



# **DAS-800 Series User's Guide**





# **DAS-800 Series User's Guide**



Revision A - December 1993  
Part Number: 85790





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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 the Control Panel to test the 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.







- Appendix B lists the connector pin assignments.
- Appendix C describes how to use the DAS-800 Series External Driver. The DAS-800 Series External Driver allows you to use DAS-800 Series boards with certain data acquisition and analysis software packages.
- Appendix D describes the Keithley Memory Manager. The Keithley Memory Manager allows you to allocate sufficient memory when running under Windows™.

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).





# 1

## Overview

The DAS-800 Series is a family of analog input and digital input and output (I/O) boards for an IBM® PC/XT™, AT® or compatible computer. 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  $\pm 5$  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.
- 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.





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**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. You can use application programs written to support the DAS-8 with the DAS-800, application programs written to support the DAS-8 PGA with the DAS-801, and application programs written to support the DAS-8 PGA/G2 with the DAS-802.

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## Supporting Software

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You can use DAS-800 Series boards with the following software:

- **DAS-800 Series standard software package** - Shipped with DAS-800 Series boards. Includes function libraries for writing application programs under DOS in a high-level language such as Microsoft QuickBasic and Microsoft Visual Basic™ for DOS, support files, utility programs, and language-specific example programs. Refer to the *DAS-800 Series Function Call Driver User's Guide* for more information.
- **ASO-800 software package** - The optional Advanced Software Option for DAS-800 Series boards. Includes function libraries for writing application programs under Windows and DOS in a high-level language such as Borland® C/C++, Borland Turbo Pascal® for DOS and Windows, and Microsoft Visual Basic for Windows; support files; utility programs; and language-specific example programs. Refer to the *DAS-800 Series Function Call Driver User's Guide* for more information.
- **DAS-800 Series utilities** - The following utilities are provided as part of both the DAS-800 Series standard software package and the ASO-800 software package:
  - *Configuration utility* - The configuration utility (D800CFG.EXE) allows you to create or modify a configuration file. The configuration file indicates the settings of switches and jumpers on the board and provides other configuration information. This information is used by the DAS-800 Series Function Call Driver and other software packages to perform the board's I/O





operations. Refer to page 3-9 for more information about the configuration utility.

- *Control Panel* - The Control Panel allows you to perform operations on DAS-800 Series boards, without programming. It provides a quick way to test your board and monitor your I/O operation. Two versions of the Control Panel are available: CTL800.EXE (for DOS) and CTL800W.EXE (for Windows). Refer to Chapter 5 for more information about the Control Panel.
- *Calibration utility* - The calibration utility (CAL800.EXE) allows you to calibrate the analog input circuitry of DAS-800 Series boards. Refer to Chapter 6 for more information about the calibration utility.
- **DAS-800 Series custom controls** - Help you to write application programs in Visual Basic for Windows. Refer to the *VisualDAS Custom Controls User's Guide* for more information.
- **Data acquisition and analysis application software** - Many menu-driven, integrated software packages are available for DAS-800 Series boards, including VIEWDAC<sup>®</sup>, EASYEST LX<sup>®</sup>, and EASYEST AG<sup>™</sup>. In addition, programming tools, such as the ASYST<sup>®</sup> scientific and engineering programming language, are available to help you customize your own application program.

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**Note:** If you use VIEWDAC, EASYEST LX / AG, or ASYST to program your DAS-800 Series board, you must use the DAS-800 Series External Driver, which is shipped as part of the DAS-800 Series standard software package. Refer to Appendix C for information on using the DAS-800 Series External Driver.

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- **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.





## Accessories

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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 boards** - 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.





- **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.







