use.**
- **The CN-72 (with cold junction sensors) is for thermocouple use.** The CN-72 has a clear plastic shield over its screw terminals to protect you from high voltage on the input terminals.

Hardware Setup

DBK42 Connection

The DBK42 has screw-terminal connectors for easy access to the analog inputs. 2-wire and 4-wire hookups are shown later in this section.

Note: Analog channels are isolated from each other, and no analog ground is provided.

DBK42 Configuration

Up to 16 DBK42s can connect to a LogBook or a Daq device. As a daisy-chain interface, each module must appear unique and use a different channel.

To configure the module, locate the 16x2-pin header (JP1) near the front of the DBK42 board. Note the 16 jumper locations labeled CH0 through CH15 representing the base Analog Input Channels. Place the jumper on the channel you wish to use.



Only one jumper is used on a single DBK42. No two cards in a system can use the same JP1 setting.

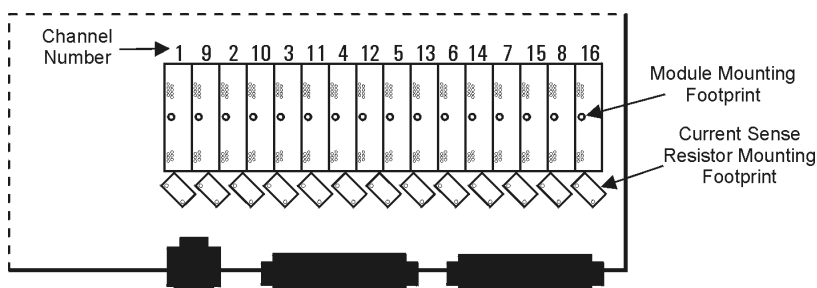
JP1	
<input type="checkbox"/>	CH15
<input type="checkbox"/>	CH14
<input type="checkbox"/>	CH13
<input type="checkbox"/>	CH12
<input type="checkbox"/>	CH11
<input type="checkbox"/>	CH10
<input type="checkbox"/>	CH9
<input type="checkbox"/>	CH8
<input type="checkbox"/>	CH7
<input type="checkbox"/>	CH6
<input type="checkbox"/>	CH5
<input type="checkbox"/>	CH4
<input type="checkbox"/>	CH3
<input type="checkbox"/>	CH2
<input type="checkbox"/>	CH1
<input checked="" type="checkbox"/>	CH0

*Factory Default
Channel
Configuration*

5B Module Connection

Each input of the DBK42 is processed through a user-installed 5B signal-conditioning module. Different 5B modules are used with different transducer and signal sources. To install the modules:

1. Match the footprint of the module with the footprint on the circuit board (see figure).
2. Gently place the module into the footprint, and screw it down.
3. When installing current input modules (SC-5B32 series), install the supplied current-sense resistor (SC-AC-1362) in the resistor footprint adjacent to the module mounting footprint.
4. Record the module's channel number; label all units and connectors for identification.



Module Installation

Power Considerations

The DBK42 has an internal, isolated switching-type power supply that operates on 10-20 VDC at varying input currents depending on the input voltage and 5B-module loading. The power drain at a given output load is constant; input current will vary inversely with the input voltage.

A DBK42 populated with strain-gage modules will draw more current than with other types of input modules. The table shows the DC input requirements for the worst-case setup (with 16 strain-gage modules or 16 thermocouple modules).

Input Volts	With Strain-Gage Modules	With Thermocouple Modules
	Input Amperes	Input Amperes
10 VDC	3.0 A	0.60 A
11 VDC	2.7 A	0.54 A
12 VDC	2.4 A	0.48 A
13 VDC	2.2 A	0.44 A
14 VDC	2.0 A	0.40 A
15 VDC	1.9 A	0.38 A
16 VDC	1.8 A	0.36 A
17 VDC	1.7 A	0.34 A
18 VDC	1.6 A	0.32 A
19 VDC	1.5 A	0.30 A
20 VDC	1.4 A	0.28 A

Power sources include:

- The standard TR-25 AC plug-in power pack (provided with the DBK42) can supply 900 mA at 15 VDC. The optional TR-40U can supply 2700 mA at 15 VDC.
- The DBK30A battery pack can supply power for a typical DBK42 configuration; however, in a fully-populated strain-gage configuration, the battery run-time will be limited to about 1½ hours.
- A 12 V lead-acid gel-cell type battery can easily power a fully-populated strain-gage configuration. The battery drain will be about 2.4 A-hr; battery size should be considered for systems with long run-times. (For example, a common-size 5.0 A-hr battery will operate for about 2 hours). A typical automotive 12-V lead-acid battery (e.g., 60 A-hr) can easily power a DBK42 for long run-times (about 24 hours).

The input fuse is a 4-A Slo-Blo 1-1/4" × 1/4" glass-type such as Littelfuse 313004 or Bussman MDL-4.

Terminal Block Connection

Input signals (and excitation leads) must be wired to the DBK42 signal termination panel. Sixteen 4-terminal blocks accept up to 16 inputs. These connectors are located on a removable PC board that plugs into two DIN96 rectangular connectors on the rear panel.

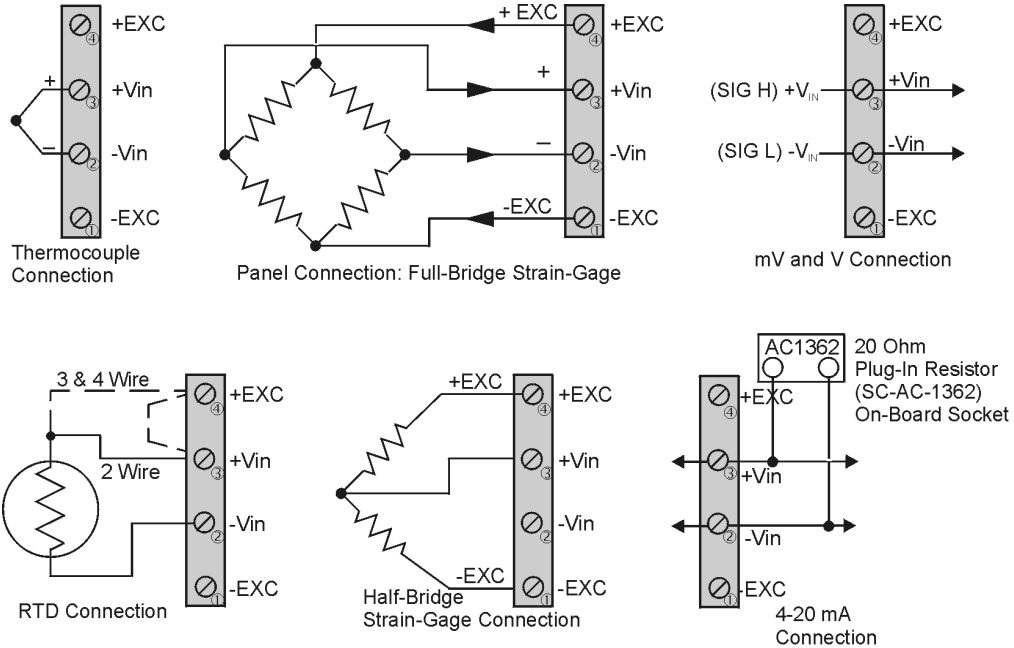
WARNING	
	Shock Hazard! The DBK42 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK42 before changing the wiring or configuration.

Terminal blocks are connected internally to their corresponding signal conditioning module. The terminal blocks accept up to 14-gage wire into quick-connect screw terminals. Terminals on each block are numbered 1 through 4. Each type of input signal or transducer (such as a thermocouple or strain gage) should be wired to its terminal block as shown in the figure. Wiring is shown for RTDs, thermocouples, 20 mA circuits, mV/V connections, and for full- and half-bridge strain gages.

WARNING



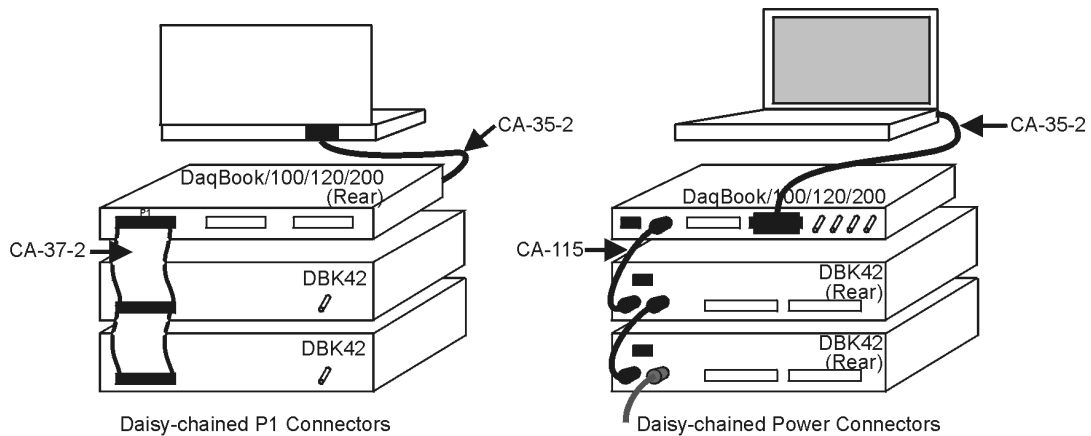
Shock Hazard! The DBK42 is designed to sense signals that may carry dangerous voltages. De-energize circuits connected to the DBK42 before changing the wiring or configuration.



DBK42 Terminal Connections

P1 Connection. The DBK42 attaches to the P1 analog I/O connector or to a DBK200 series P4-Adapter's P1 analog I/O connector. (Up to 16 units can be attached to one LogBook or Daq device.) Connect the appropriate ribbon cable (with -x indicating the number of cards to be connected) from the LogBook's, Daq device's, or adapter's P1 port to the DB37 connector at the end of the option card.

Note: A series of interface cables are available for connecting up to sixteen DBK42s.



Daisy-Chaining DBK42s

$mx+b$ Values for 5B Modules

The $mx+b$ calculations for most 5B modules are included within LogView software. The table shows the m and b values for various 5B modules.

5B Module	m Value	b Value	Engineering Unit(s)
Isolated Voltage Input (5 V Current Requirement, 30 mA)			
SC-5B31-01	1/5	0	mV, V
SC-5B31-02	1	0	mV, V
SC-5B31-03	2	0	mV, V
SC-5B31-04	2/5	-1	mV, V
SC-5B31-05	2	-5	mV, V
SC-5B31-06	4	-10	mV, V
Isolated Wideband Voltage (5 V Current Requirement, 30mA)			
SC-5B41-01	1/5	0	V
SC-5B41-02	1	0	V
SC-5B41-03	2	0	V
SC-5B41-04	2/5	-1	V
SC-5B41-05	2	-5	V
SC-5B41-06	4	-10	V
Isolated Millivolt Input (5 V Current Requirement, 30 mA)			
SC-5B30-01	2	0	mV
SC-5B30-02	10	0	mV
SC-5B30-03	20	0	mV
SC-5B30-04	4	-10	mV
SC-5B30-05	20	-50	mV
SC-5B30-06	40	-100	mV
Isolated Wideband Millivolt (5 V Current Requirement, 30 mA)			
SC-5B40-01	2	0	mV
SC-5B40-02	10	0	mV
SC-5B40-03	20	0	mV
SC-5B40-04	4	-10	mV
SC-5B40-05	20	-50	mV
SC-5B40-06	40	-100	mV
Isolated Linearized T/C Input (5 V Current Requirement, 30 mA)			
SC-5B47-J-01	152	0	°C
SC-5B47-J-02	80	-100	°C
SC-5B47-J-03	100	0	°C
SC-5B47-K-04	200	0	°C
SC-5B47-K-05	100	0	°C
SC-5B47-T-06	100	-100	°C
SC-5B47-T-07	40	0	°C
SC-5B47-E-08	200	0	°C
SC-5B47-R-09	250	+500	°C
SC-5B47-S-10	250	+500	°C
SC-5B47-S-11	260	+500	°C
Isolated RTD Input (5 V Current Requirement, 30 mA)			
SC-5B34-01	40	-100	°C
SC-5B34-02	20	0	°C
SC-5B34-03	40	0	°C
SC-5B34-04	120	0	°C
SC-5B34-C-01	24	0	°C
SC-5B34-C-02	24	0	°C
SC-5B34-N-01	24	0	°C
Isolated Current Input (5 V Current Requirement, 30 mA)			
SC-5B32-01	3.2	4	mA
SC-5B32-02	4	0	mA
Voltage Switch Input			
SC-AC-1367	1	0	V

DBK42 – Specifications

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

Module Capacity: 16 (input only) 5B modules

Size: 8.5" × 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

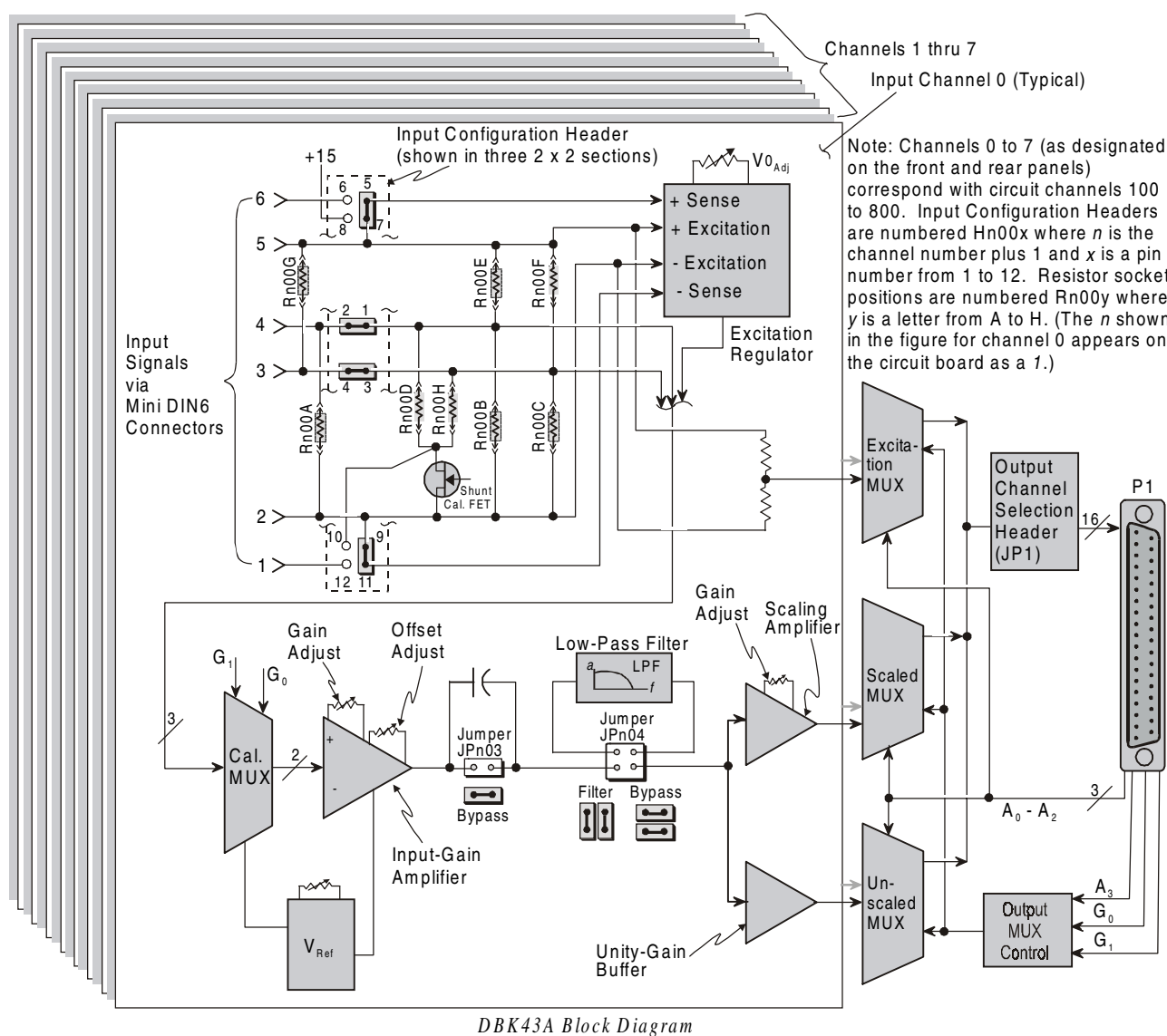
DBK43A Eight-Channel Strain-Gage Module

Because of the DBK43A's flexibility in configuration, please read the entire section before setup and operation. Sections are ordered as follows:

- *Overview* describes the unit's basic operation.
- *Hardware Connection* describes power and signal hookups.
- *Hardware Configuration* shows how to configure: various strain gages (*Bridge Applications*), AC coupling and low-pass filter options, and channel selection.
- *Hardware Adjustment* describes the setup procedure to adjust the trimpots for: the excitation voltage, gain of the input and scaling amplifiers, and circuit offsets for each channel.
- *GageCal Program* explains a utility calibration program, helpful in a load cell application.
- *Example* walks you through typical setups for a strain gage and a load cell.
- *DBK43A Specifications* lists performance specifications.

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- and quarter-bridge strain gages, the DBK43A can accommodate user-supplied bridge-completion resistors. The **bridge circuit must be complete** for the DBK43A to operate correctly. Each channel of the DBK43A offers a selectable 3-pole, low-pass filter with a user-set cut-off frequency. Remote-sense terminals are provided to make 6-wire Kelvin connections. Up to 2 DBK43A modules can be connected to each of 16 analog base channels for up to 256 input signals.

The DBK43A provides an amplifier gain range of $\times 100$ to $\times 1250$ for use with strain gages having 0.4 to 10 mV/V sensitivities. Most strain gages are specified for a full-scale value of weight, force, tension, pressure, or deflection with an output of mV/V of excitation. For example, a strain gage with a full-scale rating of 1000 lb of tension might output 2 mV/V of excitation at full load. With an excitation of 10 VDC, 1000 pounds of load would produce an output of 20 mV.

The module's 0 to 5 VDC offset and output-scaling permit nulling of large quiescent (inactive or motionless) loads and expansion of the dynamic range for maximum resolution. Typically, the quiescent output is non-zero. Prior to a force being applied, a mounted strain gage can be in a state of partial deflection resulting in an output. In the case of a tension gage, this output may be due to the weight of a hook or empty container.

The DBK43A includes an internal excitation voltage source. The wide-range excitation regulator is adjustable from 1.5 to 10.5 VDC with a current limit of 50 mA.

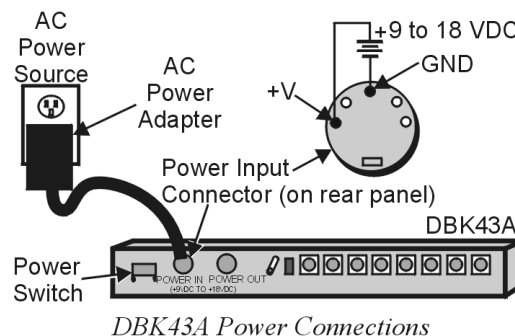
Hardware Connection

Power Connection

The DBK43A requires input voltage between +9 and +18 VDC. The DC source should be filtered but not necessarily regulated—the DBK30A is recommended for portable use. The module'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 9-18 VDC source, make sure leads are connected to the proper DIN terminals.



CAUTION



POWER IN : The power connectors are rated at 5 amps maximum DC current. The power supply provided with the DBK43A can power the unit but not any auxiliary devices. If using the DBK43A's power supply, do not use the POWER OUT terminal. If using another power supply to power auxiliary devices from the POWER OUT terminal, make sure that power supply is current-rated for the units connected (up to 5 amps DC).

POWER OUT : Maximum output current is 3 amps DC. Use a power supply capable of supplying 5 amps DC at POWER IN.

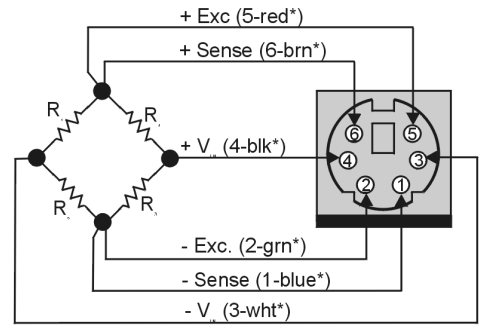
Signal Connection

The figure shows the 6-pin signal connector (1 of 8) on the back of the DBK43A, and a full-bridge with remote sensing configuration.

CAUTION



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).



* Mini-DIN6 connector pin; color code of CA-132 cable

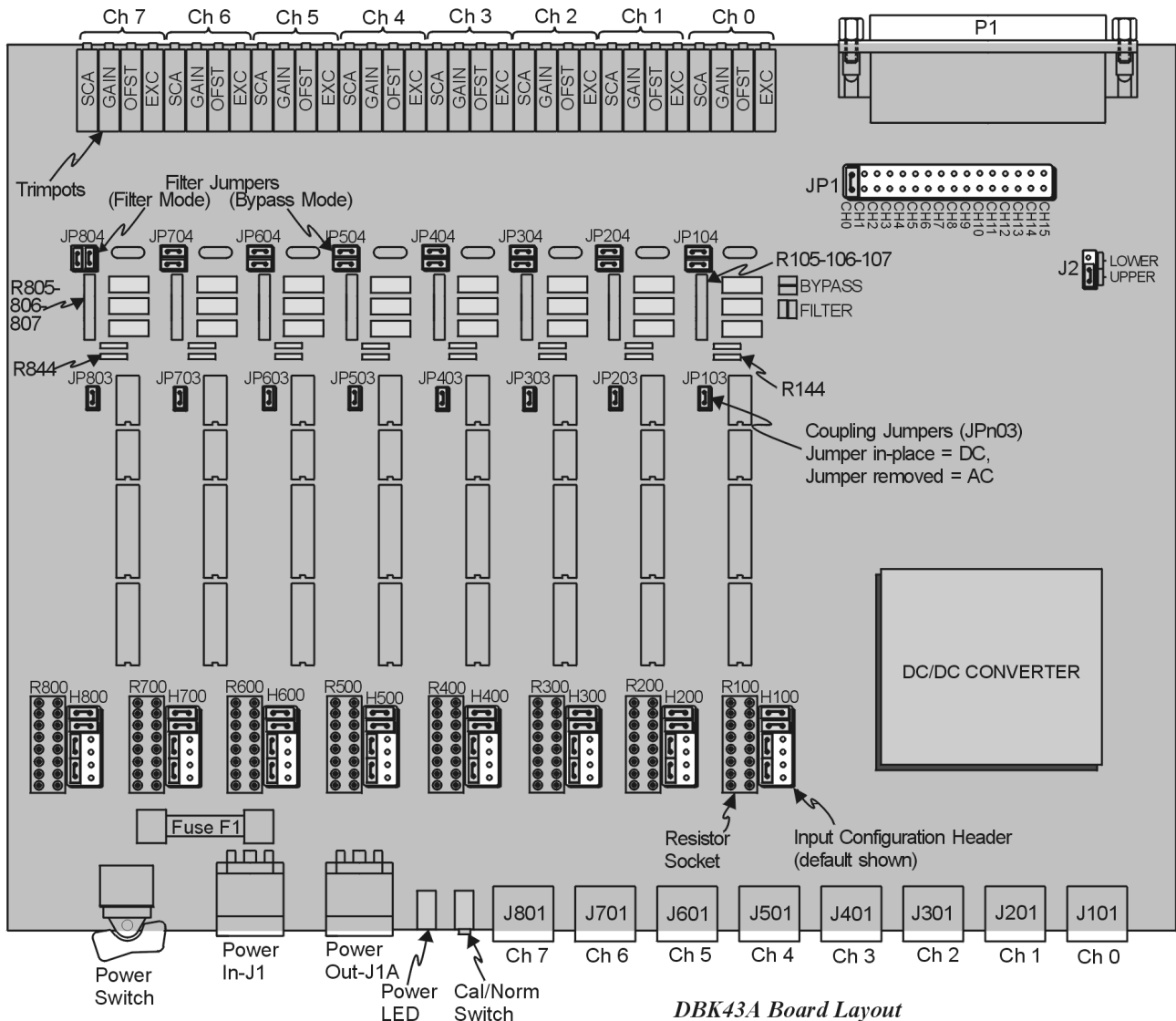
DBK43A Signal Input Connection

Hardware Configuration

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 figure shows the DBK43A board layout for locating jumpers, switches, resistors, etc.



DBK43A Board Layout

Bridge Applications

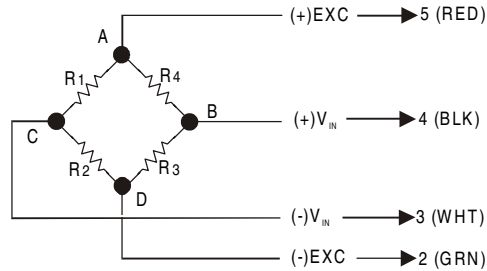
There are several ways to hook-up strain gages—all are configured into a 4-element bridge (the 4 legs in a bridge circuit). The *quarter-*, *half-* or *full-* designation for a strain gage refers to how many elements in the bridge are strain-variable. A quarter bridge has 1 strain-variable element; a 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 standard symbol for a 4-element bridge type strain gage is referenced to the channel bridge-completion resistor designations for the DBK43A.

If R1 - R4 is a fixed resistor, it may be placed internally in the Rn locations on the resistor plug. "n" is the channel number +1.

R1 = Rn00F
R2 = Rn00C
R3 = Rn00E
R4 = Rn00B

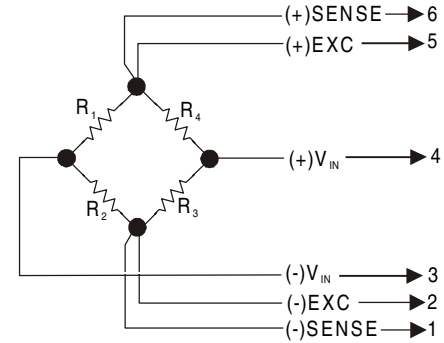
Example:
R3 in channel 7 = R800E location



Bridge-Completion Resistors

Any or all of the 4 resistive elements may be strain-variable. Where an element is a fixed resistor, the fixed resistor may be installed in the internal location provided. (The n is the channel number +1; for an internal resistor on channel 7, the location is R800E.)

Connections are provided for Kelvin-type excitation. The excitation regulators stabilize the voltage at the points connected to the on-board sampling dividers. Unless you run separate sense leads to the excitation terminals of the strain gage, the voltage regulation is most accurate at the terminal blocks on the DBK43A. In a Kelvin-type connection, six wires run to a 4-element strain gage, and the excitation regulation is optimized at the strain gage rather than at the terminal blocks. This connection works with as little as 10 feet of 22 gauge lead wire if accuracy is critical. (See *Full-Bridge with Remote Excitation Sensing Configuration* in full-page figure.)



Kelvin-type Excitation Leads

The Kelvin connection using the remote sensing lines performs best when the entire bridge is localized (no bridge-completion resistors inside the DBK43A) and all leads are contained in a multi-conductor cable. If individual wire leads are used, the two sense wires should be tightly twisted to form a pair. Likewise, the two excitation wires and the two bridge-output wires should be twisted together).

The internal excitation source is attached to a voltage regulator in the DBK43A circuitry. This regulator provides the excitation to the actual transducer (there is a separate regulator for each transducer, hence 8 regulators per DBK43A). Each regulator has a maximum current of 50 mA. The maximum excitation voltage that can be provided by the DBK43A excitation regulator is: $0.05 \times R$ (where R = the resistance in ohms of 1 element in the bridge circuit).

CAUTION

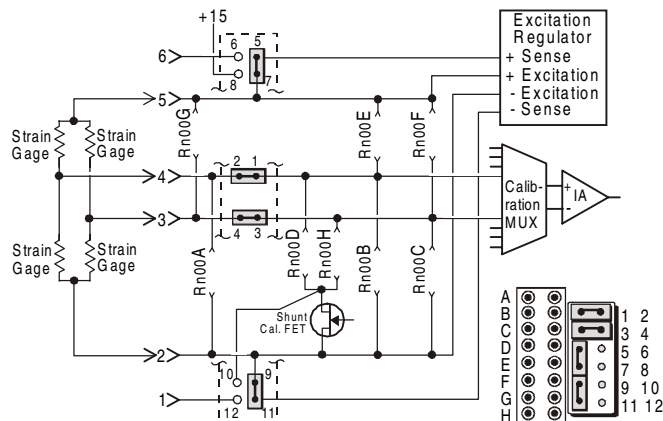


Setting the excitation voltage above the maximum voltage allowed can cause the DBK43A to fail. The maximum allowable excitation voltage is determined by the following equation.

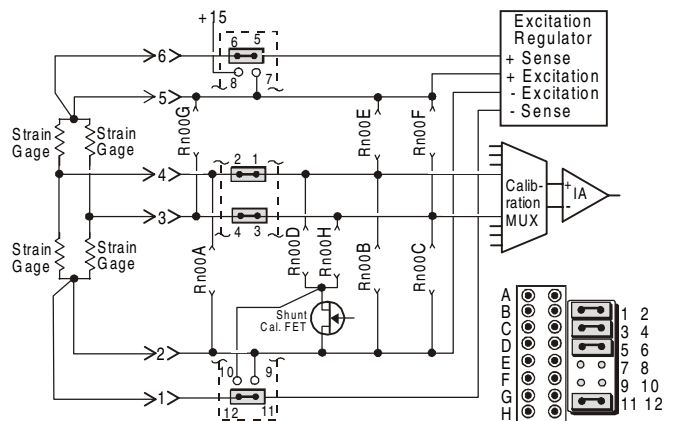
$$V_{\text{MAX[EXC]}} = 0.05 \times R$$

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

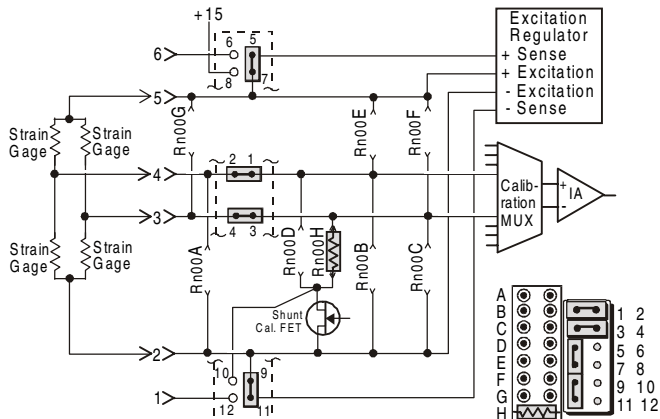
The full-page figure shows various strain-gage configurations.



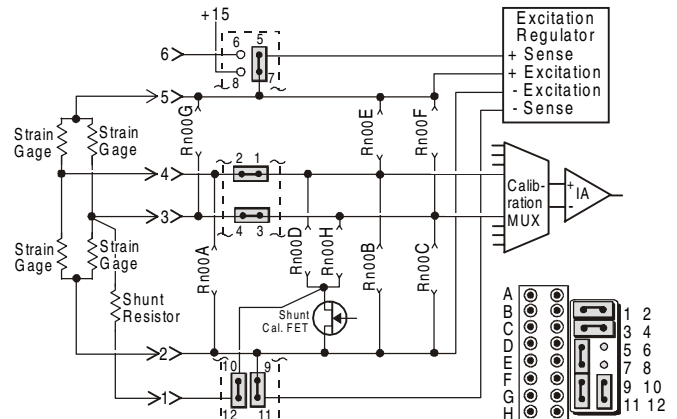
Full-Bridge Configuration



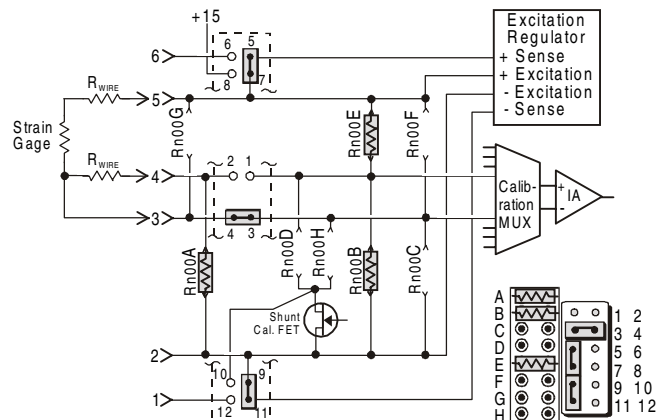
Full-Bridge with Remote Excitation Sensing Configuration



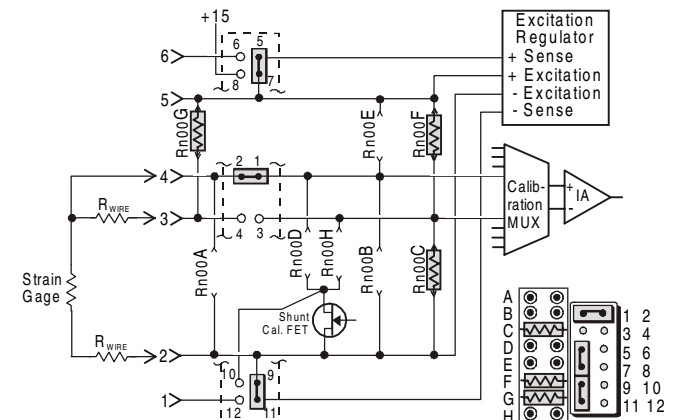
Full-Bridge with Internal Shunt Calibration Resistor Configuration



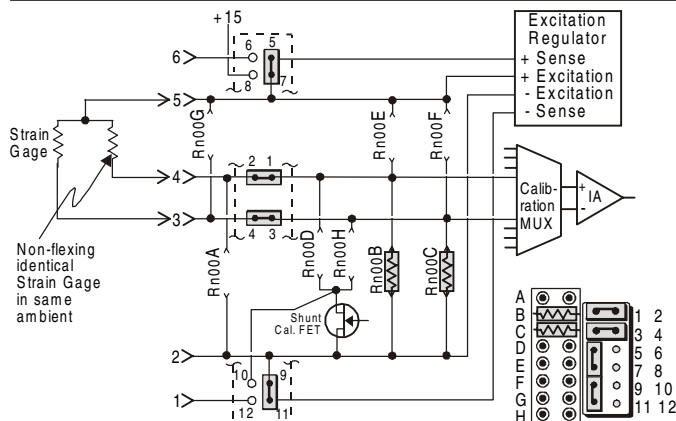
Full-Bridge with Remote Shunt Calibration Resistor Configuration



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.
- Handle plugs with care to avoid damaging pins.
- To prevent heat damage to the plug and ensure proper fit, perform soldering with plug in a mating socket.
- To prevent contact with other components, snip resistor leads after soldering, just long enough to mount on the forked support.
- Install or remove these pre-configured plugs into the appropriate sockets as needed.

