

KEITHLEY

EXP-1800

User's Guide



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EXP-1800

User's Guide

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Keithley Instruments assumes no responsibility for damages consequent to the use of this product. This product is not designed with components of a level of reliability suitable for use in life support or critical applications.

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.



The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.


Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.


When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Preface

This guide is intended to help you understand the installation, interface requirements, functions, and operation of the EXP-1800 expansion accessory. The EXP-1800 is an accessory for DAS-1800ST/HR/AO Series boards (referred to in this manual as the DAS boards) or KPCI-3107/KPCI-3108 boards (referred to as KPCI boards).

This guide focuses primarily on describing the EXP-1800 and its capabilities, setup, and typical hookups. The guide also treats calibration and troubleshooting. To follow the information and instructions contained in this manual, you must be familiar with the operation of an IBM[™] PC/XT[™] and PC AT[®] (or equivalents) in the MS-DOS[®] or Windows[™] environments. You must also be familiar with data-acquisition principles and application.

Organization of the *EXP-1800 User's Guide* is as follows:

- Chapter 1 describes the features and accessories of the EXP-1800.
- Chapter 2 describes operating features of the EXP-1800 in more detail. This chapter contains a block diagram and brief descriptions of the features as they relate to your options for setting up and using the EXP-1800s.
- Chapter 3 contains instructions for inspecting and setting up the EXP-1800.
- Chapter 4 shows the preferred methods of making I/O (Input/Output) connections to a DAS/KPCI board and available accessories.
- Chapter 5 discusses calibration requirements and instructions.
- Chapter 6 contains information on isolating and determining the source of operating problems. This chapter also contains instructions for obtaining technical support.

- Appendix A contains EXP-1800 specifications.
- Appendix B contains pin assignments for the DAS board and EXP-1800 I/O connectors.
- Appendix C describes the assignment of logical channel numbers for a DAS/KPCI board and all attached EXP-1800s for use in software such as the Control Panel utility (ASO) or AIO Panel Utility (DriverLINX).
- An index completes this guide.

Overview

The EXP-1800 is an external channel-expansion accessory that places 16 differential inputs on any single-ended input channel of an attached DAS-1800ST/HR/AO Series or KPCI-3108 Series board. A daisy chain of EXP-1800s can provide up to 256 channels of measurement to an attached DAS/KPCI board.* The channel-gain queue of the attached DAS/KPCI board controls the multiplexing sequence of input channels and the gains on the EXP-1800, enabling high-speed acquisition of data from the expansion channels.

This chapter describes the features, supporting software, and accessories of the EXP-1800.

***Note:** Configurations of more than 4 EXP's may be better implemented using 2700 series systems, which will have reduced noise and lower system pricing.

Features

Features of the EXP-1800 include the following:

- Contains 16 differential inputs.
- Multiplexes the differential inputs under the control of and at the speed of the host DAS/KPCI board.
- Provides optimum throughput even with changing gains.
- Connects in a daisy chain to additional EXP-1800s through ribbon cable to provide up to 256 inputs for a DAS/KPCI board.

- Contains a 16-position jumper block for selecting the input channel of the attached DAS/KPCI board.
- Offers gains of 1 and 50 that combine with gains of the DAS/KPCI board to provide usable system gains of 1 to 400.
- Works with optional, plug-in, field-wiring accessories containing convenient screw terminals.
- Provides mass-termination connector access for its own I/O channels and for the DAS/KPCI board I/O.
- Accepts power from the computer or from an external source that switches in only while the computer is on. *KPCI-3108 requires use of external power and PG-408A.
- Provides holes for a 4-to-20 mA current-measuring resistor at each input (additional range is available with other resistance values).
- Contains a switch-activated, 80 Hz, passive filter for each input.
- Contains a switch-activated, open-thermocouple-detection circuit for each input.
- Contains a switch-activated, low-side bias resistor for each input. (Before you use this circuit, refer to the cautionary note on page 3-4.)
- Contains two, non-interactive, offset trim pots for input calibration
- Works with the supporting software of the attached DAS/KPCI board.
- Conforms to VME 6U card size and fits a variety of Eurocard enclosures, including the ENCL Series enclosures from Keithley.

Supporting Software

Supporting software for the DAS/KPCI boards also supports the EXP-1800. Refer to your DAS/KPCI board user's guide for a description of this software.

Accessories

The following accessories are available for use with the EXP-1800:

- **CAB-50** is the cable you use to form a daisy chain of EXP-1800s; this cable is available in two lengths, as follows: the CAB-50 is 4 inches long, and the CAB-50/1 is 18 inches long.
- **CDAS-2000** is the cable you use to connect an EXP-1800 to a DAS board; this cable is 24 inches long.
- **CAB-PWR** is the cable you use to connect external power to an EXP-1800 in a daisy chain; this cable is available in two lengths, as follows: the CAB-PWR is 4 inches long and the CAB-PWR/1 is 18 inches long with a jack on one end and stripped and tinned leads on the other.
- **FWA-EXP** is a field-wiring accessory containing screw terminals and a CJC circuit. This accessory plugs into connector J5 to deliver signals from field wiring to the input channels of the EXP-1800.
- **FWA-1800U** is a field-wiring accessory containing screw terminals. This accessory plugs into connector J1 on the EXP-1800 to route signals from field wiring directly to the attached DAS/KPCI board.
- **ENCL Series** are desktop enclosures for one (ENCL-1), two (ENCL-2), or four (ENCL-4) EXP-1800s with access for all required cabling or accessories.
- **PG-408A** is a snap-in DC/DC converter module for use with an EXP-1800 that is to be powered from an external +5 V source.
- **PWR-5V** is a power supply for supplying external power to EXP-1800s; this supply has an IEC 320 connector and converts 100 to 240 VAC at 50 to 60 Hz to +5 VDC.
- **STA-3108-A1 and CACC-2000** are used to connect an EXP-1800 to a CAB-1284CC cable from a KPCI-3108 Series board.

2

Functional Description

This chapter describes features of the EXP-1800. The descriptions are provided to familiarize you with the operating options and to enable you to make the best use of your EXP-1800. Figure 2-1 shows a block diagram of the EXP-1800.

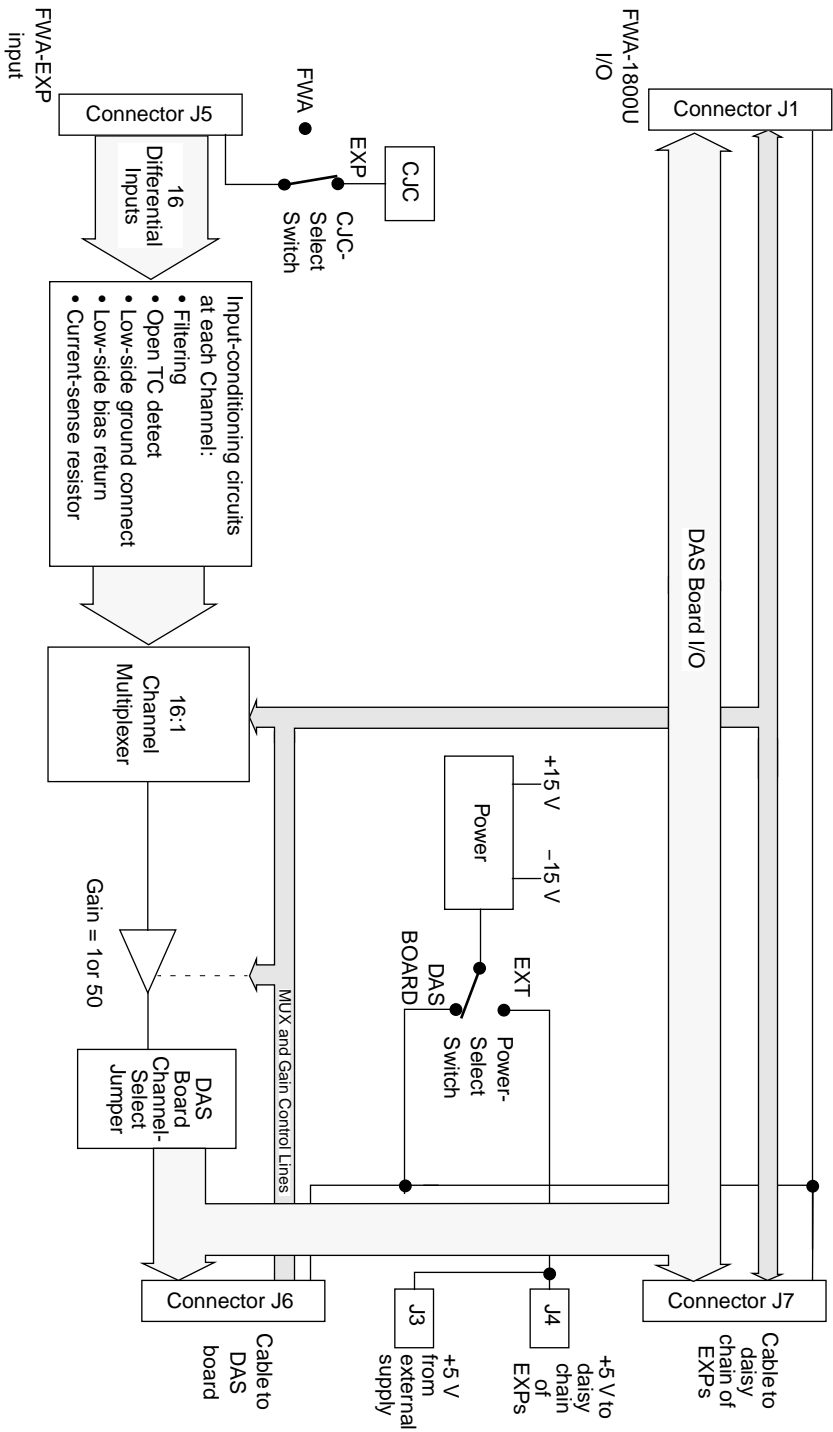


Figure 2-1. Block Diagram of EXP-1800

Ground Types

An EXP-1800 contains separate grounds for low-level signals, analog power returns, digital signals, and the chassis. The ground for analog signals is LL GND (low-level ground); as its title suggests, LL GND is for low-level analog input signals and is designed to be as noise-free as possible. The ground for analog power returns, bypass capacitors, and so on is GND A. The ground for digital signals is GND D. Chassis ground is CH GND.

Input-Conditioning Options

The input of each EXP-1800 channel contains the conditioning circuitry shown in Figure 2-2.

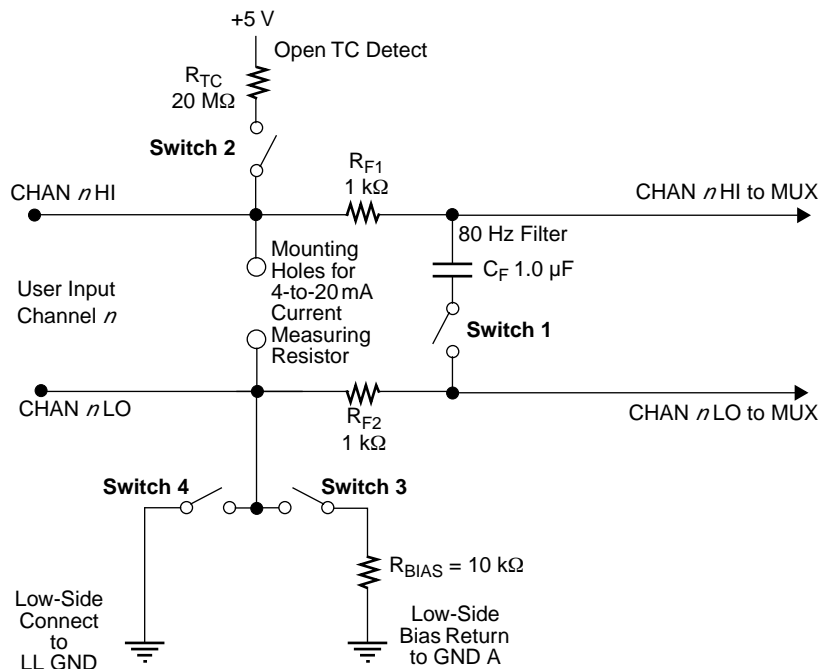


Figure 2-2. EXP-1800 Input Conditioning Circuits at Each Input

Descriptions of the individual conditioning circuits are as follows:

- **Filtering** - Closing switch 1 activates an 80 Hz low-pass filter composed of R_{F1} , R_{F2} and C_F .
- **Open-thermocouple detection** - Closing switches 2 and 3 activates an open-thermocouple detector composed of R_{TC} and R_{BIAS} .
- **Low-side bias return** - Closing switch 3 provides a reference to analog power ground (GND A) through R_{BIAS} for ungrounded differential inputs. This reference to ground provides some isolation from other channels. Before using this switch, refer to the cautionary note on page 3-4.
- **Low-side ground connect** - Closing switch 4 enables you to reference an input directly to low-level ground (LL GND), making a single-ended input. Before using this switch, refer to the cautionary note on page 3-4.
- **Mounting holes for 4-to-20 mA current-measuring resistor** - Selecting and mounting a resistor in these holes allows you to make 4-to-20 mA or other current measurements.

