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KEITHLEY

DAS-800 Series

User's Guide



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DAS-800 Series
User's Guide

Revision D - June 2002
Part Number: 86870

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Safety Precautions

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.

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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

The *DAS-800 Series User's Guide* provides the information needed to set up, install, and use DAS-800 Series boards.

The manual is intended for data acquisition system designers, engineers, technicians, scientists, and other users responsible for setting up, cabling, and wiring signals to DAS-800 Series boards. It is assumed that users are familiar with data acquisition principles and with their particular application.

The *DAS-800 Series User's Guide* is organized as follows:

- Chapter 1 provides an overview of the features of DAS-800 Series boards, including a description of supported software and accessories.
- Chapter 2 provides a more detailed description of the analog input, digital I/O, and counter/timer I/O features of DAS-800 Series boards.
- Chapter 3 describes how to unpack, configure, and install DAS-800 Series boards.
- Chapter 4 describes how to attach accessory and expansion boards and how to wire signals to DAS-800 Series boards.
- Chapter 5 describes how to use DriverLINX Analog I/O Panel and DriverLINX Test Panel options to test functions of DAS–800 Series boards.
- Chapter 6 describes how to calibrate DAS-800 Series boards.
- Chapter 7 provides troubleshooting information.
- Appendix A lists the specifications for DAS-800 Series boards.

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- Appendix B lists the connector pin assignments.

An index completes this manual.

Throughout the manual, keep the following in mind:

- References to DAS-800 Series boards apply to the DAS-800, DAS-801, and DAS-802 boards. When a feature applies to a particular board, that board's name is used.

- References to Microsoft® QuickBasic™ apply to both Microsoft QuickBASIC (Version 4.0) and Microsoft QuickBasic (Version 4.5).

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1

Overview

The DAS–800 Series is a family of high–performance analog and digital I/O boards with DriverLINX software requiring:

- an IBM PC or compatible AT (386, or Pentium CPU) with 2 MB of memory
- at least one floppy disk drive, and one fixed disk drive
- MS–DOS/PCDOS 3.1 or higher
- Microsoft Windows 95/98 or Windows NT
- a compiler supporting Microsoft Windows development
- a mouse is highly recommended

The DAS–800 Series includes the DAS–800, DAS–801, and DAS–802 boards. The major features of DAS–800 Series boards are as follows:

- Eight analog input channels (single-ended on the DAS-800; single-ended or differential on the DAS-801 and DAS-802).
- Fixed ±5 V analog input range for the DAS-800; nine unipolar and bipolar, software-selectable analog input ranges for the DAS-801 and DAS-802.
- On-board 8254 counter/timer circuitry, which you can use as a hardware internal clock source and/or for general-purpose counter/timer I/O operations.
- Software-selectable conversion clock source.
- Digital trigger.

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- Hardware gate.
- Four-word FIFO to store converted data; overrun detection logic to detect lost data points.
- Software-selectable interrupt source.
- Three bits of digital input.
- Four bits of digital output.

Note: DAS-800 boards are enhancements of DAS-8 boards; DAS-801 boards are enhancements of DAS-8 PGA boards; DAS-802 boards are enhancements of DAS-8 PGA/G2 boards. DriverLINX for DAS-800 Series does not support the older MetraByte DAS-8 Series. Both 16- and 32-bit support for the DAS-8 Series is available under Windows 95 only, using a previous version of DriverLINX. Refer to the *DriverLINX Installation* and *Configuration Guide and Using DriverLINX With Your Hardware—Configuring the DAS-800 Series* manuals.

Supporting Software

The following software is available for operating DAS-800 Series boards:

- **DAS-800 Series standard software package -** Shipped with DAS-800 Series boards. Includes DriverLINX® for Microsoft® Windows and function libraries for writing application programs such as Microsoft Visual C++; Microsoft Visual Basic; Borland Delphi®; utility programs; and language-specific example programs.
- **DriverLINX -** the high-performance real-time data-acquisition device drivers for Windows application development includes:
  - D*riverLINX API DLLs and drivers supporting the DAS-800 Series hardware*
  - *Analog I/O Panel - A DriverLINX program that verifies the installation and configuration of DriverLINX to your DAS-800 Series board and demonstrates several virtual bench-top instruments*

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- *Learn DriverLINX - an interactive learning and demonstration program for DriverLINX that includes a Digital Storage Oscilloscope*
- Source Code - for the sample programs
- DriverLINX Application Programming Interface files - for the DAS-800 Series compiler
- DriverLINX On-line Help System - provides immediate help as you operate DriverLINX
- Supplemental Documentation - on DriverLINX installation and configuration; analog and digital I/O programming; counter/timer programming; technical reference; and information specific to the DAS-800 Series hardware.

- **DAS-800 Series utilities -** The following utilities are provided as part of both the DAS-800 Series standard software package:
  - *DriverLINX Calibration Utility*
  - *DriverLINX Test Panel*
- **DAS-800 Series register I/O map** - If you cannot satisfy your application's requirements with the available software packages and you are an experienced programmer, you may be able to program your DAS-800 Series board through direct register I/O instructions. Contact the factory for more information.

Note: Attempts to combine register-level programing of counter/timer functions with DriverLINX programming can produce unexpected results.

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Accessories

The following accessories are available for use with DAS-800 Series boards:

- **STC-37 screw terminal connector** - For all DAS-800 Series boards, provides 37 screw terminals that allow you to access the functions of the board; connects directly to the DAS-800 Series board without a cable.

- **STA-08 screw terminal accessory** - For the DAS-800 board only, provides screw terminals that allow you to access the functions of the board; provides a breadboard area with power and additional screw terminals to access the user-designed circuitry.

- **STA-08PGA screw terminal accessory** - For the DAS-801 and DAS-802 boards only, provides screw terminals that allow you to access the functions of the board; provides a breadboard area with power and additional screw terminals to access the user-designed circuitry.

- **EXP-16 and EXP-16/A expansion board**s - Sixteen-channel multiplexer and signal-conditioning expansion boards; provide cold junction compensation (CJC) for thermocouples and switch-selectable gains ranging from 0.5 to 2000.

- **EXP-GP expansion board** - An 8-channel signal-conditioning expansion board; connects to RTDs, thermistors, strain gages, and other variable resistance sensors; provides CJC for thermocouples and switch-selectable gains of 1, 10, 100, and 1000 or 2.5, 25, 250, and 2500.

- **MB Series modules and backplanes** - MB Series modules are high-performance, signal-conditioning modules that measure thermocouple, RTD, strain gage, voltage, and current inputs and are installed in MB Series backplanes. MB Series backplanes provide screw terminals for connecting the high-level analog I/O signals.

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- **STA-SCM8 screw terminal accessory** - Allows you to connect a DAS-800 Series board to up to four MB-02 backplanes; provides screw terminals that allow you to access the functions of the board; provides a breadboard area with power for the user-designed circuitry.

- **C-1800 cable** - Unshielded, 18-inch cable with a 37-pin connector on each end; allows you to connect a DAS-800 Series board to an STA-08, STA-08PGA, EXP-16, EXP-16/A, or EXP-GP.

- **S-1800 cable** - Shielded, 18-inch cable with a 37-pin connector on each end; allows you to connect a DAS-800 Series board to an STA-08, STA-08PGA, EXP-16, EXP-16/A, or EXP-GP.

- **C8-MB1 cable** - Cable with a 37-pin connector on one end and a 26-pin-connector on the other end; allows you to connect a DAS-800 Series board to an MB-01 or MB-02 backplane.

- **C-2600 cable** - An 18-inch cable with a 26-pin connector at each end; allows you to connect an STA-SCM8 screw terminal accessory to an MB-02 backplane.

Refer to the Keithley *Data Acquisition Catalog & Reference Guide* or contact your local sales office for information on obtaining these accessories.

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2

Functional Description

This chapter describes the following features of DAS-800 Series boards:

- Analog input features
- Digital I/O features
- Counter/timer I/O features
- Interrupts
- Power

A functional block diagram of a DAS-800 Series board is shown in Figure 2-1.

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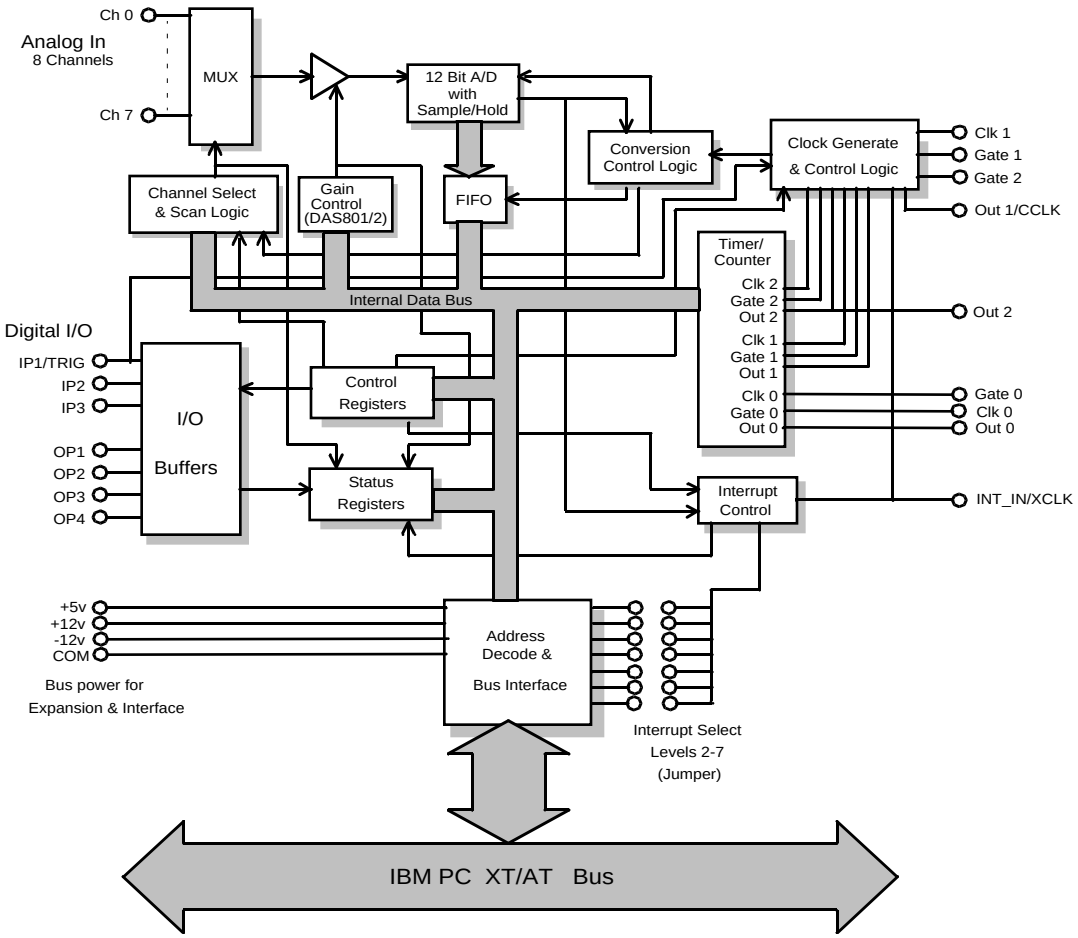


Figure 2-1. DAS-800 Series Functional Block Diagram

Analog Input Features

DAS-800 Series boards use a 12-bit, successive approximation analog-to-digital converter (ADC) with integral sample and hold. The ADC provides 12-bit resolution ±1 least significant bit (LSB), providing an effective accuracy of 11 bits. The ADC converts one sample every 25 µs, providing a maximum conversion frequency of 40 kHz.

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Channel Configuration

DAS-800 Series boards contain eight on-board analog input channels. The following subsections describe the input configurations supported for each channel, the gains and input ranges supported for each channel, and the methods of specifying a channel or channels for an analog input operation.

Input Configuration

On the DAS-801 and DAS-802, you can configure each channel as either single-ended or differential. The differences between a single-ended and a differential input configuration are described as follows:

- **Single-ended** - A single-ended input configuration is appropriate if you are measuring relatively high-level signals (greater than 1 V), if the source of the input signal is close to the board (less than two feet), or if all input signals are referred to a common ground. This configuration does not provide common-mode noise rejection.

- **Differential** - A differential input configuration is appropriate if you are measuring low-level signals, if high source resistances (greater than 100 Ω) exist, or if common-mode voltages exist between the voltage source and the host's chassis ground. In a differential configuration, a separate positive and negative terminal is provided for each channel. Any common-mode noise that is picked up equally on both inputs is rejected because the difference is zero.

You specify the input configuration by setting switches on the board. The switches connect or disconnect the inverting side of the input signal to low-level ground. Refer to page 3-13 for information on setting the switches.

Notes: On the DAS-800, the channels are always configured as single-ended; all signals are referred to a single low-level ground.

If you are using EXP-16, EXP-16/A, or EXP-GP expansion boards or MB-02 backplanes, you must configure the on-board analog input channels associated with the expansion boards or backplanes as single-ended.

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Gains and Ranges

A DAS-800 board measures analog input signals in the range of ±5 V.

Each DAS-801 or DAS-802 board contains a programmable gain amplifier (PGA), which allows you to measure analog input signals in one of several software-selectable unipolar and bipolar ranges. For each channel on a DAS-801 or DAS-802 board, you can specify one of five bipolar and four unipolar analog input ranges.

Table 2-1 lists the gains supported by DAS-800 Series boards and the analog input voltage range for each gain.

Table 2-1. Supported Gains

Board	Gain	Range	
		Bipolar	Unipolar
DAS-800	1	±5 V	Not available
DAS-801	0.5	±10 V	Not available
	1	±5 V	0 to 10 V
	10	±500 mV	0 to 1 V
	100	±50 mV	0 to 100 mV
	500	±10 mV	0 to 20 mV
DAS-802	0.5	±10 V	Not available
	1	±5 V	0 to 10 V
	2	±2.5 V	0 to 5 V
	4	±1.25 V	0 to 2.5 V
	8	±625 mV	0 to 1.25 V

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Note: Analog input channels on DAS-800 Series boards are provided with protection against signals outside the specified analog input range. All DAS-800 Series boards can tolerate voltages up to ±35 V and transients of several hundred volts without damaging the board.

When measuring signals at differential inputs, DAS-801 and DAS-802 boards can tolerate common-mode voltages up to ±35 V and transients of several hundred volts without damaging the board; however, for normal operation of the board, make sure that the common-mode voltage is no more than 12 V – ((G / 2) x V_D), where G is the gain and V_D is the differential input voltage.

Channel Selection

You can use DAS-800 Series boards to acquire data from a single analog input channel or from a range of contiguous, on-board analog input channels using automatic channel scanning. These two methods of channel selection are described as follows:

- **Single channel** - You use software to specify a single channel and initiate a conversion.

- **Automatic channel scanning** - You use software to specify the first and last channels in a range of contiguous, on-board channels (0 to 7). The channels are sampled in order from first to last; the hardware automatically increments the analog input multiplexer address shortly after the start of each conversion. When the last address is reached, the multiplexer returns to the start address and the channels are sampled again. For example, assume that the start channel is 4, the stop channel is 7, and you want to acquire five samples. Your program reads data first from channel 4, then from channels 5, 6, and 7, and finally from channel 4 again.

  The start channel can be higher than the stop channel. For example, assume that the start channel is 7, the stop channel is 2, and you want to acquire five samples. Your program reads data first from channel 7, then from channels 0, 1, and 2, and finally from channel 7 again.

  When using automatic channel scanning, all contiguous, on-board channels must have the same gain (analog input range).

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Note: DriverLINX allows you to acquire data from a range of multiple channels that includes channels on expansion boards or MB Series backplanes. The Expansion Board Configuration for Keithley DAS-800 Series dialog in DriverLINX of the Special selection of the Device Subsystem Page allows you to record the settings of your analog input multiplexers and enable the expansion channels. Refer to *Keithley DAS-800 Series—Using DriverLINX with Your Hardware* manual that accompanies DriverLINX.