Bridge-completion resistor values are typically $350 \pm 0.1\%$ ohm or $120 \pm 0.1\%$ ohm. Use the resistor value to match the particular strain gage in use.

Input Configuration Headers

Eight 2×6 pin-headers with pin numbers 1 to 12 are on the board, 1 for each channel designated H100 (channel 0) to H800 (channel 7). The user can position jumpers on this header to configure inputs from a variety of bridge types.

- Jumping header pins 1-to-2 and 3-to-4 connects the +Vin and -Vin to the calibration MUX for different bridge configurations.
- Jumping pins 5-to-7 and 9-to-11 allows **internal sense regulation** of the excitation regulator.
- Jumping pins 5-to-6 and 11-to-12 allows for **remote excitation sensing**.
- Jumping pin 10-to-12 allows the use of a remote shunt-calibration resistor.

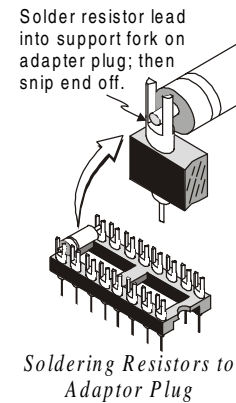
See previous figure for header configurations that correspond with different bridge-wiring schemes.

Resistor Sockets and Adapter Plugs

Eight 2×8 resistor sockets with rows numbered A to H are on the board; 1 socket for each channel and designated R100 (channel 0) to R800 (channel 7). An adapter plug for soldering resistors is included for each channel; user-soldered plugs facilitate changing configurations as needed.

- Bridge-completion resistors include: Rn00B, Rn00C, Rn00E, and Rn00F. Resistors Rn00A and Rn00G are used to complete 3-wire strain-gage configurations.
- Rn00D and Rn00H are internal shunt resistors from +V in and -V in respectively to -excitation.

Just inserting resistors into the socket makes an unreliable connection and is not recommended. To achieve a reliable connection, solder resistors to the adapter plug to match the proper row as shown in the previous figure, *DBK43A Bridge-Configuration Settings*. Soldering should be done with the plug inserted into the resistor socket; otherwise, heat from soldering can distort the shape of the plug. After soldering, the resistor leads should be snipped off close to the support to prevent contact with other components.



Handle the adaptor plugs with care to prevent pin damage.

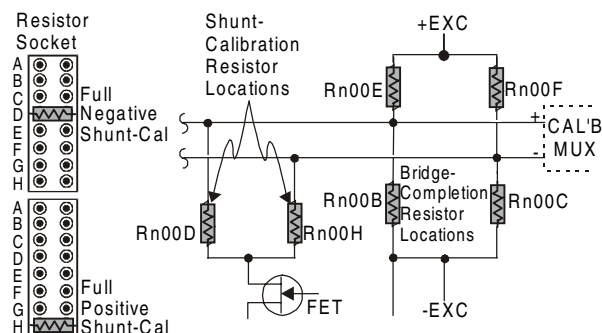
Shunt-Calibration Resistors

The DBK43A provides physical locations for internal shunt-calibration resistors. Each channel has resistor locations that can be shunted across one or the other of the lower bridge arms by a hardware and software-accessible solid state switch (FET transistor) to create a repeatable bridge imbalance with a precision resistor. For any balanced bridge, a resistance value can be applied in parallel with one of the four bridge elements to create a predictable imbalance and output voltage. For example, a 350Ω 2mV/V strain gage will deliver full output if one arm drops by 0.8% (about 2.80Ω) to 347.2Ω. A 43.4 kΩ resistance shunted across one or the other lower bridge elements will result in full-positive (Rn00H) or full-negative (Rn00D) output. For best results, Rn00H and Rn00D should be across the strain element when it is switched in.

An approximate formula for the shunt-cal resistance value is: $R_{\text{Shunt}} = R_{\text{Bridge Arm}} [V_{\text{Excitation}} / 4 (V_{\text{Out}})]$.

Example: $R_{\text{Shunt}} = 350 [10 / 4(0.020)]$
 $= 43.75 \text{ k}\Omega$

In all cases, the resistance of the solid-state switch will be negligible when compared to the shunt resistance. Changing the CAL/NORM switch (on the rear panel) to the CAL position while reading the bridge will activate the shunt-calibration resistors. After reading the offset, return the switch to the NORM position for normal bridge readings.



Shunt-Calibration Resistors can be used with any full-, half-, or quarter-bridge configuration.

AC Coupling and Low-Pass Filter Options

Per channel, the DBK43A accommodate coupling and low-pass filter options including:

- AC coupling, or DC coupling
- Using or bypassing the filter
- Choice of the filter's corner frequency via a SIP resistor network
- Filter gain (default of $\times 2$ can be changed to $\times 1$).

The AC coupling, or DC coupling choice on each channel is set by the presence or absence of shunt jumpers on 2-pin headers. If the shunt jumper is in place, the coupling is DC. If the shunt jumper is absent, the coupling is AC. See table for channels and corresponding headers.

Channel	Header
0	JP103
1	JP203
2	JP303
3	JP403
4	JP503
5	JP603
6	JP703
7	JP803

The choice of using or bypassing the low-pass filter for each channel is made by the orientation of two shunt jumpers on a 2 \times 2 pin header. When the shunt jumpers are oriented horizontally (like the “bypass” symbol on the circuit board) the filter is bypassed. When the shunt jumpers are oriented vertically (like the “filter” symbol), the filter is in the signal path.

Channel	Header
0	JP104
1	JP204
2	JP304
3	JP404
4	JP504
5	JP604
6	JP704
7	JP804

The corner frequency of a low-pass filter is determined by three resistor values in each filter circuit. The resistors are listed in the following table. These resistor locations have been physically arranged to allow the use of a 6-pin SIP network as a convenient means of changing all 3 resistors. The machined-pin socket will also allow you to insert individual resistors.

Channel	Resistors
0	R105-R106-R107
1	R205-R206-R207
2	R305-R306-R307
3	R405-R406-R407
4	R505-R506-R507
5	R605-R606-R607
6	R705-R706-R707
7	R805-R806-R807

The next table is a list of some common frequencies, the nominal resistance value, and a Bourns part number for a suitable network.

Frequency	Resistance (Ω)	Bourns P/N
10 Hz	27,000	4606X-102-273
20 Hz	12,000	4606X-102-123
50 Hz	5,600	4606X-102-562
100 Hz	2,700	4606X-102-272
200 Hz	1,200	4606X-102-122
500 Hz	560	4606X-102-561
1,000 Hz	270	4606X-102-271
2,000 Hz	120	4606X-102-121
5,000 Hz	56	4606X-102-560
10,000 Hz	27	4606X-102-270
20,000 Hz	12	4606X-102-120

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

Note: The default $\times 2$ gain option meets the needs of most applications.

Channel	R (10K)
0	R144
1	R244
2	R344
3	R444
4	R544
5	R644
6	R744
7	R844

P1 Output Channel and Card Address Selection

All 8 channels on the DBK43A are multiplexed into 1 of the LogBook 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's 16 base channels, up to 32 DBK43As can be used for a maximum of 256 channels. For LogView and GageCal these channels are identified from 0-0-0 to 15-2-7.

Hardware Adjustment

Bridge circuit transducers are used for many different applications, and the DBK43A is flexible enough to support most of them. Each DBK43A channel circuit has an excitation regulator, a high gain (100-1250) input amplifier with offset adjustment, a low-pass filter, a scaling (1-10) amplifier, and a calibration multiplexer.

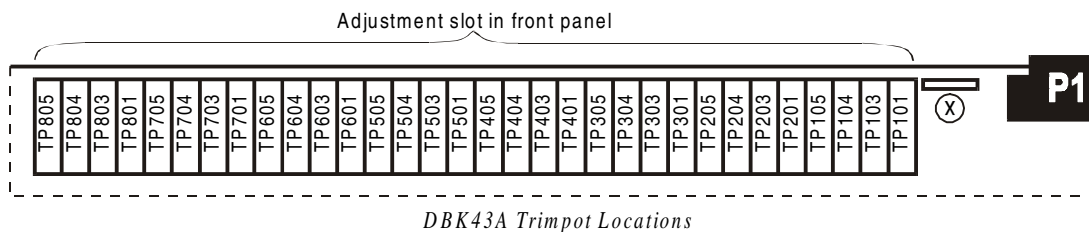
Trim pots

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

EXC	for adjusting the excitation voltage to the transducer
GAIN	for setting the gain of the input amplifier
OFFSET	for adjusting the circuit offset for quiescent loads or bridge imbalance
SCALE	for setting the gain of the scaling amplifier

	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7
EXC	TP101	TP201	TP301	TP401	TP501	TP601	TP701	TP801
GAIN	TP104	TP204	TP304	TP404	TP504	TP604	TP704	TP804
OFFSET	TP103	TP203	TP303	TP403	TP503	TP603	TP703	TP803
SCALE	TP105	TP205	TP305	TP405	TP505	TP605	TP705	TP805

The figure shows trimpot locations.



CAL/NORM Switch

The CAL/NORM switch is located between the CH7 input and the power LED on the rear panel.

- In the NORM position, the unit's function is identical with 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 commands that control the calibration multiplexer in each circuit. The calibration multiplexer is used to switch out the bridge circuit and apply internal reference voltages for use in the DBK43A setup. The calibration multiplexer also allows the LogBook to record the individual adjustments via LogView.



Reference Note: Refer to Appendix A for DBK43A calibration instructions. Note that the GageCal program does not apply to DBK43A.

DBK43A Setup Procedure

A typical setup procedure is as follows:

1. Disable the low-pass filters JPx04 ($x = 1-8$ for channels 0-7), and set DC coupling (install JPx03) for all the channels to be setup. If you plan to use the filter during your acquisition, note the gain in the filter stage (default $\times 2$, or $\times 1$ with resistor removed) and allow for it in your setup.
2. Determine what the excitation for the transducer will be from the transducer specifications and the current limitations of the DBK43A excitation regulator.
3. Determine what the maximum voltage will be from the transducer at maximum load or strain, and calculate what the DBK43A channel total gain should be based on a full-scale LogBook (bipolar -5 V to +5 V, unipolar 0 to 10 V).
4. Determine how the total gain will be distributed between input amplifier gain, filter gain and scaling amplifier gain.
5. Hook up the transducer to the DBK43A according to the figures in the *Signal Connection* and *Bridge Applications* section. Install the appropriate bridge-completion resistors if applicable.
6. To read the excitation voltage, the CAL/NORM switch must be in the "CAL" position. Send the DBK43SetOffset command (usually through a gain setting in the software). Set the excitation voltage for the transducer by adjusting the trimpot labeled EXC. To obtain the actual excitation voltage, multiply the voltage read by a factor of 2.11 (because the LogBook reads to 5 V and a voltage divider is used in the circuit). Alternatively, divide the voltage value you want for your excitation by 2.11 and adjust the EXC trimpot until you achieve that reading. After the excitation voltage is set, return the CAL/NORM switch to NORM position.
7. Send the DBK43SetOffset command (usually through a gain setting in the software). Adjust the OFFSET trimpot for a reading of 0.00 volts. This removes all offset from the DBK43A channel circuit.
8. Send the DBK43SetInputGain command (usually through a gain setting in the software). Adjust the GAIN trimpot for a voltage reading equal to (.005)(the desired input amplifier gain).
9. Send the DBK43SetScalingGain command (usually through a gain setting in the software). Adjust the SCALE trimpot for a voltage reading equal to (.005)(the desired input amplifier gain)(the desired scaling amplifier gain).
10. Send the DBK43ReadBridge command (default). With the quiescent (normal or inactive) load or strain applied, adjust the OFFSET trimpot for a reading of 0.00 volts. This adds offset to the circuit to compensate for the quiescent load and allows maximum resolution for the measurement.
11. Enable the low-pass filter and/or AC coupling if required for your application.
12. From the transducer specifications and the total gain of the DBK43A channel, calculate the LogBook voltage/transducer units and apply it to your LogBook voltage readings through software.
13. Apply a known load or strain and verify the DBK43A and software settings.

Set-Up Notes:

- The offset adjustment is unipolar 0 to 5 V on the input amplifier output. If the offset can not be adjusted to 0.00 V at the end of the setup procedure, try swapping the Vin+ (4) and Vin- (3) wire connections or dropping the input gain and increasing the scaling gain.
- For very high system gains, the Scaling Gain might have to be set first with the Input Gain low and then set the Input Gain (the LogBook can only measure up to 10 V).
- Gain adjustments can be made by activating a shunt-cal resistor that is calculated to be at maximum load (set DBK43A read bridge with the CAL/NORM switch in the CAL position).
- Settings can be verified via shunt-cal.

Calibrating a DBK43A



Reference Note: Refer to Appendix A for DBK43A calibration instructions. Note that the GageCal program does not apply to DBK43A.

DBK43A - Specifications

Name/Function: Strain-Gage Module

Connectors: DB37 mates with P1; mini-DIN6 provided for strain-gage or external excitation connections

Number of Channels: 8

Excitation Voltage Adjustment Ranges: 1.50 to 10.50 VDC @ 50 mA

Input Gain Range: $\times 100$ -1250; separate instrumentation amplifier for each channel with gain adjustable via externally accessible 15-turn trimpot

Accommodated Bridge Types:

- Full bridge, Kelvin excitation (6-wire)
- Full bridge (4-wire)
- Half bridge (3-wire)
- Quarter bridge (2-wire)

Bridge-Completion Resistors: On-board resistor socket locations (Rn00A, Rn00B, Rn00C, Rn00E, Rn00F, and Rn00G) for 6 bridge-completion resistors per channel

Input Type: Differential

Input Impedance: 100 M Ω

CMMR: 115 dB

Excitation Current Output: 50 mA max (current limited @ 60 mA)

Excitation Sensing: Local or remote

Excitation Regulation

- Line Regulation: 0.025%
- Load Regulation: 0.05%

Reference Voltages: 2.5 VDC

Reference Accuracy: 0.05%

Reference Drift: 3 ppm/ $^{\circ}$ C

Gain Calibration Reference: 5 mVDC

Gain Calibration Reference Accuracy: 0.2%

Gain Calibration Reference Drift: 20 ppm/ $^{\circ}$ C

Gain Accuracy: 0.5%

Gain Drift: 50 ppm/ $^{\circ}$ C

Input Offset: 100 μ V max

Offset Drift: 4 μ V/ $^{\circ}$ C

Output Offset: 20 μ V

Offset Drift: 200 μ V/ $^{\circ}$ C

Offset Adjustment: 0-100% of range, 0-5 VDC (15-turn trimpot)

Full-Scale Sensitivity Range

5.00 VDC Excitation: 0.8-10 mV/V

10.00 VDC Excitation: 0.4-5 mV/V

Scaling Amplifier Gain Range: $\times 1$ -10 (15-turn trimpot)

Low-Pass Filter:

3-pole, user-selected

Corner frequency (Fc) set by user component

Attenuation -3 dB at Fc

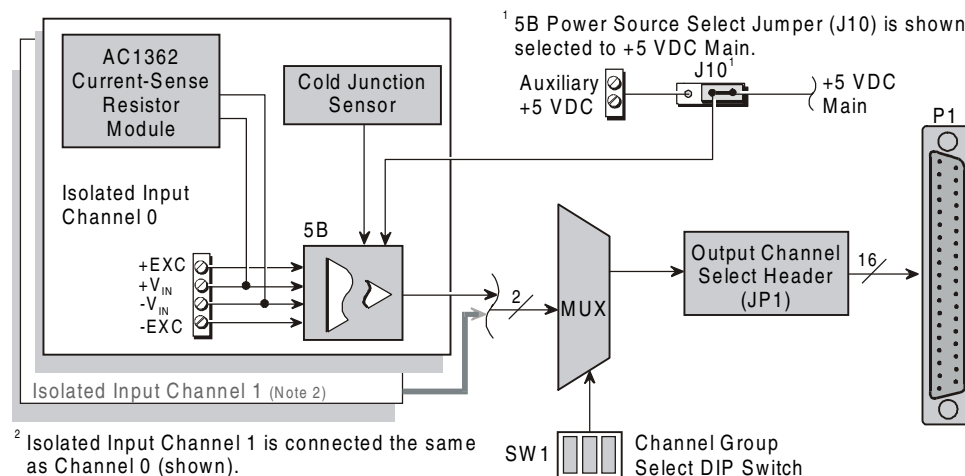
Gain $\times 2$

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

DBK44 2-Channel 5B Signal-Conditioning Card

Overview

The 2-channel DBK44 allows LogBook 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 can support up to 128 DBK44 cards, providing up to 256 isolated, analog input channels. The LogBook scans the DBK44's channels at the same 10 μ s/channel rate as other DBKs (256 scans in 2.56 ms in a full system). Each user-installed 5B module offers 500 V isolation from the system and between channels. The DBK44 has convenient screw-terminal blocks for signal inputs and excitation outputs (for use with a strain gage or RTD). Cold junction compensators (CJC) are installed and ready to use with thermocouple 5B modules. Sockets are provided for AC1362 current-sense resistor modules.



DBK44 Block Diagram

Hardware Setup

Power Considerations

The DBK44 requires +5 and ± 15 VDC from a LogBook 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 can provide (see table).

Note: For applications with more than 4 channels, it may be better to use the DBK42 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).

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	



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

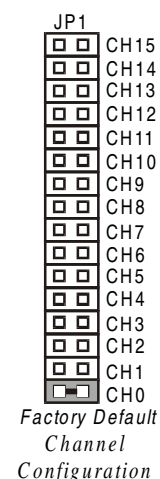


Auxiliary power input must not exceed +5 VDC. DBK44 does not regulate auxiliary power input.

Card Configuration

Up to 128 DBK44s may connect to a LogBook system. Since this is a daisy-chain interface, each module must appear unique and use a different analog input channel to the LogBook. To configure the card's channel, you must set the JP1 jumper and the SW1 DIP switch to your chosen channel as follows.

1. Locate the 16x2-pin header (labeled JP1) near the front of the card. Note the 16 jumper locations labeled CH0 through CH15 to match the main channel.
2. Place the JP1 jumper on the channel you wish to use. Only one jumper is used per card, but up to 8 DBK44s can occupy one main channel and use the same JP1 setting (but with different SW1 settings).
3. Locate the SW1 DIP switch that serves as a channel group select switch and can distinguish up to 8 cards on a channel.
4. Place the 3 mini switches (CBA) in the position that corresponds to your chosen channel as shown in the table below. For each JP1 setting, there are 8 possible SW1 settings to allow two input channels per card).

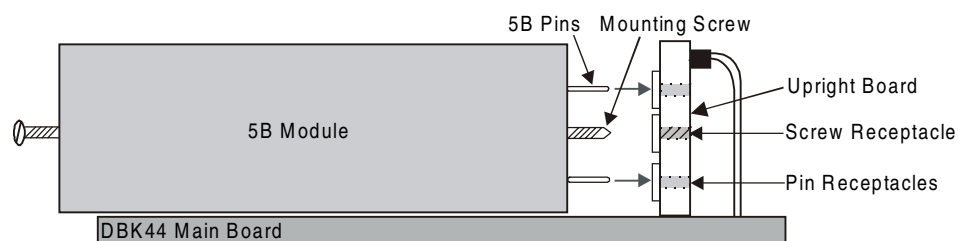


Channel Pair Determined by JP1 and SW1								
JP1 Jumper	SW1 DIP Switch Setting							
	CBA	CBA	CBA	CBA	CBA	CBA	CBA	CBA
CH0	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
CH1	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31
CH2	32-33	34-35	36-37	38-39	40-41	42-43	44-45	46-47
CH3	48-49	50-51	52-53	54-55	56-57	58-59	60-61	62-63
CH4	64-65	66-67	68-69	70-71	72-73	74-75	76-77	78-79
CH5	80-81	82-83	84-85	86-87	88-89	90-91	92-93	94-95
CH6	96-97	98-99	100-101	102-103	104-105	106-107	108-109	110-111
CH7	112-113	114-115	116-117	118-119	120-121	122-123	124-125	126-127
CH8	128-129	130-131	132-133	134-135	136-137	138-139	140-141	142-143
CH9	144-145	146-147	148-149	150-151	152-153	154-155	156-157	158-159
CH10	160-161	162-163	164-165	166-167	168-169	170-171	172-173	174-175
CH11	176-177	178-179	180-181	182-183	184-185	186-187	188-189	190-191
CH12	192-193	194-195	196-197	198-199	200-201	202-203	204-205	206-207
CH13	208-209	210-211	212-213	214-215	216-217	218-219	220-221	222-223
CH14	224-225	226-227	228-229	230-231	232-233	234-235	236-237	238-239
CH15	240-241	242-243	244-245	246-247	248-249	250-251	252-253	254-255
	256-257	258-259	260-261	262-263	264-265	266-267	268-269	270-271

5B Module Connection

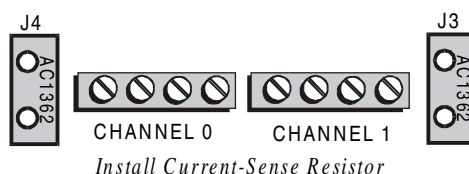
Each input of the DBK44 is processed through a user-installed 5B signal-conditioning module. Different 5B modules are used with different transducer and signal sources. To install the modules:

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).



Terminal Block Connection

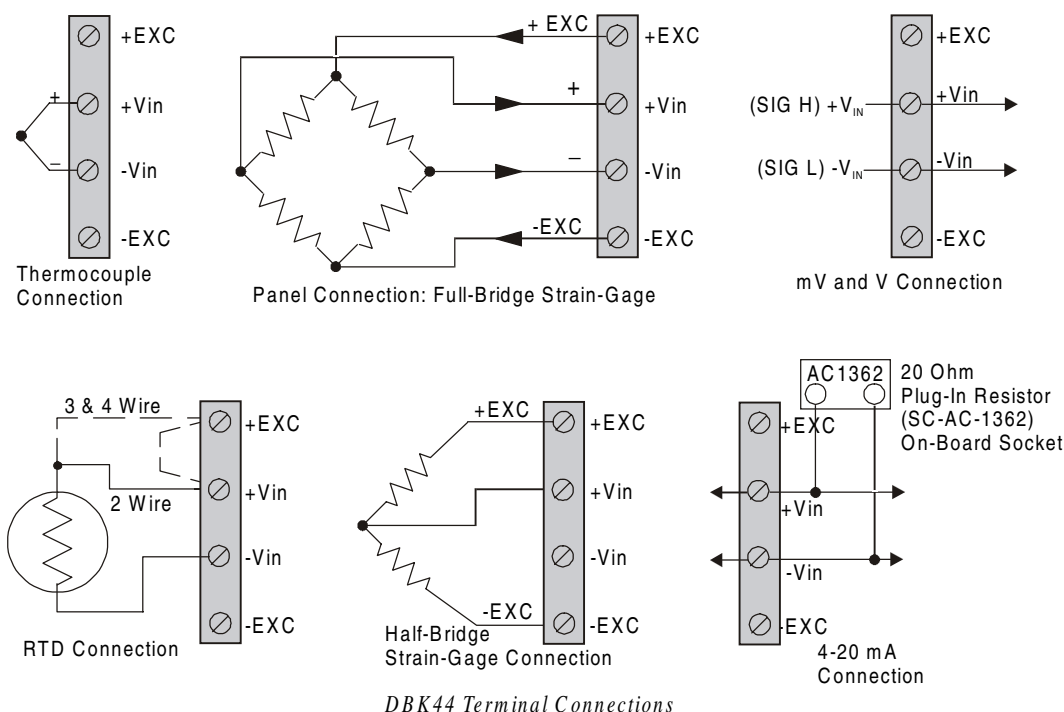
WARNING	
	Shock Hazard. De-energize circuits connected to the DBK44 before changing the wiring or configuration. The DBK44 is designed to sense signals that may carry dangerous voltages.

Input signals (and excitation leads) must be wired to the DBK44 via the 4-contact terminal blocks at the end of the card. These terminal blocks connect internally to their corresponding signal conditioning module. The terminal blocks accept up to 14-gage wire into quick-connect screw terminals that are labeled as to their function. Each type of input signal or transducer (such as a thermocouple or strain gage) should be wired to its terminal block as shown in the figure. Wiring is shown for RTDs, thermocouples, 20 mA circuits, mV/V connections, and for full- and half-bridge strain gages.

P1 Connection

The DBK44 attaches to the LogBook'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.)

Note: to meet CE safety specifications, an edge guard (kit p/n 232-0805) must be attached to the DBK44 card before insertion into a DBK41 expansion chassis. This guard helps prevent accidental access to high-voltage circuits.



mx+b Values for 5B Modules

The $mx+b$ values for many 5B modules are included within LogView; some are shown in table below.

5B Module	m Value	b Value	Engineering Unit(s)
Isolated Voltage Input (5 V Current Requirement, 30 mA)			
SC-5B31-01	1/5	0	mV, V
SC-5B31-02	1	0	mV, V
SC-5B31-03	2	0	mV, V
SC-5B31-04	2/5	-1	mV, V
SC-5B31-05	2	-5	mV, V
SC-5B31-06	4	-10	mV, V
Isolated Wideband Voltage (5 V Current Requirement, 30mA)			
SC-5B41-01	1/5	0	V
SC-5B41-02	1	0	V
SC-5B41-03	2	0	V
SC-5B41-04	2/5	-1	V
SC-5B41-05	2	-5	V
SC-5B41-06	4	-10	V
Isolated Millivolt Input (5 V Current Requirement, 30 mA)			
SC-5B30-01	2	0	mV
SC-5B30-02	10	0	mV
SC-5B30-03	20	0	mV
SC-5B30-04	4	-10	mV
SC-5B30-05	20	-50	mV
SC-5B30-06	40	-100	mV
Isolated Wideband Millivolt (5 V Current Requirement, 30 mA)			
SC-5B40-01	2	0	mV
SC-5B40-02	10	0	mV
SC-5B40-03	20	0	mV
SC-5B40-04	4	-10	mV
SC-5B40-05	20	-50	mV
SC-5B40-06	40	-100	mV
Isolated Linearized T/C Input (5 V Current Requirement, 30 mA)			
SC-5B47-J-01	152	0	°C
SC-5B47-J-02	80	-100	°C
SC-5B47-J-03	100	0	°C
SC-5B47-K-04	200	0	°C
SC-5B47-K-05	100	0	°C
SC-5B47-T-06	100	-100	°C
SC-5B47-T-07	40	0	°C
SC-5B47-E-08	200	0	°C
SC-5B47-R-09	250	+500	°C
SC-5B47-S-10	250	+500	°C
SC-5B47-S-11	260	+500	°C
Isolated RTD Input (5 V Current Requirement, 30 mA)			
SC-5B34-01	40	-100	°C
SC-5B34-02	20	0	°C
SC-5B34-03	40	0	°C
SC-5B34-04	120	0	°C
SC-5B34-C-01	24	0	°C
SC-5B34-C-02	24	0	°C
SC-5B34-N-01	24	0	°C
Isolated Current Input (5 V Current Requirement, 30 mA)			
SC-5B32-01	3.2	4	mA
SC-5B32-02	4	0	mA
Voltage Switch Input			
SC-AC-1367	1	0	V

DBK44 - Specifications

Name/Function: 2-Channel 5B Signal Conditioning Card

Module Capacity: 2 (input only) 5B modules

Weight: 8 oz. (with no modules installed)

Cable (optional): CA-37-x

DC Input Fuse: 4 A

Connection: Male DB37 mates via CA-37-1 cable with P1

Isolation:

Input Power to LogBook: 0 VDC

Signal Inputs to LogBook: 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

DBK45 4-Channel SSH and Low-Pass Filter Card

Overview

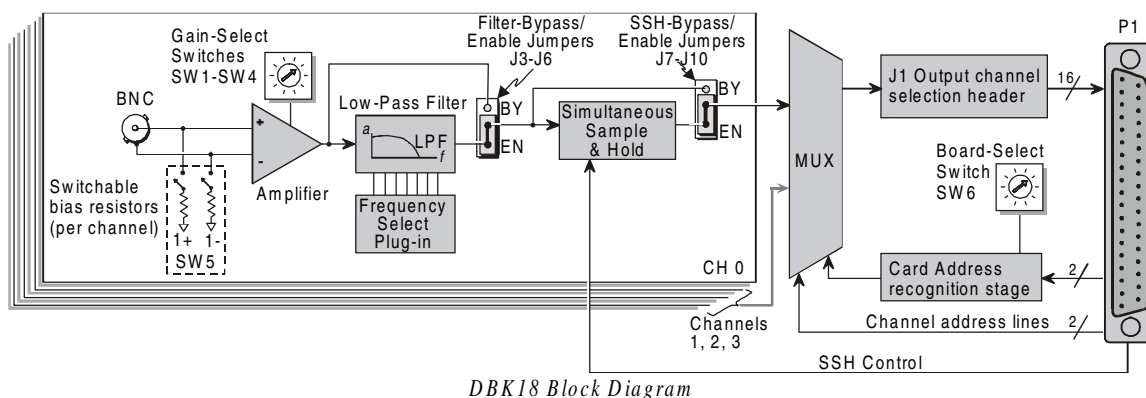
The DBK45 combines the features of the DBK17 (SSH) and the DBK18 (low-pass filter) cards. Each DBK45 provides 4 input channels to a LogBook system. Each of the main 16 analog input channels can accept 4 DBK45s, for a maximum of 64 DBK45s and 256 analog input channels. The simultaneous sample-hold function is activated at the beginning of each channel scan and freezes all signals present on DBK45 inputs for the duration of the scan, allowing for non-skewed readings of all channels.

Note: DBK45 channel should never be the 1st channel in a scan due to timing of the SSH line.

For each of the 4 channels, a separate filter and sample-hold stage follow the input stage. The outputs are connected to a 4-channel multiplexer stage. The enabled-output MUX allows 4 DBK45s to share a common analog input channel.

The DBK45 has an instrumentation amplifier for each channel, with switch-selected gains of $\times 1$, $\times 10$, $\times 100$, $\times 200$ and $\times 500$. A socket is provided for a gain resistor for custom gain-selection instead of the 5 factory-default gains. Gain for any channel can be set to any value between unity and $\times 500$ by installing an appropriate resistor. Four separate filter stages follow the 4 input stages. The outputs are connected to a 4-channel multiplexer stage. The enabled output MUX allows 4 DBK45s to share a common analog base channel.

The input connectors are BNC type connectors. The differential inputs are provided with switchable 100 K Ω bias resistors to analog common.



Hardware Setup

Card Connection



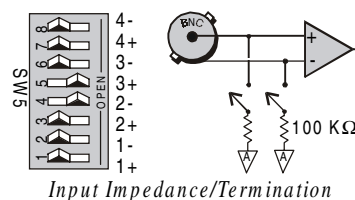
CAUTION
Input voltage levels must not exceed ± 5 V bipolar or 10 V unipolar.

The DBK45 is equipped with BNC connectors for easy access to analog inputs. Connections are provided for 4 differential inputs.

Card Configuration

Input Termination


The DBK45 provides two 100 K Ω bias resistors for each analog input. For balanced 200 K Ω input impedance, both resistors should be engaged. An 8-position DIP switch (SW5) can selectively engage the bias resistors (see figure). The switches must be in the closed position to engage the termination resistors. For unbalanced high input, only the (-) resistor should be used. If neither resistor is used, some external bias current path is required.



Gain Settings

On the printed circuit board, each channel has a gain-set switch labeled GAIN 1 to GAIN 4 (see figure) and holes for gain resistors labeled RG1 to RG4. The table in the figure shows the 5 gain values for switch settings 0 to 4. If a custom gain is desired, the switch is set to position 0; and a gain resistor must be mounted and soldered onto the board. The gain resistor's value is determined by the formula:

$$R_{\text{GAIN}} = [40,000 / (\text{Gain} - 1)] - 80 \, \Omega$$

Gain Values	Gain Switch
0 \times 1	
1 \times 10	
2 \times 100	
3 \times 200	
4 \times 500	

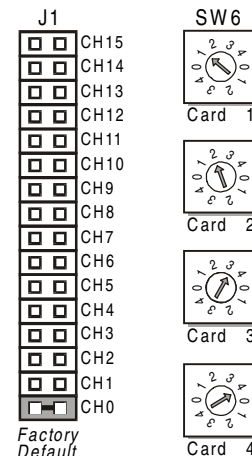
Setting Channel Gains

Address Configuration

Up to four DBK45s can be connected to each LogBook analog channel. With 16 main channels and 4 inputs per DBK45, 256 inputs are possible. Since this is a daisy-chain interface, each DBK45 must have a unique address (channel and card number).

To configure the module, locate the 16 \times 2-pin header (labeled J1) near the front of the board by P1. The 16 jumper locations on this header are labeled CH0 through CH15. Place the jumper on the channel you wish to use. Only one jumper is used. Two DBK45s in the daisy-chain can have the same channel number as long as their card number is unique.

Set switch SW6 for each DBK45 on a single channel. Verify that only one card in the system is set to a particular channel *and* card number.