Refer to page 3-4 for information on setting up the input conditioning options.

Multiplexer

An EXP-1800 multiplexes signals from 16 differential analog input channels into one signal for the analog output. The sequence of channel sampling in the multiplexer is selected by a 4-bit TTL/CMOS-compatible address on the multiplexer control lines. These lines receive the 4-bit address signals from QRAM output lines MUX 4 to MUX 7, on the DAS/KPCI board (see Appendix B for pin assignments).

You set up the multiplexer channel-sampling sequence in the DAS/KPCI board's channel-gain queue (in the QRAM circuit) using the provided utility (see the board user's guide) or driver software (see the board driver user's guide). See Appendix C for channel assignments.

Instrumentation Amplifier

The multiplexer output feeds to an instrumentation amplifier with a software-selectable gain of 1 or 50. You set the gain in the DAS/KPCI board channel-gain queue using the panel utility (see the DAS/KPCI board user's guide) or driver (see the board driver user's guide). The DAS/KPCI board delivers the gain code to the EXP-1800 gain control lines through QRAM output line GEXT.

Total gain for an EXP-1800 input is the product of the gain settings for the EXP-1800 and the DAS/KPCI board. Table 2-1 shows the achievable gains for a DAS-1801ST/AO board and an attached EXP-1800.

Table 2-1. Gains and Ranges for a DAS-1801ST/AO board with an EXP-1800

DAS Board Gain	EXP-1800 Gain	System Gain	System Unipolar Range	System Bipolar Range
1	1	1	0 to 5 V	± 5.0 V
5	1	5	0 to 1 V	± 1.0 V
50	1	50	0 to 100 mV	± 100 mV
250	1	250	0 to 20 mV	± 20 mV
1	50	50	0 to 100 mV	± 100 mV
5	50	250	0 to 20 mV	± 20 mV
50	50	2500	0 to 2 mV	± 2 mV
250	50	12500	0 to 0.4 mV	± 0.4 mV

Note: While Table 2-1 shows gains of 2500 and 12500 as achievable, the use of these gains is not practical for typical applications.

Table 2-2 shows the achievable gains for a DAS-1802ST/HR/AO board and an attached EXP-1800.

Table 2-2. Gains and Ranges for a DAS-1802ST/HR/AO board with an EXP-1800

DAS Board Gain	EXP-1800 Gain	System Gain	System Unipolar Range	System Bipolar Range
1	1	1	0 to +10.0 V	±10 V
2	1	2	0 to +5.0 V	±5.0 V
4	1	4	0 to 2.5 V	± 2.5 V
8	1	8	0 to 1.25 V	±1.25 V
1	50	50	0 to 0.2 V	±0.2 V
2	50	100	0 to 0.1 V	±0.1 V
4	50	200	0 to 50 mV	±50 mV
8	50	400	0 to 25 mV	±25 mV

Table 2-3. Gains and Ranges for a KPCI-3108 board with an EXP-1800

KPCI-3108 Board Gain	EXP-1800 Gain	System Gain	System Unipolar Range	System Bipolar Range
1	1	1	0 to +10.0 V	±10 V
2	1	2	0 to +5.0 V	±5.0 V
4	1	4	0 to 2.5 V	±2.5 V
8	1	8	0 to 1.25 V	±1.25 V
10	1	10	0 to 1.0 V	±1.0 V
20	1	20	0 to 0.5 V	±0.5 V
40	1	40	0 to 0.25 V	±0.25 V
1	50	50	0 to 0.2 V	±0.2 V
80	1	80	0 to 0.125 V	±0.125 V

Table 2-3. Gains and Ranges for a KPCI-3108 board with an EXP-1800 (cont.)

KPCI-3108 Board Gain	EXP-1800 Gain	System Gain	System Unipolar Range	System Bipolar Range
2	50	100	0 to 100 mV	±100 mV
4	50	200	0 to 50 mV	±50 mV
8	50	400	0 to 25 mV	±25 mV
10	50	500	0 to 20 mV	±20 mV
800	1	800	0 to 12.5 mV	±12.5 mV
20	50	1000	0 to 10 mV	±10 mV
*40	50	2000	0 to 5 mV	±5 mV
*80	50	4000	0 to 2.5 mV	±2.5 mV
*100	50	5000	0 to 2.0 mV	±2.0 mV
*200	50	10000	0 to 1.0 mV	±1.0 mV
*400	50	20000	0 to 0.5 mV	±0.5 mV
*800	50	40000	0 to 0.25 mV	±0.25 mV

*Achievable gains, but unlikely to be practical in typical applications.

CJC Circuit

The EXP-1800 contains CJC circuitry that delivers 0.0 mV at 0°C and 10.0 mV/°C. You use the CJC on the EXP-1800 when you are not using an FWA-EXP (which contains its own CJC).

When you are using the CJC on the EXP-1800, set the CJC source-select switch to EXP. When you are using the CJC on an FWA-EXP, set the CJC source-select switch to FWA. You can connect the CJC output voltage to any EXP-1800 input channel using jumper wires on an FWA-EXP (refer to “Connecting an FWA-EXP” on page 4-8 for instructions) or on a mass-termination connector at J5.

Power

You can set an EXP-1800 to receive power from the DAS board or from an external power supply. Power from the DAS board is always present on the ± 15 V lines of the CDAS-2000 cable*. Power from an external source must come through a separate cable that plugs into the power jack of the EXP-1800.

EXP-1800 input circuitry for external power contains a relay powered by the +5 V line from the DAS board*. The relay energizes to close its contacts only when the +5 V from the DAS board is present. Figure 2-3 shows input circuitry for power to the EXP-1800.

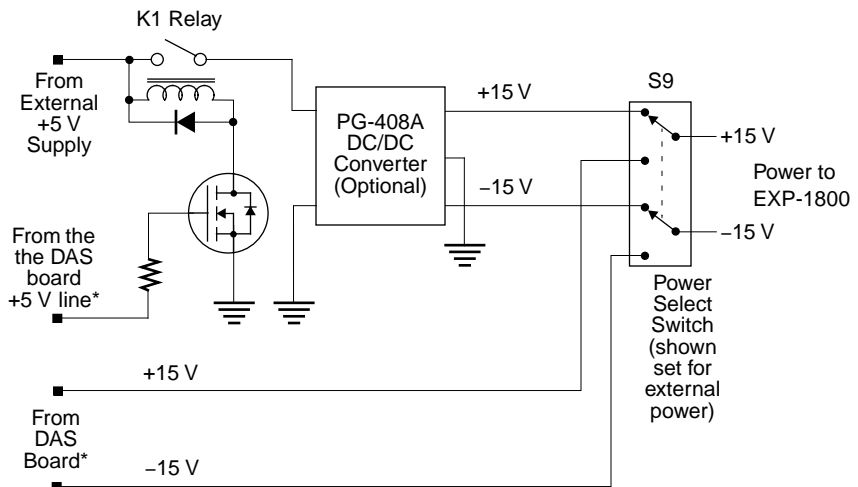


Figure 2-3. Power Select Circuit

For information on setting up an EXP-1800 for DAS board or external power, refer to page 3-6.

***Note:** These supplies are NOT available from KPCI boards. Use of EXP-1800 with KPCI-3108 Series requires the use of PG-408A and external 5VDC power supply such as PWR-5V.

Inspection and Setup

This chapter describes how to inspect and set up your EXP-1800. Read this chapter before you attempt to use your EXP-1800.

Unwrapping and Inspecting Your EXP-1800

Caution: Your computer must be turned OFF and grounded before you perform the following procedure.

After you remove the wrapped EXP-1800 from its outer shipping carton, proceed as follows:

1. Your EXP-1800 is packaged at the factory in an anti-static wrapper that must not be removed until you have discharged static electricity by either of the following methods:
 - If you are equipped with a grounded wrist strap, you discharge static electricity as soon as you hold the wrapped EXP-1800.
 - If you are not equipped with a grounded wrist strap, discharge static electricity by holding the wrapped EXP-1800 in one hand while placing your other hand firmly on a metal portion of the computer chassis.
2. Carefully remove the anti-static wrapper. (You may wish to store the wrapping material for future use.)
3. Inspect the EXP-1800 and any other item from the package for signs of damage. If damage is apparent, arrange to return the damaged item to the factory (see “Technical Support” on page 6-4).

4. Check the contents of your package against the packing list to be sure your order is complete. Report any missing items, immediately.
5. When you are satisfied with the inspection, proceed with the hardware setup.

Locating Setup Components

Refer to Figure 3-1 for the locations of all EXP-1800 components mentioned in this chapter.

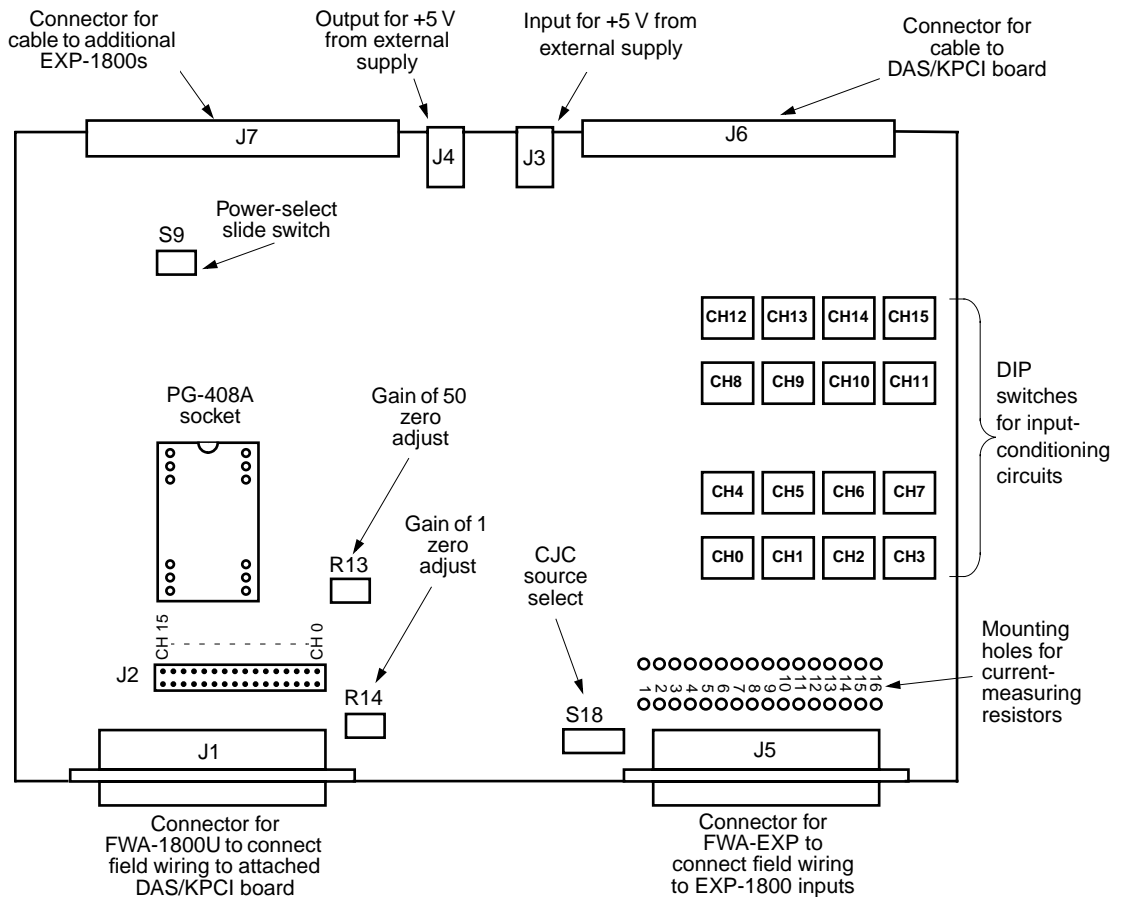


Figure 3-1. Component Locations on the EXP-1800

In Figure 3-1, connectors J6 and J7 are actually identical and interchangeable for use with a DAS/KPCI board and an EXP-1800. Similarly, external power supply connectors J3 and J4 are connected in parallel.