Automatic channel scanning is a hardware feature. In multi-channel range mode, the DAS-800 Series acquires all data from a consecutive range of analog channels.

- The Start channel's gain only applies to the first channel
- DriverLINX uses the Stop Channel's gain for all the other analog channels in the range.
- If the Start Channel is greater than the Stop Channel, the channel sequence is [Start Channel, ..., Last Channel, 0, ..., Stop Channel], where Last Channel is the highest numbered channel for the DAS-800 model the application is using.

In multi-channel list mode, the DAS-800 Series acquires all data from a random list of analog channels.

- The channel-gain list may contain up to 256 channels in any order with any allowed gain.
- The list may repeat the same channel with the same or different gains.

Automatic channel scanning is a hardware feature. The functions used to create a group of consecutive channels or a channel-gain list emulate automatic channel scanning through software. Therefore, the maximum attainable conversion frequency is reduced when using a group of consecutive channels or a channel-gain list.

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Channel Expansion

If you require additional analog input channels or signal conditioning for transducer inputs, you can use any combination of up to eight 16-channel EXP-16 expansion boards, eight 16-channel EXP-16/A expansion boards, and/or eight 8-channel EXP-GP expansion boards to increase the number of available channels to 128. You can also use up to four MB-02 backplanes to increase the number of available channels to 68.

For the EXP-16, EXP-16/A, and EXP-GP, you attach the expansion boards in a daisy-chain configuration using the S-1800 or C-1800 cable. The first expansion board in the daisy chain is associated with on-board channel 0, the next expansion board is associated with on-board channel 1, and so on. You specify the associated on-board channel by setting a jumper on each expansion board. You can access any unused on-board channels by attaching an STA-08 or STA-08PGA screw terminal accessory to the last expansion board in the daisy-chain configuration.

Figure 2-2 illustrates a daisy-chain configuration of two EXP-16 expansion boards, one EXP-GP expansion board, and an STA-08 screw terminal accessory connected to a DAS-800 board.

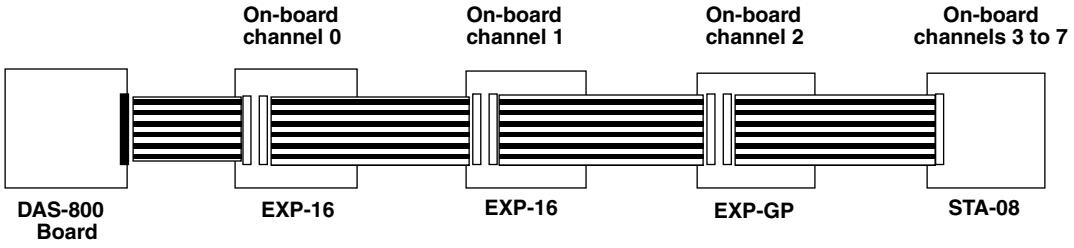


Figure 2-2. Channel Expansion

For information on attaching multiple MB-02 backplanes, refer to the *MB Series User's Guide*.

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Notes: You must specify a single-ended input configuration for all on-board channels associated with channels on EXP-16, EXP-16/A, or EXP-GP expansion boards or MB-02 backplanes.

If you are using EXP-16, EXP-16/A, or EXP-GP expansion boards or MB Series backplanes, the digital output lines of the DAS-800 Series board select the particular channel on the expansion board or backplane to read.

Refer to the appropriate expansion board documentation for more information about the EXP-16, EXP-16/A, and EXP-GP expansion boards. Refer to the *MB Series User's Guide* for more information about the MB-02 backplane.

Conversion Clock Sources

The conversion clock source determines when each analog-to-digital (A/D) conversion is initiated. DAS-800 Series boards provide the following software-selectable conversion clock sources:

- **Software** - When using a software conversion clock, the host computer issues a command to initiate a conversion. The host polls the board to determine if the conversion is complete. When the conversion is complete, the host reads the data from the ADC and returns the value. If the host reads data before the conversion is complete, the data will be invalid.

  Software-initiated conversions are suitable for measuring DC voltages; however, in applications where you must accurately control the sampling rate (as when measuring time-varying signals), it is recommended that you use either an internal or an external hardware conversion clock source.

  At power-up or system reset, the board assumes that conversions will be initiated through software.

- **Hardware (internal clock source)** - The internal clock source uses the on-board 8254 counter/timer circuitry and a crystal-controlled 1 MHz time base. The 8254 counter/timer circuitry is normally in an idle state. When you start an analog input operation, a conversion is initiated immediately. The 8254 is loaded with its initial count value

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and begins counting down. When the 8254 counts down to 0, another conversion is initiated and the process repeats.

Because the 8254 counter/timer uses a 1 MHz time base, each count represents 1 µs. For example, if you load a count of 25, the time interval between conversions is 25 µs; if you load a count of 65536, the time interval between conversions is 65.536 ms.

The 8254 contains three counter/timers: C/T0, C/T1, and C/T2. If you are using a hardware internal clock source, the time base logic uses C/T1 and C/T2 in either normal or cascaded mode, as follows:

– *Normal Mode* - A software-selectable count is loaded into C/T2 of the 8254 counter/timer circuitry. Each time C/T2 reaches terminal count, a conversion is initiated. The time interval between conversions ranges from 25 µs to 65.536 ms.

– *Cascaded Mode* - A software-selectable count is divided between C/T2 and C/T1 of the 8254 counter/timer circuitry. When C/T2 counts down to 0, C/T1 decrements by 1. C/T2 is reloaded with its count value and begins counting down again. Each time C/T2 counts down to 0, C/T1 decrements by 1. Each time both C/T2 and C/T1 reach terminal count, a conversion is initiated. The time interval between conversions ranges from 25 µs to 1.2 hours.

Note: For compatibility with the DAS-8 board, on power-up or system reset, the DAS-800 board connects the clock input of C/T2 to the CPU bus clock divided by two. If you specify a hardware internal clock source through software, the DAS-800 board connects the clock inputs of C/T1 and C/T2 to the 1 MHz time base. The DAS-801 and DAS-802 boards always connect the clock input of C/T2 to the 1 MHz time base.

Refer to page 2-17 for more information about the 8254 counter/timer circuitry.

- **Hardware (external clock source)** - An external clock source is useful if you want to sample at rates not available with the 8254 counter/timer circuitry, if you want to sample at uneven intervals, or if you want to sample on the basis of an external event. An external

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clock also allows you to synchronize conversions on multiple boards to a common timing source.

The external clock source is an externally applied TTL-compatible signal, which you attach to the INT_IN / XCLK pin (pin 24) of the main I/O connector. When you start an analog input operation, conversions are armed. At the next falling edge of the external clock source (and at every subsequent falling edge of the external clock source), a conversion is initiated.

Note: If you are using a hardware external clock source, you cannot use the INT_IN / XCLK pin (pin 24) to generate interrupts.

Figure 2-3 illustrates how conversions are initiated when using an internal and an external clock source. (Note that Figure 2-3 assumes that you are not using a hardware trigger; refer to Figure 2-4 for an illustration of conversions when using a hardware trigger.)

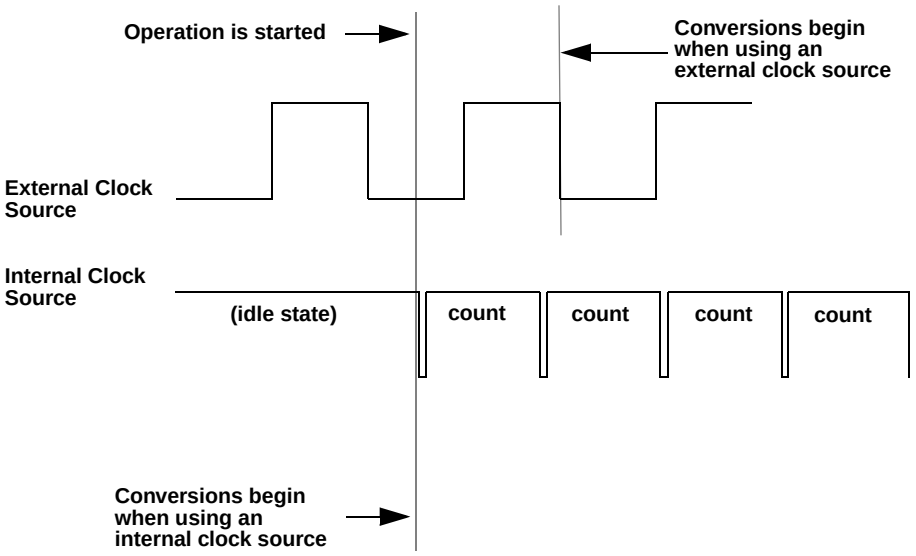


Figure 2-3. Initiating Conversions

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Notes: The ADC acquires data at a maximum of 40 kHz (one sample every 25 µs). If you are using a hardware external clock, make sure that the clock does not initiate conversions at a faster rate than the ADC can handle.

To achieve full measurement accuracy when using a gain of 500, you should limit the conversion frequency to a maximum of 25 kHz (one sample every 40 µs).

If you are acquiring samples from multiple channels, the maximum sampling rate for each channel is equal to 40 kHz divided by the number of channels.

The rate at which the computer can reliably read data from the board depends on a number of factors, including your computer, the operating system/environment, whether you are using expansion boards, the gains of the channels, and software issues.

You can synchronize conversions on multiple DAS-800 Series boards to a common, externally applied conversion clock. In addition, you can use a DAS-801 or DAS-802 board as a timing master; the output of the OUT1 pin (pin 5) on the main I/O connector of the master board acts as an external hardware conversion clock to any additional boards. You can use external circuitry, such as C/T0 on the 8254, to divide the rate of the master clock; this allows you to synchronize conversions on the additional boards to a rate different from that of the master board. Refer to page 4-13 for more information on synchronizing conversions on multiple boards.

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Triggers

A trigger is an event that must occur before a DAS-800 Series board starts an analog input operation. You can use one of the following trigger sources to trigger an analog input operation:

- **Software** - When you start the analog input operation, conversions begin immediately.
- **Hardware** - You connect a digital trigger signal to the digital input IP1 / TRIG pin (pin 25) of the main I/O connector. The trigger event occurs when the board detects a rising edge on IP1 / TRIG.

  The actual point at which conversions begin depends on whether you are using an internal or external clock source. These considerations are described as follows:

  – *Internal clock source* - The 8254 counter/timer circuitry remains idle until the trigger event occurs. When the trigger event occurs, the board initiates the first conversion immediately.

  – *External clock source* - Conversions are armed when the trigger event occurs. At the next falling edge of the external clock source, the board initiates the first conversion.

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Figure 2-4 illustrates how conversions are started when using a hardware trigger.

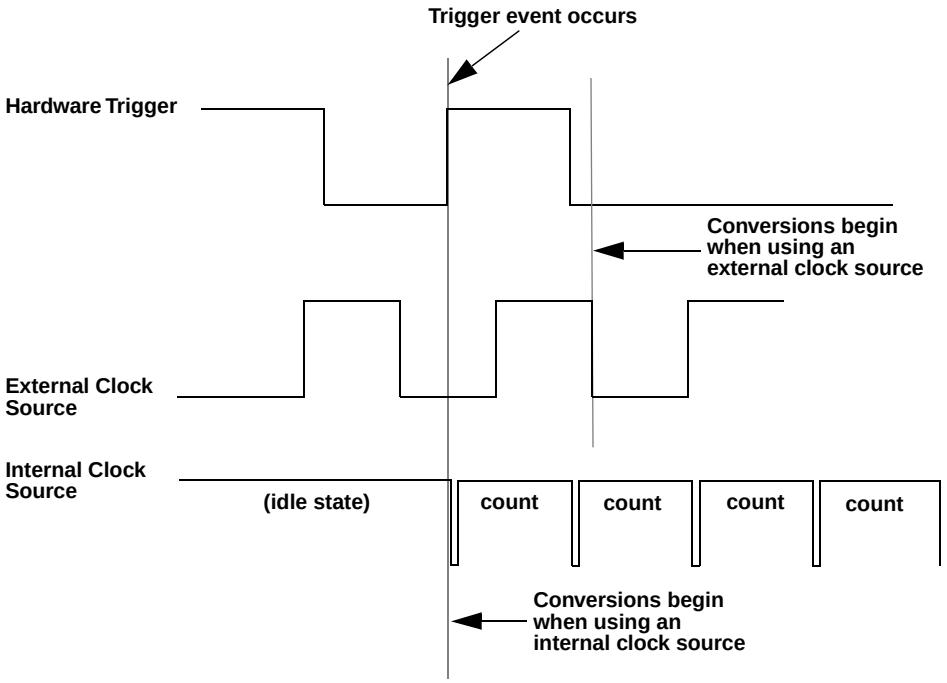


Figure 2-4. Initiating Conversions with a Hardware Trigger

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Hardware Gates

A hardware gate is an externally applied digital signal that determines whether conversions occur. You connect the gate signal to the IP1 / TRIG pin (pin 25) on the main I/O connector. DAS-800 Series boards support a positive gate only. Therefore, if the hardware gate is enabled and the signal to IP1 / TRIG is high, conversions occur; if the signal to IP1 / TRIG is low, conversions are inhibited.

Note: You cannot use the hardware gate with a hardware trigger. However, the gate signal itself can act as a trigger. If the gate signal is low when the software starts the analog input operation, the board waits until the gate signal goes high before conversions begin.

When using the hardware gate, the way conversions are synchronized depends on whether you are using a hardware external clock or a hardware internal clock, as follows:

- **External clock** - The signal from the external clock continues uninterrupted while the gate signal is low; therefore, conversions are synchronized to the external clock.

- **Internal clock** - The 8254 does not count while the gate signal is low. Whenever the gate signal goes high, the 8254 is loaded with its initial count value and starts counting; therefore, conversions are synchronized to the gate signal.

Figure 2-5 illustrates how to use the hardware gate with both an external clock and an internal clock.

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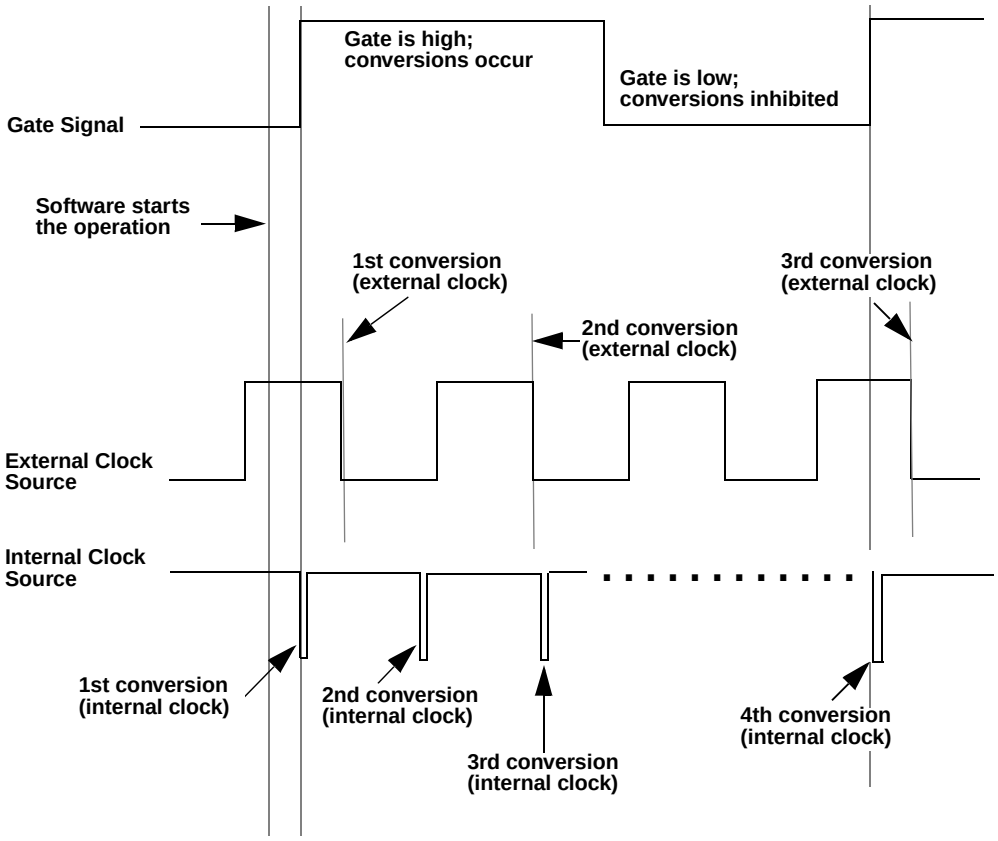


Figure 2-5. Hardware Gate

Note: Although DAS-800 Series boards do not provide a hardware-based analog trigger, you can program an analog trigger through software, using one of the analog input channels as the trigger channel. DriverLINX provides functions for both an analog trigger and a digital trigger. Refer to the *Using DriverLINX With Your Hardware— Keithley DAS-800* manual for more information.