Address Configuration

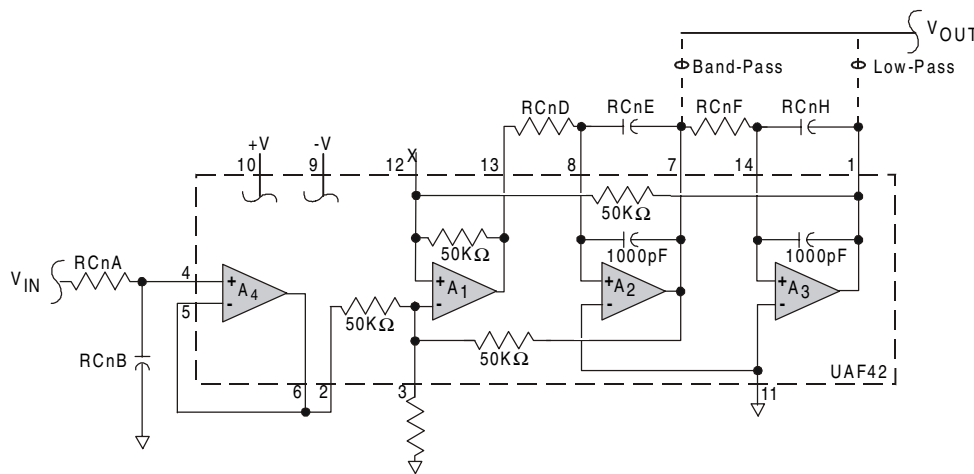
SSH Configuration

Each channel's Simultaneous-Sample-and-Hold circuit can be enabled (EN) or bypassed (BY) by placement of the jumper on J7 for channel 0, J8 for channel 1, J9 for channel 2, or J10 for channel 3. The factory-default setting is **enabled (EN)** for each channel.

Configuring DBK45 Filter Sections

There are 4 low-pass, 3-pole active filters on the DBK45. Each filter can be enabled (EN) or bypassed (BY) by placement of the jumper on J3 for channel 0, J4 for channel 1, J5 for channel 2, J6 for channel 3. The factory-default setting is **enabled (EN)** for each channel. Each filter can be configured as a Butterworth, Bessel, or Chebyshev filter with corner frequencies up to 50 kHz. Filter properties depend on the values of resistors and capacitors installed in several circuit locations. Above 10 Hz, installing capacitors is unnecessary because capacitors in the ICs are sufficient. In all cases, three resistors are required to complete the active filter circuits contained mostly within the UAF42 ICs.

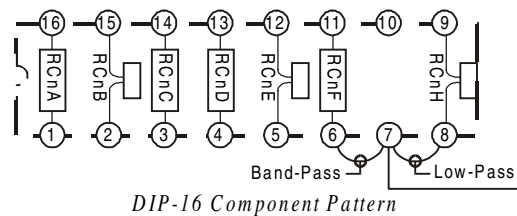
The circuit diagram shows the active filter IC in a typical section of the DBK45. The resistors and capacitors outside the IC have a physical location in a DIP-16 socket (dual in-line, 16 pins) with an RCnn designator. The RC indicates the needed part is a resistor or capacitor; the 3rd character is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



Filter Circuit Diagram

The figure shows the DIP-16 component pattern typical of the 4 filter sections. A machined-pin IC socket in each filter RC location can accept resistors and capacitors that plug into the socket. A better approach is to install these components on plug-in headers. This allows solder connections to the components and gold-to-gold, plug-in connections between the header and the sockets.

Note: “n” (no part) means open circuit.



- Pin 7 of the DIP-16 socket:
- connects to pin 8 for low-pass filtering
 - connects to pin 6 for band-pass filtering

The next table lists values of components for common corner frequencies in Butterworth filters. If you wish to design your own filter, included software from Burr-Brown provides the component values to create the desired filter. (The design math is outside 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	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	none	none	3.16 MΩ	none	3.16 MΩ	none	none
100*	1.58 MΩ	none	none	1.58 MΩ	none	1.58 MΩ	none	none
200	787 KΩ	none	none	787 KΩ	none	787 KΩ	none	none
500*	316 KΩ	none	none	316 KΩ	none	316 KΩ	none	none
1000*	158 KΩ	none	none	158 KΩ	none	158 KΩ	none	none
2000	78.7 KΩ	none	none	78.7 KΩ	none	78.7 KΩ	none	none
5000	31.6 KΩ	none	none	31.6 KΩ	none	31.6 KΩ	none	none
10000	15.8 KΩ	none	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 computes and displays phase and gain characteristics of the filter sections as a function of frequency.

DBK45 - Specifications

Name/Function: Simultaneous Sample and Hold and Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors

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

Number of Cards Addressable: 64

Dimensions: 8.25" × 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: $R_{GAIN} = [40,000 / (\text{Gain} - 1)] - 80 \Omega$

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, ×500, 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: $5 \times 10^{12} \Omega$ 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 pre-configured for any of the following frequencies: 5 Hz, 10 Hz, 100 Hz, 500 Hz, or 1 kHz—all are Butterworth-type filters.

DBK50/51 Voltage Input Modules

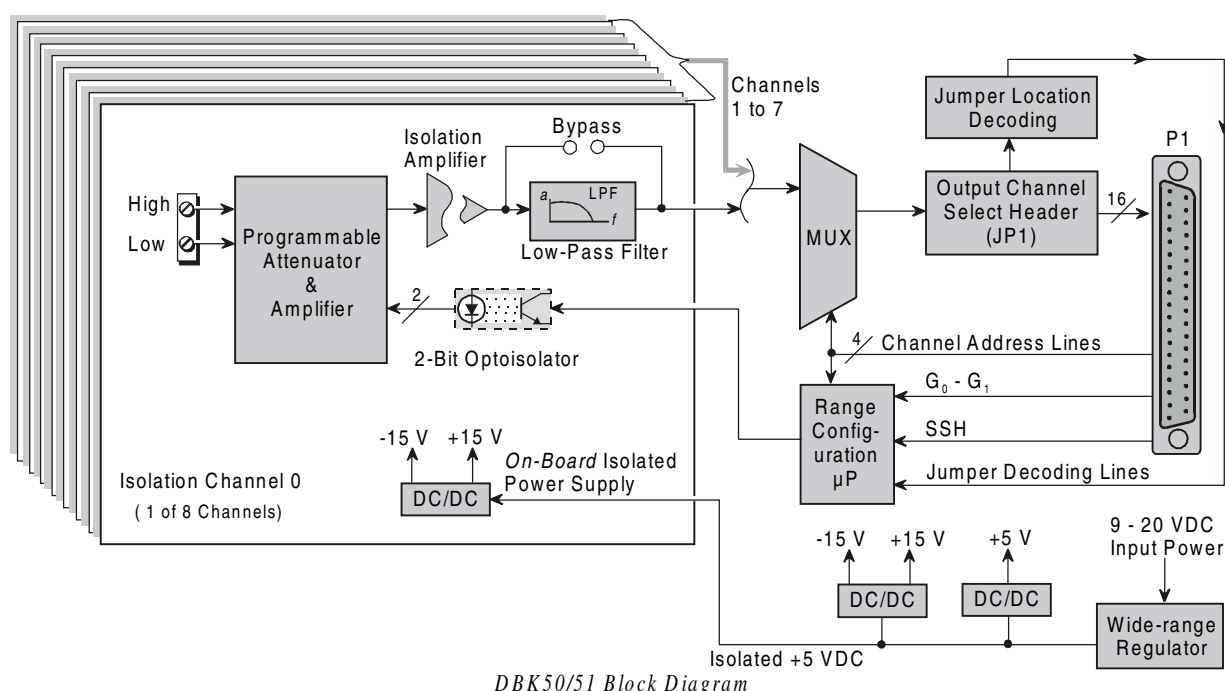
Overview

Except for their ranges, the DBK50 (high-voltage) and the DBK51 (low-voltage) are identical. Both have 8 channels isolated from themselves (750 V) and from the LogBook 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 3 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.



Input Attenuation/Gain Factors

Gain and attenuation may be calculated using the formula:

$$K = V_{in} / V_{out}$$

where: **K** is the attenuation or gain factor (the values of **K** for available voltage ranges are given in the table).

V_{in} is the voltage applied to the module input channel.

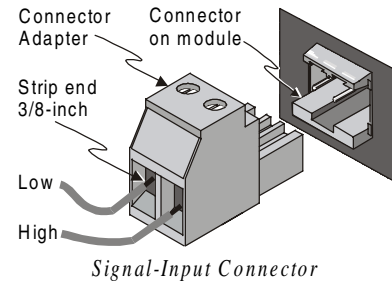
V_{out} is the amplified or attenuated voltage from the module output back to the main unit.

Input Range	Function	K
300 V Range	Attenuates	60
100 V Range	Attenuates	20
10 V Range	Attenuates	2
1 V Range	Amplifies	0.2
100 mV Range	Amplifies	0.02
Note: not all input ranges are available on a single unit.		

Hardware Setup

Signal-to-Module Connection

The DBK50/51 rear panel has 8 plug-in screw terminals for easy access to the 8 analog input channels. There is a high (right side) and a low (left side) terminal in each pair to maintain consistent polarity (see figure). For AC signals, the polarity is arbitrary unless multiple signals must maintain their phase relationship.



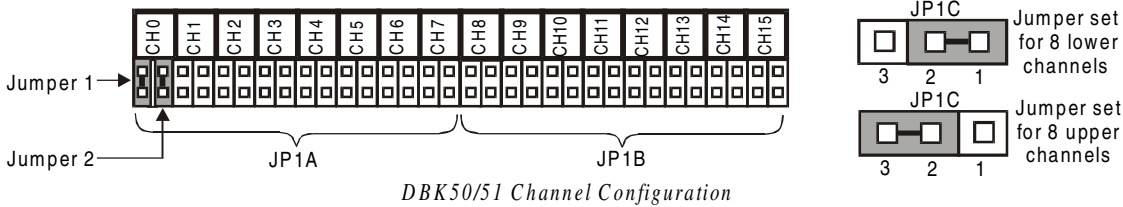
Module Configuration

Several jumpers must be set on the DBK50/51 to match your application:

- 2 jumpers on JP1 or JP1B to select the LogBook main channel to use
- 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)

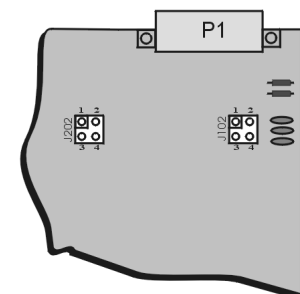
The main output channel is one of the 16 LogBook channels. Each DBK50/51 has 8 input channels and can be set to an upper or lower sub-channel that allows 2 modules to share a single LogBook channel. (Thus, a fully-populated system can have 256 input channels.)

After determining a main channel number for the module, set two jumpers on JP1A or JP1B for the desired channel (both jumpers must be used side-by-side on the selected channel—see figure). Next, set the JP1C jumper for the upper or lower sub channel. Two modules may share the same main channel if one is set to the upper sub channel and the other set to the lower sub channel.



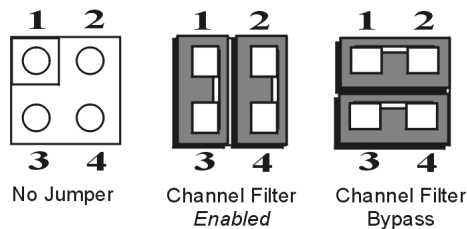
Each of the 8 input channels has a 3-pole low-pass filter that may be manually selected or bypassed by positioning 2 shunt jumpers on 2×2 headers for each channel. Orient the jumpers parallel/horizontal (enable) or perpendicular/vertical (bypass) to the header label (JP102 to JP802 for each of 8 channels). The following figure can be used for orientation.

Not to Scale



DBK50/51 partial board, referencing two of eight filter jumpers.

This reference applies to Channel Filter Jumpers J102 through J802 (for channels 1 through 8, respectively).



Jumpers Set to 1-3 & 2-4 = Filter Enabled
Jumpers Set to 1-2 & 3-4 = Filter Bypass

Channel Filter Jumper Settings for DBK50 and DBK51

The low-pass filter sections 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	4606X-102-470
3500 Hz	100 Ω	4606X-102-101
1750 Hz	200 Ω	4606X-102-201
750 Hz	470 Ω	4606X-102-471
350 Hz	100 k Ω	4606X-102-102
175 Hz	2 k Ω	4606X-102-208
75 Hz	4.7 k Ω	4606X-102-208
35 Hz	10 k Ω	4606X-102-103
17.5 Hz	20 k Ω	4606X-102-203
7.5 Hz	47 k Ω	4606X-102-473
3.5 Hz	100k Ω	4606X-102-104

DBK50/51 - Specifications

Name/Function: 8-Channel Isolated Voltage Input Module

Connectors: Male DB37, mates with P1

Inputs: Removable screw terminals

Number of Channels: 8, individually isolated

Isolation:

Channel-to-Channel: 750 V

Channel-to-System: 1250 V

Input Impedance: >10 M Ω

Bipolar Input Ranges:

± 300 V, ± 100 V, ± 10 V, ± 100 mV, ± 1 V, ± 10 V

Output Voltage Range: ± 5 VDC

Attenuation Ratios: $K = V_{in} / V_{out}$

100 mV, $K = 0.02$ (gain = 50)

1 V, $K = 0.2$ (gain = 5)

10 V, $K = 2.0$ (gain = 0.5)

100 V, $K = 20.0$ (gain = 0.05)

300 V, $K = 60.0$ (gain = 0.017)

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

Included AC Adapter: 15 VDC 0.9 A

Size: 8½" × 11" × 1-3/8"

DBK52 Thermocouple Input Module

Overview

The DBK52 provides LogBook users with the ability to scan and input thermocouple data for various computer-based temperature-monitoring systems. Features include:

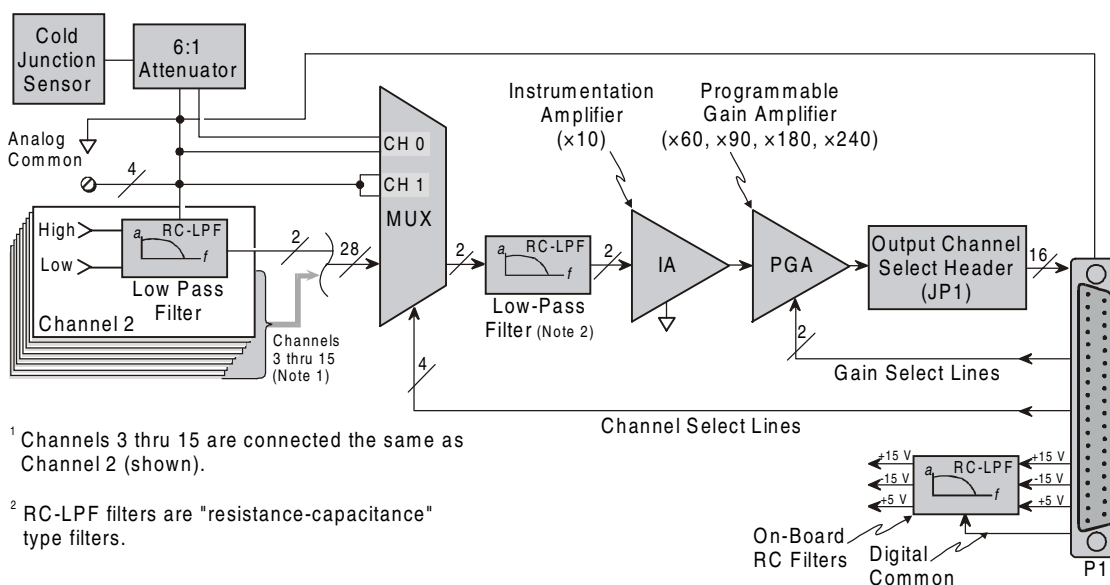
- Each DBK52 can connect up to 14 thermocouples. Up to 16 DBK52s may attach to a single LogBook to measure a maximum of 224 (16 × 14) temperatures.
- Standard, miniature jacks can connect to all T/C types.
- Onboard cold junction sensor (CJS) circuitry is accessible via a built-in channel to the system.
- A built-in short-to-ground channel back to the system eliminates offset errors via software.
- RC low-pass input filters reject high frequency noise for thermocouple shields.
- An external analog-common access jack provides a bias-current return path for differential signal inputs.
- An onboard programmable gain amplifier supports most thermocouple types and temperature ranges.
- Software-based linearization (in LogView) converts analog signals into temperature values.

The table shows the temperature range for each thermocouple type.

T/C Type	J	K	T	E	N28	N14	S	R	B
Temperature Range °C	-200 to 760	-200 to 1260	-200 to 400	-270 to 1000	-270 to 400	0 to 1300	0 to 1780	0 to 1780	0 to 1820
Temperature Range °F	-328 to 1400	-328 to 2300	-328 to 752	-454 to 1832	-454 to 752	32 to 2372	32 to 3236	32 to 3236	32 to 3308

Thermocouple accuracy depends on the thermocouple itself, the cold-junction sensor, A/D conversion, and linearization. The DBK52 and the LogBook systems use quality components and software compensation to minimize error from these sources. Systems achieve a $\pm 1^\circ\text{C}$ CJS accuracy that contributes to the overall accuracy. When the software is calibrated, gain and offset errors are virtually eliminated. The DBK52's built-in auto-zero channel dynamically eliminates any other system offset errors.

True differential measurements of T/Cs require bias-current referenced to the analog common. Resistors from each input T/C are connected to the analog common. Filter capacitors across each input operate with input protection resistors to form a single-pole RC low-pass filter.



DBK52 Block Diagram

Hardware Setup

Module Connection

The DBK52 has miniature T/C jacks to connect different types of thermocouples and an analog-ground access point. Connections are provided for 14 thermocouples. **Thermocouple polarities must be observed.** Thermocouple types J, K, T, E, N28, N14, S, R and B are supported by the LogView software and may be connected to DBK52 board channels CH2 through CH15.

- **CH0** is reserved for the cold-junction compensation sensor (factory installed).
- **CH1** is permanently shorted to allow software-driven auto-zero to compensate for temperature drift.

Thermocouple wire is standardized and color-coded as shown in the table. T/Cs have a very small output. Long T/C leads can pickup lots of noise. Use shielding as needed, and average several readings in software to minimize noise effects.

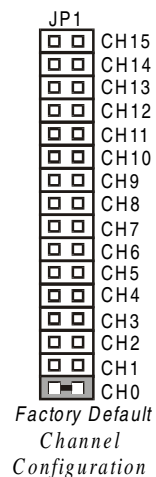
After all connections are in place, secure wires to captive areas (pre-drilled holes) at the rear edge of the board. Nylon tie wraps (not included) work well for this purpose.

T/C Type	(+) Lead to Channel-Hi	(-) Lead to Channel-Lo
J	White	Red
K	Yellow	Red
T	Blue	Red
E	Violet	Red
N28	Orange	Red
N14	Orange	Red
S	Black	Red
R	Black	Red
B	Gray	Red

Module Configuration

Up to 16 DBK52s may be connected to a LogBook. As a daisy-chain interface, each module must appear unique to the LogBook. Each module uses a different analog input channel. To configure the module:

1. Assign a channel number to the module. **The assigned number must not be used by any other DBK card or module.**
2. Locate the 16×2-pin header near the front of the board labeled JP1, and place the jumper on the LogBook channel you wish to use. There are 16 jumper locations on this header labeled CH0 through CH15. Only one jumper setting is used on a single module; no other module in a common daisy-chain can use the same jumper setting.



DBK52 - Specifications

Name/Function: Thermocouple Input Module

Connectors:

DB37 male, mates with P1.

Thermocouples attach directly to on-board jacks.

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: $\times 60$, $\times 90$, $\times 180$, $\times 240$

Inputs:

14 differential thermocouples

1 cold-junction compensation

1 auto zero

Cold Junction Sensor Output: 100 mV/°C

Voltage Ranges/Gains:

0 to 80 mV $\times 60$

0 to 50 mV $\times 90$

0 to 25 mV $\times 180$

0 to 20 mV $\times 240$

0 to ± 10 mVDC

Input Impedance: 20 k Ω

Input RC Filter -3 dB Frequency: 15.9 kHz

Gain Accuracy:

Uncalibrated: 0.15%

Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Type/Range/Accuracy/Resolution: see table

Type	Range		Accuracy		Resolution			
	Min	Max	(<0°C)	(>0°C)	12-bit <0°C	12-bit >0°C	16-bit <0°C	16-bit >0°C
J	-200°C	760°C	0.6°C	0.6°C	1.2°C	0.5°C	0.1°C	0.1°C
K	-200°C	1260°C	1.6°C	1.0°C	1.1°C	0.8°C	0.1°C	0.1°C
T	-200°C	400°C	1.4°C	0.8°C	0.8°C	0.3°C	0.1°C	0.1°C
E	-270°C	1000°C	1.4°C	0.9°C	1.6°C	0.7°C	0.1°C	0.1°C
N28	-270°C	400°C	0.8°C	0.8°C	1.0°C	1.0°C	0.1°C	0.1°C
N14	0°C	1300°C	—	1.0°C	—	5.0°C	—	5.0°C
S	0°C	1780°C	—	1.6°C	—	1.3°C	—	0.1°C
R	0°C	1780°C	—	1.6°C	—	1.7°C	—	0.1°C
B	0°C	1820°C	—	1.8°C	—	1.5°C	—	0.1°C

DBK53/54 Low/High-Gain Analog Multiplexing Modules

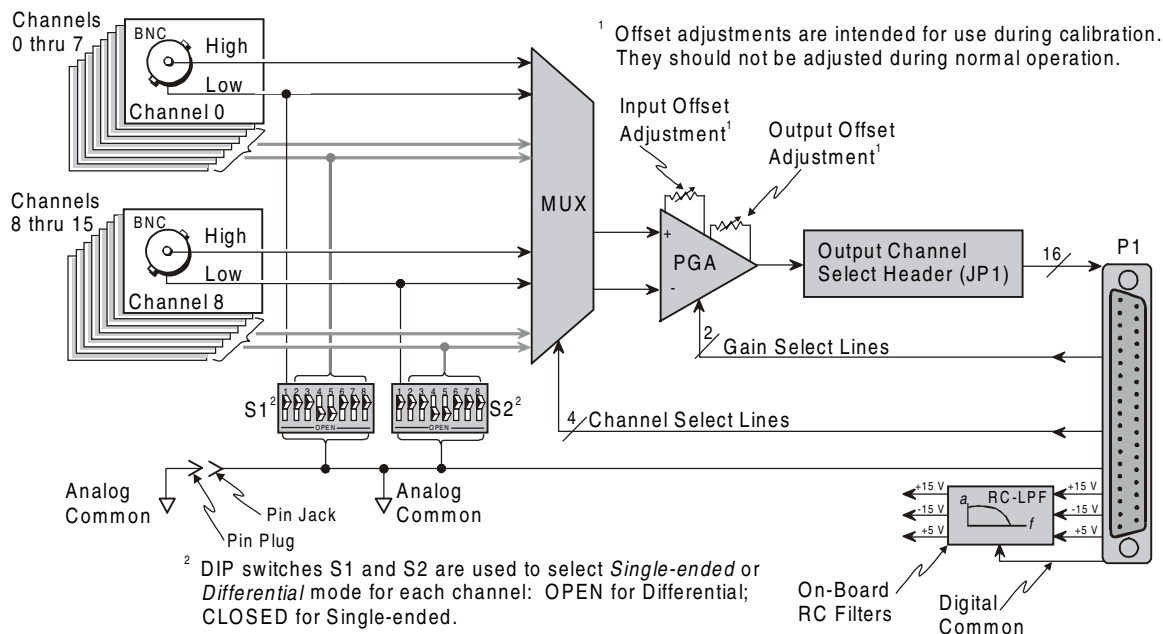
Overview

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 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 expansion module/power supply.
- Use one of the LogBook'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 512 location scan sequencer can directly program the expansion modules to scan external signals at the same 10 μ s/channel rate as on-board channels. (The time skew between channels is constant.)

The amplification gains for each module are:

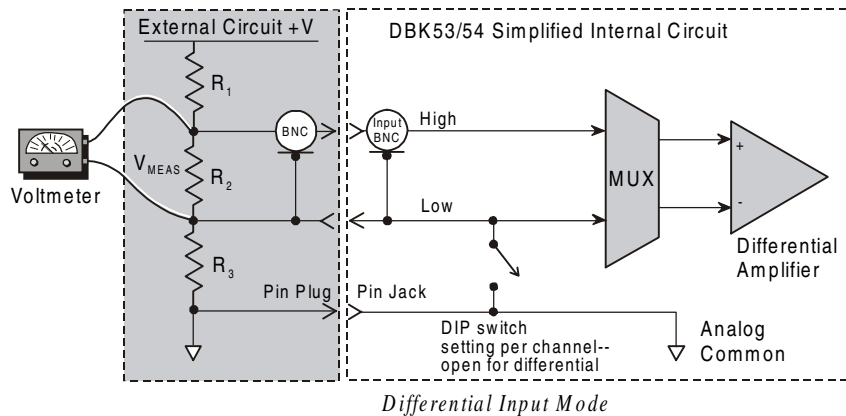
- The DBK53 has 4 gain ranges of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ that are scan-programmable per channel. These gains can be combined with the standard gains of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ for net gains of $\times 1$, $\times 2$, $\times 4$, $\times 8$, $\times 16$, $\times 32$, and $\times 64$.
- The DBK54 has 4 gain ranges of $\times 1$, $\times 10$, $\times 100$ and $\times 1000$ that are scan-programmable per channel. These gains can be combined with the standard gains of $\times 1$, $\times 2$, $\times 4$, and $\times 8$ for net gains of $\times 1$, $\times 2$, $\times 4$, $\times 10$, $\times 20$, $\times 40$, $\times 80$, $\times 100$, $\times 200$, $\times 400$, $\times 800$, $\times 1000$, $\times 2000$, $\times 4000$, and $\times 8000$.



Hardware Setup

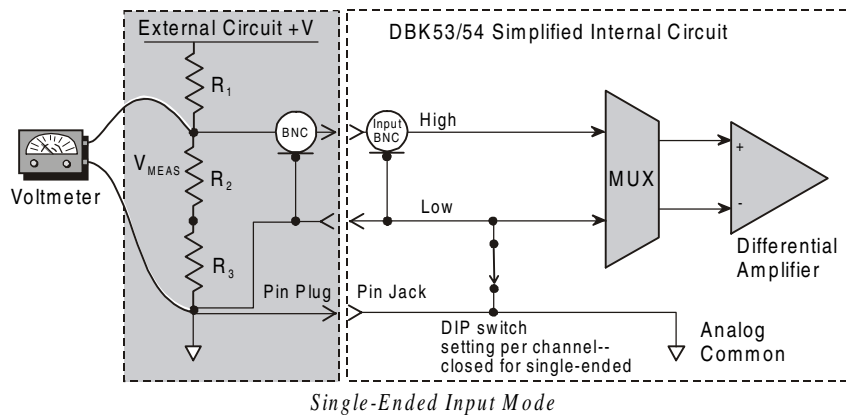
Differential Mode

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



Single-Ended Mode

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



Module Connection

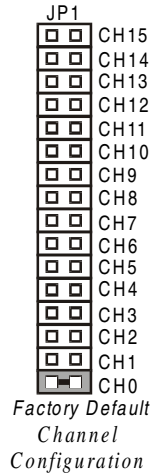
When connecting analog inputs, carefully consider the requirements for signal connection and ground referencing. Use BNC-terminated cables (test leads) to interface with the channel inputs. Be sure to provide the necessary analog common connection.

Module Configuration

Up to 16 DBK53/54s may be connected to a LogBook. As a daisy-chain interface, each module must appear unique to the LogBook. Each module uses a different analog input channel.

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. Locate the 16×2-pin header near the front of the board labeled JP1, and place the jumper on the LogBook channel you wish to use. The 16 jumper locations on this 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.



DBK53/54 - 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



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Overview

This chapter explains how LogBook systems can handle signals in an optimum way and avoid noise problems. The first part of the chapter explains channel expansion and configuration. Then, most of the chapter explains how to apply basic concepts of data acquisition. The discussion centers on signals: how to manage them, how to use different types of signals, and how to reduce common noise problems. Lastly, the chapter offers basic troubleshooting tips.

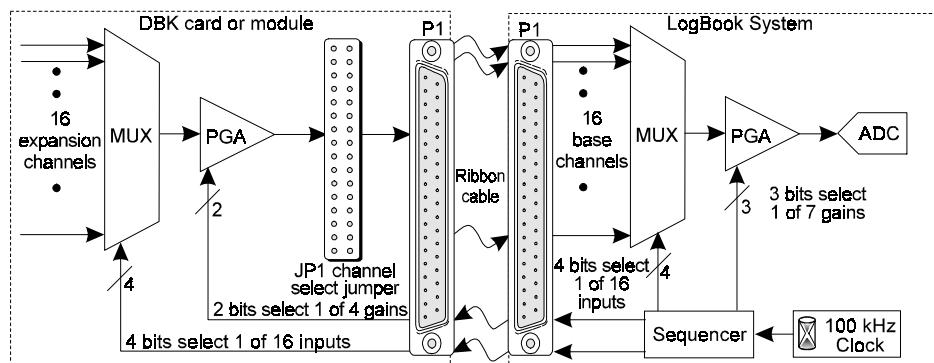
This table defines data acquisition terms *as used in this manual*.

Data Acquisition Terms and Meanings	
Acquisition	A collection of scans acquired at a specified rate as controlled by the sequencer.
Analog	A signal of varying voltage or current that communicates data. Many analog signals have the form of sine waves.
Analog-to-Digital Converter (ADC)	A circuit or device that converts analog voltage values into digital values, such as binary bits, for use in digital computer processing.
Bipolar	A range of analog signals that includes positive and negative values (e.g., -10 to +10 V); see <i>unipolar</i> .
Buffer	<i>Buffer</i> refers to a circuit or device that allows a signal to pass through it, while providing isolation, or other function, without altering the signal. <i>Buffer</i> can refer to one of the following: <ul style="list-style-type: none"> (a) A device or circuit that allows for the temporary storage of data during data transfers. Such storage is often necessary to compensate for differences in data flow rates. A FIFO (First In - First Out) buffer is one in which the data that is stored first, is also the first data to leave the buffer. (b) A follower stage used to drive a certain number of gates without overloading the preceding stage. (c) An amplifier that accepts high source-impedance input and results in low source-impedance output (effectively, an impedance buffer). (d) Buffer Amplifier (see <i>Buffer Amplifier</i>).
Buffer Amplifier	An amplifier used primarily to match two different impedance points, and isolate one stage from a succeeding stage in order to prevent an undesirable interaction between the two stages. (Also see <i>Buffer</i>).

Data Acquisition Terms and Meanings	
Channel	<p><i>Channel</i> usually refers to a single <i>input</i> or <i>output</i> entity.</p> <p>In a broader sense, an <i>input channel</i> is a signal path between the transducer at the point of measurement and the data acquisition system. A channel can go through various stages (buffers, multiplexers, or signal conditioning amplifiers and filters). Input channels are periodically sampled for readings.</p> <p>An <i>output channel</i> from a device can be digital or analog. Outputs can vary in a programmed way in response to an input channel signal.</p>
Common mode	Common mode pertains to signals that are identical in amplitude and duration; also can be used in reference to signal components.
Common mode voltage	Common Mode Voltage refers to a voltage magnitude (referenced to a common point) that is shared by 2 or more signals. Example: Signal 1 is +5 VDC referenced to common. Signal 2 is +6 VDC referenced to common. The common mode voltage for the two signals is +5.5 VDC $[(5 + 6)/2]$.
Crosstalk	An undesired transfer of signals between systems or system components. Crosstalk causes signal interference, more commonly referred to as <i>noise</i> .
Data Logger	A system that efficiently saves large quantities of data to suitable memory media.
Digital	A digital signal is one of discrete value, in contrast to a varying signal. Digital data is represented by combinations of binary digits (0s and 1s).
Digital-to-Analog Converter (DAC)	A circuit or device that converts digital values (binary bits), into analog signals.
DIP Switch	A DIPswitch is a group of miniature switches in a small <i>Dual In-line Package</i> (DIP). Typically, users set these switches to configure their particular application.
Differential mode	The differential mode measures a voltage between 2 signal lines for a single channel. (Also see <i>single-ended mode</i>).
Differential mode voltage	<p>Differential Mode Voltage refers to a voltage difference between 2 signals which are referenced to a common point. Example: Signal 1 is +5 VDC referenced to common. Signal 2 is +6 VDC referenced to common.</p> <p>If the +5 VDC signal is used as the reference, the differential voltage is +1 VDC (+6 VDC - +5 VDC = +1 VDC).</p> <p>If the +6 VDC signal is used as the reference, the differential voltage is -1 VDC (+5 VDC - +6 VDC = -1 VDC).</p>
ESD	Electrostatic discharge (ESD) is the transfer of an electrostatic charge between bodies having different electrostatic potentials. This transfer occurs during direct contact of the bodies, or when induced by an electrostatic field. ESD energy can damage an integrated circuit (IC); so, safe handling is required.
Excitation	Some transducers [e.g. strain gages, thermistors, and resistance temperature detectors (RTDs)] require a known voltage or current. Typically, the variation of this signal through the transducer corresponds to the condition measured.
Gain	The degree to which an input signal is amplified (or attenuated) to allow greater accuracy and resolution. Gain can be expressed as $\times n$ or $\pm dB$.
Isolation	<p>The arrangement or operation of a circuit so that signals from another circuit or device do not affect the <i>isolated</i> circuit.</p> <p><i>Isolation</i> usually refers to a separation of the direct link between the signal source and the analog-to-digital converter (ADC). Isolation is necessary when measuring high common-mode voltage.</p>
Linearization	Some transducers produce a voltage in linear proportion to the condition measured. Other transducers (e.g., thermocouples) have a nonlinear response. To convert nonlinear signals into accurate readings requires software to calibrate several points in the range used and then interpolate values between these points.
Multiplexer (MUX)	A device that collects signals from several input channels and outputs them on a single channel.
Sample (reading)	The value of a signal on a channel at an instant in time. When triggered, the ADC reads the channel and converts the sampled value into a 12- or 16-bit value.
Scan	The channels that are selected for sampling.
Sequencer	A programmable device that manages channels and channel-specific settings.
Simultaneous Sample-and-Hold	An operation that gathers samples from multiple channels at the same instant and holds these values until all are sequentially converted to digital values.
Single-ended mode	The single-ended mode measures a voltage between a signal line and a common reference that may be shared with other channels. (Also see <i>differential mode</i>).
Trigger	An event to start a scan or mark an instant during an acquisition. The event can be defined in various ways; e.g., a TTL signal, a specified voltage level in a monitored channel, a button manually or mechanically engaged, a software command, etc. Some applications may use pre- and post-triggers to gather data around an instant or based on signal counts.
TTL	Transistor-Transistor Logic (TTL) is a circuit in which a multiple-emitter transistor has replaced the multiple diode cluster of the diode-transistor logic circuit; typically used to communicate logic signals at 5 V.
Unipolar	A range of analog signals that is always zero or positive (e.g., 0 to 20 V). Evaluating a signal in the right range (unipolar or bipolar) allows greater resolution by using the full-range of the corresponding digital value. See <i>bipolar</i> .