Setting the Input-Conditioning Options

The four switches in the input-conditioning circuits (see “Input-Conditioning Options” on page 2-3) of each channel are contained in a 4-pole DIP switch represented by the diagram in Figure 3-2. Note that the switch numbers in the diagram of Figure 2-2 on page 2-3 correspond to the numbers printed on the DIP switch.

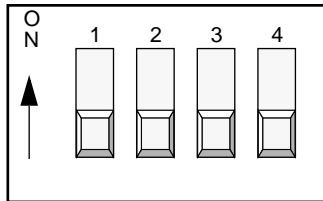


Figure 3-2. A 4-Pole DIP Switch for Input-Conditioning Options

A switch is closed when pushed to the ON position. Figure 3-2, shows all of the switches set for their default (open) positions.

Generally, you leave all switches open for a pure differential input. You close only switch 1 for a differential input that is to have low-pass filtering. You close switches 1, 2, and 3 together for thermocouple measurements (leaving switch 4 open), or you close switches 2 and 3, leaving 1 and 4 open for no filter. You close only switch 4 for a wide-band, single-ended input. You close switches 1 and 4 together for a single-ended input that requires low-pass filtering.

Note: You should have no need for closing switches 3 and 4 together, as this combination of settings shorts R_{BIAS} to ground and seriously degrades EXP-1800 performance.

The following subsections describe the use of each of the input-conditioning circuits and their switches.

Signal Filtering (Switch 1)

Closing switch 1 combines resistors R_{F1} and R_{F2} with capacitor C_F to form an 80 Hz low-pass filter. Opening switch 1 disables the filter to give faster settling time. A closed setting is recommended for thermocouple measurements. The default setting for switch 1 is open.

Open-Thermocouple Detection (Switches 2 and 3)

Closing switch 2 puts the 20 M Ω resistor, R_{TC} , between the high side of a thermocouple input and the +5 V supply. Closing switch 3 completes the open-thermocouple-detection circuit by putting the 10 k Ω resistor, R_{BIAS} , between the low side of a thermocouple input and ground. Resistors R_{TC} and R_{BIAS} respond to an open thermocouple by changing the input voltage to +5 V. As this voltage is larger than what a thermocouple can produce, you can develop a software routine to sense any input voltage above a certain threshold and flag the open thermocouple. (At any system gain of four or higher, the DAS/KPCI board will read this channel as being at the positive full scale value). The default setting for switches 2 and 3 is open.

Ground Selection (Switches 3 and 4)

Closing switch 3 provides a reference to analog power ground (GND A) for differential circuits that are not grounded. Switch 3 must be closed when you wish to activate open-thermocouple detection. The default setting for switch 3 is open.

Closing switch 4 enables you to reference an input to low-level ground (LL GND). The default setting for switch 4 is open.

Caution: Use care when you short channels to LL GND. Switching a single channel to LL GND is not generally a problem. However, shorting multiple channels to LL GND can cause significant ground current to flow (as a result of common mode potential between channel sources), resulting in noise and degradation not only in the shorted channels but all other active channels. In this case, short the channels to GND A.

4-to-20 mA Current Measuring

The 4-to-20 mA current-measuring option requires the installation of a resistor in the mounting holes for the desired channel input. These mounting holes are located as shown in Figure 3-1 on page 3-2. A typical resistor value for this option is 250 Ω . (with 0.1% accuracy).

While 4 to 20 mA is the more frequently used measuring range, the actual measuring range of this option is 100 μ A to 100 mA, at a nominal 0.03% accuracy. To determine a resistance value for a particular current value, use the relationship

$$R_{Sample} = \frac{DASFS}{(DASGain) \cdot (EXPGain) \cdot (I_{FullScale})}$$

where R_{Sample} is the value of the current-measuring resistor, DASFS is the full-scale input range of the DAS/KPCI board, $DASGain$ is the gain of the DAS/KPCI board, $EXPGain$ is the gain of the EXP-1800, and $I_{FullScale}$ is the anticipated current flow. For example, with a DAS/KPCI board full-scale input of ± 10 V and gain of 8, an EXP-1800 gain of 50, and a full-scale current of 100 μ A, the resistance becomes 250 Ω , as follows:

$$R_{Sample} = \frac{10}{(8) \cdot (50) \cdot (0.0001)}$$

Positioning the Channel-Select Jumper

The EXP-1800 contains a 16-position jumper block for selecting the DAS/KPCI board input channel that is to receive the multiplexed output from the EXP-1800. To select a board input channel, move the jumper to the pins for the corresponding channel number. Figure 3-3 shows the EXP-1800 jumper block set for channel 3.

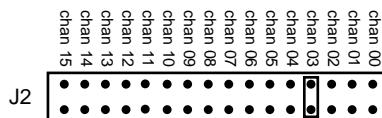


Figure 3-3. EXP-1800 Jumper Block

Setting the CJC-Select Switch

Switch S18 determines whether your data acquisition system uses the CJC circuit on the EXP-1800 or the CJC circuit on the FWA-EXP. The two positions for this switch are marked as FWA (for using the CJC on the FWA-EXP) and EXP (for using the CJC on the EXP-1800).

While the CJC circuits on the EXP-1800 and the FWA-EXP are the same, the CJC on an attached FWA-EXP gives the more accurate measurement of temperature at the field-wiring connections. Therefore, if you are using an attached FWA-EXP for thermocouple measurements, set switch S18 to FWA.

Setting Up for Power

The ability of a DAS board to provide power for EXP-1800s is as follows:

- A DAS-1800AO Series, DAS-1800ST-DA Series, or DAS-1802HR-DA board can provide power for no more than one EXP-1800. If you need to attach more than one EXP-1800, you must set up each additional EXP-1800 to receive power from an external supply.
- A DAS-1801ST, DAS-1802ST, or DAS-1802HR board can provide power for no more than two EXP-1800s. If you need to attach more than two EXP-1800s, you must set up each additional EXP-1800 to receive power from an external supply.

To set up an EXP-1800 to receive power from the DAS board, set the power-select switch (S9) of the EXP-1800 to DAS BOARD (internal power).

To set up an EXP-1800 to receive power from an external supply, perform the following steps. (NOTE: This is the only way to use with KPCI-3108 Series.)

1. Install a PG-408A DC/DC converter module (see the following section for installation instructions).
2. Set the power-select switch to EXT (external power).
3. Connect a +5 V supply to the external power supply jack (refer to Chapter 4 for instructions on connecting multiple EXP-1800s).

Installing a PG-408A DC/DC Converter

The PG-408A DC/DC converter module is an encapsulated package with connector pins protruding from its bottom surface. The socket for this package is a space on the EXP-1800 marked as shown in Figure 3-1 on page 3-2.

Pin 1 on the PG-408A is indicated either by a beveled corner on the module or a beveled corner on the module label. Be sure to match pin 1 of the PG-408A with pin 1 of the socket (pin 1 is marked on the EXP-1800) when snapping the module onto the EXP-1800. Figure 3-4 shows a diagram of the pin 1 location.

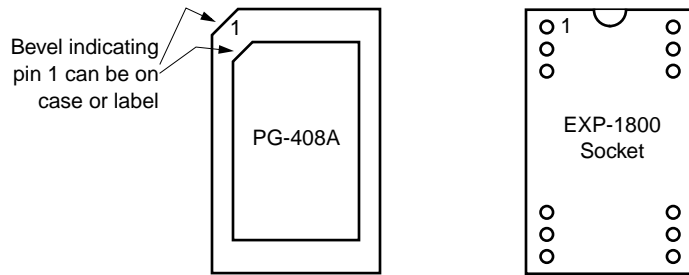


Figure 3-4. Locating Pin 1 on the PG-408A and the Socket

Installing in a Desktop Enclosure

Each version of an ENCL Series enclosure contains slotted card guides and a rear panel that accommodates the rear connectors of each installed EXP-1800. Figure 3-5 shows an ENCL-4 enclosure (without rear panel) with four pairs of slotted card guides. Screw holes for front-panel screws of the EXP-1800s are shown on the front face of each card guide.



**Figure 3-5. ENCL-4 Shell with Four Pairs of Slotted Card Guides
(rear panel not shown)**

To install an EXP-1800 in an ENCL Series enclosure, perform the following steps:

1. Remove the four standoffs from each EXP-1800 to be installed.
2. Insert an EXP-1800 into the slots of a pair of card guides.
3. Gently push the EXP-1800 toward the rear of the desktop enclosure until the front-panel screws meet the tapped holes on the fronts of the card guides.
4. Fasten the front-panel screws to the card guides.

An ENCL-4 containing four EXP-1800 appears as shown in Figure 3-6. Refer to Chapter 4 for cabling instructions.

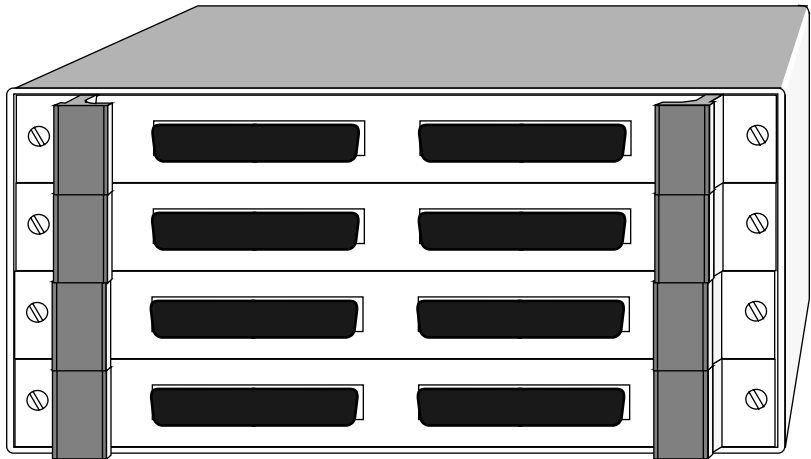


Figure 3-6. ENCL-4 Enclosure Containing Four EXP-1800s

4

Cabling and Wiring

This chapter describes the cabling and wiring required for making connections to your EXP-1800.

Caution: Avoid electrical damage by turning off power to all equipment in your data acquisition system before making connections.

Connecting to a DAS Board

Before connecting an EXP-1800 to a DAS board, configure the channels of the DAS board as single-ended inputs. An EXP-1800 connects directly to the main I/O connector of a DAS board through a CDAS-2000 cable, as shown in Figure 4-1.