# 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.





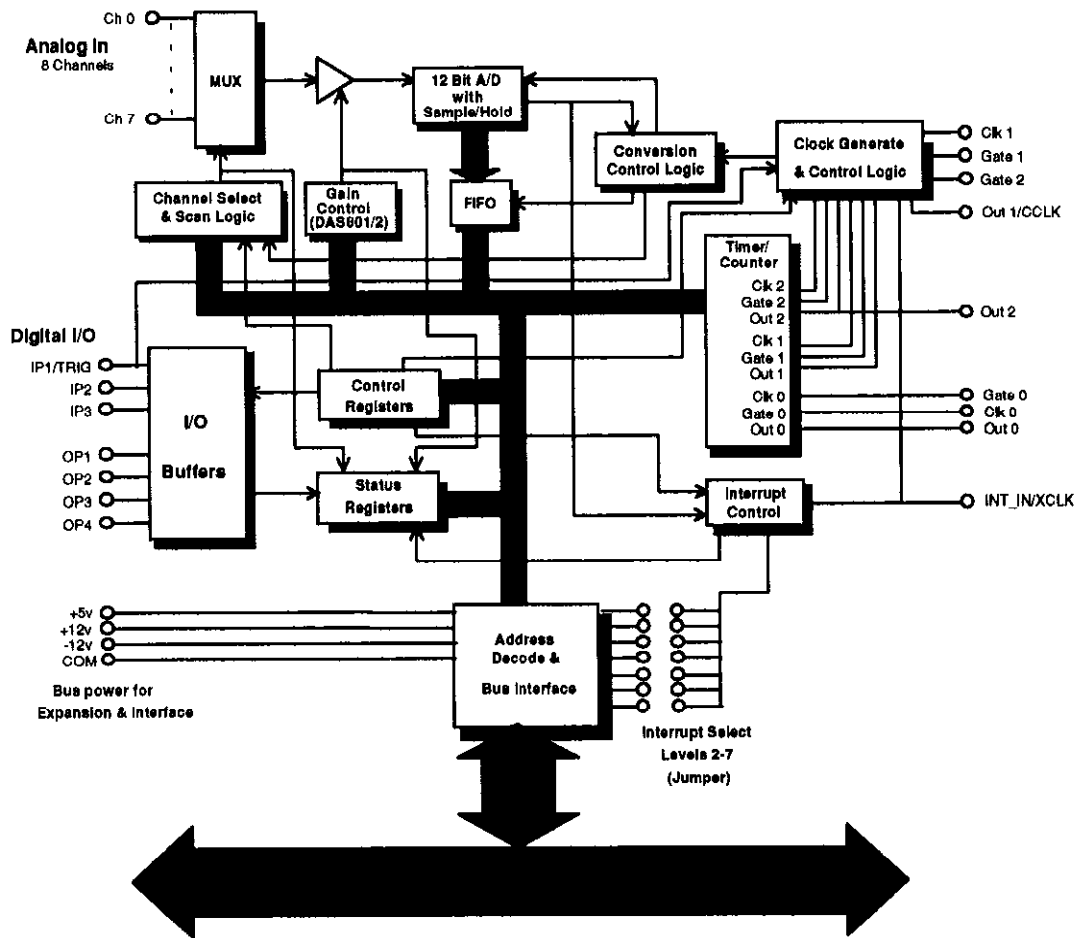


Figure 2-1. DAS-800 Series Functional Block Diagram

## 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  $\pm 1$  least significant bit (LSB), providing an effective accuracy of 11 bits. The ADC converts one sample every 25  $\mu$ s, providing a maximum conversion frequency of 40 kHz.



## 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  $\Omega$ ) 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 3-16 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  $\pm 5$  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	$\pm 5$ V	Not available
DAS-801	0.5	$\pm 10$ V	Not available
	1	$\pm 5$ V	0 to 10 V
	10	$\pm 500$ mV	0 to 1 V
	100	$\pm 50$ mV	0 to 100 mV
	500	$\pm 10$ mV	0 to 20 mV
DAS-802	0.5	$\pm 10$ V	Not available
	1	$\pm 5$ V	0 to 10 V
	2	$\pm 2.5$ V	0 to 5 V
	4	$\pm 1.25$ V	0 to 2.5 V
	8	$\pm 625$ mV	0 to 1.25 V



---

**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  $\pm 35$  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  $\pm 35$  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  $12 \text{ V} - ((G / 2) \times V_D)$ , 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:** If you want to acquire data from a range of multiple channels that includes channels on expansion boards or MB Series backplanes, you can create a group of consecutive channels through software. In addition, if your application requires non-consecutive channels or different gains for each channel, you can create a channel-gain list through software. The DAS-800 Series Function Call Driver provides functions for creating a group of consecutive channels or channel-gain list; refer to the *DAS-800 Series Function Call Driver User's Guide* for more information. The Control Panel also allows you to set up a group of consecutive channels or channel-gain list; refer to Chapter 5 for more information. You can also set up a group of consecutive channels or channel-gain list using DAS-800 Series custom controls; refer to the *VisualDAS Custom Controls User's Guide* for more information.

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***

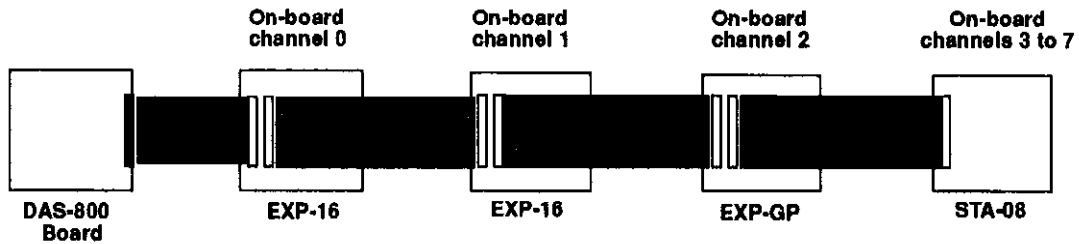
If you require additional analog input channels or signal conditioning for transducer inputs, you can use any combination of up to eight 16-channel EXP-16 expansion boards, eight 16-channel EXP-16/A expansion boards, and/or eight 8-channel EXP-GP expansion boards to increase the number of available channels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

---

**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.

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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 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  $\mu$ s. For example, if you load a count of 25, the time interval between conversions is 25  $\mu$ s; 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  $\mu$ s 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  $\mu$ s to 1.2 hours.