Channel Control and Expansion

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



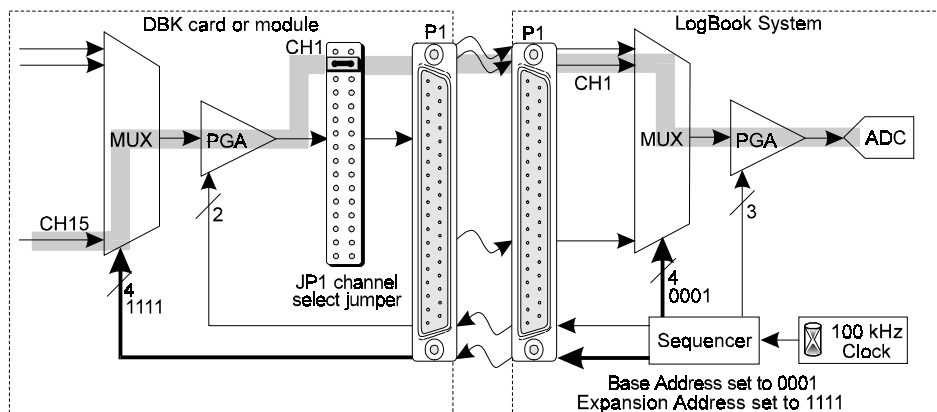
The figure above shows the functional parts related to channel control and expansion:

- The **sequencer** selects the channel and gain by controlling multiplexers (MUX) and programmable gain amplifiers (PGA) in both the LogBook and the DBK. The sequencer uses 4 expansion address lines to provide 16 unique channel addresses for each base channel. A 100 kHz clock and user programming of the scan sequence control the sequencer.
- The **DBK multiplexer** selects 1 of 16 (max) channels as directed by the sequencer. The selected signal goes to the PGA, then to the channel-selection jumper, and then to the LogBook via P1.
- The **LogBook multiplexer** selects 1 of 16 base channels from P1 input lines as directed by the sequencer. The selected signal goes to the PGA and then to the A/D converter (A/D).
- The **PGAs** can vary the gain on a per channel basis as directed by the sequencer. For DBKs with a PGA, the sequencer can combine the gains of the DBK PGA and the LogBook PGA for a variety of gain settings.
- The **P1 interface** has a signal line for each of the 16 base channels and control lines for gain setting (pins 5, 6) and sub-channel selection (pins 3, 4, 22, 23).
- The **JP1 channel select jumper** in the DBK can be placed on pins for channel 0 through channel 15. Until the base channel capacity is filled (16 max), multiple cards can use the same JP1 channel setting if their DIP switches are set to identify unique sub-channel card numbers.

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

Besides the base channel selection on JP1, many DBKs must be set the sub-channel (or card) number by a DIPswitch labeled SW1. DBKs vary in their channel capacity and identification—refer to the respective DBK section.

Example (see next figure): To select channel 15 on a DBK card connected to base channel 1, the sequencer expansion address would be set to 1111, the base address would be set to 0001, JP1 would be set to channel 1. Depending on the DBK, a DIPswitch would be set to identify one of multiple cards on a single channel.



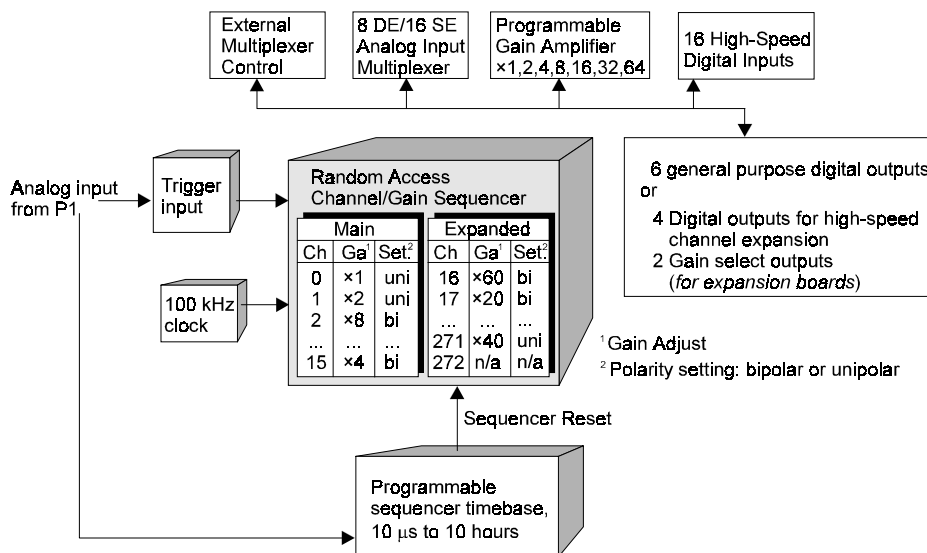
Example Channel Selection

Signal Acquisition

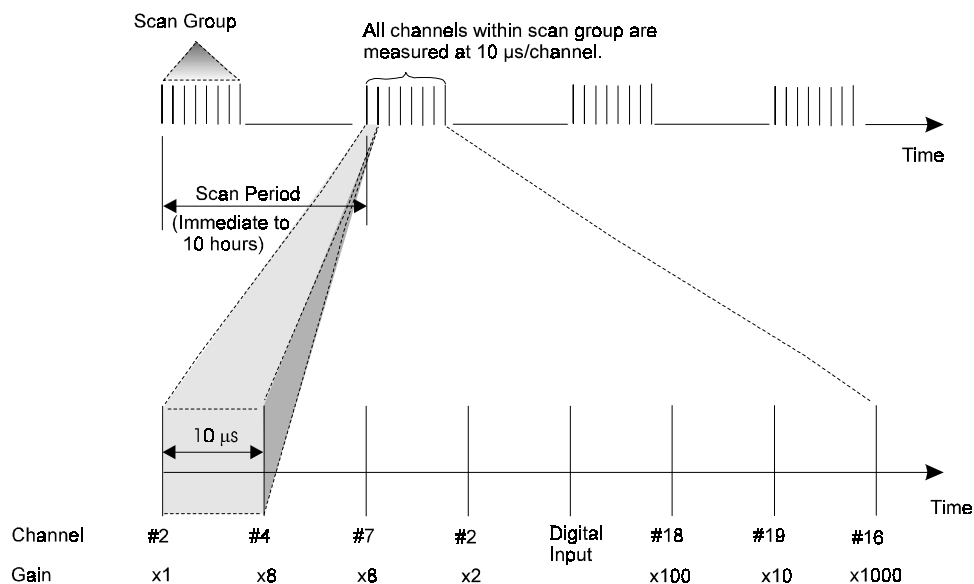
Sequencer

The hardware sequencer performs several functions:

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



LogBook holds the scan information in its internal sequencer. On every timebase “tick”, the sequencer steps through all the programmed channels and sets the gain and uni/bi-polar setting for each channel. Thus, each sample in a scan is read optimally. Besides controlling the LogBook, the sequencer also controls the programmable features on expansion cards via the P1 connector. This architecture ensures the same 10 μ s sampling of external channels as internal channels.

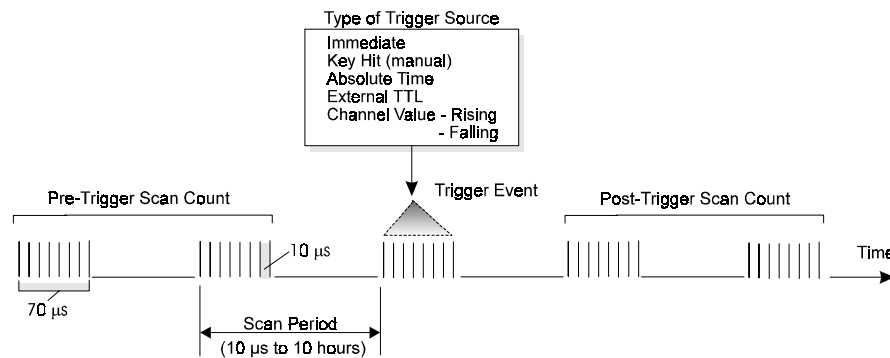


Scan Rate

Most sampling of analog signals occurs on the timebase of the LogBook clock. The **scan period** is the time duration between successive scans. Inversely, the **scan rate**, or **scan frequency** is the number of scans per time interval, usually expressed in *scans per second*. The channels within the scan are always sampled at a fixed period of 10 μs (100 kHz rate). Generally, the sampling frequency must be greater than twice the highest signal frequency of interest to prevent aliasing error. **Note:** Except in the case of a single-channel scan, the sampling rate per channel can be much slower than the scan rate.

Triggering

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



- The **pre-trigger scan count** specifies the number of scans that are to be collected before the trigger point. If the pre-trigger scan count is greater than zero, the system will continuously collect data until the trigger is satisfied. If no pre-trigger scans are required, the system sits idle until the trigger; then, it collects the post-trigger scans before it disarms.
- The **post-trigger scan count** specifies the number of scans to be collected after the trigger point. After the trigger, the post-trigger scans will be collected as programmed and then the system will disarm itself.
- The **trigger source** can be a software command, an external TTL input, etc. An analog input channel on reaching a specified voltage level can be used to trigger the system. (In this mode, an analog output channel is used to internally set the analog threshold—making it unavailable for other use.)

Counter/Timer Functions

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

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

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

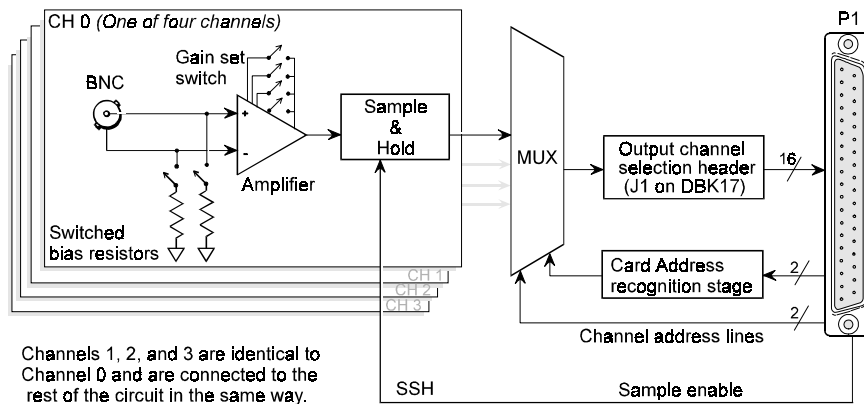
The counter channels can act as 4 independent 16-bit up-counters or as 2 32-bit counters (with channels 0 and 2 cascaded and with channels 1 and 3 cascaded).

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

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

Simultaneous Sample and Hold (SSH)

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



Simultaneous Sample and Hold Circuit, DBK17 Example

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

The figure shows how SSH is used in the DBK17 SSH Card. Each input signal continuously passes through an instrumentation amplifier and into a sample-and-hold stage. When the sample enable line goes high, each channel's sample-and-hold stage will “freeze” the current analog value. The values for all channels are separately “latched” within 50 ns of each other. These signals are held in a stable condition while the multiplexer switches through all channels and sends them one-by-one to the LogBook where the ADC digitizes each reading. The resulting data is a snapshot of conditions at an instant, but the multiplexing and analog-to-digital conversion are spread over a longer time interval. The simultaneous sample and hold circuit allows you to gather up to 256 simultaneous samples using sixty-four DBK17s.

Input Isolation

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

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

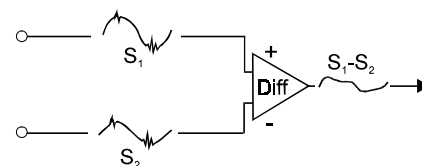
Signal Modes

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

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

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

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



Noise Reduction in Differential Mode

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

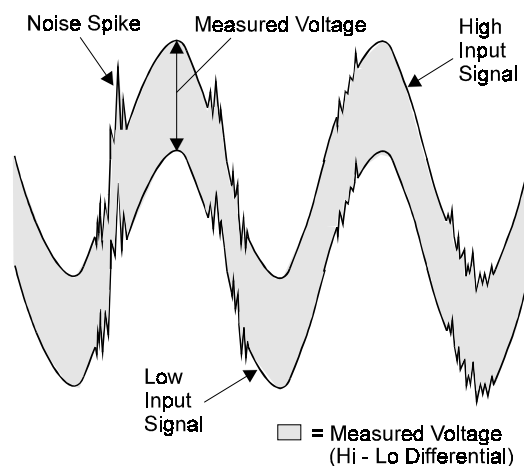
References for Differential Modes

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

Differential Mode, Ground-Referenced

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

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

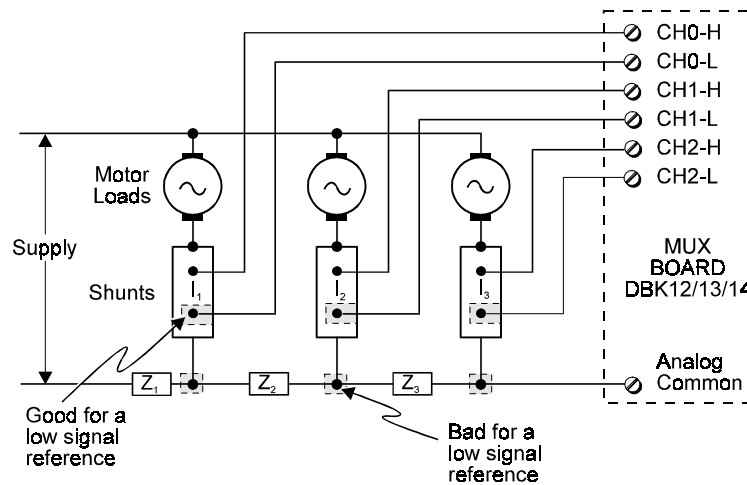


Common-Mode Voltage: Noise Cancellation with Differential Measurement

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

Differential Mode, Shunt-Referenced

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

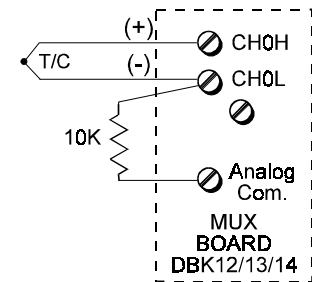


Differential Circuit with Shunt-reference

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

Differential Mode, Floating

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



Floating Differential Circuit



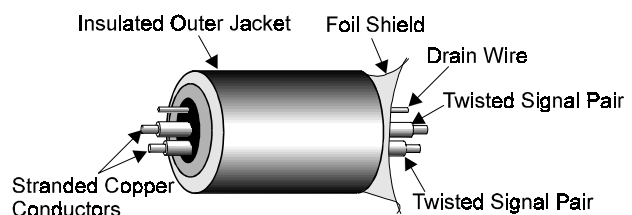
Differential signal hookups do not provide isolation or any kind of circuit protection. Other ways to protect circuits from high-voltage spikes must be used.

Connecting Differential Amplifiers

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

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

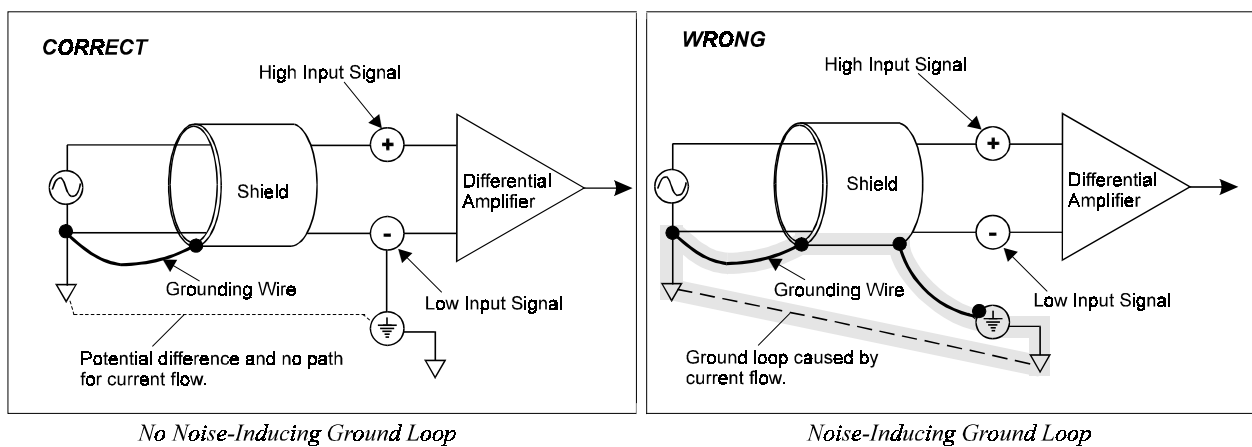
The twisted signal pairs should make use of low impedance, stranded copper conductors; and the foil shield should be of the type using multiple folds.



Shielded Signal Cable

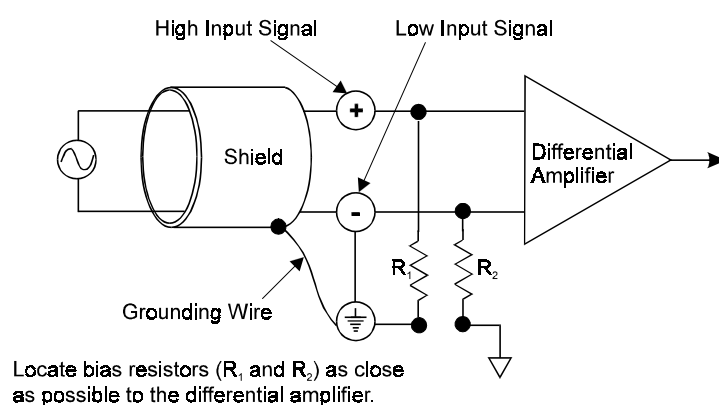
The copper-stranded drain wire should be considered as part of the shield, and should be connected as described later in this section. Proper use of a quality signal cable will result in a dramatic reduction of noise.

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



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

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



Unipolar and Bipolar Measurement

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

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

12-Bit vs 16-Bit Resolution

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

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

Signal Problems

System Noise

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

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

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

Averaging

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

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

Analog Filtering

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

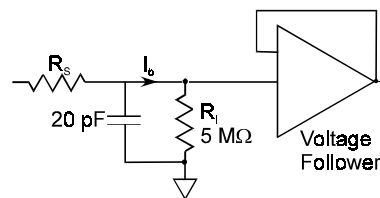
Filter circuits can be active or passive:

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

Input and Source Impedance

As shown in the figure to the right, each LogBook input has an impedance of 5 MΩ in parallel with approximately 20 picofarad (pF) of capacitance. Each input also has a typical bias current (I_b) of 100 nano-Ampere (250 nA maximum). This input impedance (R_i) combines with the transducer's source impedance (R_s) forming a voltage divider. With a high source impedance, this divider can distort the voltage read by the LogBook. The actual voltage read is represented by the equation:

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



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

Crosstalk

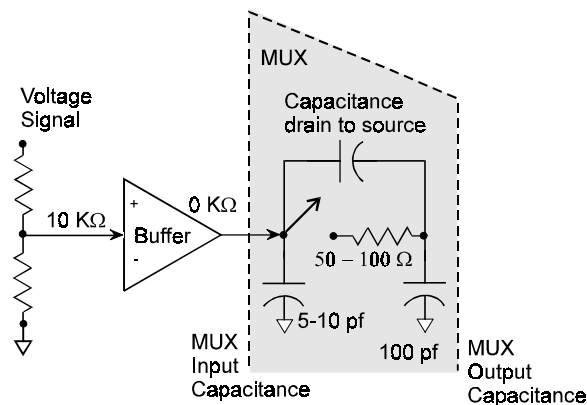
Crosstalk is a type of noise related to source impedance and capacitance, in which signals from one channel leak into an adjacent channel, resulting in interference or signal distortion. The impact of source impedance and stray capacitance can be estimated by using the following equation.

$$T = RC$$

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

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

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



Troubleshooting

Users can solve some problems on their own without factory assistance. Before calling for help, you should go through the troubleshooting checklist below.

Troubleshooting Checklist

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

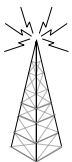
1. **Power.** Check power and fuses to all affected units. Sometimes cycling the power off and then back on may allow system parameters to reset themselves correctly.
2. **Signal.** Check signal lines and connectors. Connectors must be free of corrosion; lines should be undamaged free of sharp bends and twists. Signal paths should avoid potential sources of noise (high voltage and electromagnetic interference).
3. **Self-Test.** Run system diagnostic tests to confirm the LogBook is properly connected to the PC.
4. **Software.** Try to acquire data with the LogView windows application. If you are unable to acquire data in both LogView and another program, a hardware problem is likely. If you can make readings in LogView by enabling the input reading column, but you cannot log data to disk, an interrupt problem is likely.
5. **Interrupt.** Make sure the interrupt selected matches the interrupt used by the parallel port. The program MSD.EXE (comes with DOS 6.0 and later) reports the interrupt usage of the computer. In some cases, an interrupt conflict may arise due to a Windows printer driver stealing the interrupt. (Some Hewlett-Packard and LexMark printer drivers are known to do this.) For such a problem, you must edit the SYSTEM.INI file and remove lines loading the printer drivers. In other cases, the hardware is incapable of accepting interrupts through the parallel port.
6. **Parallel port.** Make sure the parallel port selected is the same as the port to which the LogBook is connected. Also, make sure the correct protocol is selected.
7. **Software setup.** Make sure the device selected in software matches the hardware being used. Verify that setup parameters are correct for your application and attached DBK cards and modules.
8. **Power management.** The POWER.EXE power management program that is used by some notebook computers is known to affect proper operation of the parallel and PCMCIA ports. If you are having such trouble, remove the line loading this program from your AUTOEXEC.BAT file.
9. **Device drivers.** Some computers are pre-configured for numerous device drivers in their AUTOEXEC.BAT and CONFIG.SYS files. These drivers often conflict and can be a source of trouble. It is helpful for diagnostic purposes to boot the machine and test the system with the minimum number of device drivers loaded.

Electrostatic Discharge (ESD)



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.

Radio Frequency Interference



Daq* hardware complies with the limits for a Class B digital device according to FCC rules and CE specifications. These limits provide reasonable protection against harmful interference in a residential environment. If not installed or used correctly, this equipment can radiate radio frequency energy and interfere with radio communications. You can determine if the interference is caused by your LogBook system by turning power to your system off and on and observing the effect on the interference. You can often correct radio interference by one or more of the following measures:

- **Antenna Adjustment:** Re-orient or relocate the receiving antenna.
- **Spatial Separation:** Increase the separation between the equipment and the receiver.
- **Circuit Separation:** Connect the LogBook and receiver equipment to different circuits.

Otherwise, consult an experienced radio/television technician for help. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 004-000-00345-4.

Customer Assistance

To report problems and receive support, call the manufacturer's Applications department (phone numbers and address at the beginning of this manual). When you call, please have the following information available:

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

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

- A contact person who can discuss the problems encountered
- The return shipping instructions
- All troubleshooting notes and comments on tests performed and all problem-related conditions.

Note: Before calling for assistance, take a few minutes to read all parts of the manual that may be relevant to the problem conditions. Also, work through the *Troubleshooting Checklist*.



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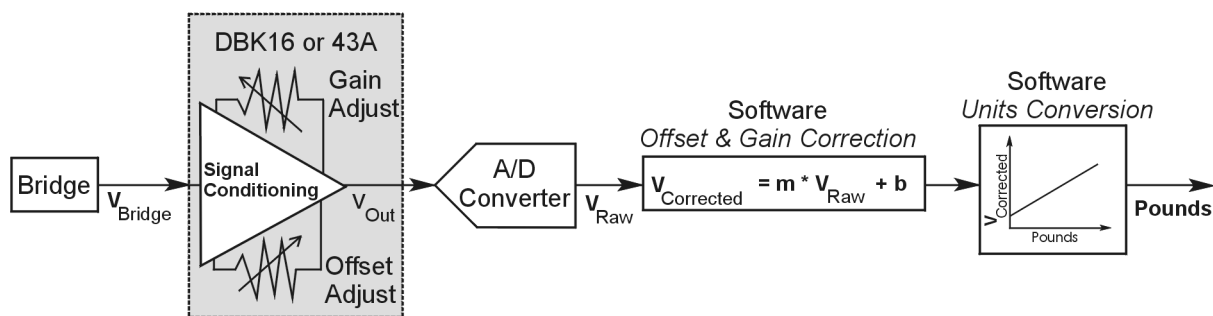
Creating a Units Conversion Transfer FunctionA-15

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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

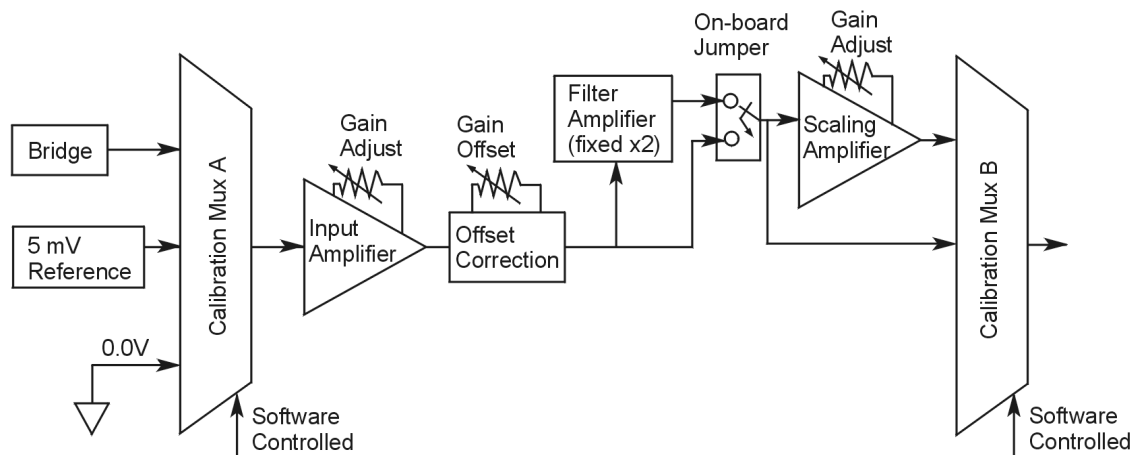
The trimpots provide course tuning so large quiescent offsets can be nulled and the bridge signal can be amplified to match the A/D input range. Once these adjustments are made, the operator can periodically fine-tune the calibration via software using LogView's 2-Point calibration feature (see page 15 of this appendix). LogView's scale and offset features provide a simple means to apply a transfer function that converts the voltage to user units, for example, pounds, as in the above block diagram.

Bridge circuit transducers are used for many different applications, and the strain gage signal conditioning modules are flexible enough to support most of them. Each channel circuit has an excitation regulator, a high gain (x100 to x1250) input amplifier with offset adjustment, a low-pass filter, a scaling (x1 to x10) amplifier, and a calibration multiplexer.

By using software-controlled multiplexers, on-board reference voltages can be read by the data acquisition system so that precise gains and offsets can be set. LogView provides a means of easily controlling the calibration multiplexers so that the reference voltages can be displayed while the trimpots are being adjusted.

There are four trimpots to set up each channel circuit. The trimpots are labeled to represent the following adjustments:

- **EXC** - for adjusting the excitation voltage to the transducer
- **GAIN** - for setting the gain of the input amplifier
- **OFFSET** - for adjusting the circuit offset for quiescent loads or bridge imbalance
- **SCALE** - for setting the gain of the scaling amplifier



Signal-Flow Relationship of Software Controlled Multiplexers and On-Board Reference Voltages



This calibration procedure can only be executed while LogBook is attached to a PC that is running LogView.

Note: 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

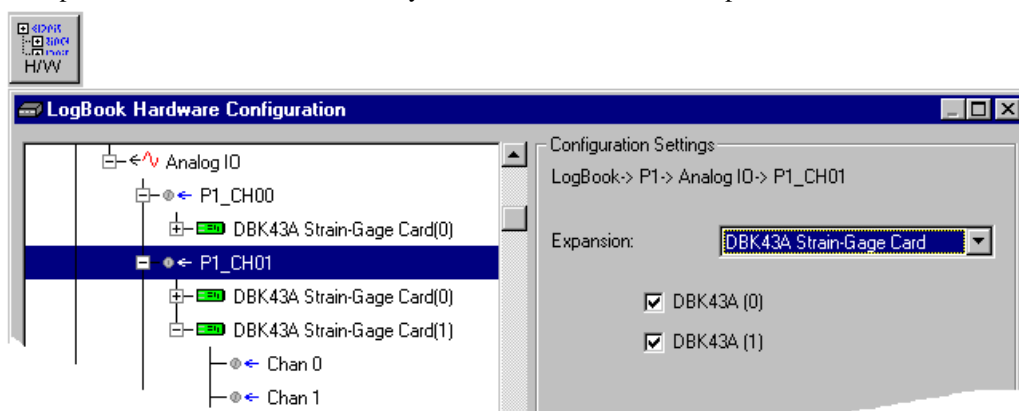
Since the applied calibration-signals are DC, set DC coupling for all the channels that are being adjusted. *If your application requires AC coupling*, don't forget to remove the jumpers when the adjustment procedure has been completed.

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.

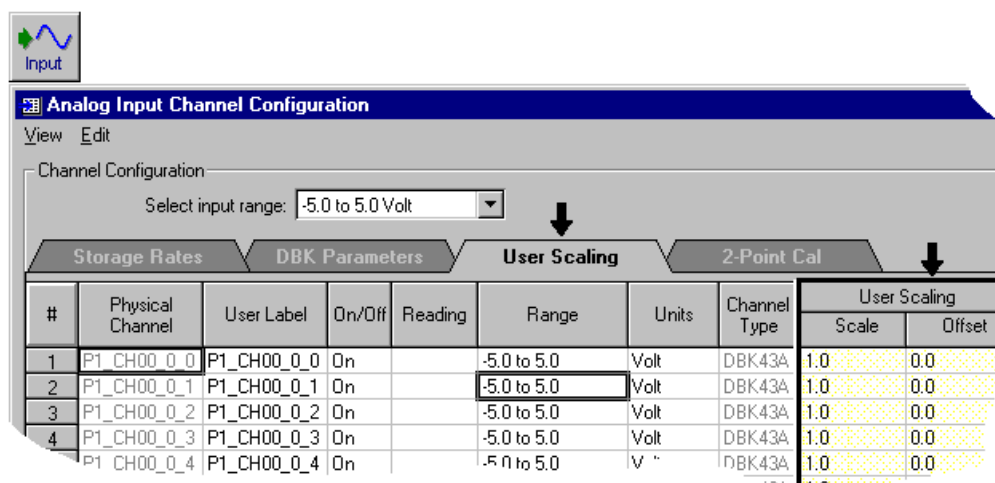
Initialize LogView

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 chapter 3.



LogBook Hardware Configuration, Button and Screen

Open the *Analog Input Channel Configuration Window*. Click the User Scaling Tab and verify that all of the strain gage channels that are to be adjusted have scale and offset values of 1 and 0, respectively.



Analog Input Channel Configuration Window, Button and Screen ... "User Scaling" Tab Selected

For all of the strain gage channels that are to be adjusted, set their ranges to $\pm 5V$. Click the *DBK Parameters* tab to expose the strain gage signal conditioning programmable settings.



Click the Attach button to substantiate a connection between the PC and the LogBook.

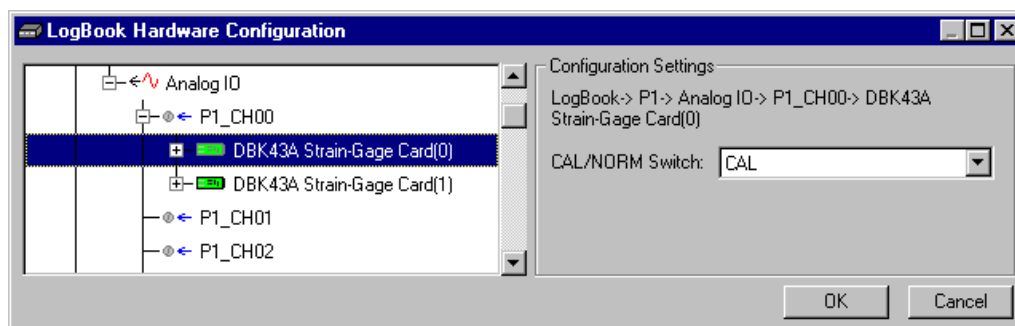
Adjust the Excitation - DBK16

For DBK16, set the excitation voltage for the transducer by adjusting the trimpot labeled EXC and measuring the voltage with a voltmeter across the +EXC and -EXC on the bridge or at the terminals of the signal conditioning module.