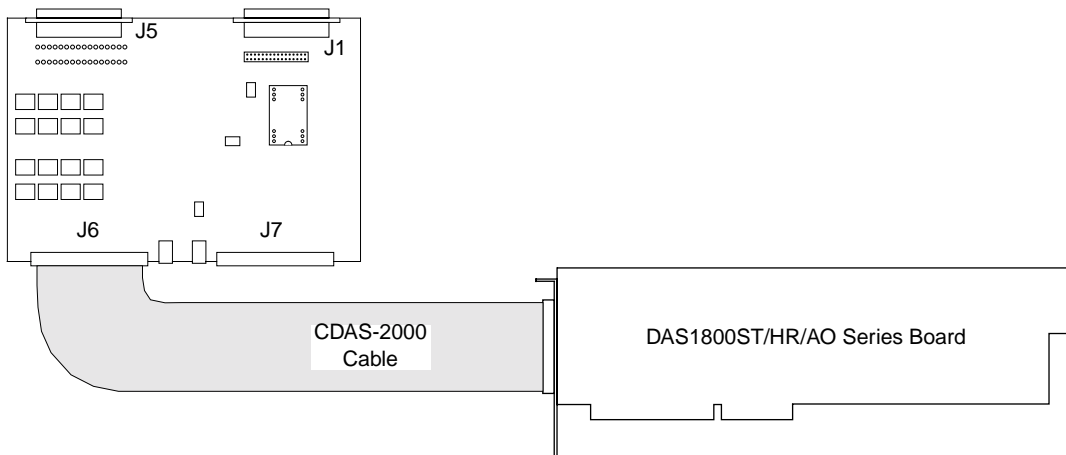
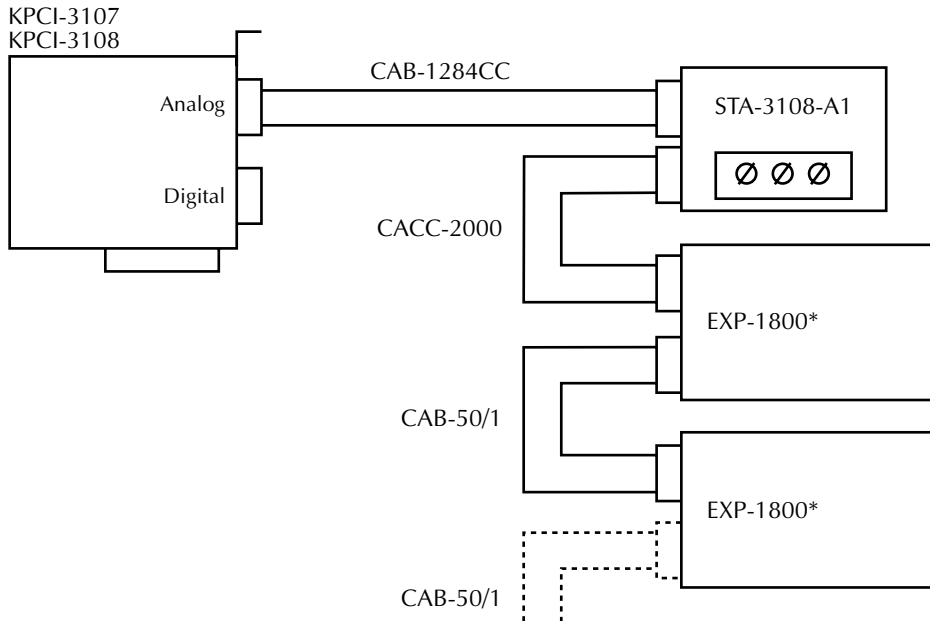


Figure 4-1. Connecting an EXP-1800 to a DAS Board

Connecting to a KPCI-3108 Series Board

Channel Expansion EXP-1800 connection



*When using the EXP-1800, either a PWR-5V (120VAC source) or PWR-5V/E (230VAC source) must be used in conjunction with a PG480A (DC-DC converter).

Figure 4-2. Channel Expansion — EXP-1800 Connection

Note: When using EXP accessories, the noise specification of the KPCI-3108 is degraded. Use of signal averaging (25 points or more) is advised. Configurations requiring more than four EXP-1800s can generally be implemented with lower noise (and at lower cost) using the 2700 series.

Connecting Multiple EXP-1800s on Standoffs

You can attach up to 16 EXP-1800s to a DAS/KPCI board. To connect additional EXP-1800s, use a CAB-50/1 cable, as shown in Figure 4-3.

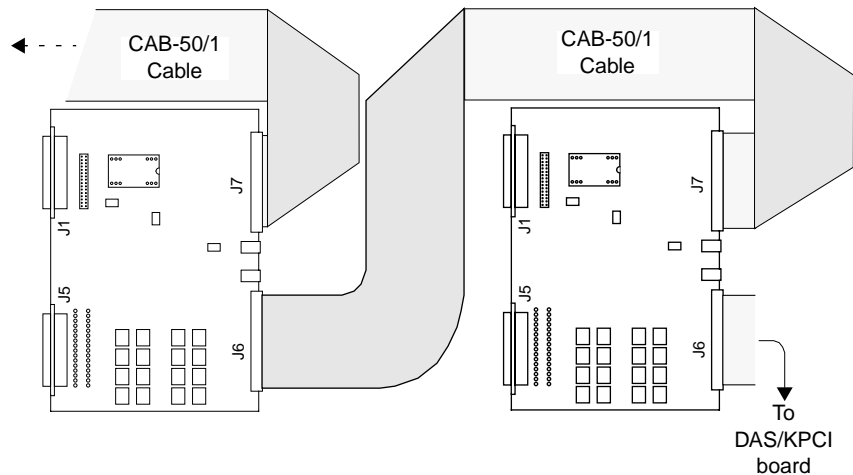


Figure 4-3. Connecting Multiple EXP-1800s on Standoffs

Note: When you connect more than one EXP-1800 in a daisy chain, the multiplexer control lines to all EXP-1800s are in parallel and delivering the same multiplexer channel-selection sequence to all attached EXP-1800s simultaneously.

The DAS board furnishes power only for the first one or two EXP-1800s in a daisy chain (refer to “Setting Up for Power” on page 3-6). (KPCI boards cannot furnish power to EXP-1800s and must always be used with external power.) If you are attaching additional EXP-1800s, you must first perform the setup procedure described on page 3-6. Connect external power to the additional EXP-1800s as shown in Figure 4-4.

CAUTION:
The center terminal of the power supply output connector must be positive, or the power switching circuit of the EXP-1800s will not work.

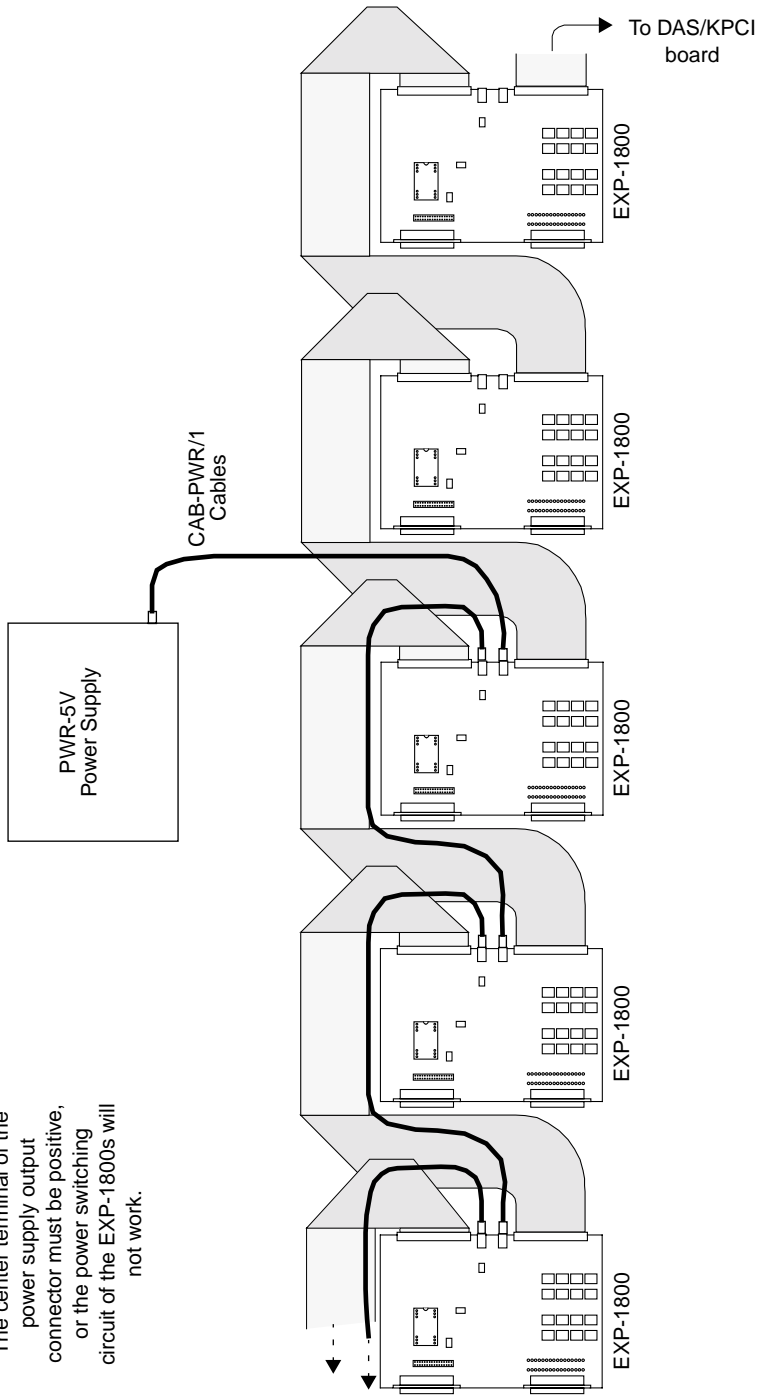


Figure 4-4. Connecting External Power for Multiple EXP-1800s on Standoffs

When you feed power to the EXP-1800s through series cabling, as shown in Figure 4-4, you can power up to four EXP-1800s from a single external power supply (this limitation is caused by wire size in the cables). If you feed power to the EXP-1800s through parallel wiring (a separate set of wires from the power supply to each EXP-1800), the only limitation is the current capacity of the power supply.

Note: If you prefer to make your own cables for external power, you can obtain a connector compatible with connectors J4 and J5; this connector is Switchcraft PW and H S760.

Connecting Multiple EXP-1800s in Desktop Enclosure

You can attach up to 16 EXP-1800s in enclosures to a DAS/KPCI board. To connect one or more additional EXP-1800s that are mounted in a desktop enclosure, use CAB-50 cables as shown in Figure 4-5.

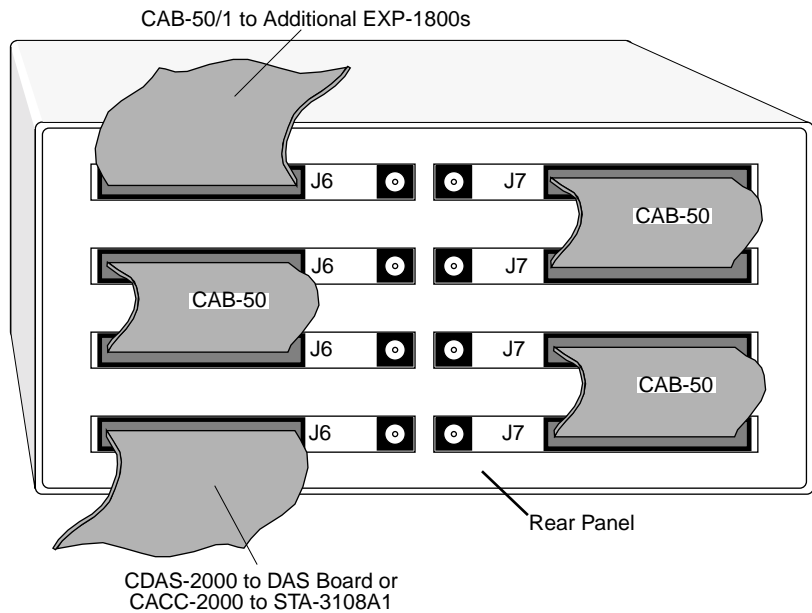
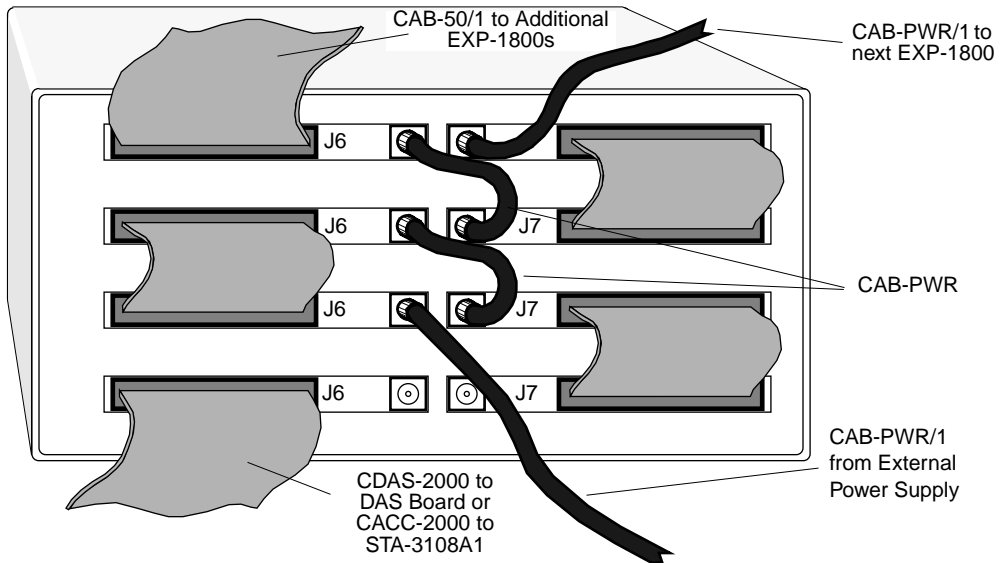


Figure 4-5. Connecting Multiple EXP-1800s in an ENCL-4 Desktop Enclosure

Note: When you connect more than one EXP-1800 in a daisy chain, the multiplexer control lines to all EXP-1800s are in parallel and delivering the same multiplexer channel-selection sequence to all attached EXP-1800s simultaneously.