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Data Transfer

Because DAS-800 Series boards do not support DMA (Direct Memory Access), data is always transferred from a DAS-800 Series board to the host computer's memory through an output port. Data can be transferred as either a foreground process or a background process. If data is transferred in the background, the end-of-conversion interrupt must be enabled so that the board can notify the host computer when new data is available; refer to page 2-25 for more information about interrupts. If data is transferred in the foreground, interrupts are not required.

DAS-800 Series boards contain a four-word, first-in, first-out memory location (FIFO). When you initiate conversions under hardware control, using an internal or external clock source, the result of each conversion is automatically stored in the FIFO.

Note: When you use software to initiate conversions, the FIFO control logic is automatically disabled and the FIFO is emptied.

The FIFO increases the maximum attainable conversion frequency by increasing the maximum software interrupt latency allowed by a factor of four (up to the maximum conversion frequency of 40 kHz).

If the conversion frequency is too fast or if the time required to service the interrupt is too long, the hardware may perform more than four conversions before the converted data is read. The hardware can detect this condition and generate an error to indicate that unread data in the FIFO was overwritten and samples were lost.

Note: When using DriverLINX, the operation of the FIFO is transparent. The DriverLINX software performs the data transfer.

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Digital I/O Features

DAS-800 Series boards contain three digital input lines and four digital output lines. The digital input lines are associated with the IP1 / TRIG, IP2, and IP3 pins on the main I/O connector; the digital output lines are associated with the OP1, OP2, OP3, and OP4 pins on the main I/O connector. Logic 1 at a pin indicates that the input/output is high (greater than 2.0 V); logic 0 at a pin indicates that the input/output is low (less than 0.8 V).

The digital input lines are compatible with TTL-level signals. If no signal is connected to a digital input line, the input appears high (logic 1).

You can use the digital input and output lines for any general-purpose task, with the following exceptions:

- If you are using an expansion board for an analog input operation, the four digital output lines control the multiplexers on the expansion boards to determine the expansion board channel that is acquiring data; in this case, you cannot use the digital output lines for general-purpose digital output operations.
- If you are using an external digital trigger or hardware gate, you must use the IP1 / TRIG pin to attach the trigger/gate signal; in this case, you cannot use IP1 / TRIG for general-purpose digital input operations.

8254 Counter/Timer Circuitry

Each DAS-800 Series board contains 8254 counter/timer circuitry; the 8254 contains three counter/timers: C/T0, C/T1, and C/T2.

C/T0 is always available for general-purpose tasks. If you are using a hardware internal clock source for an analog input operation, both C/T1 and C/T2 of the 8254 counter/timer circuitry are dedicated to internal functions and cannot be used for general-purpose tasks. If you are using a hardware external clock source, C/T0, C/T1, and C/T2 are always available for general-purpose tasks.

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C/T0 and C/T1 have a clock input pin on the main I/O connector; all counter/timers have a gate input pin and an output pin on the main I/O connector. You can attach a clock source (0 to 10 MHz) to the clock input pins (CLK0 and CLK1). Pull-up resistors of 3.3 kΩ are provided on the three gate input pins (GATE0, GATE1, and GATE2); therefore, the gates appear enabled if no signal is attached to the gate inputs. You can use the output pins (OUT0, OUT1, and OUT2) for pulse or frequency outputs.

When C/T0, C/T1, and C/T2 are available for general-purpose tasks, you can cascade counter C/T2 to counter C/T1 to provide an extended counting range. To cascade these counters, externally wire the output of counter C/T2 to the clock input of counter C/T1.

Notes: For compatibility with the DAS-8 board, on power-up or system reset, the DAS-800 board connects the clock input of C/T2 to the CPU bus clock divided by two. If you specify a hardware internal clock source through software, the DAS-800 board connects the clock inputs of C/T1 and C/T2 to the 1 MHz time base. The DAS-801 and DAS-802 boards always connect the clock input of C/T2 to the 1 MHz time base.

You can use the OUT1 pin of a DAS-801 or DAS-802 board to synchronize conversions on multiple boards. Refer to page 4-13 for more information.

The CLK1, GATE1, and GATE2 pins are provided for compatibility with DAS-8, DAS-8 PGA, and DAS-8 PGA/G2 boards on power-up or system reset. If you specify a hardware internal clock source through software, you cannot use these pins.

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You can program the 8254 counter/timer circuitry to operate in one of the following counter/timer modes:

- **Pulse on terminal count (Mode 0)** - This mode is useful for event counting or for programming a time delay. The software forces the output low. On the next clock pulse after the software writes the initial count value, the counter is loaded. When the counter reaches zero, the output goes high and remains high until the software writes a new count value. Note that the output does not go high until $n + 1$ clock pulses after the initial count is written, where n indicates the loaded count.

  A high gate input enables counting; a low gate input disables counting. The gate input has no effect on the output. Note that an initial count value written while the gate input is low is still loaded on the next clock pulse.

  Figure 2-6 illustrates pulse on terminal count mode.

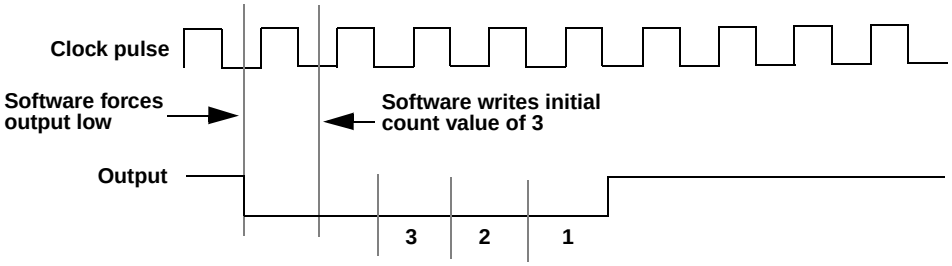


Figure 2-6. Pulse on Terminal Count Mode

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- **Programmable one-shot (Mode 1)** - This mode is useful for providing a hardware-triggered delay or one-shot pulse. The output is initially high. A trigger loads the initial count value into the counter. At the next clock pulse after the trigger, the output goes low and remains low until the counter reaches zero. (The one-shot pulse is *n* clock cycles in duration, where *n* indicates the loaded count.) After the counter reaches zero, the output goes high and remains high until the clock pulse after the next trigger; this makes the one-shot pulse retriggerable.

  You do not have to reload the count into the counter. The gate input has no effect on the output. Writing a new count to the counter during a one-shot pulse does not affect the current one-shot pulse.

  Figure 2-7 illustrates programmable one-shot mode.

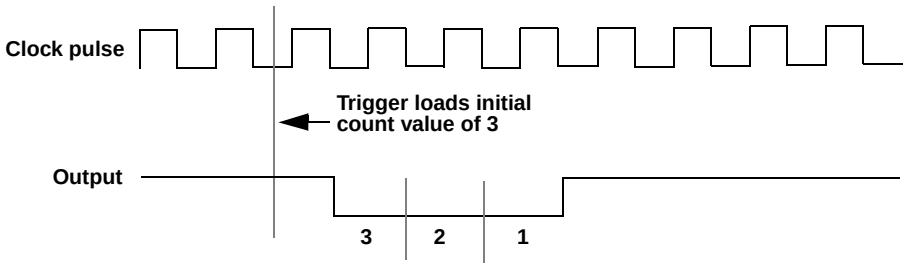


Figure 2-7. Programmable One-Shot Mode

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- **Rate generator (Mode 2)** - This mode is useful for generating a real-time clock interrupt. The output is initially high. A trigger loads the initial count value into the counter. At the next clock pulse after the trigger, the counter starts counting down. When the counter reaches one, the output goes low for one clock pulse and then goes high again. The counter is then reloaded with the initial count value and the process repeats.

  A high gate input enables counting; a low gate input disables counting. If the gate goes low during an output pulse, the output is set high immediately; this allows you to use the gate input to synchronize the counter.

  Writing a new count to the counter while counting does not affect the current counting sequence. In this mode, a count of 1 is illegal.

  Figure 2-8 illustrates rate generator mode.

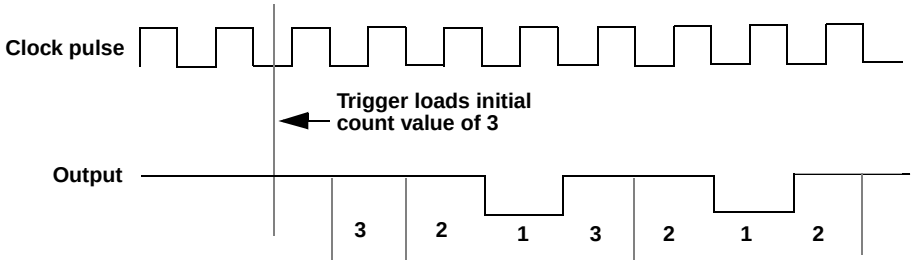


Figure 2-8. Rate Generator Mode

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- **Square-wave generator (Mode 3)** - This mode is useful for square-wave generation. The output is initially high. A trigger loads the initial count value into the counter. At the next clock pulse after the trigger, the counter starts counting down. When half the initial count has elapsed, the output goes low for the remainder of the count. When the total count elapses, the counter is reloaded with the initial count value, the output goes high again, and the process repeats. If the initial count is odd, the output is high for $(n + 1) / 2$ counts and low for $(n - 1) / 2$ counts, where n indicates the loaded count.

  A high gate input enables counting; a low gate input disables counting. If the gate goes low while the output is low, the output is set high immediately; this allows you to use the gate input to synchronize the counter.

  Figure 2-9 illustrates square-wave generator mode.

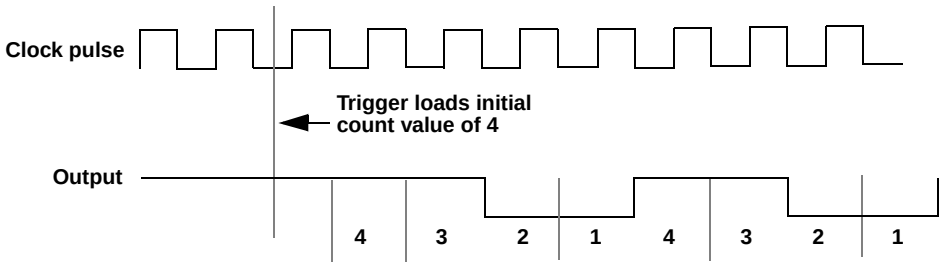


Figure 2-9. Square-Wave Generator Mode

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- **Software-triggered strobe (Mode 4)** - The output is initially high. Writing the initial count through software loads the initial count value into the counter at the next clock pulse, but the counter does not start counting. At the next clock pulse, the counter starts counting down. When the counter reaches zero, the output goes low for one clock pulse and then goes high again. Note that the output does not go low until $n + 1$ clock pulses after the initial count is written, where n indicates the loaded count.

  A high gate input enables counting; a low gate input disables counting. The gate input has no effect on the output.

  Figure 2-10 illustrates software-triggered strobe mode.

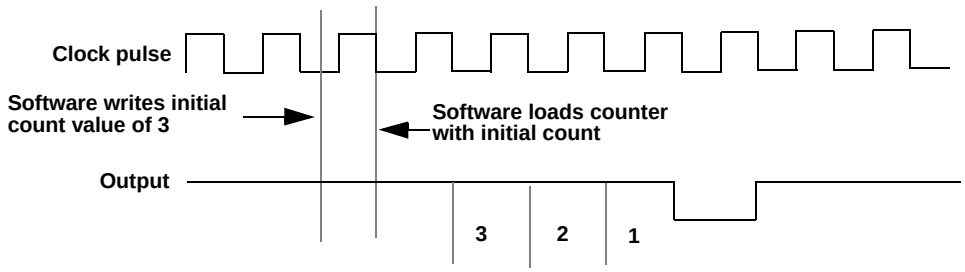


Figure 2-10. Software-Triggered Strobe Mode

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- **Hardware-triggered strobe (Mode 5)** - The output is initially high. A rising edge of the gate input acts as a trigger. The counter is loaded with the initial count value on the next clock pulse after the trigger, but the counter does not start counting. At the next clock pulse, the counter starts counting down. When the counter reaches zero, the output goes low for one clock pulse and then goes high again. Note that the output does not go low until $n + 1$ clock pulses after the trigger event occurs, where n indicates the loaded count.

  After the trigger event occurs, the gate input has no effect on the output. Writing a new value during counting does not affect the counting sequence.

  Figure 2-11 illustrates hardware-triggered strobe mode.

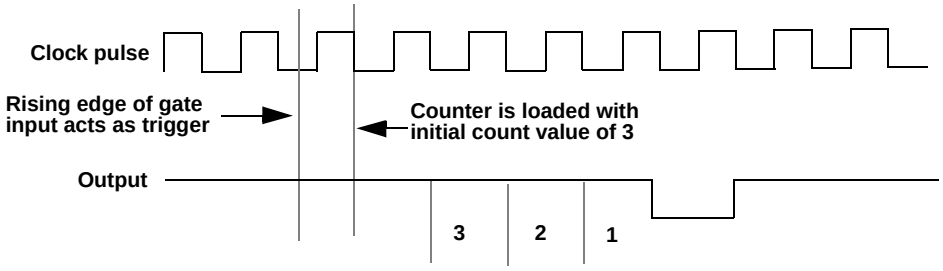


Figure 2-11. Hardware-Triggered Strobe Mode

Refer to 8254 documentation for information on programming the 8254 counter/timer circuitry for general-purpose tasks. Table 2-2 lists several companies that provide documentation for the 8254.

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Table 2-2. Sources for 8254 Documentation

Company	Address and Telephone Number
Intel Corporation	Literature Sales P.O. Box 7641 Mt. Prospect, IL 60056-7641 (800) 468-3548
Harris Semiconductor	Literature Department P.O. Box 883, MS CB1-28 Melbourne, FL 32901 (407) 724-3739
Newbridge Microsystems	603 March Road Kanata, Ontario Canada K2K 1X3 (613) 592-0714 (800) 267-7231

Interrupts

DAS-800 Series boards can generate interrupts from one of the following interrupt sources:

- **External interrupt** - An interrupt is generated when a rising edge is applied to the INT_IN / XCLK pin (pin 24) on the main I/O connector.

  Note: If you are using an external interrupt, you cannot use the INT_IN / XCLK pin (pin 24) to connect a hardware external clock source.

- **End-of-Conversion (EOC) interrupt** - An interrupt is generated when an A/D conversion is complete.

The interrupt source is software-selectable. At power-up or system reset, the board assumes that the interrupt source is an external interrupt.

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You can select only one interrupt at a time. If you are using an interrupt, you must select the interrupt level (2, 3, 4, 5, 6, or 7) using a jumper on the board. If you are not using an interrupt, you can disable interrupts using a jumper on the board. Refer to page 3-14 for more information.

Note: If you are acquiring data in the background, interrupts must be enabled and the interrupt source must be an EOC interrupt.