Adjust the Excitation - DBK43A

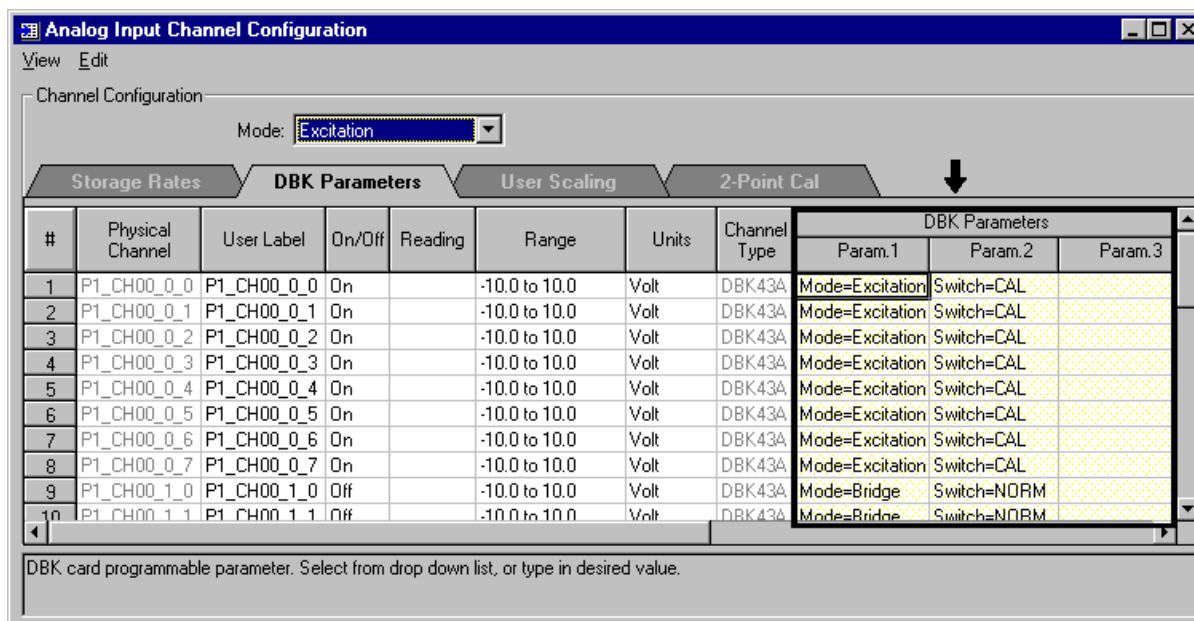
DBK43A is equipped with a switch that allows the excitation voltage to be read by the LogBook and displayed in LogView. For all DBK43A units to be adjusted, you must:

1. Reposition the DBK43A's "physical" calibration switch (located next to the Power LED) to the CAL position.
2. Select CAL in LogView. This is detailed in the following paragraph.
Open the *LogBook Hardware Configuration* window and select DBK43A (see following figure). In the Configurations settings box, set the CAL/NORM Switch to CAL. If the DBK43A is not displayed click the + to the left of the base channel (to which it is attached), this action expands the hardware tree in the *LogBook Hardware Configuration* window. Repeat this process for all DBK43A units that are to be adjusted. Click OK to lock in the changes.



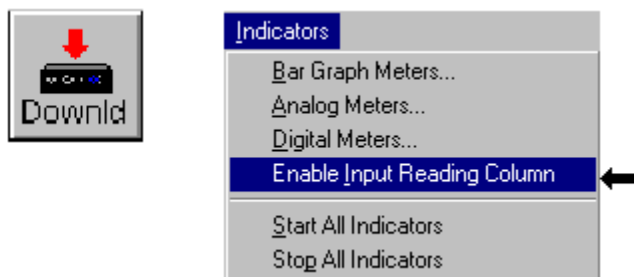
Setting a DBK43A Cal/Norm Switch to "CAL"

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



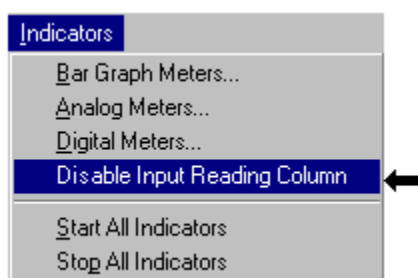
Selecting "Mode = Excitation" for DBK Parameter 1

3. Click the Download button to send the current configuration to the LogBook.
4. Select Indicators \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.



Download Button Selecting “Enable Input Reading Column”(from the Indicators Pull-Down Menu)

8. Set the excitation voltage for each transducer by adjusting the trimpot labeled EXC for the associated channel while reading their values in LogView.
9. Select Indicators \ Disable Input Reading Column from the menu bar.



Selecting “Disable Input Reading Column”(from the Indicators Pull-Down Menu)

8. Return the physical calibration switches (of the applicable DBK43As) to the NORM position.
9. In LogView, open the *LogBook Hardware Configuration Window* (hardware tree) and select NORM for each DBK43A.

<p>This completes the section entitled: “Procedures Common to All Calibration Steps (Required)”</p>
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Nameplate Calibration and Manual Calibration

To properly calibrate a strain gage channel using the **Nameplate method**, the required gain must first be calculated. If the desired gain and offset are already known [as in the **Manual calibration** method] skip to the section, *Determining the Gain of Each Amplification Stage*.

The following examples outline the necessary steps for determining the required gain for **Nameplate calibration**. Both *strain gage* and *load cell* examples are provided.

Calculating the Required Gain

Determining a Strain Gage's Maximum Output Voltage

Most strain gages come with Gage Factors (GF) used to calculate the approximate output of the bridge circuit with a typical strain value. The formula is:

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

Where: V_{BR} = Bridge output voltage

V_{EXC} = Excitation Voltage

G = Gage Factor

S = Strain in user units (in μStrain)

B = Configuration factor (1 for $\frac{1}{4}$ bridge, 2 for $\frac{1}{2}$ bridge, 4 for full bridge)



The equation, $V_{BR} = (V_{EXC} * G * S * B) / 4$ produces a linear estimate. If you are using a non-linear strain gage you should refer to strain gage theory for additional information as needed.

For a 120 ohm strain gage with a gage factor of 2.1 and excitation voltage of 5 V, applying 4000 microstrain would produce a bridge output of 10.5mV for a $\frac{1}{4}$ bridge configuration.

$$V_{BR} = (5 * 2.1 * 4000 \times 10^{-6}) / 4 = 10.5 \text{ mV}$$

Determining a Load Cell's Maximum Output Voltage

Load cells come with a mV/V specification—for each volt of excitation at maximum load, the load cell will output a specific millivolt level.

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

Where: V_{LC} = Load cell output voltage

R = Load cell spec (mV/V)

V_{EXC} = Excitation voltage

Consider a 3000 pound load cell rated at 2.05 mV/V using 10 V of excitation (assume a 350Ω load cell). When 3000 pounds is applied, the voltage out of the load cell is 20.5mV.

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

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

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

Using the Calculated Maximum Voltage to Determine the Necessary Gain

To maximize the resolution and dynamic performance of the system, the sensor's output should be amplified to correspond to the data acquisition system's input range.

Using the LogBook's $\pm 5\text{V}$ input range, the required gain is calculated by dividing 5V by the maximum output voltage of the sensor. Before performing the calculation, it is typically a good idea to pad the maximum sensor voltage by about 5% so that, once amplified, it won't bump into the limit of the 5V range.

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

Where: G = Gain

V_{LB} = LogBook input range

V_{GO} = Maximum gage output

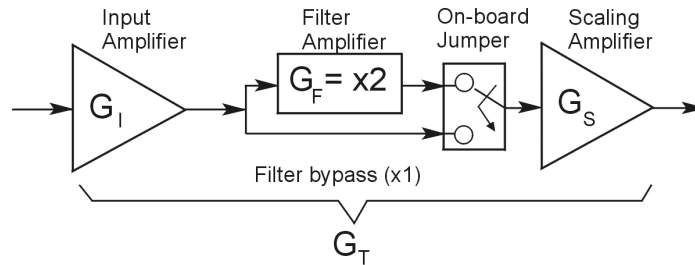
For the strain gage in the previous example with a maximum output of 10.5mV, the required gain is:

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

For the above load cell with a maximum output of 20.5mV, the required gain is:

$$G = 5.0V / (0.0205V + 0.0205V * 0.05) = 232.3$$

Determining the Gain of Each Amplification Stage



The system's total gain is:

$$G_T = G_I * G_F * G_S$$

Where: G_T = Total gain

G_I = Input amplifier gain

G_F = Filter gain

G_S = Scaling amplifier gain

Note: Maximum gain calibration is x1000 for $\pm 5V$ range.

The majority of the gain should be assigned to the Input Amplifier, with the Scaling Amplifier used for fine-tuning. If the filter is enabled, a gain of x2 is automatically introduced.

The input amplifier has a gain range of $\times 100$ to $\times 1250$; the filter gain $\times 1$ or $\times 2$; and the scaling amplifier has a range of $\times 1$ to $\times 10$. For the strain gage example, if we round off our gain to $\times 420$, any of these possible settings will work.

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



For Option C, the LPF gain is typically $\times 2$.

For gains of $\times 1$ (if the filter is enabled), the following apply:

DBK16 - For a gain of $\times 1$ (if the filter is enabled), 10K Ω resistors R44 and R46 must have been previously removed (for the low and high channels, respectively). See DBK16 section of chapter 5 for resistor locations.

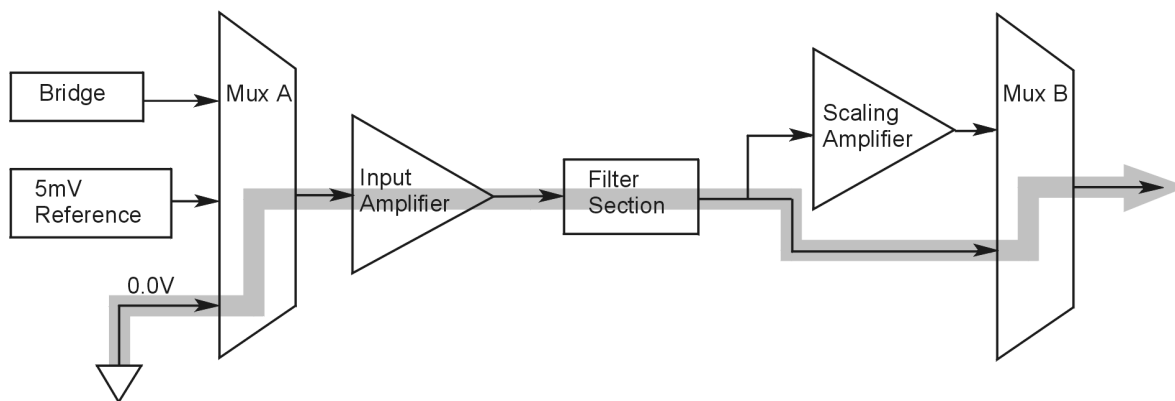
DBK43A - For a gain of $\times 1$ (if the channel filters are enabled), removal of the following 10 K Ω resistors applies: Ch0 – R144, Ch1 – R244, Ch3 – R444, Ch4 – R544, Ch5 – R644, Ch6 – R744, Ch7 – R844. See DBK43A section of chapter 5 for resistor locations.

Channel Calibration Procedure

Adjust the Offset

The following steps are used to adjust the offset.

1. In the Param1 column (see page A-4 for location), select all of the DBK43A channels that are to be adjusted.
2. **Select Mode = SetOffset** from the drop down list above the grid. This selection commands the calibration multiplexer to route the 0.0V reference through the entire analog path (see following figure).



“Mode = Offset” 0.0 Volt Reference is Routed

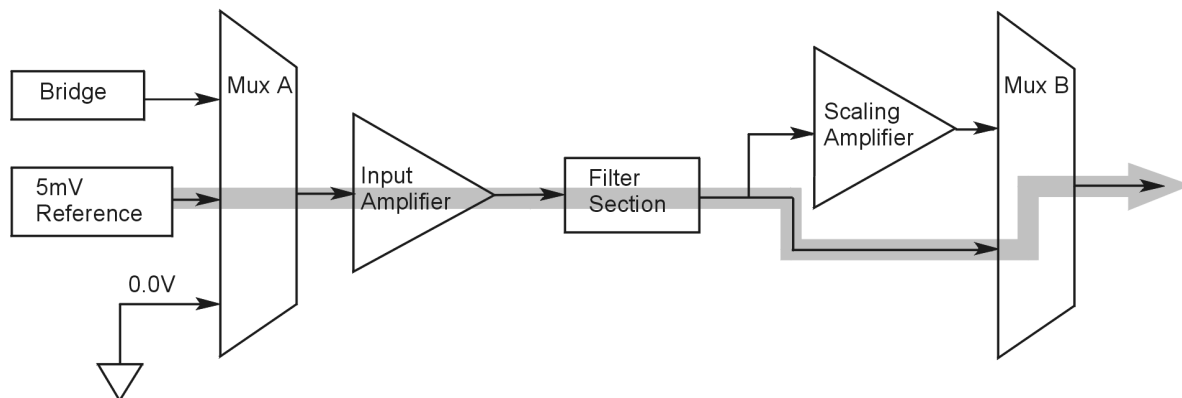
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button. This sends the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar. This displays the offset values for the enabled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

Adjust the Input Amplifier Gain

Perform the following steps to adjust the Input Amplifier Gain.

1. In the Param1 column (see page A-4 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.

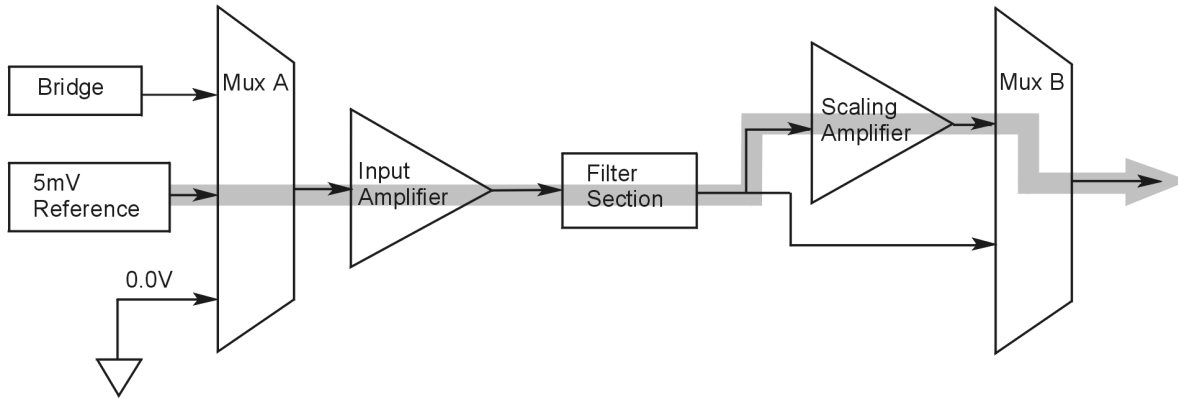
Example 2: If $G_I = 250$ and the filter is *enable*; the GAIN trimpot would be adjusted to obtain 2.50V.

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 4 for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = SetScalingGain** from the drop down list above the grid. This selection commands the calibration multiplexer to route a 5mV reference through all of the amplification stages as shown below.



“Mode = ScalingGain,” 5 milli-Volt Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the values for each channel.
6. For the associated channel, set the voltage to $[G_T * 0.005]$ for each transducer by adjusting the trimpot labeled SCALE. Use the total system gain (G_T) calculated earlier.

Example: If $G_T = 435.5$, the SCALE trimpot would be adjusted to obtain 2.17 V.

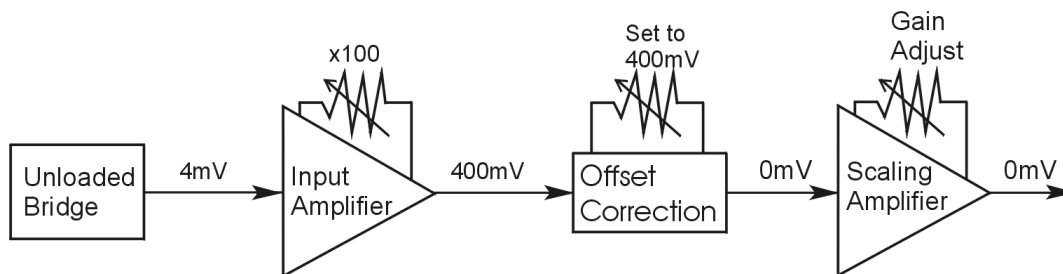
7. Select Indicators \ Disable Input Reading Column from the menu bar.

Trimming Bridge Quiescent Load

Most bridges have some level of offset, even if no quiescent load is present. In quarter and half bridge situations, use of 1% bridge completion resistors can cause up to 1mV/V of offset. If the bridge has 4mV of offset and the Input Amplifier is set to x100, the Offset potentiometer would need to nullify 400mV.

DBK16 – For DBK16s, the Offset Potentiometer can adjust out 0 to +5V of offset amplified by the Input Amplifier.

DBK43A – For DBK43As, the Offset Potentiometer can adjust out -1.25 to +5V of offset amplified by the Input Amplifier.

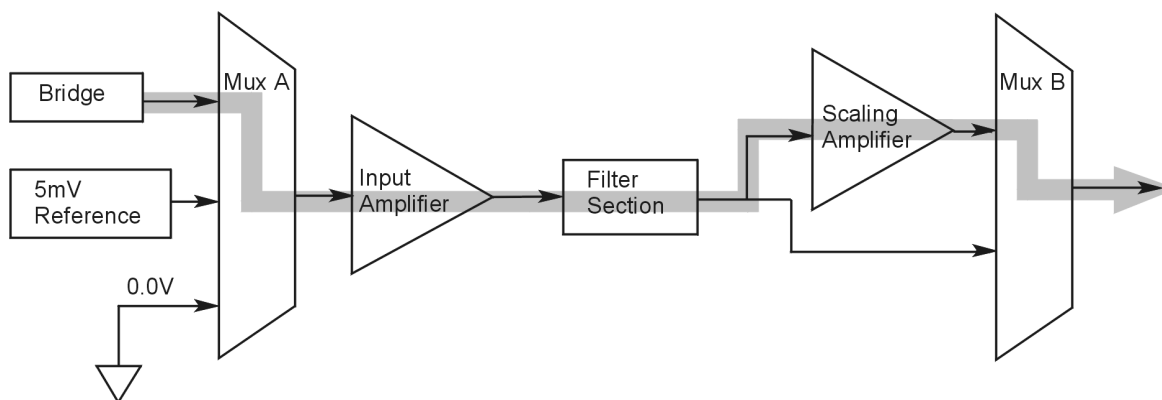


Trimming Bridge Quiescent Load

If a significant amount of quiescent offset is present and the Input Amplifier gain is set too high, the Offset Potentiometer will not have enough range to adequately nullify the offset. In this case, the gain of the Input Amplifier must be reduced while the gain of the Scaling Amplifier is increased proportionately.

Use the following steps to trim bridge quiescent load (unload the bridge).

1. In the Param1 column (see page A-4 for location), select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer output through the analog path as shown below.



“Mode = Bridge,” Reference Route

3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, set the offset voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.

Note: If you are unable to nullify the quiescent offset of the bridge, your Input Amplifier gain may be too high. Information regarding gain redistribution can be found in the section entitled, *Determining the Gain of Each Amplification Stage*.

7. Select Indicators \ Disable Input Reading Column from the menu bar.

2-Point Calibration



This 2-point calibration method makes use of trimpot adjustments. It should not be confused with the LogView software 2-Point Calibration (discussed in chapter 3, and on page A-15 of this appendix).

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 A-4 for location), select all of the DBK43A channels that are to be adjusted.
3. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.
4. Turn off all the channels in the system, except for those DBK43A channels that are to be adjusted.
5. Click the Download button to send the current configuration to the LogBook.
6. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.

Adjust the Offset

For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer. This is accomplished by adjusting the trimpot labeled OFFSET. If the first point is actually a calibrated load, you will need to move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

Complete the following steps to adjust the channel gain.

1. Apply the second load to each gage channel. The value of this load should approximate that of the maximum expected load. For the best results, a gain should be selected so that the bridge’s maximum output equals 90% of the A/D’s input range.
2. Calculate the desired voltage for the second point using the following equation:

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

Where: V_D = Desired voltage for 2nd point of calibration
 L_A = Applied load used in calibrating the 2nd point
 L_M = Maximum load expected during usage
 V_I = Input voltage range

Example: The load standard that will be applied to the gage as the 2nd point in the 2-Point calibration is 100lbs. The maximum expected load during usage is 150lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

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

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

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

3. Apply the second calibrated load to each gage and set the voltage to V_D , as derived in step 2. Do this for each transducer by adjusting the trimpots labeled GAIN and SCALE for the associated channel. Note that the GAIN trimpot provides most of the amplification (course adjustment), while the SCALE trimpot allows for fine-tuning.

Repeating the Process



Since adjusting the gain for the first time will have an affect on the offset, it is recommended that offset and gain adjustment be performed twice for each channel.

Shunt Calibration

Shunt calibration is virtually identical to the 2-Point method just discussed, except that the second point is simulated. The simulated load is achieved by shunting one leg of the bridge with a shunt resistor. Shunt calibration is the preferred calibration method when applying a real load (of a value approximating the maximum expected load) is not practical. To adjust the channel gain, the shunt must be applied to the bridge.



Calculate and install the necessary shunt resistor before continuing.

- **DBK43A** has direct support for shunt calibration, accommodating the resistor in its enclosure and allowing the software to apply it when requested.
- **DBK16** does not have direct support, so the shunt resistor must be applied externally and switched in manually.

Adjust the Offset

Adjust the offset as follows.

1. In the Param1 column, select all of the DBK43A channels that are to be adjusted.
2. Select **Mode = Bridge** from the drop down list above the grid. This selection commands the calibration multiplexer to route the transducer voltage through the analog path.
3. Turn off all the channels in the system except for those DBK43A channels that are to be adjusted.
4. Click the Download button to send the current configuration to the LogBook.
5. Select Indicators \ Enable Input Reading Column from the menu bar to display the offset values for each channel.
6. For the associated channel, apply the first calibrated load to each gage (typically no-load) and set the voltage to 0.0V for each transducer by adjusting the trimpot labeled OFFSET.



If the first point is an actual calibrated load, you must move the load to each gage, one at a time, to adjust its associated offset.

Adjust the Input and Scale Amplifier Gain

For the best results, a gain should be selected so that the bridge's maximum output equals 90% of the A/D's input range.

1. Use the following equation to calculate the desired shunt voltage (V_D).

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

Where: V_D = Desired voltage from the after amplification when the shunt is applied

L_s = Simulated load produced by shunt

L_M = Maximum load expected during usage

V_I = Input voltage range

Example: The simulated load produced by the shunt 100lbs. The maximum expected load during usage is 150lbs. The programmable input range of the data acquisition system is set for $\pm 5V$. The desired output voltage of the strain gage signal conditioning electronics is:

$$V_D = (100/150) * 5 * 0.90 = 3V$$

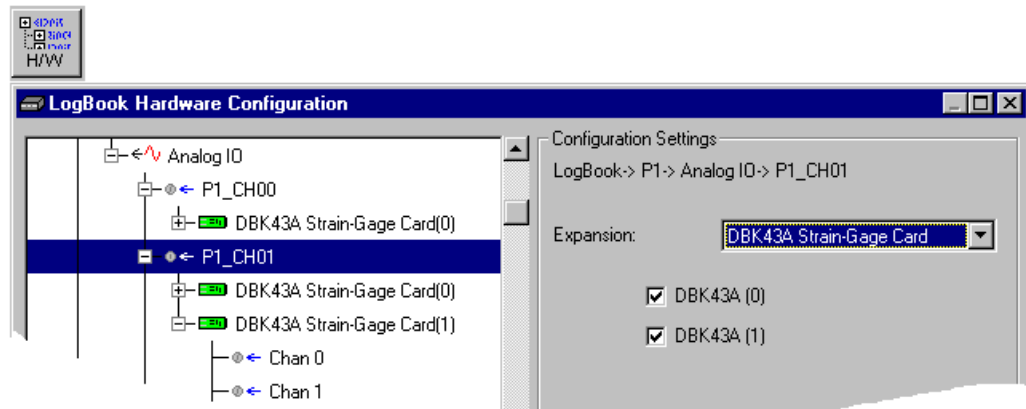
In this example, we would adjust the GAIN and SCALE trimpots until a value of 3V is measured. If 150lbs is applied to the gage, a voltage of 4.5V will be measured.

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

For **DBK16, only** ... Externally apply the shunt resistor and set the voltage to V_D , as derived above for each transducer. This is done by adjusting the trimpots labeled GAIN and SCALE for the associated channel. The GAIN trimpot is used for course adjustment; and the SCALE trimpot for fine-tuning.

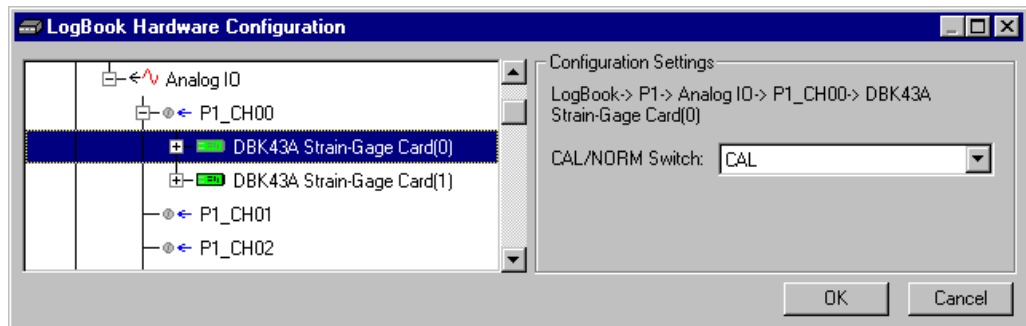
For **DBK43A only** ... DBK43 is equipped with a physical switch that allows the shunt to be applied when directed by the software. For each DBK43A to be adjusted, move this physical switch from NORM to CAL.

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



LogBook Hardware Configuration, Button and Screen

2. Select the DBK43A from the *LogBook Hardware Configuration* window's hardware tree.
3. 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"

2. Repeat this process for each DBK43A that is to be adjusted.
3. Click OK to lock in the changes.
4. Open the Analog Input Channel Grid. In the Param1 column (see page 4 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.
5. Click the Download button to send the current configuration to the LogBook.
6. Select Indicators \ Enable Input Reading Column from the menu bar to display the excitation values for each channel.

7. Set the voltage to V_D , as derived above, for each transducer. This is accomplished by adjusting the trim pots labeled GAIN and SCALE for the associated channel. The GAIN trim pot provides for course adjustment. The SCALE trim pot provides for fine tuning.
8. Select Indictors \ Disable Input Reading Column from the menu bar.
9. Return the physical NORM/CAL switches (of the applicable DBK43As) to the NORM position.
10. 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 chapter 3 has been repeated below for convenience.

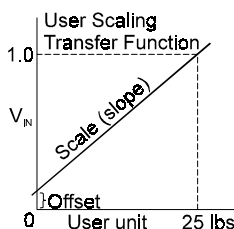
Storage		DBK Parameters		User Scaling			2-Point Cal	
#	Physical Channel	User Label	On/Off	Reading	Range	Units	Channel Type	User Scaling
								Scale Offset
1	P1_CH00	P1_CH00	On		0.1 to 500.1	lbs	Local	25.0 0.1
2	P1_CH01	P1_CH01	On		0.0 to 2000.0	apples	Local	100.0 0.0
3	P1_CH02	P1_CH02	On		-10.0 to 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 on page 12 of this appendix.

During the LogView software procedure, 1 or 2 loads are read and compared with expected values. The software automatically calculates and applies the necessary correction factors.

LogView 2-point and 1-point calibration information from chapter 3 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	2-Point Calibration								-
								Set P1	Actual P1	Get P1	Set P2	Actual P2	Get P2	Cal Scale	Cal Offset	
1	P1_CH00	P1_CH00	On		0.1 to 500.1	lbs	Local	0.0	2.0	Execute	100.0	95.0	Execute	1.075	-2.15	
2	P1_CH01	P1_CH01	On		0.0 to 2000.0	apples	Local			Execute			Execute	1.0	0.0	
3	P1_CH02	P1_CH02	On		-10.0 to 10.0	Volt	Local			Execute			Execute	1.0	0.0	

The above figure shows the columns in the **2-Point Calibration** tab. To fine tune the accuracy of the value coming from a linear sensor, LogView provides both 1- and 2-point calibration.

- **One-point calibration** can be used to zero a channel, such as a thermocouple channel, which is usually more accurate in scale than offset. One example of one-point calibration is that of placing a thermocouple in an ice bath and setting the 0°C point, and no other.
- **2-point calibration** determines the scale and offset factors to convert the raw readings into accurate calibrated readings. Two points of known (set) values must be compared with two actual sensor readings.

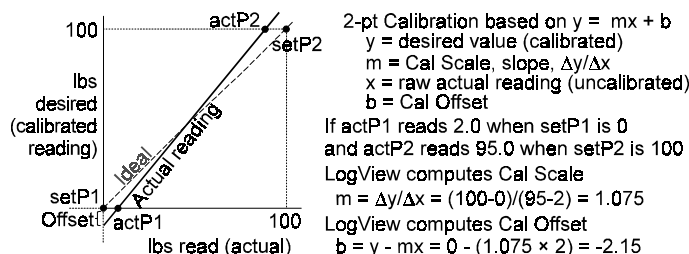
An example of 2-Point Calibration (via LogView Software).

To calibrate a strain-gage scale:

1. Unload the scale.
2. Enter a value of 0.0 into the *Set P1* column.
3. Click the *Get P1 Execute* button. This lets you read the actual sensor value (2.0 in the example).
4. Place a 100 lb. weight on the scale.
5. Enter a value of 100 into the *Set P2* column.
6. Click the *Get P2 Execute* button. This lets you read the actual sensor value (95.0 in the example).

LogView automatically computes the **Cal Offset** factor (near 0) and **Cal Scale** factor (near 1).

From this point on, LogView automatically applies the $y = mx + b$ equation to the incoming reading, resulting in a calibrated reading.



This appendix has two error lists, one for *LogView* software and one for LogBook hardware.

Software Errors

These errors can appear in the LogBook Monitor window of LogView.

0	No Error	240	Invalid Version
Command Error Definitions		241	Hardware Error
100	Command Error	250	Hardware Missing
101	Invalid Character	251	Mass Storage Error
102	Syntax Error	252	Missing Media
103	Invalid Separator	253	Corrupt Media
104	Data Type Error	254	Media Full
105	GET Not Allowed	255	Directory Full
108	Parameter Not Allowed	256	File Name Not Found
109	Missing Parameter	257	File Name Error
110	Command Header Error	258	Media Protected
111	Header Separator Error	260	Expression Error
112	Program Mnemonic Too Long	261	MathError In Expression
113	Undefined Header	270	Macro Error
114	Header Suffix Out Of Range	271	Macro Syntax Error
120	Numeric Data Error	272	Macro Execution Error
121	Invalid Character In Number	273	Illegal Macro Label
122	Mantissa Too Large	274	Macro Parameter Error
Not Defined In SCPI		275	Macro Definition Too Long
123	Exponent Too Large	276	Macro Recursion Error
124	Too Many Digits	277	Macro Redefinition Not Allowed
128	Numeric Data Not Allowed	278	Macro Header Not Found
130	Suffix Error	280	Program Error
131	Invalid Suffix	281	Cannot Create Program
134	Suffix Too Long	282	Illegal Program Name
138	Suffix Not Allowed	283	Illegal Variable Name
140	Character Data Error	284	Program Currently Running
141	Invalid Character Data	285	Program Syntax Error
144	Character Data Too Long	286	Program Runtime Error
148	Character Data Not Allowed	290	Memory Use Error
150	String Data Error	291	Out Of Memory
151	Invalid String Data	292	Referenced Name Does Not Exist
154	String Data Too Long	293	Referenced Name Already Exists
158	String Data Not Allowed	294	Incompatible Type
160	Block Data Error	Device-Specific Error Definitions	
161	Invalid Block Data	300	Device Specific Error
168	Block Data Not Allowed	310	System Error
170	Expression Command Error	311	Memory Error
171	Invalid Expression	312	PUD Memory Lost
178	Expression Data Not Allowed	313	Calibration Memory Lost
180	Macro Definition Error	314	Save Recall Memory Lost
183	Invalid Inside Macro Definition	315	Configuration Memory Lost
184	Macro Parameter Command Error	320	Storage Fault
Execution Error Definitions		321	Device Out Of Memory
200	Execution Error	330	Self Test Failed
201	Invalid While In Local	340	Calibration Failed
202	Settings Lost Due To RTL	350	Queue Overflow
203	Command Protected	360	Communication Error
210	Trig Error	361	Parity Error In Program Message
211	Trig Ignored	362	Framing Error In Program Message
212	Arm Ignored	363	Input Buffer Overrun
213	Init Ignored	Query Error Definitions	
214	Trig Deadlock	400	Query Error
215	Arm Deadlock	410	Query Interrupted
220	Parameter Error	420	Query Unterminated
221	Settings Conflict	430	Query Deadlocked
222	Data Out Of Range	440	Query Unterm After Indef Response
223	Too Much Data	Power On Event Definitions	
224	Illegal Parameter Value	500	Lbk Event Power On
225	Operation Out Of Memory	600	Lbk Event User Request
230	Lists Not Same Length	700	Lbk Event Request Control
231	Data Corrupt Or Stale	800	Lbk Event Operation Complete
232	Data Questionable	900	Outputs Deteriorating
233	Invalid Format	905	Losing Trigger Events
		906	Losing Stop Events

Hardware Errors

The following is a list of fatal hardware errors. LogBook's ERROR LED indicator (on the front panel) will blink on/off the number of times indicated by the flash code. If the LogBook is attached to an LBK1, the corresponding control terminal message will be displayed (otherwise, you must count the LED flashes to determine the error). Note that flash codes 08, 09, and 17 are associated with multiple errors and thus require an LBK1 to determine which error applies.

ERROR LED

<u>Flash Code</u>	<u>Control Terminal Message</u>
1	NS486 Chip Revision Changed Error
2	Watchdog Timeout Error
3	Flash Startup Code Checksum Error
4	Flash FPGA Code Checksum Error
5	DRAM initialization not complete Error
6	DRAM Sizing Error
7	1 MB DRAM SIMM - Insufficient Memory
8	DRAM Address Line Error
8	DRAM Data Line Error
8	DRAM Integrity Test Error
9	SRAM Address Line Error
9	SRAM Data Line Error
9	SRAM Integrity Test Error
10	SRAM Low Battery Error
11	FPGA Load Error
12	Real Time Clock Low Battery Error
13	DRAM Parity Error
14	Analog Output Slot Empty
15	Calibration Table Verification Error
16	ADC Self Calibration Error
17	TRAP: Divide by Zero, or Divide Overflow
17	TRAP: Debug Trap; Hardware Breakpoint
17	TRAP: Non-Maskable Interrupt (NMI)
17	TRAP: Software Breakpoint
17	TRAP: INT0 Instruct.: Overflow Detected
17	TRAP: BOUND instruction: Range Exceeded
17	TRAP: Invalid Opcode
17	TRAP: Coprocessor Not Available
17	TRAP: Double Fault
17	TRAP: Coprocessor Segment Overrun
17	TRAP: Invalid Task State Segment
17	TRAP: Segment Not Present
17	TRAP: Stack Exception
17	TRAP: General Protection Fault
18	Printf Floating Point Error
19	FPGA PC-Card File Checksum Error
20	FPGA PC-Card File Load Error

DRAM = Dynamic Random Access Memory (the 4- or 16-MB SIMM board)
SRAM = Static Random Access Memory



Reference Note: This appendix contains information that may prove helpful to DBK4 users. If you are reading this section for applicability to DBK4, you should also read the DBK4 section of chapter 5, and possibly sections of chapter 6, *Signal Management and Troubleshooting Tips*.