The DAS board furnishes power only for the first one or two EXP-1800s in a daisy chain (refer to “Setting Up for Power” on page 3-6). (KPCI boards cannot furnish power to EXP-1800s and must always be used with external power.) If you are attaching additional EXP-1800s, you must first perform the setup procedure described on page 3-6. Connect external power to the additional EXP-1800s as shown in Figure 4-6.



CAUTION:

The center terminal of the power supply output connector must be positive, or the power switching circuit of the EXP-1800s will not work.

Figure 4-6. Connecting External Power to EXP-1800s in an ENCL Series Enclosure (lower EXP-1800 is powered by DAS board)

When you feed power to the EXP-1800s through series cabling, as shown in Figure 4-6, you can power up to four EXP-1800s from a single power supply (this limitation is caused by wire size in the cables). If you feed power to the EXP-1800s through parallel wiring (a separate set of wires from the power supply to each EXP-1800), the only limitation is the current capacity of the power supply.

Note: If you prefer to make your own cables for external power, you can obtain a connector compatible with connectors J4 and J5; this connector is Switchcraft PW and H S760.

Connecting an FWA-EXP

The FWA-EXP field wiring accessory is a compact, screw-terminal panel that plugs into connector J5 of an EXP-1800. This accessory provides an interface between field wiring and circuits of the EXP-1800.

The FWA-EXP contains a CJC circuit with the same characteristics as the one on the EXP-1800 (refer to “CJC Circuit” on page 2-7). You can connect the output of the CJC on the EXP-1800 or on the FWA-EXP to the input of any EXP-1800 channel using the following steps:

1. On the EXP-1800, set the CJC select switch as follows:
 - To use the CJC on the EXP-1800, set the switch to EXP.
 - To use the CJC on the FWA-EXP, set the switch to FWA.
2. Install a wire between CJC screw terminal and the HI screw terminal of the desired channel.
3. Install a second wire between the LL GND screw terminal and the LO screw terminal of the desired input channel.

Note: If you wish to use the CJC while using the FWA-1800U, you must use the CJC on the FWA-EXP.

Before attaching the FWA-EXP, remove the two retainer screws from connector J5 on the EXP-1800. Attach the FWA-EXP as shown in Figure 4-7. Secure the FWA-EXP to J5 using the two retainer screws.

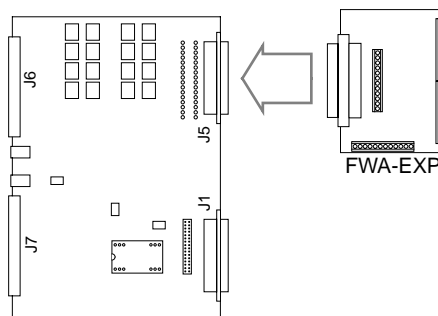


Figure 4-7. Attaching an FWA-EXP to an EXP-1800

Caution: On EXP-1800s whose connectors J1 and J5 are the same gender (on some earlier models), be particularly careful not to interchange externally applied connectors and cables. The pin assignments for the two connectors are different and exchanging the connectors could damage the EXP-1800.

The clamp on the side of the FWA-EXP is provided to serve as a strain relief for field wiring attached to the screw terminals. Run all field wiring through the clamp as shown in Figure 4-8.

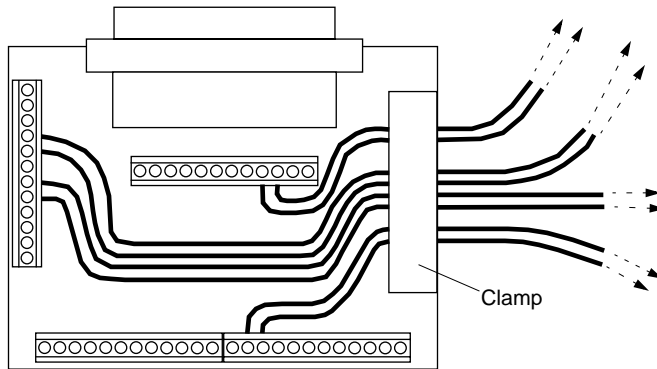


Figure 4-8. Clamping Wire Pairs Attached to Screw Terminals of the FWA-EXP

Connecting an FWA-1800U

The FWA-1800U screw terminal accessory is a compact, screw-terminal panel that plugs into connector J1 of an EXP-1800. This accessory provides direct access to the main I/O connector of the DAS/KPCI board. The FWA-1800U attaches to an EXP-1800 as shown in Figure 4-9.

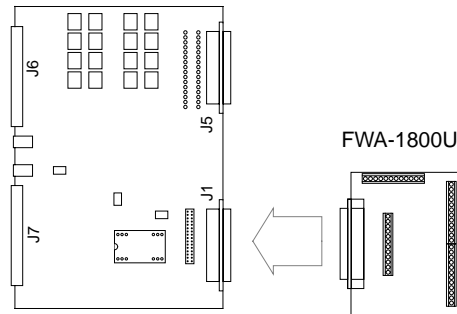


Figure 4-9. Attaching an FWA-1800U to an EXP-1800

The clamp on the side of the FWA-1800U is provided to serve as a strain relief for field wiring attached to the screw terminals. Run all field wiring through the clamp as shown in Figure 4-10.

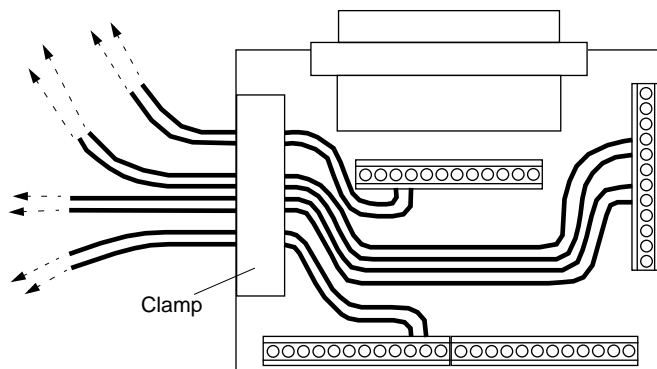


Figure 4-10. Clamping Wire Pairs Attached to Screw Terminals of the FWA-1800U

Connecting Signals

This section contains precautionary advice on making I/O connections. The section also shows some circuits for wiring signal sources to inputs of an EXP-1800.

The circuit diagrams in this section represent a single signal source wired to a single channel (channel n). In reality, you can wire separate signal sources to all the channels.

Precautions

If you expect to use a DAS/KPCI board at high gain, read the precautionary information in the following subsection. Other considerations for I/O connections are offered under “Additional Precautions” on page 4-12.

Precautions for Using a DAS/KPCI Board at High Gains

Operating a DAS/KPCI board with an EXP-1800 above gains of 50 can lead to problems if your application setup is sensitive to noise. At a gain of 250, each bit of analog output corresponds to $10\ \mu\text{V}$ (12 bit A/D) or $0.625\ \mu\text{V}$ (16 bit A/D) at the analog input. Thus, with the high speed and bandwidth of this system, analog noise and performance degradation come easily unless you take precautions to avoid them. The following collection of ideas and suggestions is aimed at avoiding these problems:

- Minimize noise from crosstalk and induced-voltage pickup in flat cables and screw-terminal accessories by using shielded cable. Connect the shield to CH GND and the inner conductors to Channel LO and HI. Channel LO and LL GND should have a DC return (or connection) at some point; this return should be as close to the signal source as possible. Induced noise from RF and magnetic fields can easily exceed tens of microvolts, even on one- or two-foot cables; shielded cable eliminates this problem.
- Avoid bi-metallic junctions in the input circuitry. For example, the kovar leads, used on reed relays, typically have a thermal emf to copper of $40\ \mu\text{V}/^\circ\text{C}$. Thermals can introduce strange random variations caused by air currents, and so on.

- Consider filtering. This approach can use hardware (resistors, capacitors, and so on) but is often accomplished more easily with software. Instead of taking a single channel reading, take 10 or more readings in quick succession and average them. If the noise is random and gaussian, averaging the multiple readings will reduce the noise by the square root of the number of readings. Use bipolar mode when averaging signals near 0V to avoid offsets.
- Consider 2700 series for systems with more than 4 EXP-1800s.

Additional Precautions

Do NOT mix your data acquisition inputs with the AC line, or you risk damaging the computer. Data acquisition systems give you access to inputs of the computer. An inadvertent short between data and power lines can cause extensive and costly damage to your computer. The manufacturer can accept no liability for this type of accident. To prevent this problem, use the following precautions:

- Avoid direct connections to an AC line.
- Make sure all connections are tight and sound so that signal wires are not likely to come loose and short to high voltages.
- Use isolation amplifiers where necessary.

Common Connection Schemes for Differential Inputs

Figure 4-11 shows three connection schemes for wiring a floating signal source to a channel of an FWA-EXP or to connector J5.

The upper two circuits of the diagram require the addition of resistors to provide a bias-current return. You can determine the value of the bias return resistors (R_b) from the value of the source resistance (R_s), using the following relationships:

- When R_s is greater than 100 Ω , use the connections in the upper circuit. The resistance of each of the two bias return resistors must equal 2000 R_s .
- When R_s is less than 100 Ω , use the connections in the middle circuit. The resistance of the bias return resistor must be greater than 1000 R_s .

- In the input-conditioning circuits for the upper and lower diagrams, switches 3 and 4 should be open (refer to “Input-Conditioning Options” on page 2-3).
- In the input-conditioning circuit for the center diagram, switch 4 should be open and switch 3 should be open if $R_S > 20 \Omega$. If $R_S < 20 \Omega$, you can substitute an onboard $R_{BIAS} = 10 \text{ k}\Omega$ for R_B instead of using R_B as shown in Figure 4-11.