If an interrupt condition is satisfied, an on-board flip-flop is set. If interrupts are enabled (through both hardware and software), the board generates an interrupt to the host, driving the selected host interrupt line to an active state.

Power

The analog circuitry on the DAS-800 board is powered by the ±12 V of the host computer. The DAS-801 and DAS-802 boards contain a DC/DC converter to provide power to the analog circuitry.

Note: Many laptop computers and other types of battery-operated computers do not have a –12 V power supply. If your computer does not have a –12 V power supply, you cannot use a DAS-800 board.

The host computer can provide power for EXP-16, EXP-16/A, and EXP-GP expansion boards and MB Series backplanes; however, certain power limitations exist. Table 2-3 lists the maximum number of expansion boards and backplanes that the host can power.

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Table 2-3. Expansion Board / Backplane Power Limitations

Expansion Board / Backplane	Maximum Number Powered by Host
EXP-16	4
EXP-16/A	4
EXP-GP	3
MB-01	Always use external power.
MB-02	Always use external power.
MB-03	4
MB-04	2
STA-1360	4

If you want to use more expansion boards or backplanes than indicated in Table 2-3, you must connect an external power supply to the additional expansion boards or backplanes. Refer to the appropriate expansion board documentation for information on providing external power to EXP-16, EXP-16/A, and EXP-GP expansion boards. Refer to the *MB Series User's Guide* for information on providing external power to MB Series backplanes.

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3

Setup and Installation

This chapter describes how to install the software in your computer, unpack and inspect the board, configure the board, and install the board in your computer.

If you are familiar with switches and jumpers and with the items that are configurable on DAS-800 Series boards, you can use Figure 3-1 as a quick reference for configuring a DAS-800 board and Figure 3-2 as a quick reference for configuring a DAS-801 or DAS-802 board. If you need additional information, refer to Configuring the Board on page 3-9.

Read this chapter and all related DriverLINX documentation before you attempt to install and use your DAS-800 Series board.

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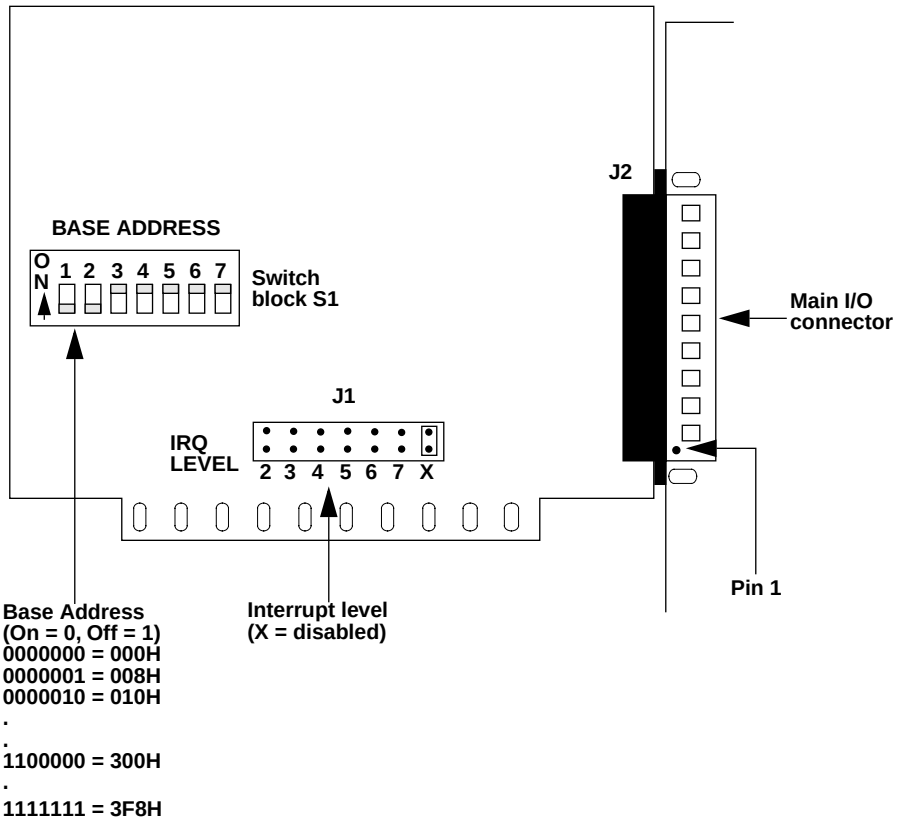


Figure 3-1. DAS-800 Board

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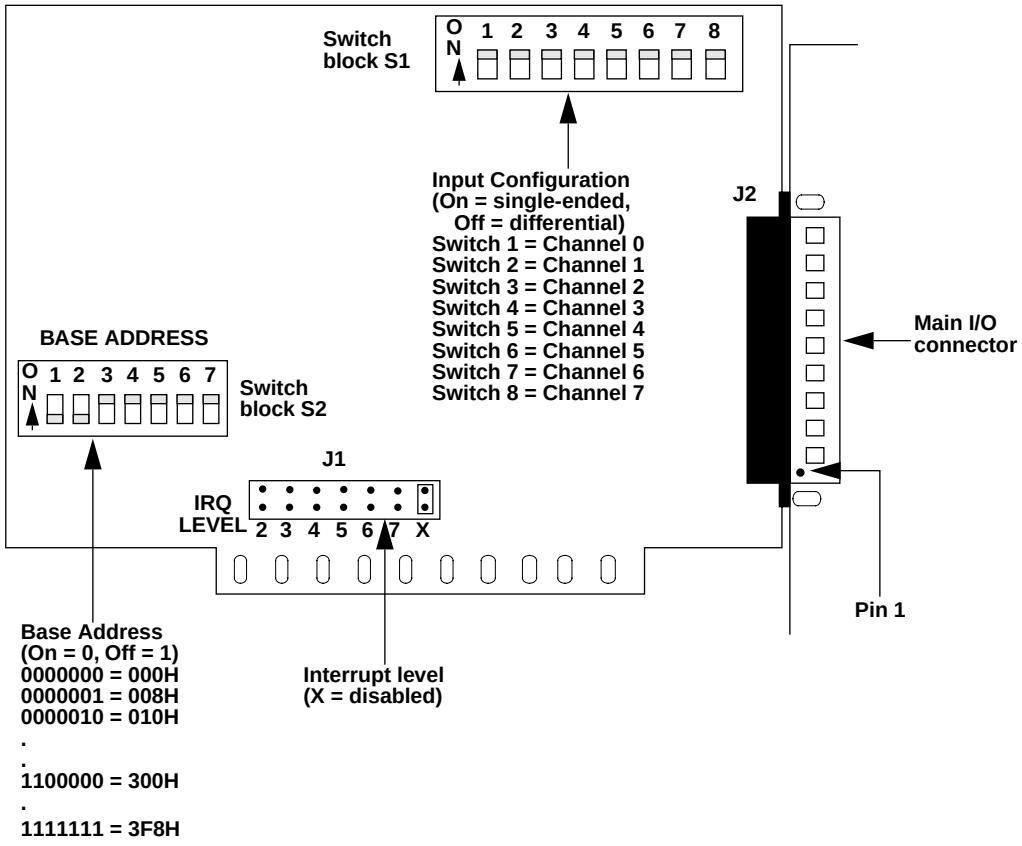


Figure 3-2. DAS-801/802 Board

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Installing and Configuring DriverLINX for DAS-800 Series Boards

Important: As a precaution against a system crash the first time you install and test any new hardware, you should exit all other programs and, if you use a disk cache, disable write caching. If the system does crash and you're using disk compression software or a disk cache utility, as a precaution after any crash, run the utility that checks the directory structures.

This section describes how to install the DAS-800 Series standard software package. The contents of these software packages are described as follows:

- **DAS-800 Series standard software package** - Shipped with DAS-800 Series boards. Includes DriverLINX® for Microsoft® Windows and function libraries for writing application programs such as Microsoft Visual C++; Microsoft Visual Basic; Borland Delphi®; utility programs; and language-specific example programs.
- **DriverLINX-** the high-performance real-time data-acquisition device drivers for Windows application development includes:
  - *DriverLINX API DLLs and drivers supporting the DAS-800 Series hardware*
  - *Analog I/O Panel - A DriverLINX program that verifies the installation and configuration of DriverLINX to your DAS-800 Series board and demonstrates several virtual bench-top instruments*
  - *Learn DriverLINX - an interactive learning and demonstration program for DriverLINX that includes a Digital Storage Oscilloscope*
  - *Source Code - for the sample programs*

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– *DriverLINX Application Programming Interface files - for the DAS-800 Series compiler*

– *DriverLINX On-line Help System - provides immediate help as you operate DriverLINX*

– *Supplemental Documentation - on DriverLINX installation and configuration; analog and digital I/O programming; counter/timer programming; technical reference; and information specific to the DAS-800 Series hardware*

- **DAS-800 Series utilities** - The following utilities are provided as part of both the DAS-800 Series standard software package:

  – *DriverLINX Calibration Utility*

  – *DriverLINX Test Panel Utility*

Installing the DAS-800 Series Standard Software Package

Note: Important—Before you begin installing any hardware or software for the DAS-800, read the *DriverLINX Installation and Configuration Guide and the Using DriverLINX with your Hardware—DAS-800 Series manuals that are packaged with the DriverLINX software. They are accessed from the DriverLINX CD-ROM after you have installed Adobe Acrobat®.*

Before Installing DriverLINX

1. Inventory your DAS-800 board's configuration settings.

2. Determine the resources your DAS-800 Series board requires.

3. Inventory your computer's resources already allocated to other installed devices.

4. Determine whether your computer has sufficient resources for your DAS-800 board

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5. Determine whether your DAS-800 board can use your computer's free resources.

6. Set any jumpers/switches to configure your DAS-800 board to use your computer's free resources.

7. Set any other jumpers/switches to configure your DAS-800 board the way you want.

8. Install your DAS-800 board into an appropriate free slot in your computer.

Selecting the DriverLINX components to Install

For your convenience in installing and uninstalling just the DriverLINX components you need, the DriverLINX CD Browser will assist you in selecting the components to install:

- **Install Drivers—**This required component installs only the files you need for configuring your hardware and running third-party data-acquisition applications that require DriverLINX.

- **Install Interfaces—**This optional component installs the files and example programs that you will need to develop custom applications for DriverLINX using C/C++, Visual Basic, Delphi, and LabVIEW.

- **Install Documentation—**This optional component installs electronic documentation for DriverLINX that you can read, search, and print using the Adobe Acrobat Reader.

- **Install Acrobat—**This optional component installs the Adobe Acrobat Reader for the DriverLINX electronic documentation.

Installing DriverLINX

1. Insert the DriverLINX CD-ROM into your computer's CD-ROM Drive.

2. Start the DriverLINX setup program. On most systems, wait a few seconds for automatic startup. Otherwise, run the setup.exe program from the CD-ROM.

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3. The DriverLINX CD-ROM Browser Map window appears on the screen. Click ‘Install Drivers,’ and follow the series of on-screen instructions.

Note: To display an explanation of a menu option on the DriverLINX CD browser map that appears next and on subsequent setup screens, place the mouse pointer over the menu item. A star next to a menu item means that the item was selected previously.

---

4. Select ‘Read Me First,’ and follow the instructions.

5. Select ‘Install Documentation.’ If you do not have Adobe Acrobat installed on your computer, install it by selecting ‘Install Adobe Acrobat.’

6. Open the manuals appropriate to the DAS-800 installation and read them before installing your DAS-800 board or configuring DriverLINX:

   – Installation and Configuration

   – *Using DriverLINX with Your Hardware—Keithley DAS-800*

   – *DriverLINX Technical Reference Manual*

   – *DriverLINX Analog I/O Programming Guide*

   – *DriverLINX Digital I/O Programming Guide*

   – *DriverLINX Counter/Timer Programming Guide*

   – *Appendix, I/O Port, Interrupt, and DMA Channel Usage*

   – Other manuals appropriate to your installation

Configuration with DriverLINX

Follow the DriverLINX on-screen instructions for installation of drivers and interfaces. Refer to the *DriverLINX Installation and Configuration Guide and Using DriverLINX with Your Hardware—Keithley DAS-800 manuals.*

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Note: Be sure to follow all programming differences between installations for Windows NT and Windows 95/98.

Before you configure DriverLINX for operation with the DAS-800 Series board, you must specify the base address, interrupt level, and input configuration by setting switches on the board.

Unpacking the Board

To prevent any damage to your DAS-800 Series board, perform the following steps when unpacking the board:

1. Remove the wrapped DAS-800 Series board from its outer shipping carton.

2. Making sure that your computer is turned OFF but grounded, hold the wrapped board in one hand while placing your other hand firmly on a metal portion of the computer chassis; this discharges any static electricity.

3. Carefully remove the board from its anti-static wrapping material. (You may wish to store the wrapping material for future use.)

4. Inspect the board for signs of damage. If any damage is apparent, arrange to return the board to the factory; refer to Chapter 7 for more information.

5. Check the remaining contents of your package against the packing list to ensure that your order is complete. Report any missing items to the factory immediately.

6. Once you have determined that the board is acceptable, you can configure the board. Refer to the next section for configuration options.

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Configuring the Board

Be sure to make note of the configuration of all switches and jumpers on the board. You will use this information to enter the correct configuration parameters using DriverLINX. Also locate any information or notes about the interrupt and DMA channels used by the other hardware devices in your computer system.

You can configure the following items on DAS-800 Series boards:

- Board type (DAS-800, DAS-801, or DAS-802).
- Base address (required by DriverLINX and other software packages to perform DAS-800 Series board operations).
- Use of C/T2 on the 8254 (cascaded or normal).
- Input range type (unipolar or bipolar) for a DAS-801 or DAS-802 board.
- Input configuration (single-ended or differential) for each channel on a DAS-801 or DAS-802 board.
- Interrupt level.
- Expansion boards used (information includes the number of expansion boards, the gains used by channels on the expansion boards, and the channel used as the CJC sensor).

Note: For EXP-16, EXP-16/A, and EXP-GP expansion boards, you must also set switches on the expansion boards to specify the gains used by channels on the expansion boards. Refer to the appropriate expansion board documentation for information about setting the switches.

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Setting the Base Address

DAS-800 Series boards are shipped with a base address of 300H. If any of the address locations between 300H and 307H are being used by another resource in your system (including another DAS-800 Series board), you must reconfigure the base address using the base address switch block (labeled S1 on the DAS-800 board; labeled S2 on DAS-801 and DAS-802 boards).

Note: In Windows NT, the default address used by DriverLINX is 768 decimal or 0x300 hex. If you have another peripheral board at the same address, select a different base address. You need a block of eight free addresses. Make sure that the switch settings for each board match the settings you set in DriverLINX. Refer to the *Using DriverLINX with Your Hardware—Keithley DAS-800* manual.

Using DriverLINX under Windows 95/98, the *Add New Hardware* automatically selects an appropriate address. To change the address, refer to the *Using DriverLINX with Your Hardware—Keithley DAS-800* manual.

The base address switch block contains seven switches, labeled 1 through 7. Switch 1 corresponds to the most significant bit (MSB) of the base address; switch 7 corresponds to the LSB of the base address. The location of the base address switch block on the DAS-800 board is shown in Figure 3-1 on page 3-2; the location of the base address switch block on the DAS-801 and DAS-802 boards is shown in Figure 3-2 on page 3-3.

You place a switch in the ON position (logic 0) by sliding the switch toward the top (numbered side) of the switch block. You place a switch in the OFF position (logic 1) by sliding the switch toward the bottom (unnumbered side) of the switch block.

Figure 3-3 illustrates the setting for a base address of 280H; switches 1 and 3 are in the OFF position and switches 2, 4, 5, 6, and 7 are in the ON position.