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Accelerometer Specification Parameters.....C-2

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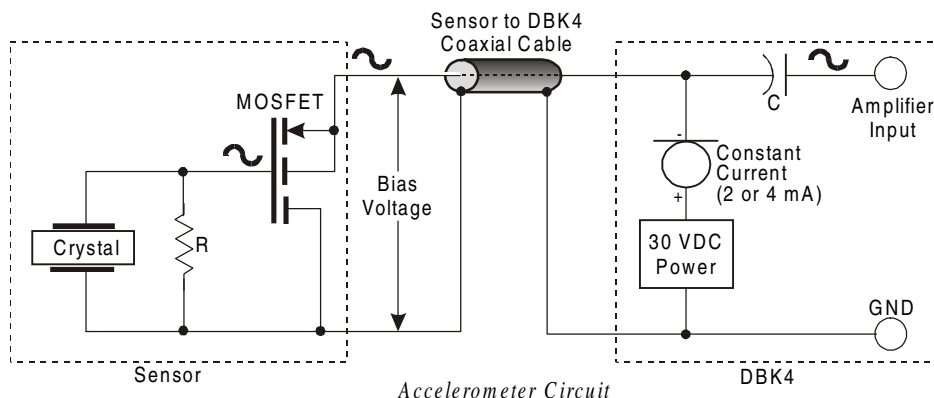
- Triboelectric Noise.....C-6

Cable Driving.....C-6

What is a Piezoelectric Accelerometer?

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

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



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

Accelerometer Specification Parameters

Noise in Accelerometers

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

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

Sensitivity

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

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

Transverse Sensitivity

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

Base-Strain Sensitivity

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

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

Acoustic Sensitivity

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

Frequency Response

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

Dynamic Range

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

Bias Level

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

Thermal Shock - Temperature Transients

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

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

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

Overload Recovery

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

Power Supply Effects

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

Connector

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

Physical Setup

Mounting Effects

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

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

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

Where:

Δf = Change in Resonant Frequency

f_n = Original Resonance Frequency without Accelerometer

m = Spring Mass

m_a = Mass of Accelerometer

Threaded Stud Mount

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

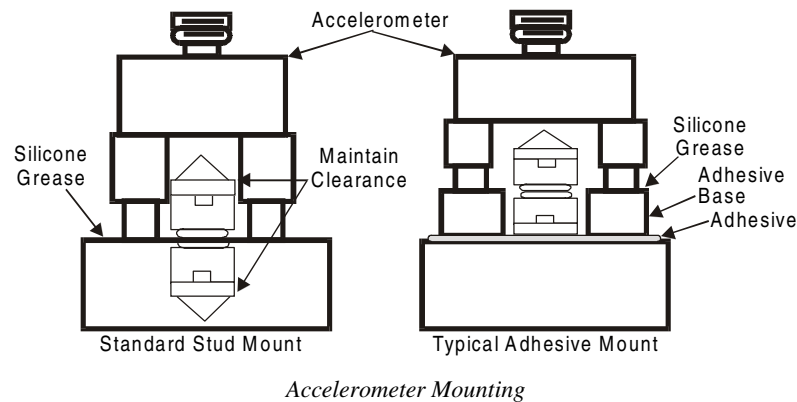
Adhesive Mounts

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

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

Removal of Adhesive Accelerometers

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



CAUTION



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

Magnetic Mounting Adapters

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

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

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

Electrical Grounding

Case-Grounded Design

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

Isolated-Base Design

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

Accelerometer Practical Limitations

Mass Loading

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

Upper Frequency Response

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

Cable-Connector Handling Precautions

Connectors

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

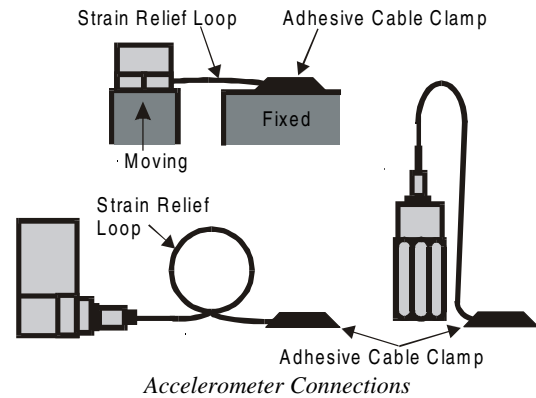
When connecting 10-32 or 5-44, thread the cables to sensor jacks. Do not use pliers to torque knurled coupling nuts in place. Hand tightening is sufficient for most applications. If the nut tends to loosen under severe shock or vibration, you may use a mild thread-locking compound. Use it very sparingly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

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

Cables

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

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



Triboelectric Noise

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

Cable Driving

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

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

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

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

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

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

Where:

f = Maximum frequency in Hz

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

C = Cable capacitance in picoFarads

V = Maximum peak measured voltage from sensor in volts

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

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

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

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Overview

CE standards were developed by the European Union (EU) dating from 1985 and include specifications both for safety and for EMI emissions and immunity. Now, all affected products sold in EU countries must meet such standards. Although not required in the USA and elsewhere, these standards are considered good engineering practice because they enhance safety while reducing noise and ESD problems.

In contracted and in-house testing, most Daq* products met the required specifications. Those products not originally in compliance were redesigned accordingly. In some cases, alternate product versions, shield plates, edge guards, special connectors, or add-on kits are required. (For examples, refer to the section *CE Enhancements for Existing Products* at the end of this appendix.)



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

CE Standards and Directives

The electromagnetic compatibility (EMC) directives specify 2 basic requirements:

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

The standards are published in the *Official Journal of European Union* under direction of CENELEC (European Committee for Electrotechnical Standardization). The specific standards relevant to Daq* equipment are listed on the product’s Declaration of Conformity and include: CISPR22:1985; EN55022:1988 (Information Technology Equipment, Class A for commercial/industrial use); and EN50082-1:1992 for various categories of EMI immunity.

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

Environmental conditions include the following:

- indoor use
- altitude up to 2000 m
- temperature 5°C to 40°C (41°F to 104°F)
- maximum relative humidity 80% for temperatures up to 31°C (87.8°F) decreasing linearly to 50% relative humidity at 40°C (104°F)
- mains supply voltage fluctuations not to exceed $\pm 10\%$ of the nominal voltage
- other supply voltage fluctuations as stated by the manufacturer
- transient overvoltage according to installation categories (overvoltage categories) I, II and III. For mains supply, the minimum and normal category is II.
- pollution degree 1 or 2 in accordance with IEC 664.

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

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

Safety Conditions

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



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



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

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

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

Emissions/Immunity Conditions

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

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

CE Enhancements for Existing Products

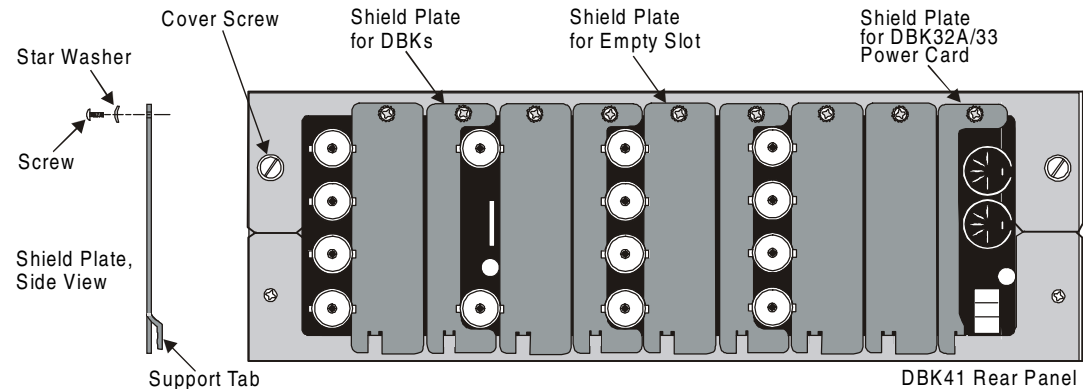
Several CE enhancements are described in the following sections:

- DBK41/CE
- Edge Guard (for the DBKs 5, 8, and 44)
- Special cables and connectors

DBK41/CE

The DBK41/CE includes 3 variations of EMI shield plates that attach to the DBK41 enclosure. Besides acting as an electrical safety barrier, these shields reduce electromagnetic interference (EMI) escaping from (or entering into) the 10-slot expansion enclosure (see figure).

Note: This CE kit is included with the DBK41/CE and is an optional accessory for a non-CE DBK41.



Edge Guards for DBKs 5, 8, and 44

A plastic barrier attached to the end of a DBK card helps prevent access to leads or circuits carrying lethal voltages. These edge guards attach to DBKs 5, 8, and 44 (see figure below) that are mounted in a DBK41/CE with EMI shield plates (see figure above). The access slot allows insulated wires to pass through the barrier or for trimpot adjustments with a small screwdriver.

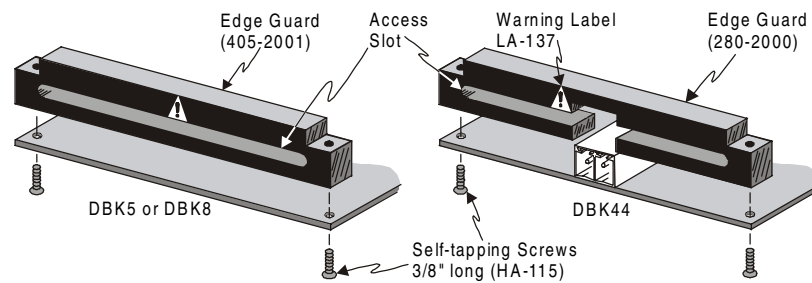
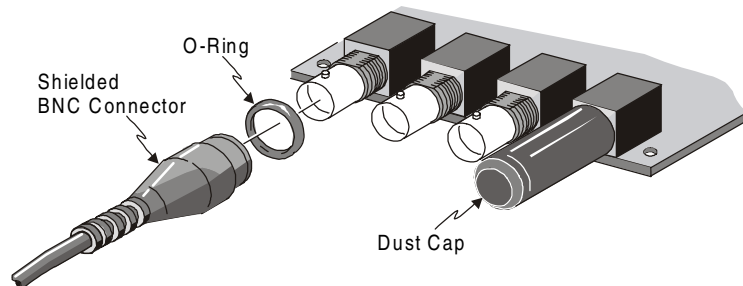


Fig 1. Edge Guard Kit for DBK5 and DBK8
(p/n 232-0806)

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

Special Cables and Connectors

Some Declarations of Conformity specify particular cables or connectors that must be used for CE compliance; e.g., the special BNC connectors used with the DBK4, DBK17, DBK18, and some other BNC-equipped cards and modules. The idea is to insulate the BNC connector from high-voltage sources such as static charges that can enter the circuitry via an exposed connector and cause ESD damage. PVC dust caps (p/n CN-96) must cover all unused BNC connectors. With dust caps removed, special coaxial cables with insulated end-connectors and rubber O-rings (p/n 418-0800) must be used (see figure). Properly installed connectors and dust caps ensure that no metallic surfaces are exposed.





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LogBooks

General

Supply Voltage Range: 10 to 45.0 VDC
Power Consumption: 0.9 A @ 15 VDC
Operating Temperature: 5° to 122°F (-15°C to 50°C)
Storage Temperature: 32° to 176°F (0°C to 80°C)
Humidity: 0 to 95% RH, non-condensing
PC-Card Memory: Standard ATA Type

LogBook/300:
Size: 8½ × 11 × 1¼ in. (216 × 279 × 44 mm)
Weight: 3.3 lb (1.5 kg)
LogBook/360:
Size: 14 × 11 × 3.5 in. (356 × 279 × 89 mm)
Weight: 7.3 lb (3.3 kg)

A/D Specifications

Type: Successive approximation
Resolution: 16 bit
Conversion Time: 10 µs

Monotonicity: No missing codes
Linearity: ±1 bit

Analog Inputs

Channels: 16 single-ended, 8 differential, expandable up to 256 differential; single-ended or differential operation is software programmable.

Connector: DB37 male, P1

Maximum Overvoltage: -35 V, +45 V

Input Current:

Differential: 0.4 µA typical, 0.7 µA max

Single-ended: 0.2 µA typical, 0.35 µA max

Input Impedance:

10 MΩ differential in parallel with 20 pF

5 MΩ single-ended in parallel with 30 pF

Calibration: Digital software calibration

Channel-to-channel Crosstalk: 100 dB

Ranges: Unipolar/Bipolar operation is software-programmable on a per-channel basis.

Unipolar:	Error % of Full-Scale	Error Drift % of Full-Scale
0 to +20 V	±0.01	±0.0004
0 to +10 V	±0.01	±0.0004
0 to +5 V	±0.01	±0.0005
0 to +2.5 V	±0.01	±0.0006
0 to +1.25 V	±0.01	±0.0008
0 to +0.625 V	±0.01	±0.0012
0 to +0.3125 V	±0.01	±0.0021
Bipolar:	Error % of Full-Scale	Error Drift % of Full-Scale
±10 V	±0.01	±0.0004
±5 V	±0.01	±0.0004
±2.5 V	±0.01	±0.0005
±1.25 V	±0.01	±0.0006
±0.625 V	±0.01	±0.0008
±0.3125 V	±0.01	±0.0012
±0.1563 V	±0.01	±0.0021

Triggering

Analog Trigger:

Programmable Level Range: full range of specified channel

Trigger to A/D Latency: 10 µs max

Digital Trigger:

Logic Level Range: 0.8 V low/2.2 V high

Trigger to A/D Latency: 10 µs max

Software Trigger:

Trigger to A/D Latency: Dependent on PC

Pre-Trigger: Up to 4 gig scans, depends on PC-card memory

Sequencer

Randomly programmable for channel and gain and for unipolar/bipolar (where applicable)

Depth: 1024 analog channels plus 128 digital channels

Channel to Channel Rate: 10 µs/channel, fixed

Maximum Rep Rate: 100 kHz

Minimum Rep Rate: 10 hours

Expansion Channel Sample Rate: Same as on-board channels, 10 µs/channel

General Purpose Digital I/O

24 I/O channels, expandable up to 192

Connector: DB37 male, P2

Device: 82C55

Maximum Input and Update Rate: 100 kHz

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Current:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 μ A

High-Speed Digital I/O

Channels: 16 input lines

Connector: DB37 male, P3

Maximum Sampling Rate: 100K words/s

Input Low Voltage: 0.8 V max

Input High Voltage: 2.0 V min

Input Low Current: 10 μ A

Input High Current: -10 μ A

Frequency/Pulse Counter

Channels: 4, 16 bits per channel, cascadeable

Connector: DBK37 male, P3

Maximum Pulse Count: 32-bit binary (2 channels cascaded)

Maximum Input Rate: 1 MHz

Input Voltage: -15 to +15 V

Threshold Voltage (Low): 0.8 V typical, 0.5 V min

Threshold Voltage (High): 1.6 V typical, 2.1 V max

Hysteresis: 400 mV min

Pulse Width (High or Low): 520 ns min

Input Impedance: 27 K Ω pull-up to +5 V in parallel with 50 pF

Frequency/Pulse Generator

Channels: 2, 16 bits per channel

Connector: DB37 male, P3

Frequency/Pulse Generating Mode: Input frequency divided by 1 to 65,535

Input Low Voltage: 0.8 V max

Input High Voltage: 2.0 V min

Input Low Current: -10.0 μ A max

Input High Current: 10.0 μ A max

Output High Voltage: 2.4 V min @ -8 mA

Output Low Voltage: 0.5V max @ 8 mA

LBK Options

LBK1 Remote-Operation Terminal (optional)

Operating Temperature: -20°C to 50°C

Connector: RJ-11

Display: LCD, 16 lines \times 40 characters

Power: None required

Dimensions: 7.875 wide" \times 4.375" long \times 1.125" high
(200 \times 111 \times 29 mm)

LBK2 Analog Output Board (optional)

Channels: 4

Connector: DB37 male, P3

Resolution: 16-bits

Maximum Offset Error: ± 0.0045 V

Maximum Gain Error of Full-Scale: $\pm 0.01\%$

Output Voltage Range: ± 10 V

Maximum Output Current: 10 mA

Maximum Update Rate: 100 kHz all channels concurrently

LogBook/GPS (LogBook/360 Only)

Supported Protocol: NMEA 0183
Required NMEA 0183 Message: GGA
Electrical: RS-232
Connection: DB9 female connector
Baud Rate: 4800 Baud

LogBook/Modem (optional)

Supported Modems: Hayes-Compatible
Maximum Baud Rate: 115K baud

DBK Option Cards and Modules

General DBK

DBK Card Size: 8¼" long × 3¼" wide × ¾" high
DBK Card Weight: 8 to 12 oz (depends on module)
DBK Module Size: 8.5" wide × 11" long × 1.375" high (221 mm × 285 mm × 25 mm).
Note: Modules with other dimensions include: DBK40, DBK41, DBK42.
DBK Module Weight: 1.4 to 5 lb (depends on module)

DBK1 - Specifications

Name/Function: 16-Connector BNC Adapter Module

Connectors:

DB37 male, mates P1
BNC connectors for signal input

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

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

Weight: 1.3 kg (3 lb)

DBK4 - Specifications

Name/Function: 2-Channel Dynamic Signal Input Card

Channels: 2

Signal Connection: 1 BNC connector per channel

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

Current Source:

Output Impedance: >1.4 MΩ

Compliance: 27 VDC

Current Levels: 2 & 4 mA

Broadband Noise: 0.3 μA RMS (B/w = 100 kHz)

Input Impedance: 150 kΩ

Gain:

Bypass Mode: ×1.583 ×15.83 ×158.3

Filter Mode: ×1 ×10 ×100

Input Ranges (FS): ±5 V ±500 mV ±50 mV

Coupling: AC, DC

AC: 1-pole, 10 Hz HPF

1-pole, 0.1 Hz HPF

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

Filter(Typical):

Distortion

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

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

Cut-off(Fc):

18 kHz	9 kHz	4.5 kHz	2.25 kHz
1125 Hz	562.5 Hz	281.2 Hz	141.6 Hz

Flatness DC - 80% Fc: ±0.2 dB

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

Accuracy Passband Center: ± 0.5 dB

DBK7 - Specifications

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

Input Channels per Card: 4

Maximum Cards per System: 64

Maximum Channels per System: 256

Input Connector: 1 BNC connector per channel

Connector: DB37 male, mates with P1

Frequency Ranges: (programmable) 0 Hz to 960 kHz

Analog Input

Low-level: 50 mV typical (100 mV max) p-p sine wave @ 10 Hz to 100 kHz. Any edge of 50 (100 max) mV amplitude and 5 V/s rate. Input impedance: AC-coupled (0.33 μ F), in series w/ 20 K Ω to ground. 15 mV hysteresis.

High-level: 0.75 V typical (1.25 V max) p-p sine wave @ 10 Hz to 100 kHz. Any edge of 0.75 V (1.25 V max) amplitude and 50 V/s rate. Input impedance: AC-coupled (0.33 μ F), in series w/ 20 K Ω to ground. 250 mV hysteresis.

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

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

Digital Input

TTL-Level: 0.001 to 960 kHz.

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

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

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

Hysteresis: 400 mV min

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

Maximum Input Voltage: -15 V to +15 V.

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%

DBK8 - Specifications

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

Connector: DB37 male, mates with P1; screw terminals for signals.

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

Input Impedance: 10 M Ω

Attenuation:

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

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

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

Output Voltage Range: ± 5 VDC

Bandwidth: 15 kHz

Attenuation Accuracy: 0.5%

Offset Voltage: typical: 0.5 mV; Max: 2.0 mV

Offset Drift typical: 4 μ V/ $^{\circ}$ C; Max: 10 μ V/ $^{\circ}$ C

DBK9 - Specifications

Name/Function: 8-Channel RTD Measurement Card

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

Configurations: 3-wire or 4-wire

Alpha: 0.00385

Inputs: 8 channels

Temperature Ranges: 100, 500, or 1000 Ω : -200 to +850 $^{\circ}$ C

RTD Excitation Current:

500 μ A @ 100 Ω

227 μ A @ 500 Ω

160 μ A @ 1000 Ω

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

Resolution: 0.3 $^{\circ}$ C

Range and RTD Type Adjustments: Jumpers on circuit board

DBK10 - Specifications

Name/Function: 3-Slot Expansion Chassis

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

Capacity: Accommodates any 3 expansion cards

Material: Aluminum

Finish: Black, powder-coated

DBK11A - Specifications

Name/Function: Screw-Terminal Card

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

Wire Size Range: 14-26 ga

BNC Option: 4 BNCs for user-soldered connection

DBK12 - Specifications

Name/Function: Analog Multiplexing Card (Low Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 2$, $\times 4$, $\times 8$

Inputs: 16 differential or single-ended (switch selectable as a group)

Voltage Range:

± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: $\pm 0.05\%$ typical, $\pm 0.25\%$ max

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20 V/ μ s typical, 10 V/ μ s min

Settling Time: 2 μ s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typical, 0.015% max

Bias Current: 150 pA, 0.2 μ A max

Offset Voltage: $\pm(0.5 + 5/G)$ mV typical; $\pm(2.0 + 24/G)$ mV max

Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typical; $\pm(2.0 + 24/G)$ μ V/ $^{\circ}$ C max

DBK13 - Specifications

Name/Function: Analog Multiplexing Card (High Gain)

Output Connector: DB37 male, mates with P1

Input Connector: Screw terminals

Gain Ranges: $\times 1$, $\times 10$, $\times 100$, $\times 1000$

Inputs: 16 differential or single-ended (switch selectable as a group)

Voltage Range:

± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy:

$\pm 0.05\%$ typical @ $G < 1000$

$\pm 0.25\%$ max @ $G < 1000$

$\pm 0.10\%$ typical @ $G = 1000$

$\pm 100\%$ max @ $G = 1000$

Maximum Input Voltage: ± 35 VDC

Slew Rate: 20V/ μ s typical, 10V/ μ s min

Settling Time:

2 μ s to 0.01% @ $G < 1000$

10 μ s to 0.01% @ $G = 1000$

CMRR:

80 dB @ $G=1$ min

86 dB @ $G=10$ min

92 dB @ $G=100$ min

94 dB @ $G=1000$ min

Non-Linearity:

0.002% typical @ $G < 1000$

0.015% max @ $G < 1000$

0.02% typical @ $G = 1000$

0.06% max @ $G = 1000$

Bias Current: 150 pA typical; 0.2 μ A @ 25 $^{\circ}$ C max

Offset Voltage: $\pm(0.5 + 5/G)$ mV @ 25 $^{\circ}$ C typical;

$\pm(2.0 + 24/G)$ mV @ 25 $^{\circ}$ C max

Offset Drift: $\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typical; $\pm(12 + 240/G)$ μ V/ $^{\circ}$ C max

DBK15 - Specifications

Name/Function: Universal Current/Voltage Input Card

Input Connectors: Screw terminals for signal connections

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

Attenuation/Shunt Resistor Connector: Machine sockets accommodate standard $\frac{1}{4}$ -watt resistors

Gain Ranges: $\times 1$, $\times 2$

Inputs: 16 differential

Voltage Input Ranges: ± 5 VDC max

Current Input Range: ± 20 mA max

Attenuator Resistors:

Accuracy: $\pm 1\%$

Temp coefficient: 100 ppm/ $^{\circ}$ C

Gain Accuracy: $\pm 0.05\%$ typical, $\pm 0.25\%$ max

Maximum Input Voltage: ± 35 VDC

Slew Rate: 10 V/ μ s

Settling Time: 2 μ s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typical, 0.015% max

Unattenuated Bias Current: 150 pA typical, 0.2 μ A max @ 25 $^{\circ}$ C

Offset Voltage:

$\pm(0.5 + 5/G)$ mV @ 25 $^{\circ}$ C typical

$\pm(2.0 + 24/G)$ mV @ 25 $^{\circ}$ C max

Offset Drift:

$\pm(3 + 50/G)$ μ V/ $^{\circ}$ C typical

$\pm(12 + 240/G)$ μ V/ $^{\circ}$ C max

DBK16 - Specifications

Name/Function: 2-Channel Strain-Gage Input Card**Input Connectors:** Screw terminals for signal connections**Output Connector:** DB37 male, mates with P1 using CA-37-x cable**Number of Channels:** 2**Excitation Voltage Range:** 1.50 to 10.50 VDC @ 50 mA (on-board adjustment for external source)**Gain Range:** $\times 100$ -1250**Types of Bridges Accommodated:**

Full Bridge, Kelvin Excitation (6-wire)

Full Bridge (4-wire)

Half Bridge (3-wire)

Quarter Bridge (2-wire)

Bridge Resistors: On-board provisions for 4 bridge-completion resistors per channel.**Type Input:** Differential DC**Input Impedance:** 100 M Ω (in parallel with 150 pF)**CMRR:** 115 dB**Excitation Voltage Source:** External 13 to 18 VDC @ 50 mA/circuit**Excitation Current Output:** 50 mA max, current limited at 60 mA**Excitation Sensing:** Local or Remote**Excitation Regulation:****Line Regulation:** 0.025%**Load Regulation:** 0.05%**Reference Voltages:** 2.500 VDC**Reference Accuracy:** 0.05%**Reference Drift:** 3 ppm/ $^{\circ}$ C**Gain Calibration Reference:** 5.00 mVDC**Reference Accuracy:** 0.2%**Reference Drift:** 20 ppm/ $^{\circ}$ CCommitted instrumentation amplifier for each section with gain adjust from $\times 100$ to $\times 1250$ via externally accessed 15-turn trimpot.**Gain Accuracy:** 0.5%**Gain Drift:** 50 ppm/ $^{\circ}$ C**Input Offset:** 100 μ V max**Offset Drift:** 4 μ V/ $^{\circ}$ C**Output Offset:** 20 μ V**Offset Drift:** 200 μ V/ $^{\circ}$ C**Offset Adjustment:** 0-100% of range, 0-5.00 VDC (15-Turn trimpot)**Full Scale Sensitivity Range:****At 5.00 VDC Excitation:** 0.8 to 10 mV/V**At 10.00 VDC Excitation:** 0.4 to 5 mV/V**Scaling Amplifier Gain Range:** $\times 1$ to $\times 10$ (15-Turn trimpot)**Low-Pass Filter:**

3 pole Butterworth, User By-Passable; -9dB @ User-set Corner Frequency

DBK17 - Specifications

Name/Function: Simultaneous Sample-Hold Card**Channels:** 4**Input Connections:** 4 BNC connectors**Output Connector:** DB37 male, which mates with P1 using CA-37-x cable**Number of Cards Addressable:** 64**Input Type:** Differential**Voltage Input Ranges:**0 to ± 5000 mVDC0 to ± 500 mVDC0 to ± 50 mVDC0 to ± 25 mVDC0 to ± 10 mVDC**Input Amplifier Slew Rate:** 12 V/ μ s minimum**Acquisition Time:**0.6 μ s (10 V excursion to 0.1%)0.7 μ s (10 V excursion to 0.01%)**Channel-to-Channel Aperture Uncertainty:** 50 ns**Output Droop Rate:** 0.1 μ V/ μ s**Input Gains:** $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$ and User-Set**Input Offset Voltage:** 500 μ V + 5000/G maximum (nullable)**Input Offset Drift:** ± 5 + 100/G μ V/ $^{\circ}$ C maximum**Input Bias Current:** 100 pA maximum**Input Offset Currents:** 50 pA maximum**Input Impedance:** 5×10^{12} Ω parallel with 6 pF**Switchable Bias Resistors:** 100 K Ω each to analog common**Gain Errors:**0.04% @ $\times 1$ 0.1% @ $\times 10$ 0.2% @ $\times 100$ 0.4% @ $\times 200$ 1.0% @ $\times 500$ **Gain vs Temperature:** $\times 1$ ± 20 ppm/ $^{\circ}$ C $\times 10$ ± 20 ppm/ $^{\circ}$ C $\times 100$ ± 40 ppm/ $^{\circ}$ C $\times 200$ ± 60 ppm/ $^{\circ}$ C $\times 500$ ± 100 ppm/ $^{\circ}$ C**Non-Linearity:** $\times 1$ to $\pm 0.015\%$ full-scale $\times 10$ to $\pm 0.015\%$ full-scale $\times 100$ to $\pm 0.025\%$ full-scale $\times 200$ to $\pm 0.025\%$ full-scale $\times 500$ to $\pm 0.045\%$ full-scale**Common-Mode Rejection Ratio (CMRR):**70 dB minimum @ $\times 1$ 87 dB minimum @ $\times 10$ 100 dB minimum @ $\times 100$ 100 dB minimum @ $\times 200$ 100 dB minimum @ $\times 500$

DBK18 - Specifications

Name/Function: Low-Pass Filter Card

Channels: 4

Input Connections: 4 BNC connectors

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

Number of Cards Addressable: 64

Input Type: Differential

Voltage Input Ranges:

0 to ± 5000 mVDC
0 to ± 500 mVDC
0 to ± 50 mVDC
0 to ± 25 mVDC
0 to ± 10 mVDC

Input Amplifier Slew Rate: 12 V/ μ s minimum

Input Gains: $\times 1$, $\times 10$, $\times 100$, $\times 200$, $\times 500$ and User-Set

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

Input Offset Drift: $\pm 5 + 100/G$ μ V/ $^{\circ}$ C maximum

Input Bias Current: 100 pA maximum

Input Offset Currents: 50 pA maximum

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

Switchable Bias Resistors: 100 K Ω each to analog common

Gain Errors:

0.04% @ $\times 1$
0.1% @ $\times 10$
0.2% @ $\times 100$
0.4% @ $\times 200$
1.0% @ $\times 500$

Gain vs Temperature:

$\times 1 \pm 20$ ppm/ $^{\circ}$ C
 $\times 10 \pm 20$ ppm/ $^{\circ}$ C
 $\times 100 \pm 40$ ppm/ $^{\circ}$ C
 $\times 200 \pm 60$ ppm/ $^{\circ}$ C
 $\times 500 \pm 100$ ppm/ $^{\circ}$ C

Non-Linearity:

$\times 1$ to ± 0.015 % full-scale
 $\times 10$ to ± 0.015 % full-scale
 $\times 100$ to ± 0.025 % full-scale
 $\times 200$ to ± 0.025 % full-scale
 $\times 500$ to ± 0.045 % full-scale

Common-Mode Rejection:

70 dB minimum @ $\times 1$
87 dB minimum @ $\times 10$
100 dB minimum @ $\times 100$
100 dB minimum @ $\times 200$
100 dB minimum @ $\times 500$

Active Filter Device: UAF42 (Burr-Brown)

Number of Poles/Filter: 3

Types of Filters: Bessel, Butterworth, Chebyshev

Frequency Range: 0.1 Hz to 20 kHz

The frequency is set by installation of 4-6 resistors and/or capacitors in sockets.

Default Frequency: 1 Hz

Other frequencies may be implemented by soldering resistors and/or capacitors to locations on the 4 blank plug-in headers provided. Values for common frequencies and their component values are provided with the blank headers.

DBK19 - Specifications

Name/Function: High-Accuracy Thermocouple Card

Connector: DB37 male, mates with P1;
thermocouples attach to on-board screw terminals.