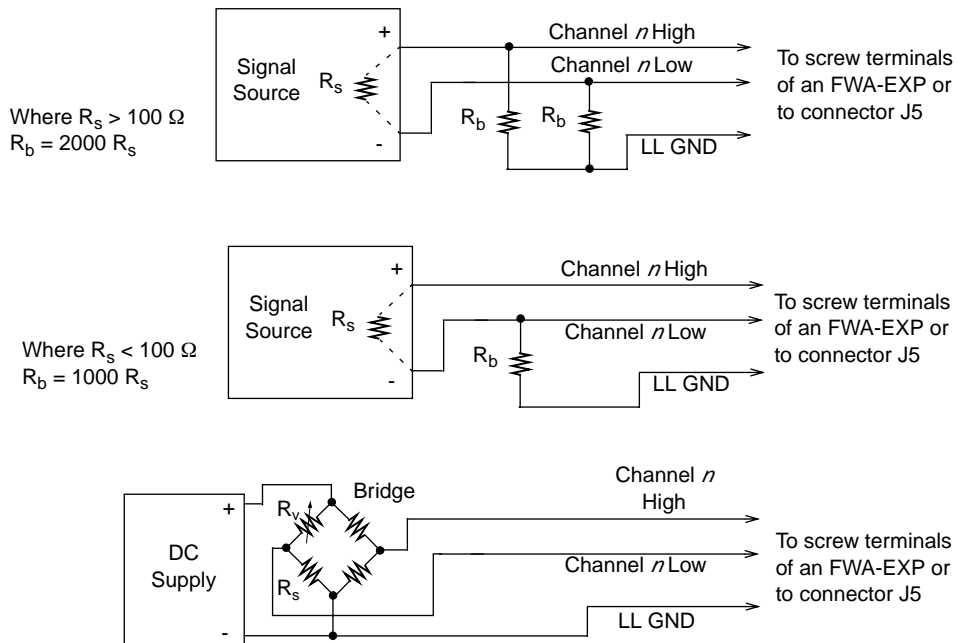


Figure 4-11. Three Types of Connections for Wiring a Signal Source to an FWA-EXP or to Connector J5

In the lower circuit of Figure 4-11, bias current return is inherently provided by the source. The circuit requires no bias resistors. R_S is the signal source resistance while R_V is the resistance required to balance the bridge.

Avoiding Ground Loops with Differential Inputs

Very often, the signal-source ground and the EXP-1800 ground are not at the same voltage level because of the distances between equipment wiring and the building wiring. This difference is referred to as a *common-mode voltage* (V_{cm}) because it is normally common to both sides of a differential input (it appears between each side and ground). Since a differential input responds only to the difference in the signals at its high and low inputs, its common-mode voltages cancel out and leave only the signal. However, if your input connections contain a ground loop, your input could see the sum of the signal-source and common-mode voltages. Figure 4-12 shows the proper way to connect a differential input while Figure 4-13 illustrates the effect of a ground loop.

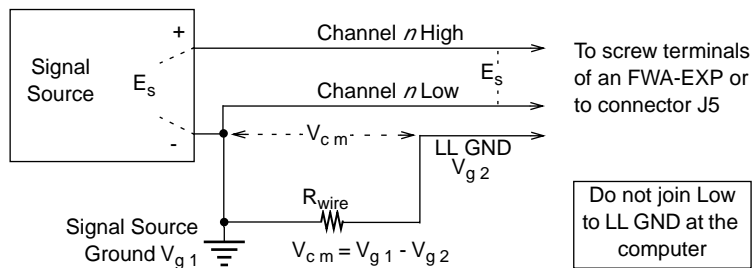


Figure 4-12. A Differential Input Configuration that Avoids a Ground Loop

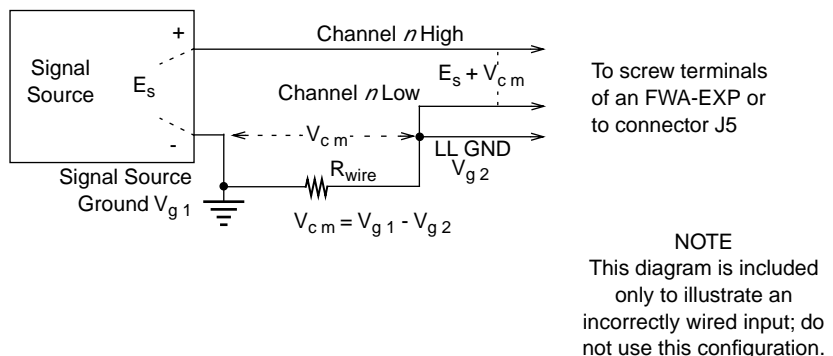


Figure 4-13. Differential Input Configuration with a Ground Loop

5

Calibration

Your EXP-1800 is initially calibrated at the factory. You are advised to check the calibration of your EXP-1800 every six months and to calibrate again when necessary.

The EXP-1800 requires only a zero adjustment for calibration. The calibration procedure uses a DAS/KPCI board to measure the output from your EXP-1800.

This chapter describes the requirements and procedures for calibrating an EXP-1800.

When using DAS Boards

Equipment Requirements

The equipment requirements for calibrating an EXP-1800 are as follows:

- **DAS board** - Use a DAS-1800ST/HR/AO Series board to control the EXP-1800 channel-selection circuit during analog offset calibration.
- **Calibration program** - Use the CAL1800.EXE program to calibrate the EXP-1800; CAL1800.EXE is a part of your DAS board ASO software package. For DriveLINX, a separate calibration program is available from our website at www.keithley.com.
- **Configuration program** - Use the CFG1800.EXE program to create a configuration file for the DAS board; this file is used by the calibration program; CFG1800.EXE is a part of your DAS board software package.

- **FWA-EXP optional accessory** - Attach an FWA-EXP (or mass-termination connector) to EXP-1800 I/O connector J5.
- **CDAS-2000 cable** - Use a CDAS-2000 cable to connect an EXP-1800 to a DAS board.

Potentiometer Locations

Refer to Figure 5-1 for locations of the potentiometers used in the calibration of an EXP-1800. The calibration program, described in the next section, directs you to these components and explains how to use them during the calibration process.

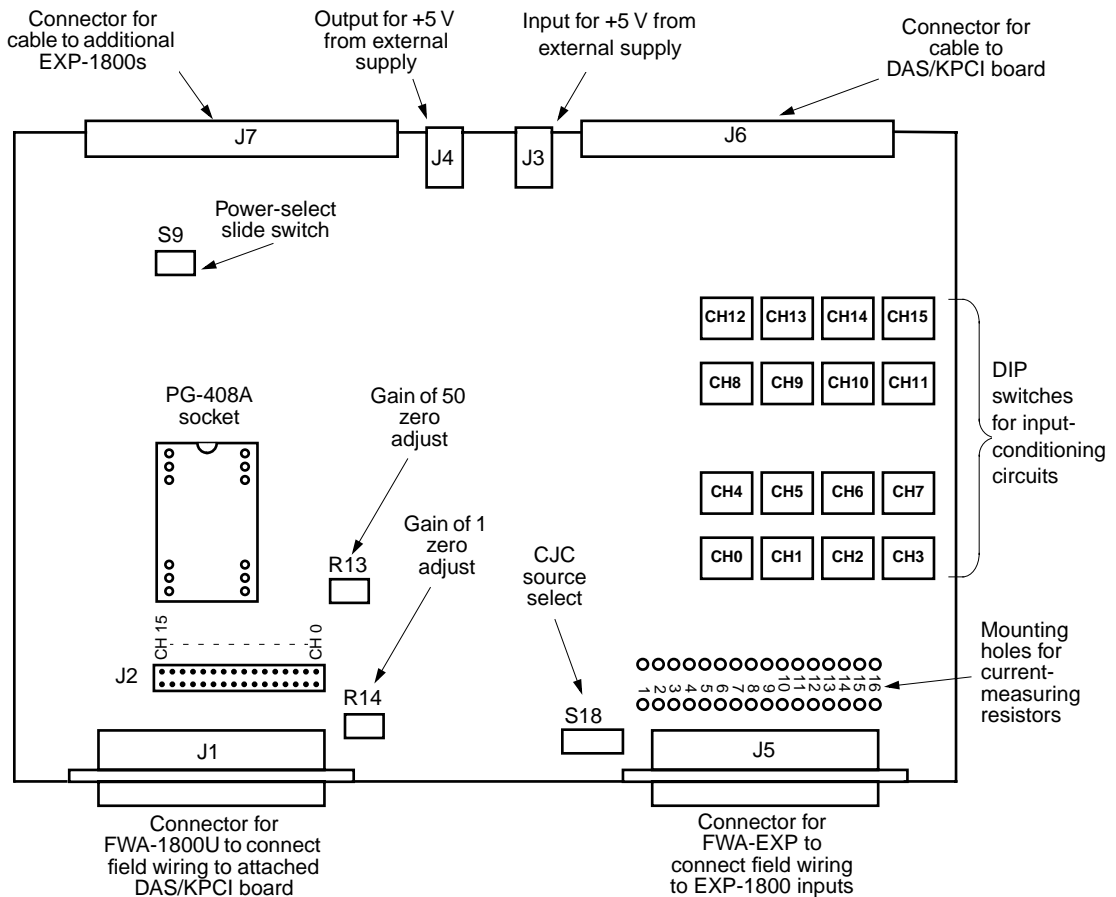


Figure 5-1. Component Locations on the EXP-1800

Calibration Procedure (DAS boards, ASO software)

To calibrate an EXP-1800 used with your DAS board, perform the following steps:

1. If the EXP-1800 is installed in an ENCL Series enclosure, remove the EXP from the enclosure and attach the four standoffs.
2. On the FWA-EXP (or mass-termination connector), wire CH15 HI and CH15 LO to GND A.
3. Set power-select switch S9 to DAS BOARD if you are using internal power or to EXT if you using external power (refer to “Setting Up for Power” on page 3-6).
4. Set the EXP-1800 channel-select jumper (at J2) to channel 0 for the first EXP-1800, channel 1 for the second, and so on.
5. Select a DAS board to connect to the EXP-1800.
6. Check your DAS board for proper functioning.
7. Connect the EXP-1800 to the DAS board using a CDAS-2000 cable.
8. Run the configuration program to create a configuration file that reflects the correct configuration of your DAS board and enables the EXP-1800 option; to run the configuration program, change to the directory containing CFG1800.EXE and type the following:

```
CFG1800
```

Note: In the configuration file, be sure to select an available interrupt level (you use only interrupt mode for EXP-1800 calibration).

9. Run the calibration program using the configuration file from step 8; to run the calibration program, change to the directory containing CAL1800.EXE and type the following:

```
CAL1800
```

10. At the Open Configuration File panel, enter the name of the newly created configuration file (from Step 8); then choose OK.
11. At the DAS-1800 Calibration panel, choose the EXP-1800 to calibrate.

12. Select the EXP-1800 button to display the EXP-1800 calibration panel.
13. On the selected EXP-1800, adjust potentiometers R7 and R14 for a zero count.
14. Calibration is now complete. If your EXP-1800 was in an enclosure, remove the standoffs and return the EXP to the enclosure.

When using KPCI Boards

Equipment Requirements

- KPCI-3108 Series board
- CAB-1284CC cable
- STA-3108A1
- CACC-2000
- PG-408A DC to DC converter
- 5VDC power supply (PWR-5V)
- Installed DriverLINX for KPCI-3108 Series
- Ability to short EXP channel zero (FWA-EXP or own cable)
- Optional: 5 1/2 digit or better DMM to monitor output from EXP-1800 at the terminals of the STA-3108A1

Configuration of DriverLINX

During normal operation of an EXP-1800 with a KPCI-3108 Series board, the digital output lines (OP0..OP4) of the KPCI-3108 board will be set for 'Enable EXP addressing'. For this procedure, change the configuration to general purpose use. In the DriverLINX Configuration Panel (Start Menu\Programs\DriverLINX\DriverLINX Configuration Panel) configure the KPCI-3108 digital output lines (OP0...OP4) for general purpose Output as shown in Figure 5-2.

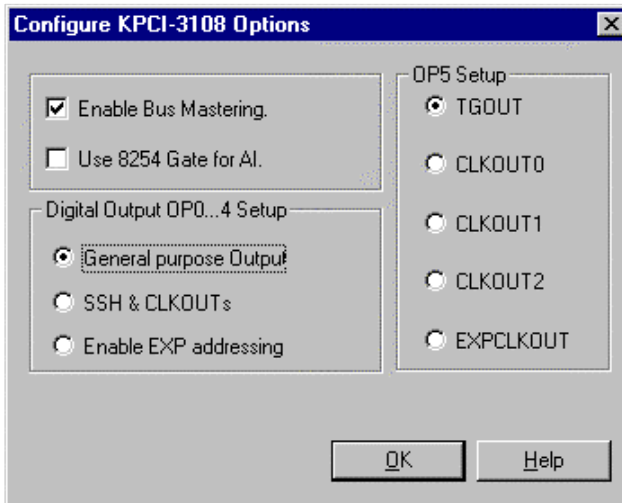


Figure 5-2. General Purpose Output

Additionally, the analog input channel configuration should always be set for Single Ended mode as shown below when using EXP accessories with plug-in boards. See Figure 5-3.