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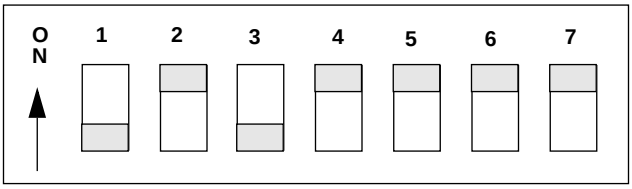


Figure 3-3. Setting the Base Address

Table 3-1 lists I/O addresses commonly used by IBM PC/XT, AT, and compatible computers. Determine an even boundary of eight I/O addresses within the range of 000H to 3F8H that is not being used by another resource in your system (including another DAS-800 Series board), and set the switches to the appropriate base address.

Table 3-1. I/O Address Map (000H to 3FFH)

Address Range	Use
000H to 00FH	8237 DMA #1
020H to 021H	8259 PIC #1
040H to 043H	8253 timer
060H to 063H	8255 PPI (XT)
060H to 064H	8742 controller (AT)
070H to 071H	CMOS RAM and NMI mask register (AT)
080H to 08FH	DMA page registers
0A0H to 0A1H	8259 PIC #2 (AT)
0A0H to 0AFH	NMI mask register (XT)
0C0H to 0DFH	8237 DMA #2 (AT - word-mapped)
0F0H to 0FFH	80287 numeric processor (AT)
1F0H to 1FFH	Hard disk (AT)
200H to 2FFH	Game / control
210H to 21FH	Expansion unit (XT)

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Table 3-1. I/O Address Map (000H to 3FFH) (cont.)

Address Range	Use
238H to 23BH	Bus mouse
23CH to 23FH	Alternate bus mouse
278H to 27FH	Parallel printer
2B0H to 2DFH	EGA
2E0H to 2EFH	GPIB (AT)
2E8H to 2EFH	Serial port
2F8H to 2FFH	Serial port
300H to 31FH	Prototype card
320H to 32FH	Hard disk (XT)
378H to 37FH	Parallel printer
380H to 38FH	SDLC
3A0H to 3AFH	SDLC
3B0H to 3BBH	MDA
3BCH to 3BFH	Parallel printer
3C0H to 3CFH	EGA
3D0H to 3DFH	CGA
3E8H to 3EFH	Serial port
3F0H to 3F7H	Floppy disk
3F8H to 3FFH	Serial port

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Notes: The Expansion Board Configuration for Keithley DAS-800 Series dialog in DriverLINX allows you to record the settings of your analog input multiplexers and enable the expansion channels. Make sure that the switch settings match the settings you define in DriverLINX. Refer to the *Using DriverLINX with Your Hardware—Keithley DAS-800 manual.*

On models DAS-801 and DAS-802, using a multiplexer requires setting the associated base channel's switch to single-ended.

The DriverLINX Analog Input subsystem has 8 analog input single-ended or differential signal connections depending on the model of your DAS-800 board. DriverLINX maps these signals to Logical Channels. DriverLINX uses several of these control connections for external clock, trigger, and gating inputs. Refer to the *Using DriverLINX with Your Hardware—Keithley DAS-800 manual.*

All DAS-800 Series boards have 8 analog input channels. On DAS-801 and DAS-802 models, you can switch each channel to differential or single-ended. The switch setting affects only the connections for the channel. DriverLINX grays out this property in the configuration dialog.

Setting the Input Configuration

DAS-801 and DAS-802 boards are shipped with the input configuration for all channels set to single-ended. If this is not appropriate for your application, you can reconfigure the input configuration on a channel-by-channel basis using the input configuration switch block (labeled S1).

Note: The default input configuration in the DriverLINX configuration file is also single-ended for all channels. Make sure that the switch settings match the settings you establish in DriverLINX.

The input configuration switch block contains eight switches, labeled 1 through 8. Switch 1 corresponds to channel 0; switch 2 corresponds to channel 1, and so on. The location of the input configuration switch block on the DAS-801 and DAS-802 boards is shown in Figure 3-2 on page 3-3.

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You place a switch in the ON position (single-ended) by sliding the switch toward the top (numbered side) of the switch block. You place a switch in the OFF position (differential) by sliding the switch toward the bottom (unnumbered side) of the switch block.

Figure 3-4 illustrates the setting for channels 0, 5, and 7 configured as single-ended (switches 1, 6, and 8 are in the ON position) and channels 1, 2, 3, 4, and 6 configured as differential (switches 2, 3, 4, 5, and 7 are in the OFF position).

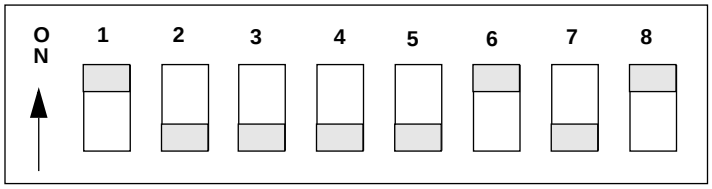


Figure 3-4. Setting the Input Configuration

Notes: Since DAS-800 boards always use a single-ended input configuration, they do not contain an input configuration switch block.

Setting the Interrupt Level

DAS-800 Series boards are shipped with interrupts disabled. If you want to use interrupts, you must set an appropriate interrupt level using jumper block J1.

Notes: DriverLINX modes specify preferred hardware data transfer techniques: Foreground or synchronous modes, Background or asynchronous modes. DriverLINX supports three modes with the DAS-800 Series for its commands: Polled mode, Interrupt mode, and Other mode. Refer to the *Using DriverLINX with Your Hardware—Keithley DAS-800 manual*.

If you intend to acquire data in the background, you must enable interrupts by setting an interrupt level.

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Jumper block J1 contains seven pairs of jumper posts, labeled 2, 3, 4, 5, 6, 7, and X (disabled). You set the interrupt level by placing the supplied jumper clip over the appropriate posts. Note that you can set only one interrupt level at a time.

Figure 3-5 illustrates the setting for interrupt level 5; the jumper clip is over the posts labeled 5.

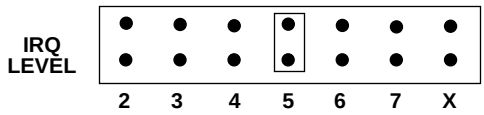


Figure 3-5. Setting the Interrupt Level

Table 3-2 lists interrupt levels commonly used by IBM PC/XT, AT, and compatible computers. Select an interrupt level that is not being used by another resource in your system (including another DAS-800 Series board), and set the jumper to the appropriate interrupt level. It is recommended that you select interrupt level 3, 4, 5, or 7, if available.

Table 3-2. Interrupt Levels

Level	Use
2	Reserved (XT), interrupts 8 to 15 (AT)
3	Serial port COM2 or SDLC
4	Serial port COM1 or SDLC
5	Hard disk (XT), LPT (AT)
6	Floppy disk
7	LPT

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Installing the Board

Before installing a DAS-800 Series board in your computer, make sure that the switches and jumper on the board are set appropriately and that the jumper and switch settings match the settings you configure in DriverLINX.

Caution: Installing or removing a board with the power ON can cause damage to your computer.

To install the board, perform the following steps:

1. Turn power to the computer and all attached equipment OFF.
2. Remove the computer chassis cover.
3. Select an available slot. The DAS-800 requires a single, short slot; the DAS-801 and DAS-802 require a single, 1/2-slot.
4. Loosen and remove the screw at the top of the blank adapter plate, and then slide the plate up and out to remove.
5. Insert and secure the board connector in the selected slot.
6. Replace the computer chassis cover.
7. Plug in all cords and cables.
8. Turn power to the computer ON.

After you install the DAS-800 Series board in the computer, you can attach an expansion board, if necessary, and wire the appropriate signals to the board; refer to Chapter 4 for information. Before writing your application program, you can test the functions of the DAS-800 Series board using the DriverLINX AIO Panel or Test Panel for testing your DriverLINX installation and configuration; verifying signal inputs to the DAS-800 Series board; sending test signals to external devices.

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Refer to the documentation provided with your computer for more information on installing boards.

Configuring DriverLINX

After you have successfully installed the DAS-800 Series board in your computer, start Windows to install DriverLINX. For detailed instructions on installing DriverLINX, see the documentation provided on the DriverLINX CD-ROM; especially the *DriverLINX Installation and Configuration Guide* and the *Using DriverLINX with Your Hardware—Keithley DAS-800* manuals.

Run "Learn DriverLINX" (LearnDL.exe) from the DriverLINX program group to tell DriverLINX how you configured your DAS-800 Series board and to verify that everything is properly installed and configured.

1. Start Windows as you normally would and select the Program Manager window. Install DriverLINX if you have not previously done so.

2. Either select the "Learn DriverLINX" icon created when you installed DriverLINX or enter "<drive>:/DRVLNX/LEARNDL" in the Command Line edit box activated by selecting from the File menu the Run... option. <drive> is the letter of the hard disk drive where DriverLINX is installed.

3. Immediately after loading Learn DL, the Open DriverLINX DLL dialog box appears. Select the name of the hardware-specific DLL from the list for your DAS-800 board. The name is an abbreviation of the board's model number.

4. From the main menu bar of Learn DL, select the Device menu and choose Select...

5. Select the Logical Device you wish to configure and then click on the OK button (return).

6. Again select the Device menu and then choose the Configure... option to display the Device Configuration Dialog Box.

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7. From the Model list, select the model name for your DAS-800 Series board you are configuring.

8. If the value displayed in the Address edit box is not correct, type the correct value into the box. You may enter the address in decimal or hexadecimal using the c-notation for hex, (that is, 768 decimal = 0x300 hexadecimal).

9. Choose the correct options for the Analog, digital, and Counter/Timer Sections by first clicking on the appropriate radio button in the middle of the dialog box and then completing the group of dialog fields in the lower third of the dialog box. Be sure to click on both the Input and Output radio buttons for the Analog and Digital groups to see all the dialog fields.

10. After you have made all your selections, save the configuration parameters by clicking on the OK button. This will create or update the configuration file in the Windows directory.

11. Repeat the preceding steps starting at step 5, for each Logical Device you wish to configure.

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4

Cabling and Wiring

This chapter describes how to attach accessory and expansion boards to a DAS-800 Series board, how to connect signals to a DAS-800 Series board, and how to synchronize conversions on multiple DAS-800 Series boards.

Note: Before you make any connections to a DAS-800 Series board, make sure that power to your computer and any accessories attached to the DAS-800 Series board are OFF.

Attaching Accessory and Expansion Boards

You attach an STC-37 screw terminal connector, STA-08 or STA-08PGA screw terminal accessory, or EXP-16, EXP-16/A, or EXP-GP expansion board to a DAS-800 Series board through the main I/O connector, a 37-pin, D-type connector that is labeled J2 on the board. The main I/O connector and its pin assignments on a DAS-800 board are shown in Figure 4-1; the main I/O connector and its pin assignments on a DAS-801 or DAS-802 board are shown in Figure 4-2. Refer to Appendix B for a more detailed description of the pins.

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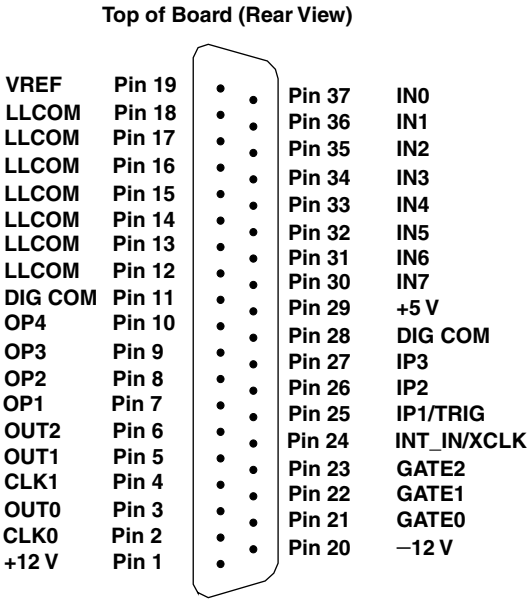


Figure 4-1. Main I/O Connector on a DAS-800 Board

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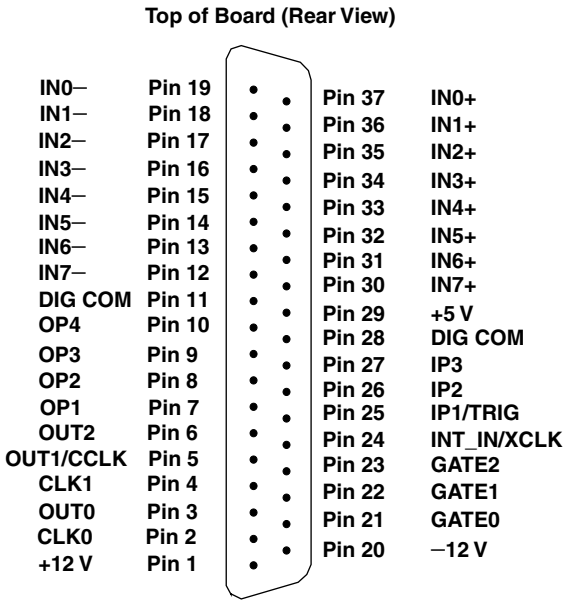


Figure 4-2. Main I/O Connector on a DAS-801 or DAS-802 Board

You attach an STC-37 screw terminal connector directly to the main I/O connector on the DAS-800 Series board. You attach an STA-08 or STA-08PGA screw terminal accessory or an EXP-16, EXP-16/A, or EXP-GP expansion board to the main I/O connector on the DAS-800 Series board using either a C-1800 or S-1800 cable. The C-1800 is the unshielded version of the cable; the S-1800 is the shielded version of the cable.

Attaching an STC-37 Screw Terminal Connector

The screw terminals on the STC-37 screw terminal connector allow you to connect field wiring to a DAS-800 Series board. The screw terminals are labeled from 1 to 37 and correspond directly to the functions of the pins on the main I/O connector on the board. For example, since pin 24 is assigned to the external clock source, use screw terminal 24 to attach a hardware external clock. Refer to Appendix B for a complete list of pin assignments.

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To connect an STC-37 to a DAS-800 Series board, directly attach the 37-pin connector on the STC-37 to the main I/O connector on the DAS-800 Series board. Figure 4-3 illustrates the connection of an STC-37 to a DAS-800 Series board.

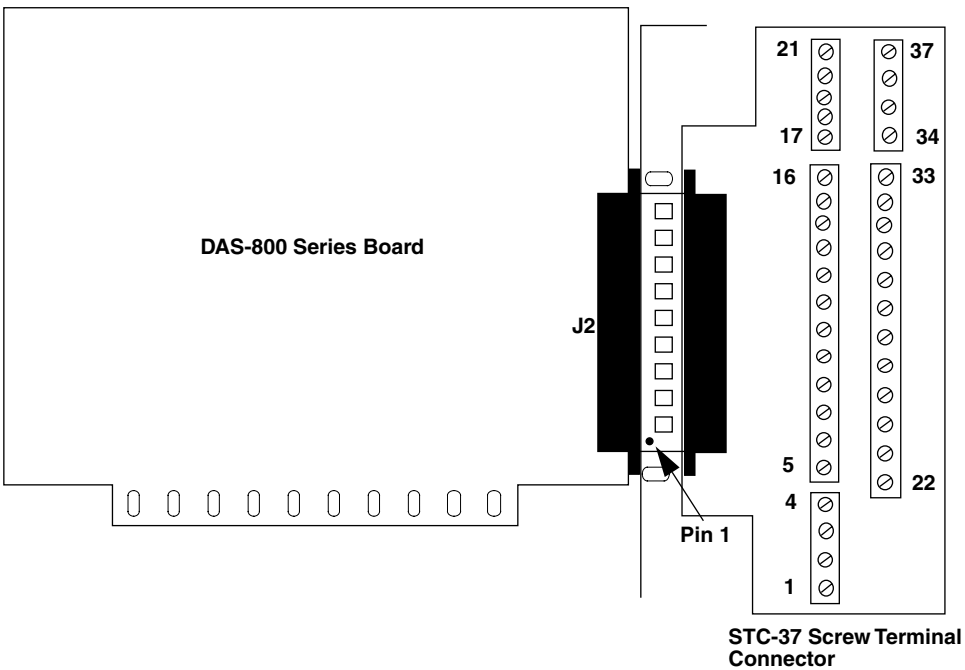


Figure 4-3. Attaching an STC-37 Screw Terminal Connector

Attaching an STA-08 / STA-08PGA Screw Terminal Accessory

The screw terminals on the STA-08 screw terminal accessory allow you to connect field wiring to a DAS-800 board; the screw terminals on the STA-08PGA screw terminal accessory allow you to connect field wiring to a DAS-801 or DAS-802 board. Each screw terminal is labeled with the name of the board function to which it is connected; the screw terminals correspond directly to the functions of the pins on the main I/O connector on the board.