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: $\times 60$, $\times 90$, $\times 180$, $\times 240$

Inputs:

14 differential thermocouples
1 cold-junction compensation
1 auto-zero

Cold Junction Sensor Output: 100mV/ $^{\circ}$ C

Voltage Ranges Gains:

0 to 80 mV @ $\times 60$
0 to 50 mV @ $\times 90$
0 to 25 mV @ $\times 180$
0 to 20 mV @ $\times 240$
0 to ± 10 mVDC

Input Impedance: 20 K Ω

Input RC Filter: -3 dB Frequency: 15.9 kHz

Gain Accuracy:

Uncalibrated: 0.15%

Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Type/Range/Accuracy/Resolution: see following table

Type	Range		Accuracy		Resolution			
	Min	Max	(<0 $^{\circ}$ C)	(>0 $^{\circ}$ C)	12-bit <0 $^{\circ}$ C	12-bit >0 $^{\circ}$ C	16-bit <0 $^{\circ}$ C	16-bit >0 $^{\circ}$ C
J	-200 $^{\circ}$ C	760 $^{\circ}$ C	0.6 $^{\circ}$ C	0.6 $^{\circ}$ C	1.2 $^{\circ}$ C	0.5 $^{\circ}$ C	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
K	-200 $^{\circ}$ C	1260 $^{\circ}$ C	1.6 $^{\circ}$ C	1.0 $^{\circ}$ C	1.1 $^{\circ}$ C	0.8 $^{\circ}$ C	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
T	-200 $^{\circ}$ C	400 $^{\circ}$ C	1.4 $^{\circ}$ C	0.8 $^{\circ}$ C	0.8 $^{\circ}$ C	0.3 $^{\circ}$ C	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
E	-270 $^{\circ}$ C	1000 $^{\circ}$ C	1.4 $^{\circ}$ C	0.9 $^{\circ}$ C	1.6 $^{\circ}$ C	0.7 $^{\circ}$ C	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
N28	-270 $^{\circ}$ C	400 $^{\circ}$ C	0.8 $^{\circ}$ C	0.8 $^{\circ}$ C	1.0 $^{\circ}$ C	1.0 $^{\circ}$ C	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
N14	0 $^{\circ}$ C	1300 $^{\circ}$ C	—	1.0 $^{\circ}$ C	—	5.0 $^{\circ}$ C	—	5.0 $^{\circ}$ C
S	0 $^{\circ}$ C	1780 $^{\circ}$ C	—	1.6 $^{\circ}$ C	—	1.3 $^{\circ}$ C	—	0.1 $^{\circ}$ C
R	0 $^{\circ}$ C	1780 $^{\circ}$ C	—	1.6 $^{\circ}$ C	—	1.7 $^{\circ}$ C	—	0.1 $^{\circ}$ C
B	0 $^{\circ}$ C	1820 $^{\circ}$ C	—	1.8 $^{\circ}$ C	—	1.5 $^{\circ}$ C	—	0.1 $^{\circ}$ C

DBK20 - Specifications

Name/Function: General Purpose Digital I/O Card

Channels: 48 I/O channels

Connector: Screw terminals

Device: 82C55 × 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 µA

DBK21 - Specifications

Name/Function: General Purpose Digital I/O Card

Channels: 48 I/O channels

Connector: DB37 male, mates with P2 pinout & to DigiBook P1, P2, P3

Device: 82C55 × 2

Output Voltage Levels:

Minimum "1" Voltage: 3.0 @ 2.5 mA sourcing

Maximum "0" Voltage: 0.4 @ 2.5 mA sinking

Output Currents:

Maximum Source Current: 2.5 mA

Maximum Sink Current: -2.5 mA

Input Voltage Levels:

Minimum Required "1" Voltage Level: 2.0 V

Maximum Allowed "0" Voltage Level: 0.8 V

Output Float Leakage Current: 10 µA

DBK23 - Specifications

Name/Function: General Purpose Optically Isolated Digital Input Module

Channels: 24 I/O channels

Channel Address: Set by DIP switch

Connector: Screw terminals for signal outputs

Input Voltage Levels:

Range: 3 to 30 VDC

Input Current: 1.5 to 15 mA

Operating Voltage Range: 9 to 24 VDC

Module Power Requirements: 0.25 W; AC adapter included

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

DBK24 - Specifications

Name/Function: General Purpose Optically Isolated Digital Output Module

Channels: 24 I/O channels

Channel Address: Set by DIP switch

Connector: Screw terminals for signal outputs

Output Channel Ratings:

Maximum current/channel: 1 A

Voltage drop @ 1 A and 25°C: 1 V

Maximum open circuit voltage: 60 VDC

Off-state leakage: 10 µA

Module Power Requirements: 1.5 W

120 VAC Adapter Supplied: 15 VDC @ 0.9 A

Isolation Voltage:

Channel-to-channel: 500 V

Channel-to-system: 500 V

Maximum Module Power Dissipation:

12 W @ 25°C

6 W @ 50°C

DBK25 - Specifications

Name/Function: 8-Channel Relay Output Card

Connectors: Screw terminals for signal outputs

Max Number of Cards: 32

Contact Rating:

2 A @ 28 VDC

0.6 A @ 120 VAC

Isolation

Channel-to-System: 250 V

Channel-to-Channel: 150 V

DBK30A - Specifications

Name/Function: Rechargeable Battery Module

Battery Type: Nickel-cadmium

Number of Battery Packs: 2

Battery Pack Configuration: 12 series-connected sub-C cells

Output Voltage: 14.4 V or 28.8 V (depending on the selected mode)

Output Fuses: 2 A

Battery Amp-Hours: 3.4 A-hr (1.7 A-hr/pack)

Charging Voltage from Supplied AC Adapter: 22 to 26 VDC @ 2 A

AC Adapter Input: 95 to 265 VAC @ 47 to 63 Hz

Charge Time: 2 hours

Charge Termination: Peak detection

DBK32A - Specifications

Name/Function: Auxiliary Power Supply Card

Isolation, Input to Output:

DBK32A: 500 VDC (DBK32: 250 VDC)

Output Voltages:

DBK32A: +15 VDC (nominal) @ 500 mA

-15 VDC (nominal) @ 500 mA

(DBK32: +15 VDC (nominal) @ 250 mA

-15 VDC (nominal) @ 250 mA)

Line Regulation: 0.5% (maximum)

Load Regulation: 1.0% (maximum)

Total Output Power: 7.5 VA (full load)

Input Voltage Range: 10 to 24 VDC

Input Current Range: 0.8 to 2.0 A

Efficiency: 60% Typical

Input Connections: DIN5 (x2 for daisy-chaining)

Output Connections: DB37 male

Parallel Provision: OR-ing diodes in output lines

Controls: ON/OFF rocker arm switch

Indicators: LED driven by positive output

Over-Voltage Protection: Hardware SCR crowbar on (+) side

Switching Frequency: 150 kHz

Operating Temperature Range: 0 to 50°C

Input Fuse Size: 2 A (Littelfuse 251002)

DBK33 - Specifications

Name/Function: Triple-Output Power Supply Card

Isolation, Input to Output: 500 VDC

Output Voltages:

+15 VDC nominal @ 250 mA

-15 VDC nominal @ 250 mA

+5 VDC nominal @ 1000 mA

Line Regulation: 0.2% max (+5 V); 5% max (± 15 V)

Load Regulation: 0.5% max (+5 V); 5% max (± 15 V)

Total Output Power: 15 VA (full load)

Input Voltage Range: 9 to 18 VDC

Included AC Adapter: 15 VDC @ 0.9 A

Full-Load Efficiency: 80% Typical

Full-Load Input Current Range:

2.10 A @ 9 VDC

1.05 A @ 18 VDC

Input Connections: DIN5 (x2 for daisy-chaining)

Output Connections: DB37 Male

Parallel Provision: OR-ing diodes on output lines allow use of multiple DBK33s in larger systems

Controls: ON/OFF rocker-arm switch

Indicators: LED driven by input voltage

Over-Voltage Protection: Fuse followed by 19 V zener clamp

Switching Frequency: 100 kHz min

Operating Temperature Range: -20 to 70°C

Input Fuse: 3 A (Littelfuse 25003)

DBK34 - Specifications

Name/Function: Vehicle UPS Module

Battery Type: Sealed-lead rechargeable

Number of Battery Packs: 2

Battery Pack Configuration: 6 series-connected D cells

Output Voltage: 12 V or 24 V (depending on jumpers)

Output Fuses: 8 A on each internal battery (2)

Battery Capacity (Amp-Hours):

5 A-hr in 12 V mode (parallel)

2.5 A-hr in 24 V mode (series)

Operating Temperature: -20°F to 122°F (-29°C to 50°C)

Size: 8½ × 11 × 1¾ in. (216 × 279 × 44 mm)

Weight: 7.2 lb (3.27 kg)

DBK40 - Specifications

Name/Function: BNC Analog Interface Module

Connection: Male DB37 mates with P1.

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

Single-Ended Mode: Center conductor carries signal, outer conductor carries signal ground.

Differential Mode: Center conductor of two adjacent BNC connectors carries high and input low signals; outer conductor of both is attached to system ground.

Analog Output Connection: One BNC connector for each of 2 analog output channels; center conductor carries signal, outer conductor carries signal ground.

TTL Trigger Input Connection: One analog output BNC connector can be switched to provide a TTL trigger input connection; in TTL mode, the second analog output channel is unavailable on the BNC connector.

Size: 6.8" wide × 5.3" long × 2.3" high

Weight: 21 oz

Length of Supplied Cable: 6 ft

DBK41 - Specifications

Name/Function: 10-Slot Analog Expansion Module

Card Capacity: 10 slots

Weight: 4 lb (with no cards installed)

Cable (optional): 8" ribbon DB37 female to DB37 female (CA-37-x)

Power Indicator: LED powered by LogBook 5 VDC

Connection: Male DB37, mates via CA-37-x cable with P1

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 to 24 VDC @ 2.6 to 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: 3 A

Power Indicator: LED powered by internal 5 VDC

Power Connection: DIN5 x2 for daisy-chaining

AC Power Pack:

120 VAC to 15 VDC converter

120 VAC to 15 VDC @ 2.0 A (optional)

Input Connections: DIN96 rectangular, standard, screw terminal adapter (optional)

Connection: Male DB37 mates via CA-37-1 cable with P1

DC/DC Converter: 10 to 24 VDC into 5 VDC (isolated)

Isolation:

Input Power to LogBook: 500 VDC

Signal Inputs to LogBook: 1500 VDC

Input Channel-to-Channel: 500 VDC

DBK43A - Specifications

Name/Function: 8-Channel Strain-Gage Module

Connectors: DB37 mates with P1; mini-DIN6 provided for strain-gage or external excitation connections

Number of Channels: 8

Excitation Voltage Adjustment Ranges: 1.50 to 10.50 VDC @ 50 mA

Input Gain Range: $\times 100$ -1250; separate instrumentation amplifier for each channel with gain adjustable via externally accessible 15-turn trimpot

Accommodated Bridge Types:

Full bridge, Kelvin excitation (6-wire)

Full bridge (4-wire)

Half bridge (3-wire)

Quarter bridge (2-wire)

Bridge-Completion Resistors: On-board resistor socket locations (Rn00A, Rn00B, Rn00C, Rn00E, Rn00F, and Rn00G) for 6 bridge-completion resistors per channel

Input Type: Differential

Input Impedance: 100 M Ω

CMMR: 115 dB

Excitation Current Output: 50 mA max
(current limited @ 60 mA)

Excitation Sensing: Local or remote

Excitation Regulation

Line Regulation: 0.025%

Load Regulation: 0.05%

Reference Voltages: 2.5 VDC

Reference Accuracy: 0.05%

Reference Drift: 3 ppm/ $^{\circ}$ C

Gain Calibration Reference: 5 mVDC

Gain Calibration Reference Accuracy: 0.2%

Gain Calibration Reference Drift: 20 ppm/ $^{\circ}$ C

Gain Accuracy: 0.5%

Gain Drift: 50 ppm/ $^{\circ}$ C

Input Offset: 100 μ V max

Offset Drift: 4 μ V/ $^{\circ}$ C

Output Offset: 20 μ V

Offset Drift: 200 μ V/ $^{\circ}$ C

Offset Adjustment: 0-100% of range, 0-5 VDC (15-turn trimpot)

Full-Scale Sensitivity Range

5.00 VDC Excitation: 0.8-10 mV/V

10.00 VDC Excitation: 0.4-5 mV/V

Scaling Amplifier Gain Range: $\times 1$ -10 (15-turn trimpot)

Low-Pass Filter:

3-pole, user-selected

Corner frequency (Fc) set by user component

Attenuation -3 dB at Fc

Gain $\times 2$

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

DBK44 - Specifications

Name/Function: 2-Channel 5B Signal Conditioning Card

Module Capacity: 2 (input only) 5B modules

Weight: 8 oz (with no modules installed)

Cable (optional): CA-37- \times

DC Input Fuse: 4 A

Connection: Male DB37 mates via CA-37-1 cable with P1

Isolation:

Input Power to LogBook: 500 VDC

Signal Inputs to LogBook: 1500 VDC

Input Channel-to-Channel: 500 VDC

DBK45 - Specifications

Name/Function: Simultaneous Sample and Hold and Low-Pass Filter Card

Number of Channels: 4

Input Connections: 4 BNC connectors

Output Connector: DB37 male, which 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: $R_{\text{GAIN}} = [40,000/(\text{Gain}-1)] - 80 \Omega$

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, ×500, 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: $5 \times 10^{12} \Omega$ 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 pre-configured for any of the following frequencies: 5 Hz, 10 Hz, 100 Hz, 500 Hz, or 1 kHz—all are Butterworth-type filters.

DBK50/51 - Specifications

Name/Function: 8-Channel Isolated Voltage Input Module

Connectors: Male DB37, mates with P1

Inputs: Removable screw terminals

Number of Channels: 8, individually isolated

Isolation

Channel-to-Channel: 750 V

Channel-to-System: 1250 V

Input Impedance: >10 MΩ

DBK50 Bipolar Input Ranges: ±10 V, ±100 V, ±300 V

DBK51 Bipolar Input Ranges: ±100 mV, ±1 V, ±10 V

Output Voltage Range: ±5 VDC

Attenuation Ratios: $K = V_{\text{in}} / V_{\text{out}}$

100 mV, $K = 0.02$ (gain = 50)

1 V, $K = 0.2$ (gain = 5)

10 V, $K = 2.0$ (gain = 0.5)

100 V, $K = 20.0$ (gain = 0.05)

300 V, $K = 60.0$ (gain = 0.017)

Bandwidth: 20 kHz (LPF bypassed)

Low-Pass Filter: Factory installed 3-pole, 3.5 Hz (bypass or user-set)

Operating Power Voltage Range: +9 to +20 VDC

Module Power Requirements: 7.5 W

Included AC Adapter: 15 VDC, 0.9 A

DBK52 - Specifications

Name/Function: Thermocouple Input Module

Connectors:

DB37 male, mates with P1

Thermocouples attach directly to on-board jacks

Thermocouple Types: J, K, S, T, E, B, R, N

Gain Ranges: $\times 60$, $\times 90$, $\times 180$, $\times 240$

Inputs:

14 differential thermocouples

1 cold-junction compensation

1 auto-zero

Cold Junction Sensor Output: 100 mV/°C

Voltage Ranges/Gains:

0 to 80 mV $\times 60$

0 to 50 mV $\times 90$

0 to 25 mV $\times 180$

0 to 20 mV $\times 240$

0 to ± 10 mVDC

Input Impedance: 20 k Ω

Input RC Filter: -3 dB Frequency: 15.9 kHz

Gain Accuracy:

Uncalibrated: 0.15%

Calibrated: 0.02%

Maximum Input Voltage: 35 VDC

CMRR (Input Stage): 110 dB type DC to 60 Hz

Offset: Software compensated

Type/Range/Accuracy/Resolution: see following table

Type	Range		Accuracy		Resolution			
	Min	Max	(<0°C)	(>0°C)	12-bit <0°C	12-bit >0°C	16-bit <0°C	16-bit >0°C
J	-200°C	760°C	0.6°C	0.6°C	1.2°C	0.5°C	0.1°C	0.1°C
K	-200°C	1260°C	1.6°C	1.0°C	1.1°C	0.8°C	0.1°C	0.1°C
T	-200°C	400°C	1.4°C	0.8°C	0.8°C	0.3°C	0.1°C	0.1°C
E	-270°C	1000°C	1.4°C	0.9°C	1.6°C	0.7°C	0.1°C	0.1°C
N28	-270°C	400°C	0.8°C	0.8°C	1.0°C	1.0°C	0.1°C	0.1°C
N14	0°C	1300°C	—	1.0°C	—	5.0°C	—	5.0°C
S	0°C	1780°C	—	1.6°C	—	1.3°C	—	0.1°C
R	0°C	1780°C	—	1.6°C	—	1.7°C	—	0.1°C
B	0°C	1820°C	—	1.8°C	—	1.5°C	—	0.1°C

DBK53/54 - 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: $\times 1$, $\times 2$, $\times 4$, $\times 8$

DBK54: $\times 1$, $\times 10$, $\times 100$, $\times 1000$

Inputs: 16 differential or single-ended jumper selectable as a group)

Voltage Range:

± 5 VDC bipolar; 0 to 10 V unipolar

Input Impedance: 100 M Ω (in parallel with switched 150 pF)

Gain Accuracy: 0.05% typical, 0.25% max

Maximum Input Voltage: 35 VDC

Slew Rate: 20 V/s typical, 10 V/s min

Settling Time: 2 s to 0.01%

CMRR: 80 dB min

Non-Linearity: 0.002% typical, 0.015% max

Bias Current: 150 pA, 0.2 A max

Offset Voltage:

$\pm(0.5 + 5/G)$ V/°C typical

$\pm(2.0 + 24/G)$ mV max

Offset Drift:

$\pm(3 + 50/G)$ V/°C typical

$\pm(2.0 + 24/G)$ V/°C max

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Data File Accessibility

PostView post-data-acquisition software supports several programs, including: *ChartView*, *DaqView*, *LogView*, *Personal DaqView*, *TempView*, and *WaveView*. These six acquisition programs create data files that can be viewed and analyzed in *PostView* after the acquisition has been completed.

PostView makes use of ASCII (**.txt**) or PostView Binary (**.iot**) files. However, most acquisition programs create the data files in raw binary format (**.bin**) during the acquisition. For these programs, a conversion of the file format must be completed before *PostView* can access the data. A further explanation follows:

- *Personal DaqView*, *DaqView*, *LogView*, and *WaveView* create raw binary (**.bin**) formatted files during the data acquisition. After the acquisition is complete, these programs convert the **.bin** formats to **.iot** or **.txt** formats (as determined by the user). *PostView* can then access the re-formatted data.
- *ChartView* and *TempView* create **.iot** or **.txt** formatted data files during the acquisition. Since *PostView* makes direct use of these formats, charts can be updated in “real-time” while the acquisition is in progress.



Reference Note:

Refer to *PostView*'s Help file for data file information relating to specific data acquisition programs. Note that some data acquisition programs can convert data formats to **.sma** format for Snap-Master or **.dat** for DADiSP.



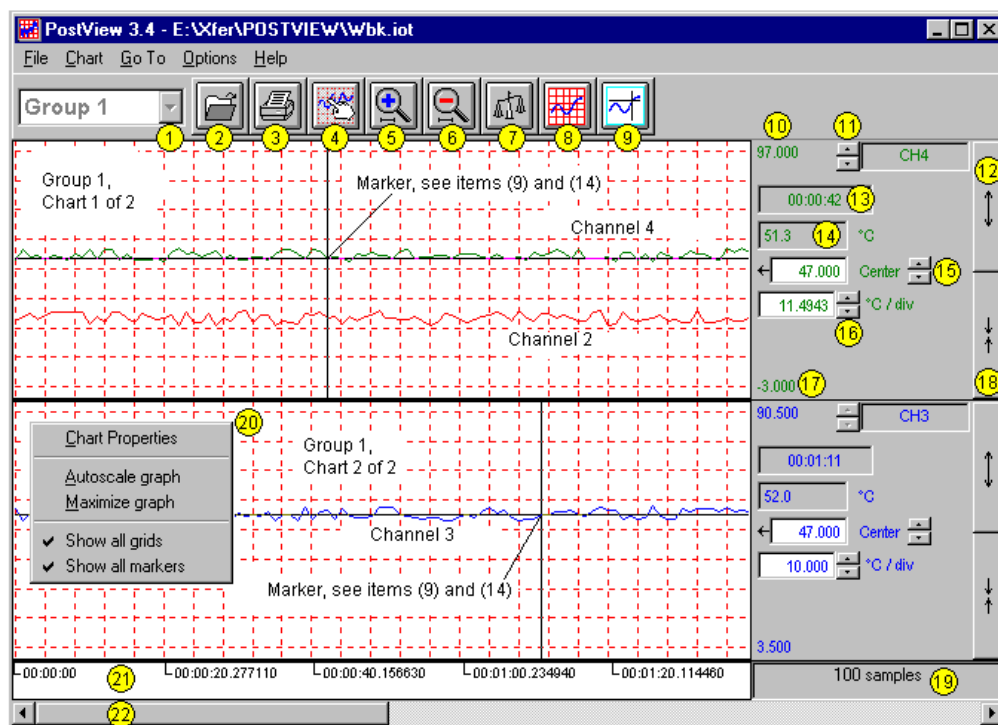
This chapter is based on *PostView* version 3.4. *PostView* 3.x versions are used in 32-bit applications, whereas *PostView* 2.x versions are used in 16-bit applications. The significant differences between 2.x and 3.x versions exist at the program level and are not visible to the user.



If you are using the more powerful *DIAdem* program [instead of *PostView*], you should skip this chapter and refer to the separate *DIAdem* User Documentation.

PostView is an independent program that allows you to view waveforms recorded by various data acquisition programs. As the data file is being created, a descriptor file used by PostView is also created.

The following figure and table highlight PostView's *Main Window* screen and control features.



PostView Main Window

PostView Control Options ¹			
☞ = Mouse, ⬆⬆ = Arrow Keypads, ⬇ = PageUp/PageDown Keypads			
1	Group Select	☞, ⬆⬆, or ⬇	
2	Open	☞, or Ctrl+O	
3	Print	☞, or Ctrl+P	
4	Setup	☞, or Ctrl+S	
5	Zoom In	☞	
6	Zoom Out	☞	
7	AutoScale	☞	
8	Show Grid	☞, Ctrl+G	
9	Show Markers	☞, Ctrl+K	
10	Chart Max Scale Value ²	Setup Dialog Box	
11	Channel Selection ²	☞, or ⬆⬆	
12	Multiply (x2) ²	☞, or [spacebar]	
13	Time at Marker	Indicates time at marker position.	
14	Value at Marker ²	-----	
15	Center ²	☞, ⬆⬆, or type-in	
16	Units/Division ²	☞, ⬆⬆, or type-in	
17	Chart Min. Scale Value ²	Setup Dialog Box	
18	Divide (÷2) ²	☞, or [spacebar]	
19	Number of Samples Displayed	Automatic indication of no. of samples per chart	
20	Pop-up Menu	☞ Right-clicking on a chart accesses a pop-up menu.	
21	Time Stamp	Hours: mins: seconds. Tenths Time stamp can be <i>relative</i> or <i>absolute</i> . Default is <i>relative</i> time stamp.	
22	Scroll	☞	

¹ **Note:** For keypad options, first use the *Tab* key to "tab over" to the desired control item. For example, you can use the tab key to highlight the Group Select (item 1), then use any of the following 3 methods to obtain the desired group: Ctrl+G, keypad arrows, or PageUp/PageDown keys.

² **Note:** Items 10 through 18 are discussed in the section, *PostView Channel Information Region*, page -5.

³ **Note:** Toolbar button functions are discussed on page -4.

⁴ **Note:** Ctrl+J will show the software version number.

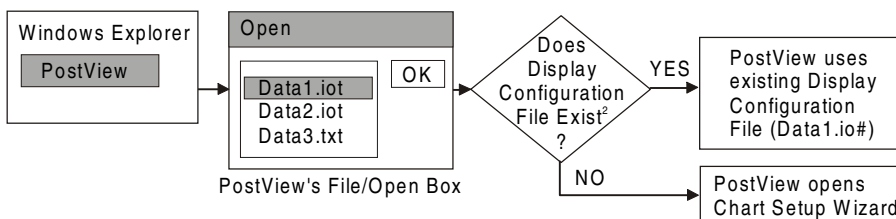
Starting PostView

The main ways of starting PostView are:

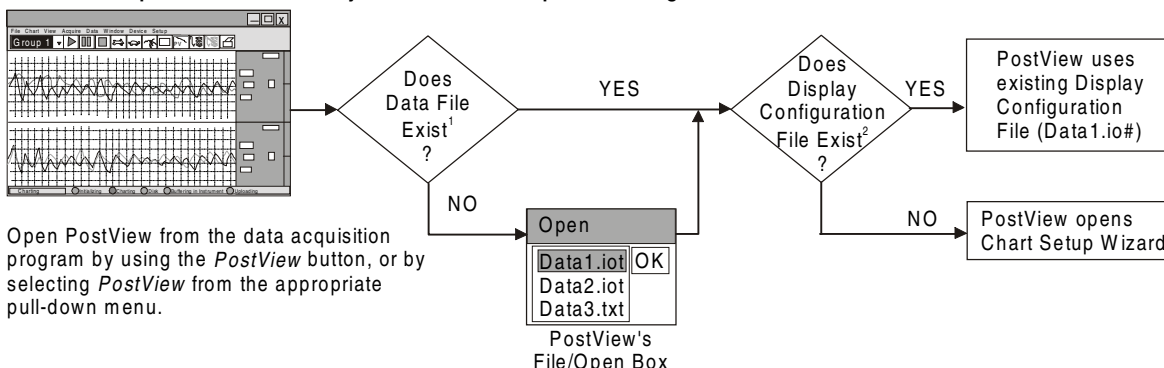
- 1) Open PostView directly from the Windows Explorer, Desktop Icon, or Start Run browse feature (on desktop).
- 2) From the acquisition program's main window, click on the toolbar's PostView button, or select PostView from the pull-down menu.

Each of these methods is illustrated in the following figure. **Actions in the decision diamond are performed automatically by PostView and require no user action.**

Method 1: Open PostView Directly from Windows Explorer, Desktop Icon, or Start Run browse



Method 2: Open PostView directly from the Data Acquisition Program



Two Basic Methods of Opening PostView

When you first open PostView the program automatically checks for the existence of an **.iot** or **.txt** data file (previous figure). If no data file can be found, PostView displays its File Open dialog box so you can select the desired file. In addition, PostView checks for a Display Configuration File (see Note). If none is found the File Open dialog box still allows you to select the desired file. In this later case the Chart Setup Wizard opens, providing a means of setting up a chart display (the number of chart groups, number of charts per group, channel assignments for each chart, and types of channels).

¹**Note:** PostView automatically checks for Data Files. These files are recognized by **.iot** or **.txt** filename extensions.

²**Note:** PostView automatically checks for Display Configuration files. These files are automatically saved when exiting your data acquisition program. These files are recognized by filename extensions of: **.io#** (for binary files) and **.tx#** (for ASCII files).

³**Note:** Several copies of PostView can be active at the same time; allowing you to view different data files during the same session. To view a data file from PostView, select *Open* under PostView's File menu, and select the desired data file.



For PostView 3.4 and later, you can start the Chart Setup Wizard from the Chart pull-down menu. Chart Setup Wizard's use in PostView is discussed on page -8. PostView Versions earlier than 3.4, have no Chart pull-down menu. In these versions, you can start the Chart Setup Wizard from the File pull-down menu.

Toolbar

The following table explains PostView toolbar items. Note that PostView Menu items are discussed on page -6.



PostView Toolbar Items		
Item #	Item	Description
1	Group Select	This feature indicates which chart group is being displayed. Clicking on the down arrow (⌵) reveals other chart groups configured by the user. To select a different chart group, simply pull down the group list and select the desired group. The group list can be obtained by any of the following control options: a) clicking the down arrow (⌵), b) using Ctrl + G on the keyboard, c) using the keyboard up or down arrow key, d) using the page up or page down key. If using a control option other than "a," you may need to select the <i>group select</i> box by pressing the keyboard's <i>Tab</i> key several times (until the <i>group select</i> box is selected). When this happens the name of the currently selected group appears in white on a dark background.
2	Open	Accesses the Open Data File window.
3	Print	Sends a snapshot of the PostView chart(s) to an assigned printer.
4	Display Configuration	The Display Configuration button accesses the <i>Display Configuration Setup</i> dialog box. This box will also be displayed if <i>manual setup</i> is selected during use of the Wizard Chart Setup program. Clicking on the button accesses a <i>Display Configuration Setup</i> box, which displays the configured structure of the groups, charts, and channels. From this box you can add or remove: (a) groups to the display configuration, (b) charts to a group, (c) channels to chart. With the use of the mouse cursor you can also select a chart or channel for additional editing. Display Configuration is discussed in more detail, immediately after description of the pull-down menu options.
5	Zoom In	The Zoom In (+) button halves the visible timebase, showing less of the waveform. For example, if 10 seconds of information is visible, clicking the Zoom In button will show 5 seconds.
6	Zoom Out	The Zoom Out (-) button doubles the visible timebase, showing more of the waveform. For example, if 10 seconds of information is visible, clicking the Zoom Out button will show 20 seconds.
7	Autoscale Y-axis Adjust	Clicking the Auto Scale button adjusts the Y-axis scaling such that all waveforms fill 90% of the chart's range. Affects all channels of the currently selected Group. The Y-axis Adjust fields show the chart's minimum and maximum for currently selected charts in the engineering units shown. Auto Scaling of individual charts can be accomplished from the pop-up menu that appears when you right-click on a chart. A pop-up menu (item 20) is shown on the main window figure on page -2.
8	Show Grid	Places a grid on the chart (s), or removes the grid if already present.
9	Show Markers	Each chart can have a cross-hair for selecting a specific point on the waveform. The time and magnitude at the marker point are displayed in the channel information region, as shown for items (13) and (14) on page -5. The Markers start out at the far left of every chart, showing the time and magnitude of the first visible point. <i>Ctrl+Left Mouse Button</i> moves the markers from all the charts <i>in unison</i> . The Options menu contains a function which allows you to turn markers on and off. When a check appears in front of this item, its associated indicator is on or visible. Selecting the menu item toggles the indicator (and the check mark) on and off.
	Trigger Event Marker	The Trigger Event Marker on the time axis shows the location of the trigger point. (See figure, <i>PostView TimeBase</i>)
	Stop Event Marker	The Stop Event Marker on the time axis shows the location of the stop point. (See figure, <i>PostView TimeBase</i>)

The Scroll Bar at the bottom of the PostView window allows the waveforms to be scrolled right or left in two ways:

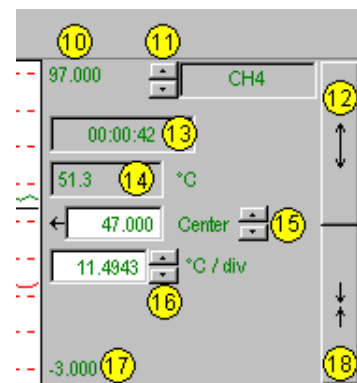
1. When clicked on, the small left and right arrow boxes scroll the waveforms approximately 20%.
2. The plain scroll button shows the relative location of the visible region of the waveforms and can be dragged along the scroll bar to any location desired.

Channel Information Region

By clicking on the up or down arrows (σ , or τ) by the channel selection box (item 11), you can select one channel (of a maximum of 4 overlapping channels) that were assigned to that chart. You could then observe the chart-related information for that specific channel. You can also select a new channel for the information region by placing the cursor in (or tabbing over to) the “Center” or “Units/Div” fields and then pressing PageUp or PageDown. This is particularly useful when your main window has been re-sized such that the channel selection boxes are not visible.

The following list identifies the various areas of the region.

- (10) Chart Max. Scale Value (Grid Limit Line)
- (11) Channel Selection (Of chart's available channels)
- (12) Multiply ($\times 2$)
- (13) Time at Marker
- (14) Value at Marker
- (15) Center (Value at chart mid-line)
- (16) Units/Division (Indicates vertical increment of one grid box.)
- (17) Chart Min. Scale Value (Grid Limit Line)
- (18) Divide ($\div 2$)



Channel Information Region

Multiply and Divide Buttons (12 & 18) - In addition to reading channel values, you can increase or decrease the size of the selected channel's chart. This is accomplished with the **Multiply** (12) and **Divide** (18) push buttons. The Multiply push-button effectively increases the size of the selected channel's chart by a factor of 2, while automatically adjusting the chart's high and low values (items 10 and 16). Aside from “clicking” on the Multiply/Divide controls, you can use your keyboard spacebar to control this feature once the button (12 or 18) is selected. Selection may be with mouse, or by tabbing over to the control.

Making changes to a channel's chart parameters does not affect the parameters of the other channels, with the following exception: Holding the keyboard's control key down while adjusting either spinner (σ/τ) for *center* (item 14), or spinner for *units/div* (item 15) causes the parameter change to apply to all channels displayed for the chart, not just the currently selected channel display. This feature applies to the spinners and keyboard up and down arrow keys, but not to the text input.

Time at Marker (13) - is the time at the marker position. It is also the time chart value (14) was read.

Value at Marker (14) - is the charted channel value at the marker position. Item (13) indicates the time this value was read.

Center Control (15) - changes the value of the selected channel's chart centerline. Changing the value of *center* results in an automatic change of the chart's high and low end values (items 10 and 17), and possibly an automatic change of the units/div (item 16). Aside from using the *center* spinner controls to change center, you can change the center value by placing the mouse cursor in (or tabbing over to) the field and then either typing in the desired value, or using the PC keyboard up and down arrow control keys.

Units/div (16) - The units in **units/div** (16) can be °C, °F, °K, °R, mV, or V. The division referenced is one vertical grid. In the example above (for Channel 4), each vertical grid increment represents 11.4943°C per division. Changing the units/division spinner controls (σ/τ) will result in an automatic adjustment of the max scale and min scale values (items 10 and 17). Aside from using the units/div triangular controls to change the value, you can change units/div from the *Display Configuration Setup* dialog box as described on page -14.


Menu Items

File	
<u>O</u> pen (Ctrl + O)	Opens a data file created by the data acquisition program. PostView automatically detects whether the file contains ASCII or binary data.
Pri <u>n</u> t	Prints a snapshot of the present PostView Chart window.
<u>E</u> xit (Ctrl + X)	Exits the File menu and closes PostView.

Chart	
Chart Display Setup	Brings up the Chart Display Sub-menu with selections to: Open a Display Configuration File, Save a Display Configuration File with present file name, or Save a Display Configuration File with a new file name.
<u>O</u> pen (F11)	Used to open a specific Chart Display Configuration file.
<u>S</u> ave	Saves the Chart Display Configuration to disk. Saves to the file that was opened from the Chart Display Setup Open menu.
<u>S</u> ave As (F12)	Used to save the Chart Display Configuration file to disk, to a new (or existing) file.
<u>S</u> etup (Ctrl + E)	Accesses Display Configuration Setup dialog box, allowing you to edit the display configuration.
<u>W</u> izard (Ctrl + W)	Accesses the Chart Setup Wizard.

Go To	
<u>P</u> ercentage (Ctrl+P)	Automatically scrolls the waveform such that the displayed waveform begins at the specified percentage.
<u>S</u> can Number (Ctrl+S)	Automatically scrolls the waveform such that the displayed waveform begins at the specified scan number.
<u>T</u> ime (Ctrl+m)	Automatically scrolls the waveform such that the displayed waveform begins at the specified time.
<u>T</u> rigger Point (Ctrl+T)	Automatically scrolls the waveform such that the displayed waveform begins at the trigger point (t = 0).
Note: In PostView Version 3.x – If there is a Pre-trigger, then Pre-trigger and Post-trigger times (in seconds) are displayed in the Go To menu's dialog box.	