Figure 5-3. Configuration for Single Ended Mode

Reboot if necessary to allow these settings to take effect.

Configuration of EXP-1800

On the EXP-1800, channel select jumper (J2) to channel 0; PG-408A installed, external 5VDC power applied, S9 switch to 'PWR SEL', the 4 position DIP switch for each channel all to OFF, apply a shorting jumper between CH0 HI and CH0 LO on the FWA-EXP.

If you have the optional 5 1/2 digit DMM, connect it at pins 33 (+) and 18 (-) on the STA-3108A1 to monitor the value that the EXP-1800 presents to channel 0 of the KPCI-3108 Series board.

Procedure

To test the operation of your system, invoke two instances of the AIO Panel application (Start|Programs|DriverLINX|Test Panels|AIO Panel). Set one to the DIO tab and the other instance to the Meter tab as shown in Figure 5-4.

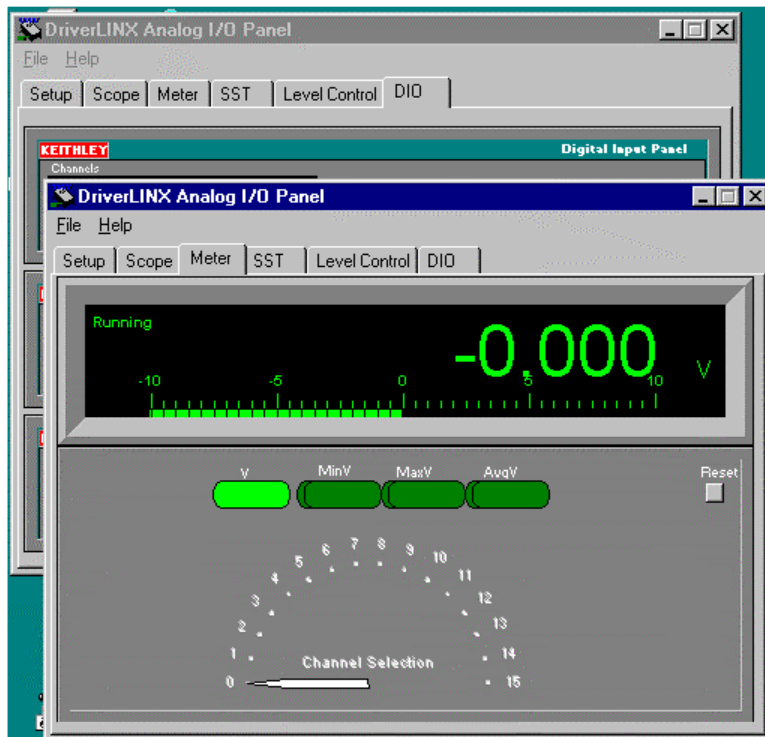


Figure 5-4. Testing Panel Operation

Position the two instances of AIOPanel side by side so that you can access them both.

Since the channel select jumper of the EXP-1800 is on channel 0, configure the Meter tab to display channel 0 of the KPCI-3108 board as shown in Figure 5-4.

The gain of the EXP-1800 can be controlled by the value of OP4 on the KPCI-3108. When OP4 is logic 1, the EXP-1800 gain of 50 is invoked. When OP4 is logic 0, the EXP-1800 is at gain of 1. Figure 5-5 shows how to use DIO tab of AIOPanel to select a gain of 50. Notice that the center panel of this page has the DO channel 0 turned on and bit 4 set to a logic 1 (two green lights).

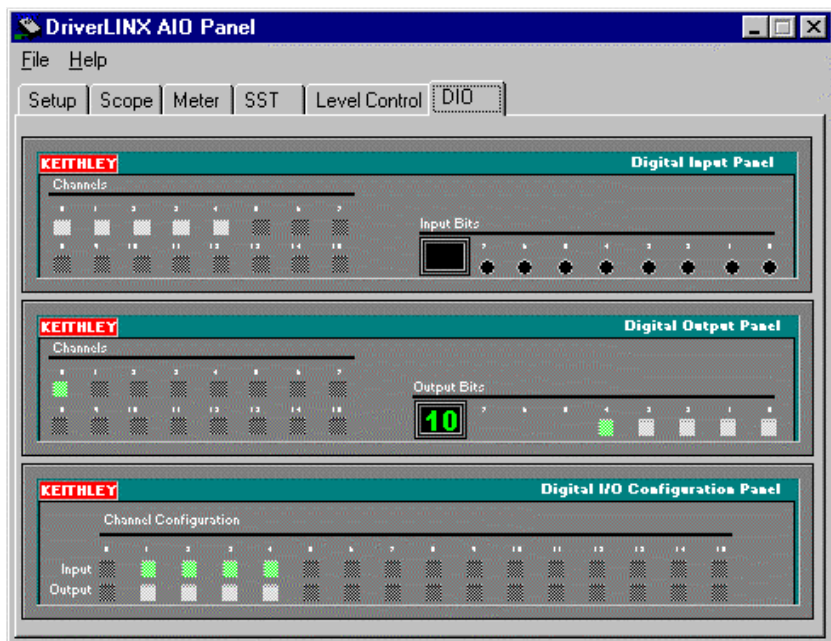


Figure 5-5. Selecting a Gain

Adjust Gain of 1 offset: Command the EXP-1800 to a gain of 1. Place a shorting jumper between CH 0 HI and CH 0 LO on the FWA-EXP. If the output from the EXP-1800 as seen on your DMM or on the Meter tab of AIOPanel is not at zero volts, adjust R14.

Adjust Gain of 50 offset: Command the EXP-1800 to a gain of 50. Place a shorting jumper between CH 0 HI and CH 0 LO on the FWA-EXP. If the output from the EXP-1800 as seen on your DMM or on the Meter tab of AIOPanel is not at zero volts, adjust R13.

Repeat these two steps one more time to minimize their interaction.

All adjustments have been made. The calibration is now finished.

Note: Other channels of the EXP-1800 can be selected by manipulating OP0..OP3 of the KPCI-3108. These four bits can generate 16 unique binary codes corresponding to the 16 channels of the EXP-1800. The numeric values the bits form (0..15) correspond to the selected channel of the EXP-1800 (0..15).

Remember to set the digital output lines (OP0..OP4) of the KPCI-3108 board to 'Enable EXP addressing' so that the DriverLINX software can automatically control the DO lines when accessing the channels/gain of the EXP-1800.

6

Troubleshooting

This chapter describes how to respond to a problem in the operation of your data acquisition system. If the problem appears serious enough to warrant technical support, refer to “Technical Support” on page 6-4 for information on how to contact an applications engineer.

Problem Isolation

Use the instructions in this section to isolate the cause of a problem before calling Keithley for technical support. Table 6-1 lists some symptoms and possible solutions for problems with an EXP-1800.

Table 6-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Computer does not boot	The power supply of the computer is too small to handle all the system components.	Check the needs of all system components and obtain a larger power supply or use external power.
System lockup	A timing error occurred.	Press [Ctrl] + [Break].
EXP-1800 appears not to operate	Configuration is incorrect. If using external power, polarity is wrong. The EXP-1800 is damaged.	Check the configuration of your EXP-1800 and of the DAS/KPCI board. Polarity of center contact on external power supply cables must be positive. Contact the Keithley Applications Engineering Department; see page 6-4.

Table 6-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Intermittent operation	<p>The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.</p> <p>Vibrations or loose connections exist.</p> <p>The EXP-1800 is overheating.</p> <p>Electrical noise exists.</p>	<p>Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, see your computer documentation for instructions on running BIOS setup).</p> <p>Cushion source of vibration and tighten connections.</p> <p>Check ambient temperature. See the documentation for your computer.</p> <p>Provide better shielding or reroute unshielded wiring.</p>
Data appears to be invalid	<p>The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.</p> <p>An open connection exists.</p> <p>Transducer is improperly connected to channel being read.</p> <p>Transducer is a differential type.</p> <p>Programming for application does not allow sufficient multiplexer settling time.</p>	<p>Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, see your computer documentation for instructions on running BIOS setup). See the documentation for your computer for instructions on running BIOS setup.</p> <p>Check wiring to screw terminals.</p> <p>Check the transducer connections.</p> <p>Check transducer specifications and board configuration.</p> <p>Refer to the caution under “Multiplexer” on page 2-4.</p>

If your EXP-1800 is not operating properly after using the information in Table 6-1, continue with the next two sections to isolate the problem.

Testing the Board and Host Computer

To isolate the problem to the EXP-1800 or to the DAS/KPCI board and host computer, use the following steps:

1. Turn off and disconnect power connections to the host computer.
2. Turn off and disconnect any external power connections to the EXP-1800.

Caution: Disconnecting a DAS/KPCI board or accessory with the power on can cause damage to your accessory, your board, and/or your computer.

3. While keeping connections to accessories intact, unplug the accessory cable connector from the DAS/KPCI board.
4. Visually check the EXP-1800 for damage. If there is obvious damage, refer to “Technical Support” on page 6-4 for information on returning the board.
5. With the EXP-1800 disconnected, check the DAS/KPCI board for proper operation. If the DAS/KPCI board does not operate properly, refer to your board’s user’s guide for troubleshooting instructions.

If the computer and DAS/KPCI board are operating properly and you have another EXP-1800 that is functional, you can test the input connections using the instructions in the next section. If you do not have another board, refer to the instructions on page 6-4 before calling Keithley Technical Support.

Testing the Input Connections

When you are sure that the computer and DAS/KPCI board are operating properly, test the EXP-1800 input connections using another EXP-1800 that is functional. To test the input connections, follow these steps:

1. Turn computer power off and connect an EXP-1800 accessory that is functional. Do not make any connections to the EXP-1800 inputs.
2. Turn computer power ON and check operation with the functional EXP-1800 in place.
3. If the EXP-1800 now functions, reconnect and check the operation of the input connections, one at a time.
4. If operation fails for an input connection, check the input for shorts and opens. Also determine whether the differential inputs are floating (not referenced to LL GND or GND A with input switches 3 or 4, as described on page 4-13).
5. If operation remains normal to this point, the problem is in the originally attached EXP-1800.
6. If you cannot isolate the problem, refer to the next section for instructions on obtaining assistance.

Technical Support

Before returning any equipment for repair, call Keithley for technical support at:

1-888-KEITHLEY

Monday - Friday, 8:00 a.m. - 5:00 p.m., Eastern Time

An applications engineer will help you diagnose and resolve your problem over the telephone. Please make sure you have the information on the following page available before you call.

EXP-1800	Model	_____
	Serial #	_____
	Revision code	_____
	Number of channels	_____
	Invoice/Order #	_____
DAS/KPCI board configuration	Model	_____
	Serial #	_____
	Revision code	_____
	Base address setting (DAS only)	_____
	Interrupt level setting	_____
	Number of channels	_____
	Input (S.E. or Diff.)	_____
	Mode (uni. or bip.)	_____
	DMA channel(s)	_____
	Number of SSH-8s	_____
Number of EXPs.	_____	
Computer	Manufacturer	_____
	CPU type	_____
	Clock speed (MHz)	_____
	KB of RAM	_____
	Video system	_____
	BIOS type	_____
Operating system	DOS version	_____
	Windows version	_____
	Windows mode	_____
Software package	Name	_____
	Serial #	_____
	Version	_____
	Invoice/Order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____
Accessories	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____

If a telephone resolution is not possible, the applications engineer will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Include the RMA number with any documentation regarding the equipment.

When returning equipment for repair, include the following information:

- Your name, address, and telephone number.
- The invoice or original purchase order number and date of equipment purchase.
- Non-warranty repair purchase order number.
- A description of the problem or its symptoms.
- The RMA number on the **outside** of the package.

Repackage the equipment using the original anti-static wrapping, if possible, and handle it with ground protection. Ship the equipment to:

ATTN: RMA # _____
Repair Department
Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, OH 44139
Telephone 1-888-KEITHLEY
FAX (440) 248-6168

Notes: If you are submitting your equipment for repair under warranty, you must include the invoice number and date of purchase.

To enable Keithley to respond as quickly as possible, you must include the RMA number on the outside of the package.