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To connect an STA-08 / STA-08PGA to a DAS-800 Series board, attach one end of the S-1800 or C-1800 cable to the main I/O connector on the DAS-800 Series board and the other end of the cable to the J1 connector on the STA-08 / STA-08PGA. Figure 4-4 illustrates the connection of an STA-08 / STA-08PGA to a DAS-800 Series board.

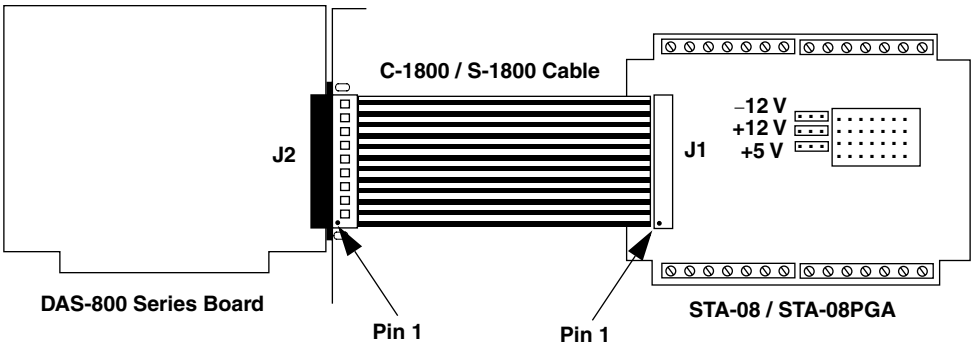


Figure 4-4. Attaching an STA-08 / STA-08PGA Screw Terminal Accessory

Attaching an EXP-16 or EXP-16/A Expansion Board

Each EXP-16 or EXP-16/A expansion board provides up to 16 analog input channels (labeled 0 to 15). The EXP-16 and EXP-16/A provide three screw terminals for each channel: low-level ground (LL GND), positive input (CH*n* HI), and negative input (CH*n* LO), where *n* indicates the number of the channel.

To connect an EXP-16 or EXP-16/A to a DAS-800 Series board, attach one end of the S-1800 or C-1800 cable to the main I/O connector on the DAS-800 Series board and the other end of the cable to the J1 connector on the EXP-16 or EXP-16/A. Figure 4-5 illustrates the connection of an EXP-16 to a DAS-800 Series board.

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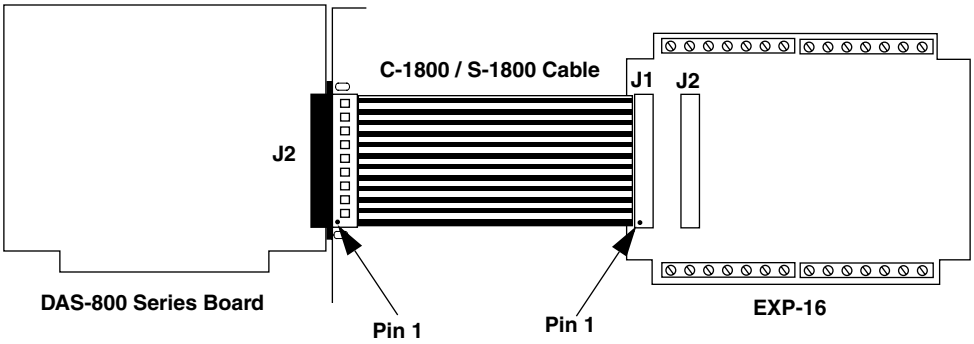


Figure 4-5. Attaching an EXP-16 or EXP-16/A Expansion Board

Refer to the EXP-16 and EXP-16/A expansion board documentation for more information about these expansion boards.

Attaching an EXP-GP Expansion Board

Each EXP-GP expansion board provides up to eight analog input channels (labeled 0 to 7). The EXP-GP provides six screw terminals for each channel: positive current excitation (+IEXC), positive input (+SENSE), negative voltage excitation (–P), negative current excitation (–IEXC), negative input (–SENSE), and positive voltage excitation (+P).

To connect an EXP-GP to a DAS-800 Series board, attach one end of the S-1800 or C-1800 cable to the main I/O connector on the DAS-800 Series board and the other end of the cable to the J1 connector on the EXP-GP. Figure 4-6 illustrates the connection of an EXP-GP to a DAS-800 Series board.

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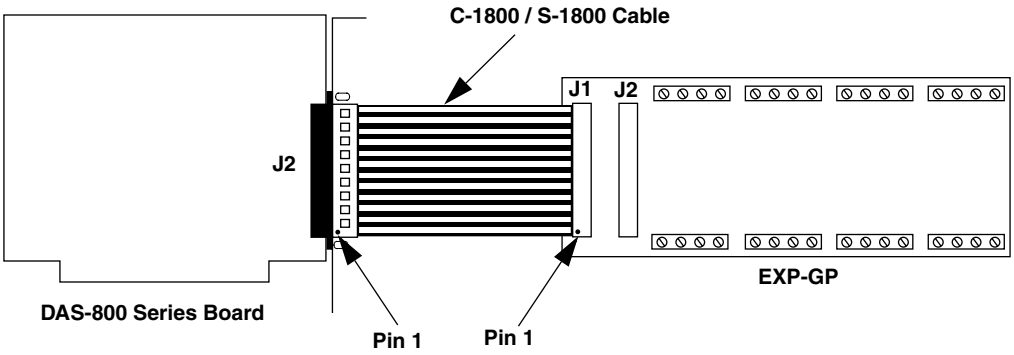


Figure 4-6. Attaching an EXP-GP Expansion Board

Refer to the EXP-GP expansion board documentation for more information about this expansion board.

Attaching an MB Series Backplane

Refer to the *MB Series User's Guide* for information on connecting DAS-800 Series boards to MB Series backplanes.

Connecting Multiple Expansion Boards

You can daisy-chain up to eight EXP-16, EXP-16/A, and/or EXP-GP expansion boards to provide up to 128 analog input channels. You connect the first expansion board to the DAS-800 Series board by attaching one end of an S-1800 or C-1800 cable to the main I/O connector on the DAS-800 Series board and the other end of the cable to the J1 connector on the expansion board. To connect additional expansion boards, attach one end of an S-1800 or C-1800 cable to the J2 connector on the previous expansion board and the other end of the cable to the J1 connector on the next expansion board in the chain.

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Note: Each EXP-16, EXP-16/A, or EXP-GP expansion board is associated with an analog input channel on the DAS-800 Series board. You specify the associated on-board channel by setting a jumper on the expansion board. Make sure that you use a unique jumper setting for each expansion board you are using. Refer to your expansion board documentation for more information.

You can use the J2 connector on the last expansion board in the chain to attach an STA-08 / STA-08PGA screw terminal accessory. This allows you to access the remaining functions of the DAS-800 Series board.

Figure 4-7 illustrates how to connect two EXP-16 expansion boards, one EXP-GP expansion board, and an STA-08 screw terminal accessory to a DAS-800 board.

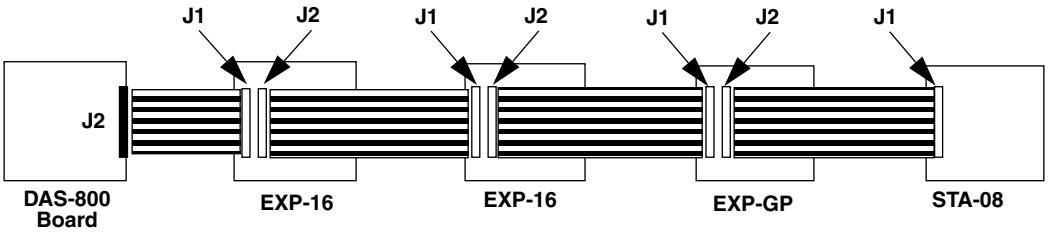


Figure 4-7. Connecting Multiple Expansion Boards

Note: You can also attach up to four MB-02 backplanes to a DAS-800 Series board using an STA-SCM8 screw terminal accessory and up to four C-2600 cables. Refer to the *MB Series User's Guide* for more information.

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Connecting Signals

This section describes how to wire signals to a DAS-800 Series board.

Although the illustrations in this section show a direct connection to a pin on the main I/O connector, you will actually wire your signal to a screw terminal on an accessory or expansion board or to a user-supplied, female 37-pin D connector. Appendix B lists the functions associated with each pin on the main I/O connector.

The DAS-800 board contains both digital commons and low-level analog commons. Use a digital common for all digital signal returns and power supply returns; use a low-level analog common for all analog signal returns.

The DAS-801 and DAS-802 boards contain digital commons, but no dedicated low-level analog commons. If you are using all eight analog input channels and all eight channels are configured for differential input, you must connect a bias return path to a digital common instead of a low-level analog common. If at least one channel is unused or configured for single-ended input, you can use the negative side of the channel as a low-level analog common.

When wiring analog input signals, it is recommended that you terminate all unused input channels to low-level ground; this prevents the internal amplifier circuitry from saturating if you select an unconnected input and ensures the accuracy of your data.

Connecting an Analog Input Signal to a Single-Ended Input

Figure 4-8 illustrates how to connect an analog input signal to single-ended analog input channel 0 on a DAS-800 board.

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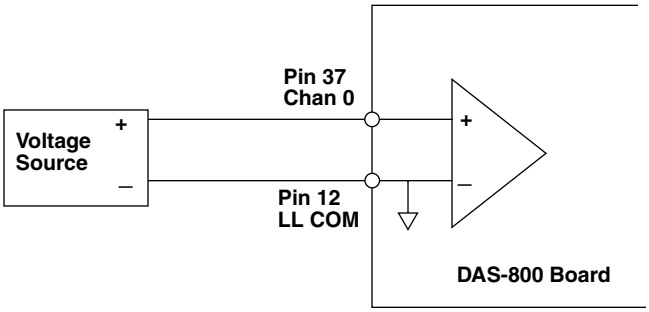


Figure 4-8. Single-Ended Input

Connecting an Analog Input Signal to a Differential Input

For differential input configurations, you must provide a bias current return path. If at least one channel is unused or configured for single-ended input, use the negative side of that channel as the low-level analog common; otherwise, use the digital common.

Figure 4-9 illustrates how to connect an analog input signal to differential analog input channel 0 on a DAS-801 board for output resistances both less than and greater than 100 Ω. Since analog input channel 7 is not used, the bias current return path is connected to the negative side of channel 7.

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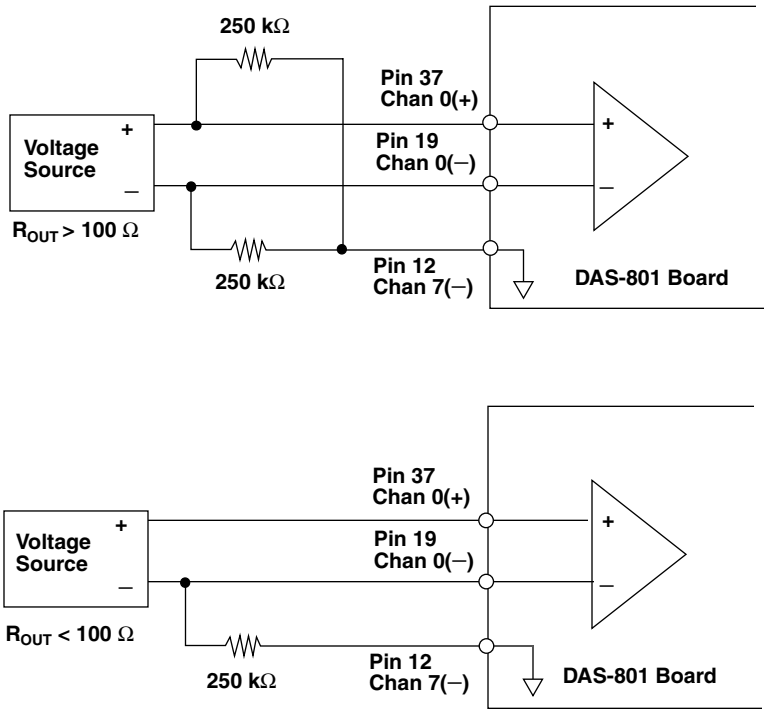


Figure 4-9. Differential Input

Note: For output resistances greater than 100 Ω, it is recommended that the sum of the resistors used be at least 5,000 times greater than the source output resistor.

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Connecting Digital Signals

You can connect the following digital signals to a DAS-800 Series board:

- **Digital input signal** - Connect a digital input signal to the IP1 / TRIG, IP2, or IP3 pin (pin 25, 26, or 27) on the main I/O connector.
- **Digital output signal** - Connect a digital output signal to the OP1, OP2, OP3, or OP4 pin (pin 7, 8, 9, or 10) on the main I/O connector.
- **External conversion clock** - Connect an external conversion clock to the INT_IN / XCLK pin (pin 24) on the main I/O connector.
- **Hardware digital trigger or hardware gate** - Connect a hardware digital trigger or hardware gate signal to the IP1 / TRIG pin (pin 25) on the main I/O connector.
- **External interrupt** - Connect an external interrupt to the INT_IN / XCLK pin (pin 24) on the main I/O connector.

Make sure that all digital signals are TTL-level compatible. Use the digital common as the return for all digital signals.

Caution: To prevent damage to DAS-800 Series boards, do not apply voltages exceeding TTL maximum levels (–0.5 V to +5.5 V) to digital input pins.

Connecting Counter/Timer I/O Signals

Refer to 8254 documentation for information on connecting counter/timer I/O signals to the clock input pin, gate input pin, and output pin of any available counter/timers on a DAS-800 Series board. Table 2-2 on page 2-25 lists several companies that provide documentation for the 8254.

Note: To cascade counter C/T2 to counter C/T1 — when C/T0, C/T1, and C/T2 are available for general-purpose tasks — externally wire the output of counter C/T2 (OUT2, pin 6 of the main connector) to the clock input of counter C/T1 (CLK1, pin 4 of the main connector).

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Synchronizing Conversions on Multiple Boards

You can use a hardware external clock source to synchronize conversions on multiple DAS-800 Series boards. In addition, you can use the output of the OUT1 pin (pin 5) on a DAS-801 or DAS-802 board (acting as a timing master) to synchronize conversions on additional DAS-800 Series boards.

Figure 4-10 illustrates how you can synchronize conversions on multiple boards, using both an external clock source and a DAS-802 board. Note that in both cases, boards 1, 2, and 3 must be configured to use an external clock.