Options	
<u>Z</u> oom Graph Out	Allows more of a chart(s) to be seen by decreasing the dimensions.
<u>Z</u> oom Graph In	Zooms in on a chart(s), providing more detail to a smaller area of the chart(s).
<u>M</u> aximize Graph	Causes PostView to display one chart only. For example, if you were viewing 3 charts and wanted to get a better view of Chart 2, you could use Maximize Graph so it would be displayed using the full chart viewing area, as compared to using one third of the area. The Maximize Graph feature can also be invoked by double-clicking in the chart region of the chart you want to maximize. Once you have maximized a chart, the pull-down menu option is replaced by a Restore option. Selecting Restore from the menu returns the main window to its previous multiple-chart viewing status. The restore feature can also be invoked by double-clicking [or right-clicking] and selecting <i>Restore graph</i> from the pop-up menu.
<u>A</u> bsolute time (Ctrl+A)	PostView normally displays timestamp information in a relative format; +/- time from the trigger point, see note. If the instrument and acquisition software that created the data file supported timestamp logging, and the feature was enabled such that timestamp information was saved with the data, then PostView can display these Absolute timestamps (instead of the relative stamps). See following note. Note: <i>Relative time</i> format, typically uses 00:00:00.0 as the start time and shows other times as hours, minutes, seconds and tenths which have elapsed since the start time. (Also see PostView Timebase, page -15.)
<u>A</u> utoscale <u>C</u> urrent Channel	For the currently selected channel, automatically generates a scale, in contrast to manually assigning the scale.
<u>A</u> utoscale <u>A</u> ll Channels	Automatically generates a scale for each channel in every chart of the selected group.
<u>S</u> how Grid (Ctrl+G)	Allows grids to be turned off and on for all visible graphs. When a check appears in front of an item, its indicator is on or visible.
<u>S</u> how Markers (Ctrl+K)	Allows markers to be turned off and on for all visible graphs. When a check appears in front of an item, its indicator is on or visible.

Data Commentary (Ctrl+C)	<p>This function is hidden, unless a comment has been added to the data header file. If such a comment has been entered, then the Data Commentary option will be visible. Selecting Data Commentary brings up a message box. The comment feature is supported by certain acquisition software, and can only be used by PostView versions 3.3 or greater. For ChartView users: note that commentary can be entered in ChartView's Setup/Data Destination dialog box, providing the commentary feature is enabled. To enable the feature in ChartView, start with the View pull-down menu and navigate as follows: View ⇒ Options ⇒ (3) Enable PostView Comment (refer to the software chapter, if needed.)</p>  <p style="text-align: center;"><i>Example of a Data Commentary Message</i></p>
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Help	
Contents	The initial PostView help screen provides an overview and listing of the help file contents. A single topic can be selected for quick access to help information.
Search	Type a word or select one from the Show Topics list for quick access to help information.
Help on Help	Provides instructions on how to use a <i>Windows</i> Help system.
About	Provides PostView's version number.

Understanding Groups, Charts, and Channels

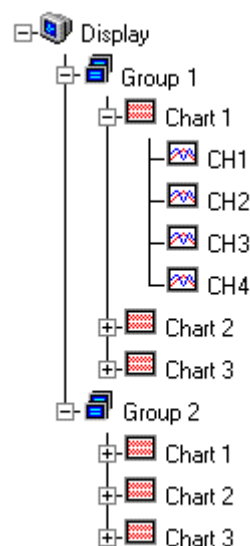
As indicated in the figure on page -3, when no display configuration file is found, PostView opens the *Chart Setup Wizard* to assist you in creating a display file. To make the best use of *Chart Setup Wizard* you need to understand the relationship of Groups, Charts, and Channels. The *Chart Setup Wizard* feature is discussed immediately following this text.

Group. “Group” refers to a group of charts. You can add and remove groups to your display, and you can add or remove charts to each group. Depending on the capabilities of your PC, you can have up to 64 groups assigned to your display.

Note: PostView can only display data from one group at a time.

Chart. A “Chart” is a display area containing up to four channels. You can assign up to 16 charts per group. Charts can be displayed with or without gridlines.

Channel. “Channel” refers to a signal channel. You can have up to 4 channels assigned to one chart. Channels will be displayed in units of °C, °F, °K, °R, mV, V, or *user defined* units, depending on the configuration and type of signal conditioning card which was used during data acquisition.



Relation of A Group to Charts and Channels

Chart Setup Wizard

Introduction

The *Chart Setup Wizard* feature allows you to create PostView's initial chart display configuration with an automated or manual method. When PostView can not locate a display configuration file, it automatically accesses the *Chart Setup Wizard* feature. If a display configuration file is located, PostView bypasses the *Chart Setup Wizard*.

Note: You can manually activate the *Chart Setup Wizard* from the Chart pull-down menu (File pull-down menu in versions preceding 3.4). Activating the *Chart Setup Wizard* will reset an existing display configuration. Prior to manually activating the Wizard feature, a "New Display Setup" box will appear to remind you of the *display reset*. You can then activate Wizard by selecting "OK," or discontinue by selecting "cancel."

Note: You can edit the display configuration file without use of the *Chart Setup Wizard* by using the *Display Configuration Setup* dialog box. This box can be accessed from *Setup* in the Chart pull-down menu (File pull-down menu in versions preceding 3.4), or by clicking on the Chart Setup button in PostView's toolbar. This method of display editing is discussed in the section, *Display Configuration*, beginning on page -10.

The chart display setup determines how your *PostView* window will appear in regard to the following:

- number of chart groups available for viewing
- number of charts shown for each selected group
- the number of overlapping channels in each chart (not to exceed 4)

You can choose to manually create a display configuration, or have one created automatically. The automatic setup method offers three choices: Simple, Moderate, and Advanced.

A *Manual Chart Creation*, **Create Charts** button allows you to bypass the *Chart Setup Wizard* and enter a manual editing mode. This option makes use of PostView's Display Configuration feature (discussed in the following *Display Configuration* section). Manual Chart Creation allows you to vary the number of assigned channels per chart, as well as vary the number of charts per group.



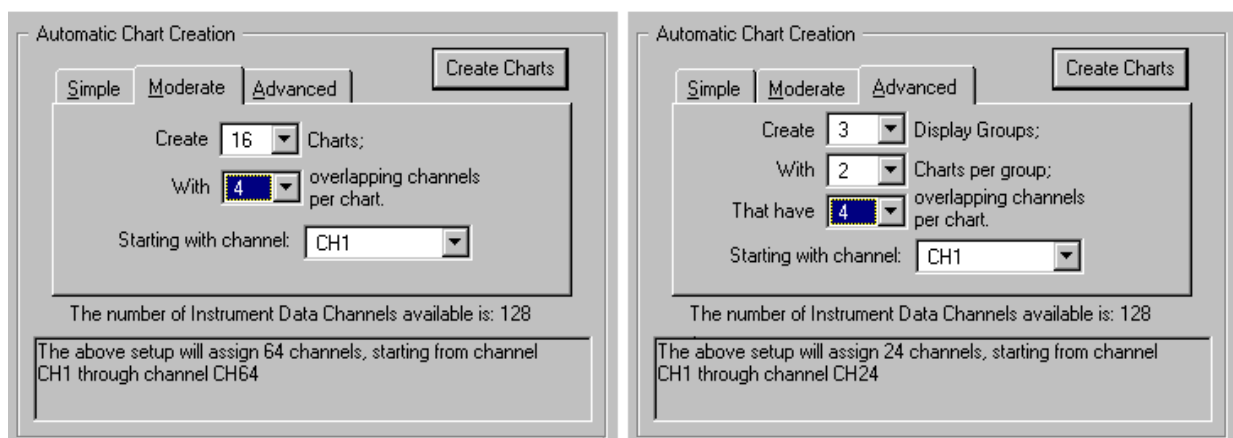
Chart Setup Wizard, Simple Mode

Chart Setup Wizard, Automatic Setup Options for PostView			
Setup Type	Group Setup (for Chart Groups)	Chart Setup	Channel Setup
S imple	1 group only	Up to 16 charts	1 channel per chart
M oderate	1 group only	Up to 16 charts	Up to 4 overlapping channels per chart
A dvanced	Up to 64 groups	Up to 16 charts per group	Up to 4 overlapping channels per chart

Note: The *Manual Charts Creation*, **Create Charts** button (above figure) allows you to exit the *Chart Setup Wizard* and enter the manual *Display Configuration* mode.

Automatic Display Creation

The previous figure shows the Simple mode dialog box for Automatic Chart Creation. The following figures show the Moderate and Advanced mode dialog boxes.



Dialog Boxes for Moderate and Advanced Modes of Automatic Chart Creation

It is a simple task to create a chart display configuration using the automatic method. The following steps apply to this feature of *Chart Setup Wizard*.

Note: If PostView locates a display configuration file, *Chart Setup Wizard* will not be activated unless you choose to manually activate the Wizard from the File pull-down menu.

1. From the *Chart Setup Wizard* window, select the desired mode (Simple, Moderate, or Advanced).

Note: Selecting *Manual Chart Creation*, *Create Charts* bypasses the *Chart Setup Wizard* and enters a manual editing mode. This option makes use of PostView's Display Configuration feature discussed in the following section, *Display Configuration*.

2. Use the pull-down arrows (τ), or use the cursor and type in a new value to make selections for the number of groups, charts, and channels as applicable.
3. If you desire to start with a channel other than channel 1, use the pull-down arrow and select the desired starting channel number.
4. When your setup is complete, click on the *Create Charts* button. A *percentage of completion* bar will appear, followed by the PostView window.

The channels in the setup you create will appear in chart form on PostView's window. The Channels will overlap on their assigned Chart (for configurations making use of multiple channels per chart), and will be visible when the applicable Group is selected. Note that only one group of charts can be viewed at a time.

Display Configuration

Note: When PostView does not find a display configuration file it automatically opens the *Chart Setup Wizard*. You can use this feature to automatically create a display configuration. You also have the option of selecting *Manual Chart Creation, Create Charts* to bypass the *Chart Setup Wizard* and enter the manual editing mode, as discussed in this section.

The Display Configuration button accesses a *Display Configuration Setup* dialog box. This box will also be displayed if:

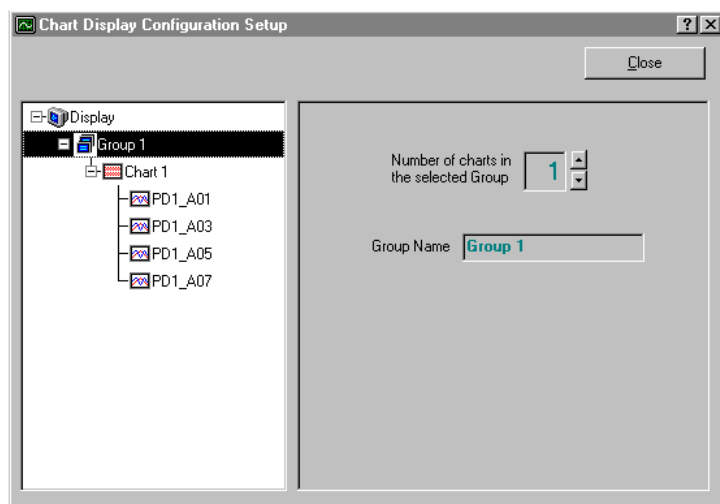
- Manual Chart Creation, Create Charts* is selected from the *Wizard Chart Setup* window
- You select *Setup* from the File pull-down menu
- You right-click on the chart region in PostView's window

Note: If multiple chart groups are present in the display configuration, the current group will be selected in the display configuration tree.

When you first click on the Display Configuration button, a *Display Configuration Setup* box appears. A display region shows the configured structure of the groups, charts, and channels. From this box you can select the number of charts to be assigned to a specific group. With the use of the mouse cursor you can also select a chart or channel for additional editing.

The rest of this section has been divided into two parts. The first pertains to editing an existing display; while the second section pertains to manually creating a display configuration from scratch, i.e., there is no existing display configuration to edit. Both methods make use of *Display Configuration Setup* dialog boxes.

Editing a Display

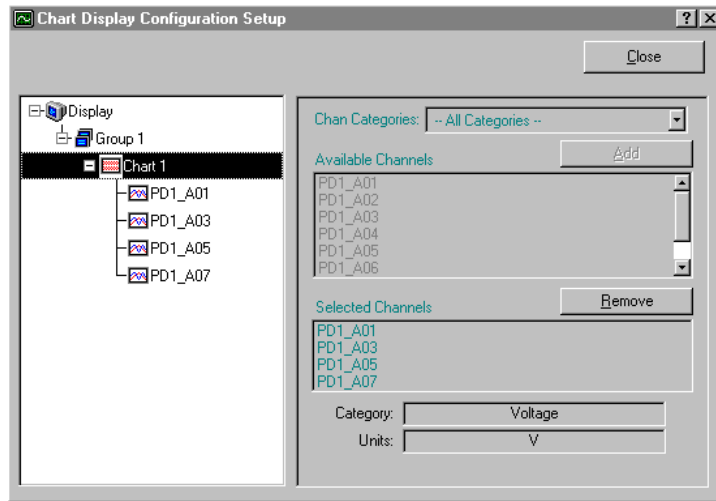


Display Configuration Setup Dialog Box with an Existing Configuration

To explain editing a configuration, we make use of an example in which assumes you want to edit Chart 1. In the following figure, Chart 1 was highlighted by clicking on it with the mouse cursor. The *Display Configuration Setup* box then changed, allowing you to see specific channel types (such as volts only) or to “Show all Types,” as in the example. From this setup box you can add or delete charts and channels. You can:

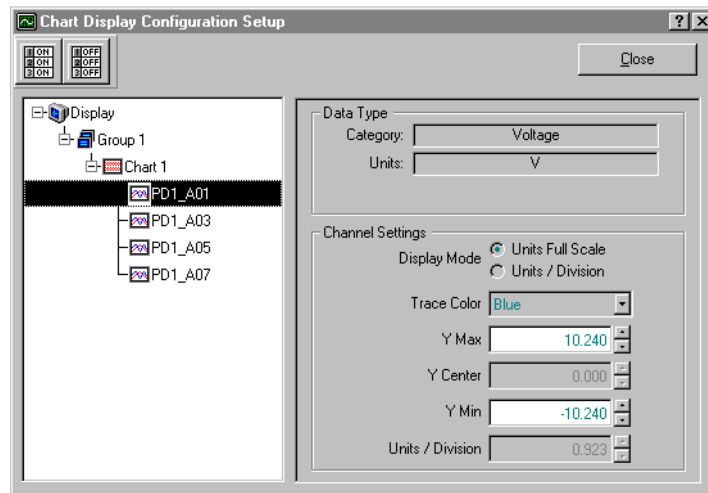
- Use the *Shift* or *Ctrl* key in conjunction with the *cursor* to select several channels for addition or deletion
- double-click on an *available channel* to add it to the selected channels
- double-click on a *selected channel* to remove it from the selected channels list

Note: When a chart contains overlapping channels which share values (such that their traces reside on top of each other), the more recent channel will obscure the earlier channel. Note that the lower a channel is on the display list, the more recent it is in regard to the display.



Adding Channel 2 to Chart 1

Another variation of the Display Configuration Setup box appears when you highlight a channel. In the following figure, Channel 1 (of Chart 1, Group 1) was selected, resulting in a new screen image. From this screen you can edit the channel setup.



Adjusting Channel Setup for Channel 1

PostView channels can be set for either of two modes: Units Full Scale or, Units/Div. The mode is selected by radio button. Mode descriptions are as follows:

Units Full Scale. When Units Full Scale is selected, as depicted in the above figure, you can alter Y Max and Y Min. These are the upper and lower limits of the channel, as they will appear on the chart when the channel is selected. When you change either parameter, Y Center and Units/Division are automatically adjusted. You can not directly adjust Y Center or Units/Division while “Units Full Scale” is selected. You can change Y Max and Y Min by using the up and down arrows, or by highlighting the existing value, typing in the new value, the pressing “Enter” on your PC keyboard.

Note: If the window size is changed, a chart operating in the Units Full Scale mode will maintain its *full scale* setting across the chart.

Units/Div. When Units/Div. is selected you can alter Y Center and Units/Div. Y Center is the centerline value of the chart when the channel is selected. Units/Div. is the vertical value of on chart grid increment. When you change Y Center or Units/Div. Y Max and Y Min are automatically adjusted. You can not directly adjust Y Max or Y Min while “Units/Div.” Is selected. You can change Y Center and Units/Div. by using the up and down arrows, or by highlighting the existing value, typing in the new value, the pressing “Enter” on your PC keyboard.

Note: If the window size is changed, a chart operating in the Units/Div. Mode will maintain its *units per division scale* setting across the chart.

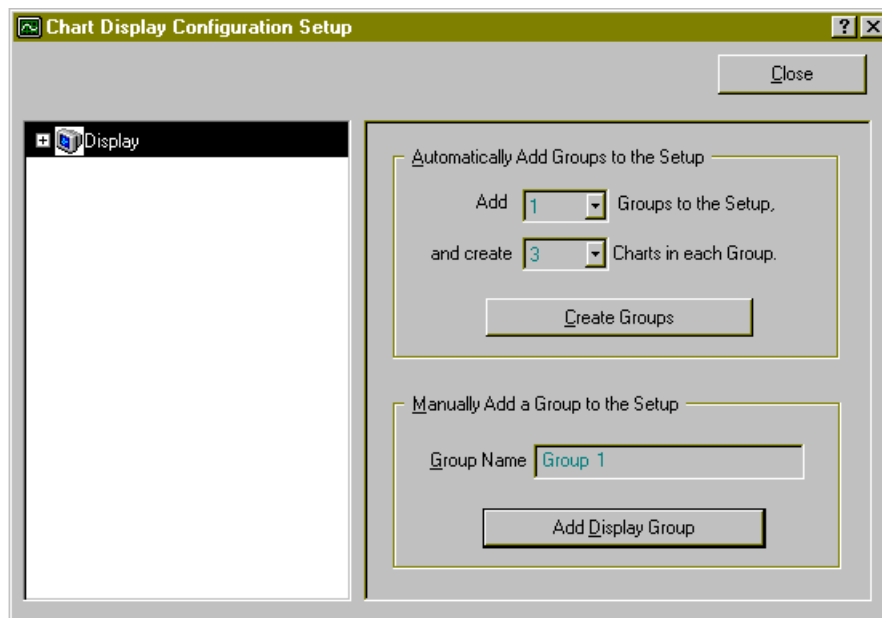
Manually Creating a Display

Note: This method of creating a display can only be accessed from the *Chart Setup Wizard*. It cannot be accessed if PostView is using an existing display configuration file.

Unlike editing a display, as just described, this method involves creating a display from scratch. If you plan to have a chart setup which is not weighted evenly, i.e., different numbers of channels per chart and different numbers of charts per group, you may want to manually create your chart display in this manner. This method can only be arrived at from the *Chart Setup Wizard* by selecting *Manual Chart Creation, Create Charts*. This bypasses the *Chart Setup Wizard* and enters the manual editing mode, discussed. Although this method is referred to as “manual,” it still contains automatic elements, such as *Automatically Add Groups to the Setup*.

Perform the following steps to manually create your chart display.

1. From the *Chart Setup Wizard* window, select *Manual Chart Creation, Create Charts*. This bypasses the *Chart Setup Wizard* and enters the manual editing mode.



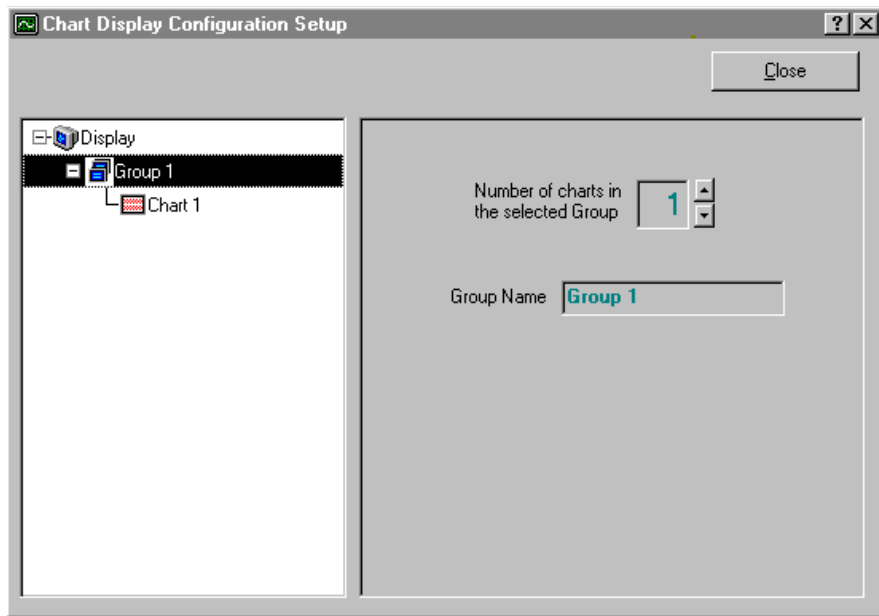
Display Configuration Setup, Initial Screen During Manual Creation

2. Perform (2a) or (2b) as appropriate to your application.

(2a) Automatically add groups to the setup. Enter the number of groups and charts desired by using the cursor and typing in the value, or by using the pull-down arrows (↑ and ↓) and making the appropriate selections; then click on the Create Groups button.

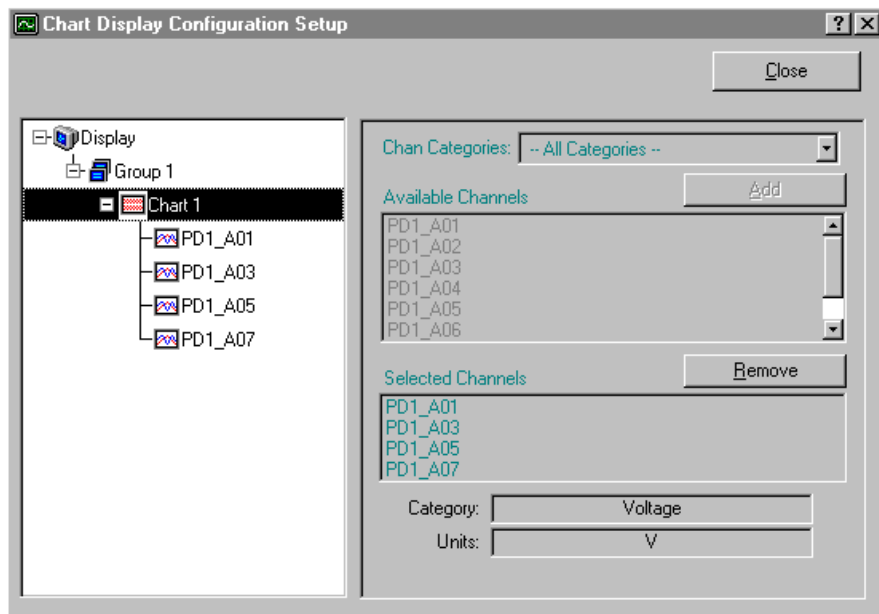
(2b) Manually add groups to the setup. Type in the name of the chart group; then click on the Add Display Group button.

The Display Configuration Setup screen changes to show chart groups, and the number of charts for the selected (black highlighted) chart group (see following figure). From this screen you can change the number of charts in a group, as well as change the group name.



Adding a Chart to Group 1

3. Change the number of charts per group if desired.
4. Change the group name if desired.
5. Click on a group to see the chart(s) assigned to the group. In the above example there is one group with one chart.
6. Click on a chart to assign channels to the chart. A screen similar to the following will appear.

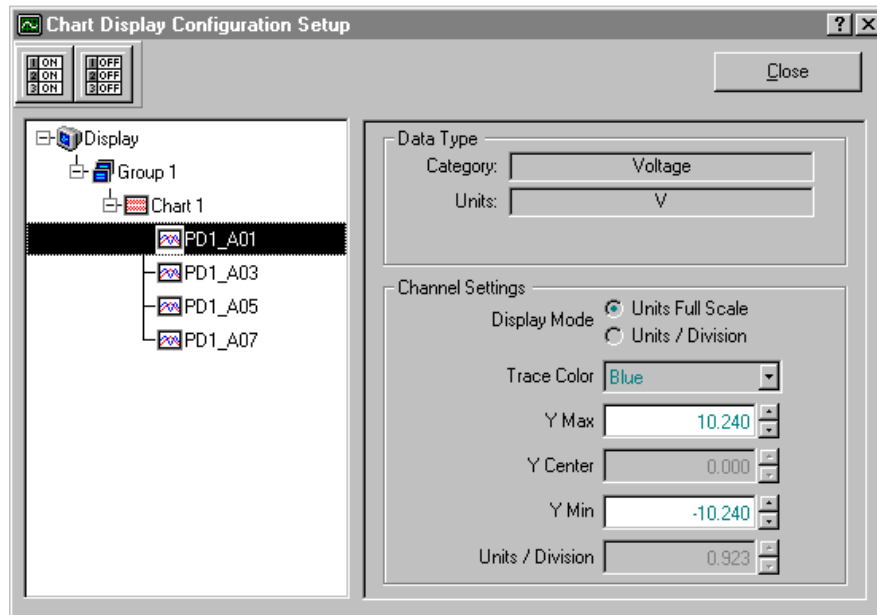


Assigning Channels to Chart 1 of Group 1

7. Choose channels for the selected chart. You can select up to 4 overlapping channels per chart. There are four methods of adding channels. These are as follows:
 - Highlight an available channel using the cursor and left-hand mouse button; then click the Add button. Repeat for each channel to be added.
 - Double-click on the channel (in the available channels list to add; in the selected channels list to remove)
 - Hold down the keyboard's *Shift* Key and use the left-hand mouse button to select a block of consecutive available channels (up to 4); then click the Add button. Example: CH3, CH4, CH5, and CH6.
 - Hold down the keyboard's *Ctrl* button and use the left-hand mouse button to select up to 4 available channels (these can be non-consecutive); then click the Add button.
Example: CH1, CH3, CH5, and CH7, as in the previous figure.

- Note:** You can remove channels by highlighting a channel(s) in the Select Channels box, and then clicking on the Remove button. In the previous figure, CH7 (in the select box) is highlighted. Clicking the Remove button would delete that channel from Chart1.
- Note:** When a chart contains overlapping channels which share values (such that their traces reside on top of each other), the more recent channel will obscure the earlier channel. Note that the lower a channel is on the display list, the more recent it is in regard to the display.
8. In the display area (on the left-hand side of the screen) click on a channel to check the channel's configuration and to re-configure the channel, if desired. The *Display Configuration Setup* Window will appear similar to that in the following figure.

This screen contains two “radio buttons” for selecting the method of adjusting the display mode and channel setup. It is the same screen that was discussed in the sub-section, *Editing an Existing Display Configuration*. From this screen you need to choose *Units Full Scale* or *Units/Div.*



Adjusting Channel Setup for Channel 1

Units Full Scale. When Units Full Scale is selected, as depicted in the above figure, you can alter Y Max and Y Min. These are the upper and lower limits of the Channel as they will appear on the chart when the channel is selected. When you change either parameter, Y Center and Units/Division are automatically adjusted. You can not directly adjust Y Center or Units/Division while “Units Full Scale” is selected. You can change Y Max and Y Min by using the up and down arrows, or by highlighting the existing value, typing in the new value, the pressing “Enter” on your PC keyboard.

Note: If the window size is changed, a chart operating in the Units Full Scale mode will maintain its *full scale* setting across the chart.

Units/Div. When Units/Div. is selected you can alter Y Center and Units/Div. Y Center is the centerline value of the chart when the channel is selected. Units/Div. is the vertical value of on chart grid increment. When you change Y Center or Units/Div. Y Max and Y Min are automatically adjusted. You can not directly adjust Y Max or Y Min while “Units/Div.” Is selected. You can change Y Center and Units/Div. by using the up and down arrows, or by highlighting the existing value, typing in the new value, the pressing “Enter” on your PC keyboard.

The Channels will overlap on their assigned Chart and will be visible when the applicable Group is selected. Note that only one group of charts can be viewed at a time.

Note: If the window size is changed, a chart operating in the Units/Div. Mode will maintain its *units per division scale* setting across the chart.

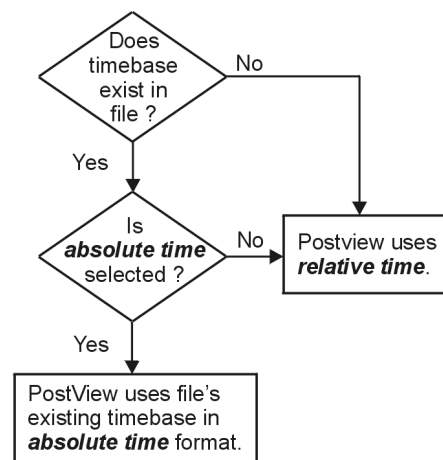
PostView Timebase

PostView automatically detects and displays the data file timebase along the X-axis at the bottom of the PostView window. The timebase can be displayed as **relative time** or as **absolute time** in the format: 00:00:00.0 (hour/minute/second/tenth). The timebase format of *absolute* or *relative* can be selected in PostView's *Option* pull-down menu, or by using Ctrl+A or Ctrl+R respectively.

Note: PostView automatically displays milliseconds (ms) or microseconds (μ s) when applicable to acquisition programs that make use of such time scales. Aside from selecting the absolute timebase (if desired) no user action is required in regard to the timebase display.

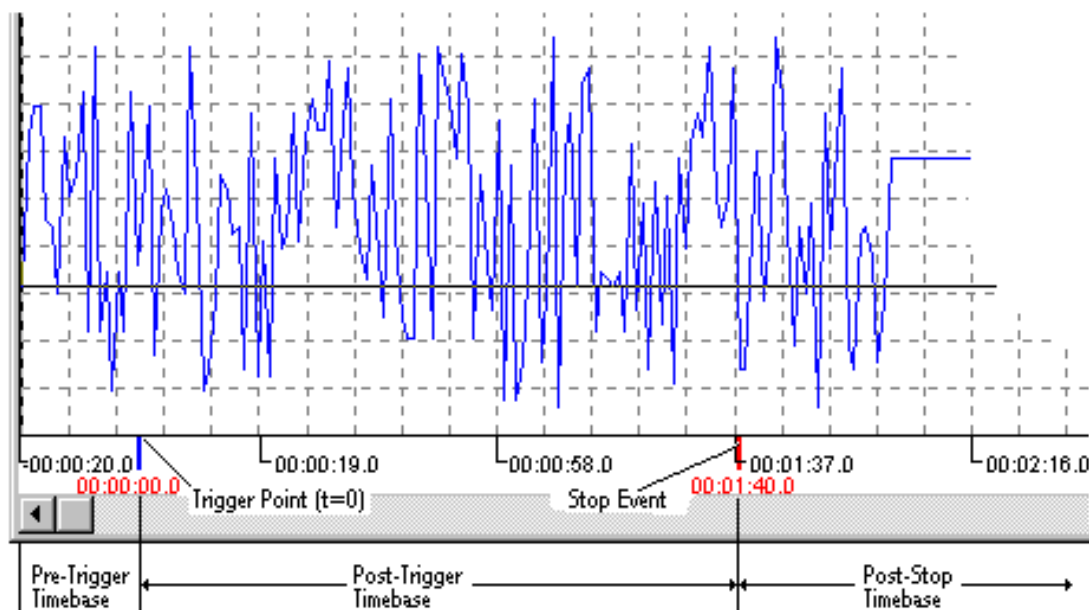
Two Points About the PostView Timebase

- When a data file is loaded into PostView for the very first time, the *relative timebase* format will be used.
- You cannot select *absolute timebase* when the data file has no timebase. In this case PostView will automatically use *relative time*.



PostView Timebase Creation

The following figure illustrates a partial timebase in the *relative* format. Note that the user could switch to absolute time with Ctrl+A on the keypad, or by selecting *Absolute time* from the *Options* pull-down menu. The example below resulted from a ChartScan/1400 using ChartView software.



Example of a PostView Timebase

Note: For many data acquisition programs, trigger point ($t = 0$) may not be the first point in the data file.

It is possible for the data acquisition program to create files containing multiple timebases, pre-trigger, post-trigger, and post-stop data. PostView accommodates all these features, as shown in the previous example (taken from a ChartScan/1400 unit with the ChartView data acquisition program).

- If pre-trigger scans are available, they will be shown prior to the trigger point and labeled with negative time numbers.
- If post-stop data is available (scans collected after the Stop Event), they are displayed after the Stop Event marker.
- If a dual timebase was used when collecting the data, PostView will show a discontinuity in the time axis when the timebase changes. When a dual timebase is used, the post-trigger scans are collected at one frequency while the pre-trigger and post-stop scans are collected at another.

Note: Some timebase aspects may differ, depending on the actual data acquisition program used. Refer to *PostView's* Help File for timebase information relating to specific data acquisition programs.

PC-Card Compatibility with LogBook Operation

To work properly, the LogBook requires a compatible PC-Card memory. A variety of 100%-compatible cards are available with your LogBook purchase. If you prefer to buy your card from another source, make sure it is an ATA-style memory card. Also, make sure the card's memory capacity is sufficient for your purpose.

To assist your selection of compatible PC-Cards, the list below shows the results of speed and function tests performed on various PC-Cards.

Note: For some cards (SanDisk in particular), early revisions of the cards were not fast enough but later revisions were OK (dates noted).

100% Compatible at all acquisition rates:

Rotating Media

IBM 105MB PCMCIA HDD
Centennial - MicroDrive 170MB
Centennial - MicroDrive 340MB
Champion Memory Products PCD520MB

Solid State Media

Panasonic BN-080AB-M
SanDisk 85MB - new rev - January 1998
SanDisk 175MB - April 1998
SanDisk 220MB - April 1998
SanDisk 10MB - June 1998
SanDisk 20MB - June 1998
SanDisk 40MB - June 1998
SEIKO EPSON SEATA-V20M
SEIKO EPSON SEATA-V04M

Compatible but NOT fast enough for 100-kHz acquisition rates:

Solid State Media

SEIKO EPSON SEATA-A15
HITACHI HB286015AT
Panasonic BN-040AA-L
Panasonic BN-020AA-L
SanDisk 4MB
SanDisk 20MB

Not compatible:

Solid State Media

SEIKO EPSON FATA-11
SEIKO EPSON FATA-20
Champion 3MB
Champion 20MB
Simple Tech

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WARRANTY/DISCLAIMER

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

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

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

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

RETURN REQUESTS/INQUIRIES

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

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

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

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

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

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

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

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