A

Specifications

Table A-1 lists specifications for the EXP-1800.

Table A-1. General Specifications

Feature	Specification
Number of inputs	16 differential inputs
Amplifier	
Configuration	Two selectable instrumentation amplifiers with gains of 1 and 50
Gain accuracy	$\pm 0.01\%$ reading, typical $\pm 0.02\%$ reading, maximum
Relative accuracy	$\pm 0.001\%$ reading, typical
Input characteristics	
Input offset current	0.6 nA maximum @ 25°C 50 nA maximum @ 0 to 70°C
Input bias current	1 nA maximum @ 25°C 100 nA maximum @ 0 to 70°C
Common Mode Rejection Ratio for 0 Hz to 1 kHz range	90 dB @ gain = 1 typical 110 dB @ gain = 50 typical
Input filter response	Single-pole RC @ 80 Hz $\pm 20\%$ (uses two 1 k Ω resistors connected differentially across a 1 μ F capacitor)

Table A-1. General Specifications (cont.)

Feature	Specification
Temperature coefficients	
Gain	± 5 ppm/ $^{\circ}$ C
Offset	± 10 μ V for gain = 1, typical ± 2 μ V for gain = 50, typical
Bandwidth (no filter)	
Full-power bandwidth	330 kHz @ gain = 1 50 kHz @ gain = 50
Noise	
rms	500 μ V @ gain = 1
p-p	3 mV @ gain = 1
rms	10 μ V @ gain = 50
p-p	70 μ V @ gain = 50
CJC (on screw-terminal panel)	
Output	+10 mV/ $^{\circ}$ C
Accuracy @ 25 $^{\circ}$ C	$\pm 0.4^{\circ}$ C, typical; $\pm 1.0^{\circ}$ C, maximum
Power requirements from a DAS board	
From ± 15 V	< 30 mA
From +5 V	300 mA
External power supply voltage	+5 V $\pm 10\%$

Note: Refer to the DAS/KPCI board user's guide for descriptions of the external I/O signals available to EXP-1800 connectors J1 and J5.

B

Connector Pin Assignments

This appendix contains pin assignments for I/O connectors of the DAS boards and the EXP-1800.

Main I/O Connector for DAS Boards

Pin assignments for main I/O connectors of DAS-1800ST/HR/AO Series boards are shown in Figure B-1.

Notes:

¹ DAS-1800ST/HR-DA and
DAS -1800AO Series boards

² DAS-1800ST-DA Series boards only

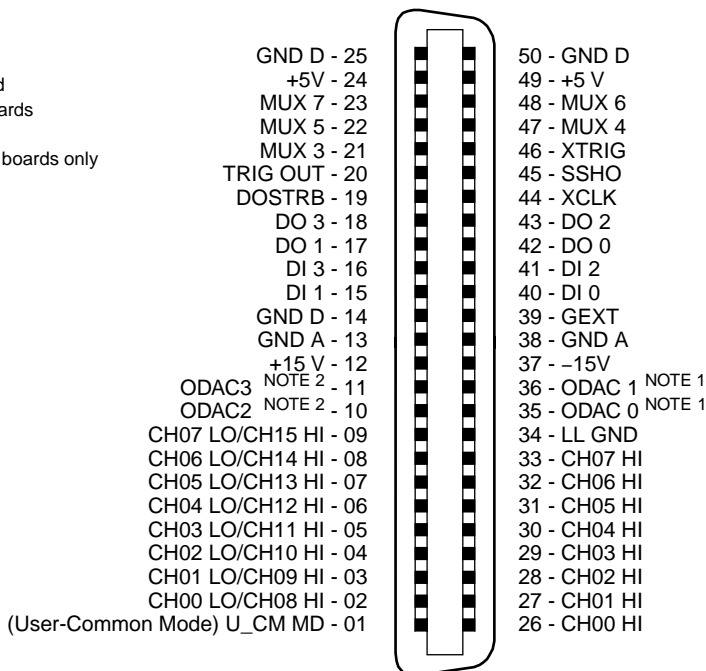


Figure B-1. Pin Assignments for Main I/O Connectors of DAS-1800ST/HR/AO Series Boards

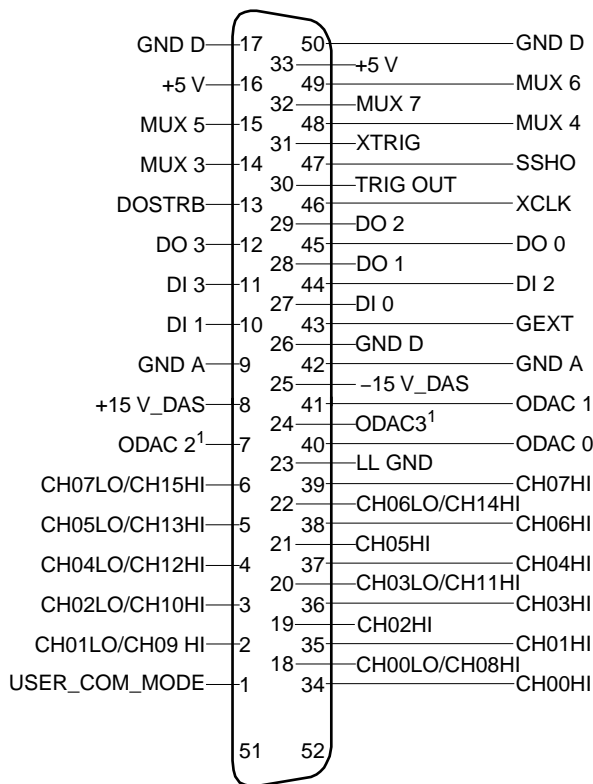
I/O Connectors of the EXP-1800

The following diagrams show pin assignments for I/O connectors of the EXP-1800.

GND D	49	50	GND D
+5 V	47	48	+5 V
MUX 7	45	46	MUX 6
MUX 5	43	44	MUX 4
NC	41	42	NC
NC	39	40	NC
NC	37	38	NC
NC	35	36	NC
NC	33	34	NC
NC	31	32	NC
NC	29	30	NC
GND D	27	28	GEXT
GND A	25	26	GND A
+15 V_DAS	23	24	-15 V_DAS
NC	21	22	NC
NC	19	20	NC
CH15 HI	17	18	LL GND
CH14 HI	15	16	CH07 HI
CH13 HI	13	14	CH 06 HI
CH12 HI	11	12	CH05 HI
CH11 HI	9	10	CH04 HI
CH10 HI	7	8	CH03 HI
CH09 HI	5	6	CH02 HI
CH08 HI	3	4	CH01 HI
NC	1	2	CH00 HI

Figure B-2. Pin Assignments for Connectors J6 and J7 of the EXP-1800

Note: Connectors J6 and J7 mate with 3M part number 3425-6050 if you prefer to construct your own ribbon cables.



Note:

¹ DAS-1800ST-DA Series boards only

Figure B-3. Pin Assignments for Connector J1 of the EXP-1800

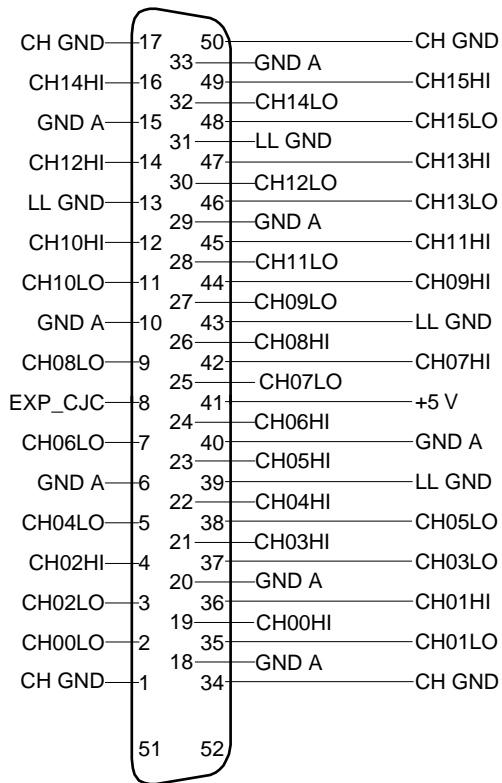


Figure B-4. Pin Assignments for Connector J5 of the EXP-1800

C

Channel Numbers for Software

This appendix describes the assignment of channel numbers for a DAS board and all attached EXP-1800s for use in software such as the Control Panel utility and the Function Call Driver.

The DAS boards are programmable for either 16 single-ended analog inputs (numbered 0 through 15) or eight differential analog inputs (numbered 0 through 7). When used with an EXP-1800, the DAS board inputs should be configured as single-ended. If you require more than the 16 single-ended onboard inputs, you can use up to 16 EXP-1800s to increase the number of available inputs to 256.

When using DAS Boards with ASO Software

EXP-1800s are assigned to consecutive onboard analog input channels, beginning with onboard channel 0. Table C-1 lists the software (or logical) channels associated with each EXP-1800.

Table C-1. Channel Numbers in Maximum EXP-1800 Configuration

Onboard Channel	EXP-1800 Software (Logical) Channels
0	0 to 15
1	16 to 31
2	32 to 47
3	48 to 63
4	64 to 79
5	80 to 95
6	96 to 111
7	112 to 127
8	128 to 143
9	144 to 159
10	160 to 175
11	176 to 191
12	192 to 207
13	208 to 223
14	224 to 239
15	240 to 255

Figure C-1 illustrates the use of three EXP-1800s and the 13 remaining onboard channels on a DAS board configured for single-ended mode. In software such as the Control Panel utility, you refer to the physical channels on the EXP-1800 attached to analog input channel 0 as logical channels 0 to 15, the physical channels on the EXP-1800 attached to analog input channel 1 as logical channels 16 to 31, and the physical channels on the EXP-1800 attached to analog input channel 2 as logical channels 32 to 47. You refer to the remaining 13 onboard analog input channels (physical channels 3 through 15) in software as logical channels 48 through 60.

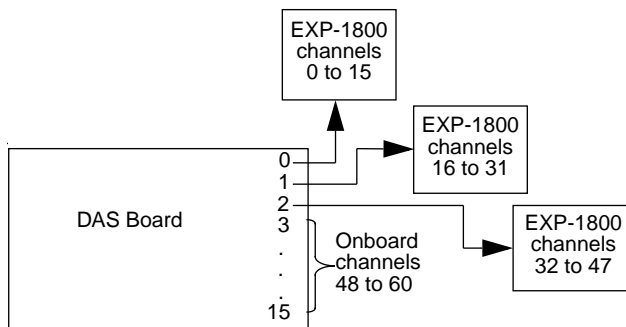


Figure C-1. Analog Input Channels

When using DriverLINX Software (DAS or KPCI Boards)

The DAS-1800 Series boards can make use of the older ASO software drivers for operation in Win3.x or Win9x. For operation of DAS-1800 Series boards in WinNT, Win2000 or WinXP, the DriverLINX Driver is required. The KPCI-3108 Series board uses DriverLINX.

The channel numbers assigned to the EXP are different under ASO than they are under DriverLINX.

Table C-1 and Figure C-1 describe the channel assignments when using ASO drivers.

When using DriverLINX, the board's single ended channels are always channels 0 through 15. An EXP can be used with any of the channels; it is not required to begin at channel 0 and increase consecutively for each additional EXP added. Figure C-2 shows the EXP channel assignments (for all boards) when using DriverLINX.

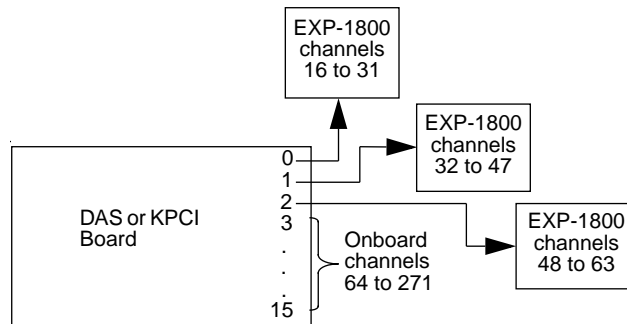


Figure C-2. Analog Input Channels when Using DriverLINX Driver

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