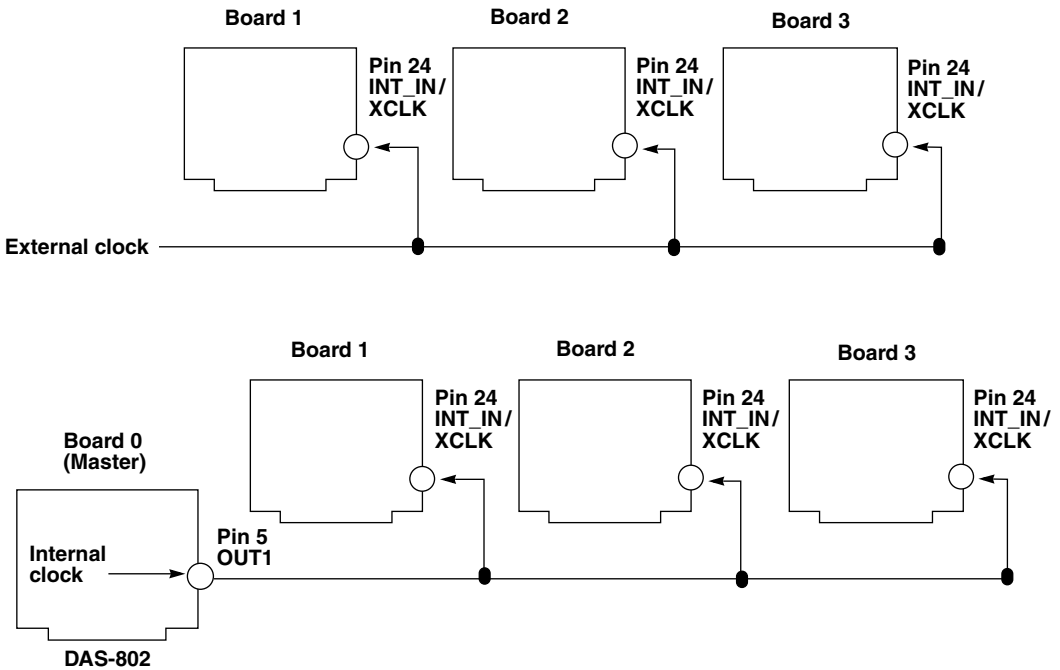


Figure 4-10. Synchronizing Conversions on Multiple Boards

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Figure 4-11 illustrates the use of C/T0 on the 8254 on board 1 to divide the rate of the master clock by the programmed count; this allows you to synchronize conversions on board 1 to a rate different from that of the master board. Note that when you use C/T0 to divide the rate of the master clock, C/T0 must be configured for counter/timer mode 2 (rate generator mode). Refer to page 2-21 or to your 8254 documentation for more information.

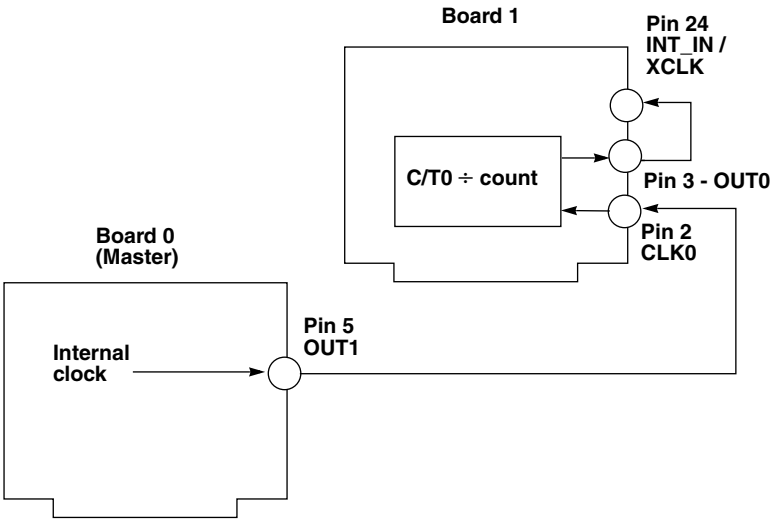


Figure 4-11. Dividing the Rate of the Master Clock

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5

DriverLINX Analog I/O Panel

The DriverLINX Analog I/O Panel is an application that demonstrates analog input/output using DriverLINX. With the Analog I/O Panel you can:

- Analyze analog signals using the simulated two-channel Oscilloscope
- Measure analog voltages using the simulated Digital Volt Meter.
- Generate Sine, Square and Triangle waves using the SST Signal Generator.
- Output DC Level voltages using the Level Control.

The Analog I/O Panel is useful for:

- Testing the DAS-800 DriverLINX installation and configuration.
- Verifying signal inputs to your DAS-800 board.
- Sending test signals to external devices.

To access this DriverLINX Analog I/O Panel:

1. Start the Analog I/O Panel with the AIO Panel item on the Windows start menu. Then perform the following steps:
2. Click the [...] button in the Driver Selection section.
3. Select the driver for your board using the *Open DriverLINX dialog.*
4. Click *OK.*

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5. Select the Logical Device you want to operate by dragging the pointer in the Device Selection section. The Analog I/O Panel displays the Scope, Meter, SST, and Level control tabs, depending on the capabilities of your DAS-800 board.

6. The Scope uses two analog input channels, referred to as ChA and ChB. Drag the channel selectors in the AI Channel Mapping section to map them to different channel numbers.

7. The SST Signal Generator uses two analog output channels, referred to as ChA and ChB. Drag the channel selectors in the AO Channel Mapping section to map them to different channel numbers.

You can now select the Scope, Meter, SST and Level Control tabs to operate your DAS-800 board.

Test Panel Application

Depending upon the DriverLINX drivers you have installed on your system, you will have one or more of the following example applications:

- Single-Value AI for analog input
- Single-Value AO for analog output
- PIO Panel for digital input and output
- CTM Test Bench for counter/timer applications.

To access this DriverLINX Test Panel, select Test Panel with the “Test Panel” item on the Windows start menu.

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6

Calibration

The analog input circuitry of DAS-800 Series boards is calibrated in the factory. It is recommended that you check the calibration every six months and recalibrate the board, if necessary.

Note: For channels using gains other than 1, the board maintains the initial calibration within an accuracy of ±0.05%. In applications where a single gain (other than 1) is used for all channels, you can achieve better accuracy by calibrating the board at the selected gain.

The following sections provide the information you need to calibrate DAS-800 Series boards.

Equipment Required

To calibrate a DAS-800 Series board, you need either:

- A digital voltmeter accurate to 6 1/2 digits on its ±10 Vdc range, such as the Keithley Model 2000, and a stable DC supply capable of providing ± 10Vdc, or:
- A calibrated DC voltage source with an output voltage range of ±10 V, with sufficient accuracy and resolution that using a meter to check the applied voltage is not necessary.

Note: If a calibrated DC voltage source is not available, use a variable DC voltage source and set its output voltage level using the voltmeter. (Measure betwen TP1 - TP2 on DAS-801 and DAS-802.

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- An STA-08 or STA-08PGA screw terminal accessory and C-1800 cable, or an STC-37 screw terminal connector.

Note: Do not attempt to calibrate a DAS-800 Series board unless your equipment is of the required accuracy.

Potentiometers

DAS-800 Series boards contain potentiometers, which you must adjust when calibrating the board. The DAS-800 board contains three potentiometers: R1 (full scale), R2 (offset), and R3 (10 V reference). The DAS-801 and DAS-802 boards contain four potentiometers: R1 (offset), R2 (full scale), R5 (unipolar 0), and R6 (high gain 0). In addition, on DAS-801 and DAS-802 boards, you must measure the voltage between two test points (TP1 and TP2) with the voltmeter when calibrating the board.

The locations of the potentiometers on the DAS-800 board are shown in Figure 6-1; The locations of the potentiometers and test points on the DAS-801 and DAS-802 boards are shown in Figure 6-2.

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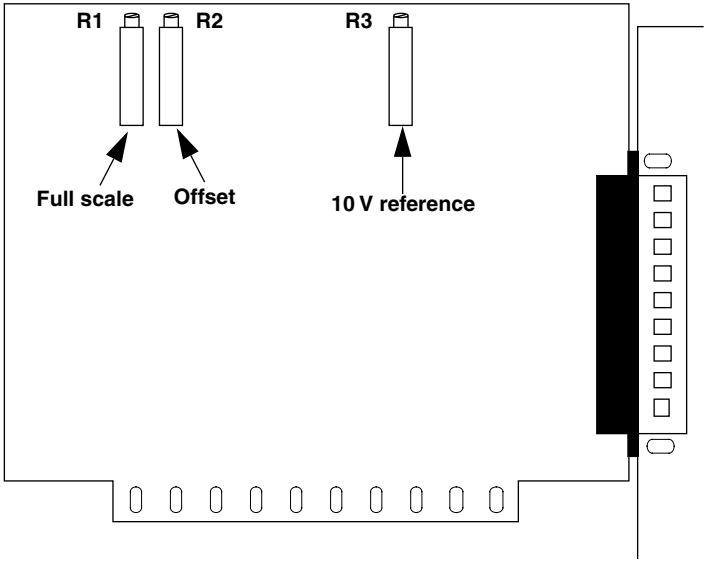


Figure 6-1. Potentiometers (DAS-800)

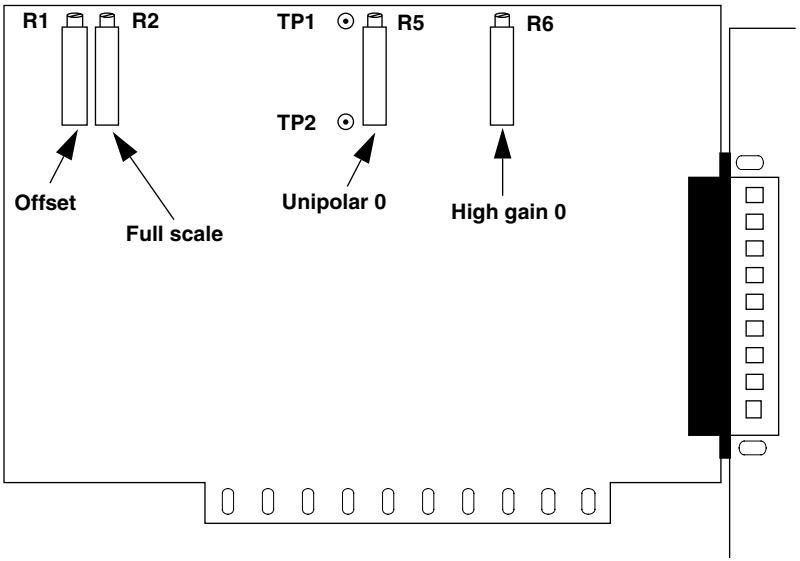


Figure 6-2. Potentiometers (DAS-801 / DAS-802)

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Calibration Utility

DriverLINX Calibration Utility will guide you through the calibration procedure. Refer to the *DriverLINX Installation and Configuration Guide* and *Using DriverLINX With Your Hardware—Configuring the DAS-800 Series manuals*. Before calibration, specify the following parameters in the setup panel to get the correct instructions:

- **Logical Device—**Board's device number, model and address.
- **Accessory—**Connection method used to connect the board to the calibration stimulus.
- **Shorted Channel—**Input channel to be "shorted" high to low.
- **Voltage Channel—**Input channel to use to apply the various calibration voltage levels
- **Calibration range—**Input range to be calibrated.

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7

Troubleshooting

If your DAS-800 Series board is not operating properly, use the information in this chapter to help you isolate the problem. If the problem appears serious enough to require technical support, refer to page 7-7 for information on how to contact an applications engineer.

If you encounter a problem with a DAS-800 Series board, use the instructions in this section to isolate the cause of the problem before calling Keithley for technical support.

Using the DriverLINX Event Viewer

The DriverLINX Event Viewer displays the Windows system event log. Applications and hardware drivers make entries in the system event log to assist in predicting and troubleshooting hardware and software problems.

DriverLINX uses the event log to report problems during driver loading or unexpected system errors. The event log can assist in troubleshooting resource conflicts and DriverLINX configuration errors. If you are having trouble configuring or initializing a Logical Device, check the event log for information from the DriverLINX driver.

Using the DriverLINX Event Viewer, you can view, save and e-mail DriverLINX event log entries under Windows 95/98 or Windows NT. DriverLINX event log entries can help you or technical support troubleshoot data-acquisition hardware and software problems.

Device initialization error messages

During device initialization, DriverLINX performs a thorough test of all possible subsystems on the DAS-800 Series board as well as the computer

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interface. If DriverLINX detects any problems or unexpected responses, it reports an error message to help isolate the problem. The device initialization error messages fall into three basic categories:

- **“Device not found”—**Board address does not match hardware setting or conflicts with another board. Verify the board’s address settings. Also, don’t confuse hexadecimal with decimal addresses in the DriverLINX Device Configure dialog box.
- **“Invalid IRQ level”** or **“Invalid DMA level”—**Selected level does not match hardware setting, conflicts with another board’s IRQ/DMA levels, or is dedicated to the computer’s internal functions (COM port, disk drive controller, network adapter, etc.)
- **"Hardware does not match configuration”—**Operating mode/range switch or jumper setting does not match selection(s) made in the DriverLINX Device Configuration dialog box.

Problem Isolation

If you encounter a problem with a DAS-800 Series board, perform the following steps to determine whether the problem is in the computer, in the DAS-800 Series board, or in the I/O circuitry:

1. Remove power connections to the host computer.
2. Unplug the accessory connector(s) or cable(s) from the DAS-800 Series board(s), keeping the connections intact on the accessory or expansion board(s).
3. Remove the DAS-800 Series board(s) from the computer and visually check for damage. If a board is obviously damaged, refer to page 7-7 for information on returning the board.
4. With the DAS-800 Series board(s) out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

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5. When you are sure that the computer is operating properly, remove computer power again, and install a DAS-800 Series board that you know is functional. Do not make any I/O connections.

6. Apply computer power and check operation with the functional DAS-800 Series board in place. This test checks the computer accessory slot. If you are using more than one DAS-800 Series board, check the other slots you are using.

7. If the accessory slots are functional, check the I/O hookups. Connect the accessory and expansion boards, one at a time, and check operation.

8. If operation is normal, the problem is in the DAS-800 Series board(s) originally in the computer. Try the DAS-800 Series board(s) one at a time in the computer to determine which is faulty. Use the troubleshooting information in the next section to try to isolate the problem.

9. If you cannot isolate the problem, refer to page 7-7 for instructions on getting technical support.

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Troubleshooting Table

Table 7-1 lists general symptoms and possible solutions for problems with DAS-800 Series boards. If your board is not operating properly after using this information, refer to page 7-7 for instructions on getting technical support.

Table 7-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Board does not respond	Base address is unacceptable.	Make sure that the base address specified in the configuration file matches the setting of the base address switch block on the board. Make sure that no other system resource is using any of the eight memory locations starting at the specified base address. Reconfigure the base address, if necessary. Refer topage 3-10 for instructions.

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Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Board does not respond (cont.)	Interrupt level is unacceptable.	Make sure that the interrupt level specified in the configuration file matches the setting of jumper J1 on the board. Make sure that no other system resource is using the specified interrupt level. Reconfigure the interrupt level, if necessary. Refer to page 3-14 for instructions.
	The board configuration is unacceptable.	Check the settings in the configuration file. Make sure that they match the settings of the switches and jumper on the board, where appropriate.
	The board is incorrectly aligned in the accessory slot.	Check installation.
	The board is damaged.	Contact the Keithley Data Acquisition Applications Engineering Department; refer to page 7-7.
Intermittent operation	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature.
	Electrical noise exists.	Provide better shielding or reroute wiring.
Analog input conversion data appears to be invalid	An open connection exists.	Check wiring to screw terminal.
	An error exists in the configuration file.	Check configuration file for correct entries.
	Electrical noise exists.	Use a shielded cable for low-level applications.

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Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Analog input conversion data appears to be invalid (cont.)	Differential input is out of range.	If you are using differential inputs, make sure that a bias current return path is provided; refer to page 4-10 for more information. Make sure that excessive common-mode voltages are not present.
	Another system resource is using one of the eight memory locations starting at the specified base address.	Reconfigure the base address of the DAS-800 Series board; refer page 3-10 to for more information. Check the I/O assignments of other system resources and reconfigure, if necessary.
System lockup	A timing error occurred.	Press [Ctrl] + [Break].

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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 that you have the following information available before you call:

DAS-800 board configuration	Model	
	Serial Number	
	Revision Code	
	Base address setting	
	Interrupt level setting	
	Number of channels	
	Input (S.E. or Diff.)	
	Mode (uni. or bip.)	
	8254 C/T2 usage (Cascade or Normal)	
	Number of EXP. brds.	
Computer	Manufacturer	
	CPU type	
	Clock speed (MHz)	
	KB of RAM	
	Video system	
	BIOS type	
Operating system	Windows version	
	Windows mode	
Software package	Name	
	Serial Number	
	Version	
	Invoice/Order Number	
Compiler (if applicable)	Language	
	Manufacturer	
	Version	

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Accessories	Type	
	Type	
	Type	
	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 order number and date of equipment purchase.
- 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, Ohio 44139
1-888-KEITHLEY
FAX (440) 248-6168

Note: 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.

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A

Specifications

Table A-1 lists the specifications for the DAS-800, DAS-801, and DAS-802 boards.

Table A-1. DAS-800, DAS-801, and DAS-802 Specifications

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
Analog Input	Number of channels	8	8	8
	Full-scale range (gain)	±5 V (1)	±10 V (0.5), ±5 V (1), ±500 mV (10), ±50 mV (100) ±10 mV (500), 0 to 10 V (1), 0 to 1 V (10), 0 to 100 mV (100), 0 to 20 mV (500)	±10 V (0.5), ±5 V (1), ±2.5V (2), ±1.25 V (4), ±625 mV (8), 0 to 10 V (1), 0 to 5 V (2), 0 to 2.5 V (4), 0 to 1.25 V (8)
	Input range selection	Not applicable	Software programmable	Software programmable
	Accuracy[1]	±0.01% of full scale ±1 bit	±0.01% of full scale ±1 bit, typical; ±0.05% of reading ±1 bit, worst case	±0.01% of full scale ±1 bit, typical; ±0.05% of reading ±1 bit, worst case

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Table A-1. DAS-800, DAS-801, and DAS-802 Specifications (cont.)

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
Analog Input (cont.)	Throughput vs. gain[2]	Not applicable	For gains ≤ 100: 40 kHz For gain of 500: 25 kHz	40 kHz (all gains)
	Input channel selection	Software selectable or automatic scanning over selected range	Software selectable or automatic scanning over selected range	Software selectable or automatic scanning over selected range
	Overvoltage protection	±35 V	±35 V	±35 V
	Input current	±5 nA, typical at 25°C ±200 nA, max.	±5 nA, typical at 25°C ±200 nA, max.	±5 nA, typical at 25°C ±200 nA, max.
	Temperature coefficient of gain drift	±45 ppm/°C, maximum	±50 ppm/°C, maximum	±50 ppm/°C, maximum
	Temperature coefficient of zero drift[3]	±100 µV/°C, maximum	(±1 ±100 / gain) µV / °C, maximum	(±1 ±100 / gain) µV / °C, maximum
	Common-mode rejection at 60 Hz	Not applicable	For gains ≤ 1: 70 dB, min. 75 dB, typical For gain of 10: 90 dB, min. 95 dB, typical For gains ≥ 100: 100 dB, min. 110 dB, typical	For gains ≤ 1: 70 dB, min. 75 dB, typical For gains > 1: 70 dB to 90 dB
	Common-mode input voltage range	Not applicable	12 V – ((gain / 2) x differential input voltage)	12 V – ((gain / 2) x differential input voltage)

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Table A-1. DAS-800, DAS-801, and DAS-802 Specifications (cont.)

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
A/D Converter	Type	Successive approximation with internal sample/hold	Successive approximation with internal sample/hold	Successive approximation with internal sample/hold
	Coding	Offset binary	Bipolar ranges: offset binary Unipolar ranges: true binary	Bipolar ranges: offset binary Unipolar ranges: true binary
	Resolution	12 bits	12 bits	12 bits
	Linearity	±1 bit (monotonic over temperature)	±1 bit (monotonic over temperature)	±1 bit (monotonic over temperature)
	Conversion time	25 µs, maximum	25 µs, maximum	25 µs, maximum
	Conversion initiation mechanisms	Software, internal time base, external clock (falling edge); software selectable	Software, internal time base, external clock (falling edge); software selectable	Software, internal time base, external clock (falling edge); software selectable
	Maximum conversion frequency	40 kHz	40 kHz	40 kHz
	Gating mechanism	External digital trigger or gate; software selectable	External digital trigger or gate; software selectable	External digital trigger or gate; software selectable
	Data transfer method	I/O read (software)	I/O read (software)	I/O read (software)
Interrupts	Source	External (rising-edge input) or end of A/D conversion; software selectable	External (rising-edge input) or end of A/D conversion; software selectable	External (rising-edge input) or end of A/D conversion; software selectable

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Table A-1. DAS-800, DAS-801, and DAS-802 Specifications (cont.)

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
Interrupts (cont.)	Levels	2 to 7, none; jumper selectable	2 to 7, none; jumper selectable	2 to 7, none; jumper selectable
	Control	Occurrence of interrupt is latched. Latch output may drive selected host interrupt line active. Interrupts are enabled, masked, and reset through software.	Occurrence of interrupt is latched. Latch output may drive selected host interrupt line active. Interrupts are enabled, masked, and reset through software.	Occurrence of interrupt is latched. Latch output may drive selected host interrupt line active. Interrupts are enabled, masked, and reset through software.
Digital I/O	Number of inputs	3 (IP1 / TRIG to IP3)	3 (IP1 / TRIG to IP3)	3 (IP1 / TRIG to IP3)
	Number of outputs	4 (OP1 to OP4)	4 (OP1 to OP4)	4 (OP1 to OP4)
	Input/output levels	TTL compatible	TTL compatible	TTL compatible
	Output high voltage	2.7 V, minimum at –0.4 mA	2.7 V, minimum at –0.4 mA	2.7 V, minimum at –0.4 mA
	Output low voltage	0.5 V, maximum at 8.0 mA	0.5 V, maximum at 8.0 mA	0.5 V, maximum at 8.0 mA
	Input high voltage	2.0 V, minimum	2.0 V, minimum	2.0 V, minimum
	Input low voltage	0.8 V, maximum	0.8 V, maximum	0.8 V, maximum
	Input high current	25 µA, max. at 2.7 V	25 µA, max. at 2.7 V	25 µA, max. at 2.7 V
	Input low current	–0.4 mA, max. at 0.4 V	–0.4 mA, max. at 0.4 V	–0.4 mA, max. at 0.4 V
	Input voltage range	–0.5 V to +5.5 V	–0.5 V to +5.5 V	–0.5 V to +5.5 V
Digital Trigger	Latency from trigger to start of first conversion	200 ns, max.	200 ns, max.	200 ns, max.

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Table A-1. DAS-800, DAS-801, and DAS-802 Specifications (cont.)

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
Counter/Timer	Type	8254	8254	8254
	Number of counters	3	3	3
	Clock source: C/T 2 C/T 1 C/T 0	 CPU bus clock divided by 2 or 1 MHz internal; software selectable External or cascaded with C/T 2; software selectable External	 1 MHz internal External or cascaded with C/T 2; software selectable External	 1 MHz internal External or cascaded with C/T 2; software selectable External
	External clock frequency	0 to 10 MHz	0 to 10 MHz	0 to 10 MHz
	External clock polarity	Negative (count changes on transition from 1 to 0)	Negative (count changes on transition from 1 to 0)	Negative (count changes on transition from 1 to 0)
	Clock pulse width	50 ns high, min, 50 ns low, min.	50 ns high, min, 50 ns low, min.	50 ns high, min, 50 ns low, min.
	Gate source: C/T 2 C/T 1 C/T 0	 External, internal (when using internal time base) External, internal (when using internal time base) External	 External, internal (when using internal time base) External, internal (when using internal time base) External	 External, internal (when using internal time base) External, internal (when using internal time base) External

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Table A-1. DAS-800, DAS-801, and DAS-802 Specifications (cont.)

Feature	Attribute	DAS-800 Specifications	DAS-801 Specifications	DAS-802 Specifications
Counter/Timer (cont.)	Input, clock, and gate signals	DTL, TTL, and CMOS compatible	DTL, TTL, and CMOS compatible	DTL, TTL, and CMOS compatible
Power Consumption	+5 V	450 mA, typical 600 mA, max.	500 ma, typical 750 mA, max.	500 ma, typical 750 mA, max.
	+12 V	7 mA, typical 9 mA, maximum	Not used	Not used
	–12 V	5 mA, typical 7 mA, maximum	Not used	Not used
General	Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C
	Storage temperature	–20°C to 70°C	–20°C to 70°C	–20°C to 70°C
	Humidity	0 to 90%, noncondensing	0 to 90%, noncondensing	0 to 90%, noncondensing
	Dimensions	5.0” x 4.25” x 0.75” (12.7 cm x 10.8 cm x 1.9 cm)	6.0” x 4.25” x 0.75” (15.2 cm x 10.8 cm x 1.9 cm)	6.0” x 4.25” x 0.75” (15.2 cm x 10.8 cm x 1.9 cm)

Notes

[1] For DAS-801 and DAS-802 boards, the accuracy reflects gain errors introduced by the PGA. You can adjust any range to the maximum accuracy of 0.01% of full scale by calibrating the board while set to that range. Refer to Chapter 6 for calibration information.

[2] Indicates measurement settling based on the specified accuracy.

[3] Includes ADC and PGA drift.

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B

Connector Pin Assignments

Figure B-1 shows the main I/O connector and its pin assignments on a DAS-800 board; Table B-1 contains a more detailed description of the pins. Figure B-2 shows the main I/O connector and its pin assignments on a DAS-801 or DAS-802 board; Table B-2 contains a more detailed description of the pins.

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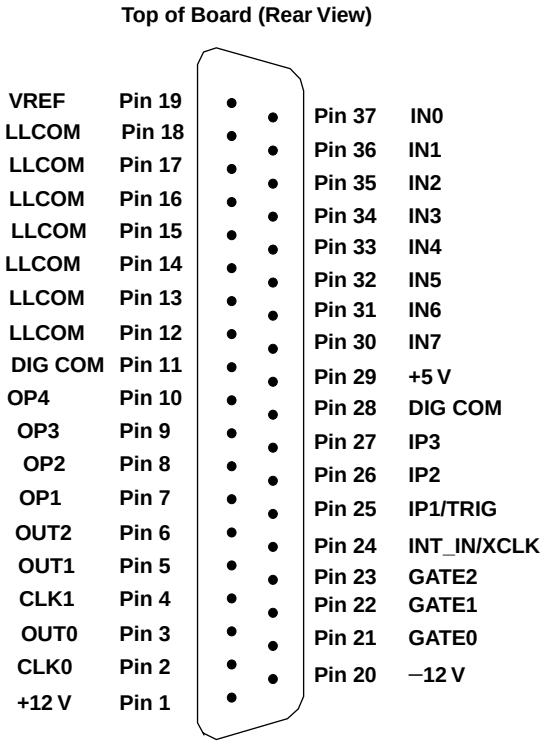


Figure B-1. Main I/O Connector (DAS-800)

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Table B-1. Main I/O Connector Pin Assignments for the DAS-800

Pin	Name	Function
1	+12 V	+12 V power from host computer
2	CLK0	8254 C/T0 clock input
3	OUT0	8254 C/T0 output
4	CLK1	8254 C/T1 clock input
5	OUT1	8254 C/T1 output
6	OUT2	8254 C/T2 output
7	OP1	Digital output bit 0
8	OP2	Digital output bit 1
9	OP3	Digital output bit 2
10	OP4	Digital output bit 3
11	DIG COM	Digital common
12	LL COM	Low-level common
13	LL COM	Low-level common
14	LL COM	Low-level common
15	LL COM	Low-level common
16	LL COM	Low-level common
17	LL COM	Low-level common
18	LL COM	Low-level common
19	VREF	10 V (±0.1 V) reference output
20	–12 V	–12 V power from host computer
21	GATE0	8254 C/T0 gate input
22	GATE1	8254 C/T1 gate input
23	GATE2	8254 C/T2 gate input
24	INT_IN / XCLK	External interrupt input / external clock source input

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Table B-1. Main I/O Connector Pin Assignments for the DAS-800 (cont.)

Pin	Name	Function
25	IP1 / TRIG	Digital input bit 0 / Digital trigger input
26	IP2	Digital input bit 1
27	IP3	Digital input bit 2
28	DIG COM	Digital common
29	+5 V	+5 V power from host computer
30	IN7	Analog input channel 7
31	IN6	Analog input channel 6
32	IN5	Analog input channel 5
33	IN4	Analog input channel 4
34	IN3	Analog input channel 3
35	IN2	Analog input channel 2
36	IN1	Analog input channel 1
37	IN0	Analog input channel 0

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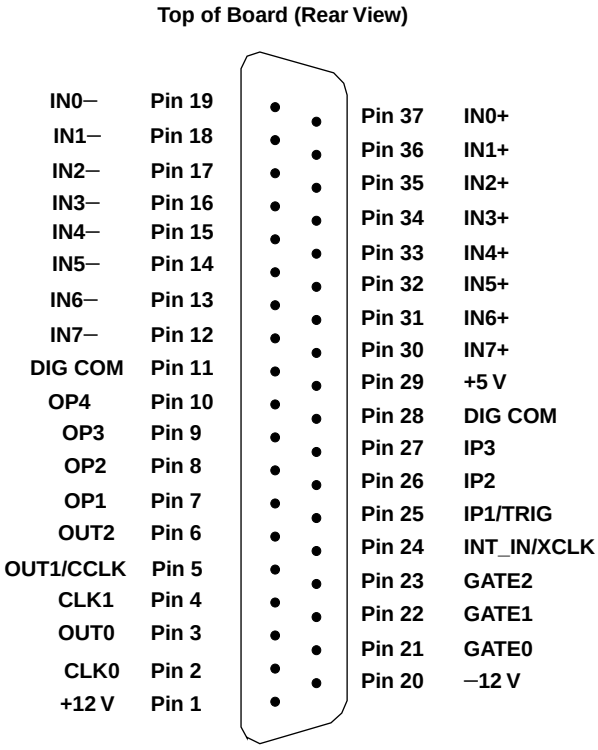


Figure B-2. Main I/O Connector (DAS-801 / DAS-802)

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Table B-2. Main I/O Connector Pin Assignments for the DAS-801 / DAS-802

Pin	Name	Function
1	+12 V	+12 V power from host computer
2	CLK0	8254 C/T0 clock input
3	OUT0	8254 C/T0 output
4	CLK1	8254 C/T1 clock input
5	OUT1 / CCLK	8254 C/T1 output / conversion clock output
6	OUT2	8254 C/T2 output
7	OP1	Digital output bit 0
8	OP2	Digital output bit 1
9	OP3	Digital output bit 2
10	OP4	Digital output bit 3
11	DIG COM	Digital common
12	IN7–	Analog input channel 7 (–)
13	IN6–	Analog input channel 6 (–)
14	IN5–	Analog input channel 5 (–)
15	IN4–	Analog input channel 4 (–)
16	IN3–	Analog input channel 3 (–)
17	IN2–	Analog input channel 2 (–)
18	IN1–	Analog input channel 1 (–)
19	IN0–	Analog input channel 0 (–)
20	–12 V	–12 V power from host computer
21	GATE0	8254 C/T0 gate input
22	GATE1	8254 C/T1 gate input
23	GATE2	8254 C/T2 gate input
24	INT_IN / XCLK	External interrupt input / external clock source input

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Table B-2. Main I/O Connector Pin Assignments for the DAS-801 / DAS-802 (cont.)

Pin	Name	Function
25	IP1 / TRIG	Digital input bit 0 / Digital trigger input
26	IP2	Digital input bit 1
27	IP3	Digital input bit 2
28	DIG COM	Digital common
29	+5 V	+5 V power from host computer
30	IN7+	Analog input channel 7 (+)
31	IN6+	Analog input channel 6 (+)
32	IN5+	Analog input channel 5 (+)
33	IN4+	Analog input channel 4 (+)
34	IN3+	Analog input channel 3 (+)
35	IN2+	Analog input channel 2 (+)
36	IN1+	Analog input channel 1 (+)
37	IN0+	Analog input channel 0 (+)

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