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**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.

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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 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.)

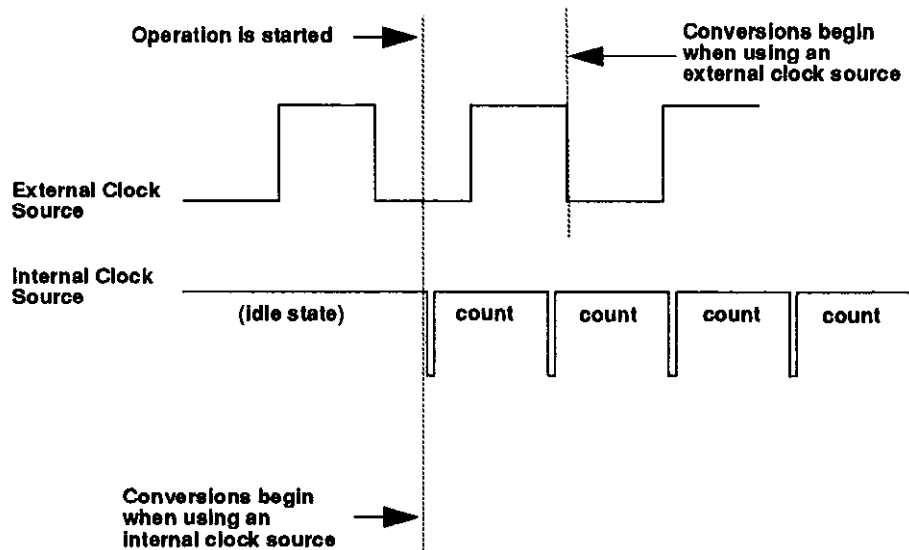


Figure 2-3. Initiating Conversions





---

**Notes:** The ADC acquires data at a maximum of 40 kHz (one sample every 25  $\mu$ s). 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  $\mu$ s).

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.





## 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.





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

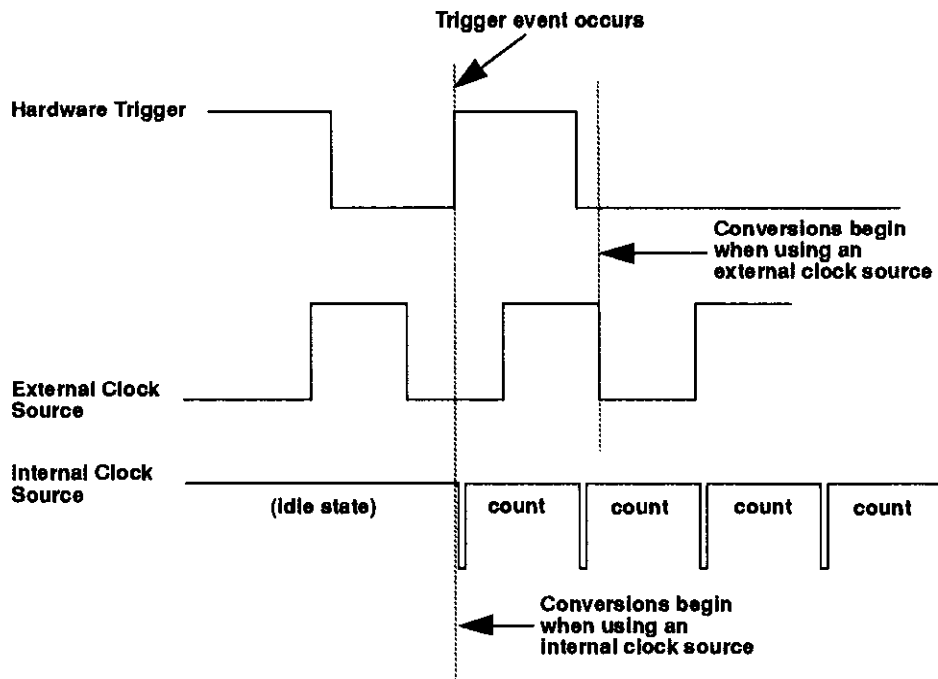


Figure 2-4. Initiating Conversions with a Hardware Trigger





## 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.



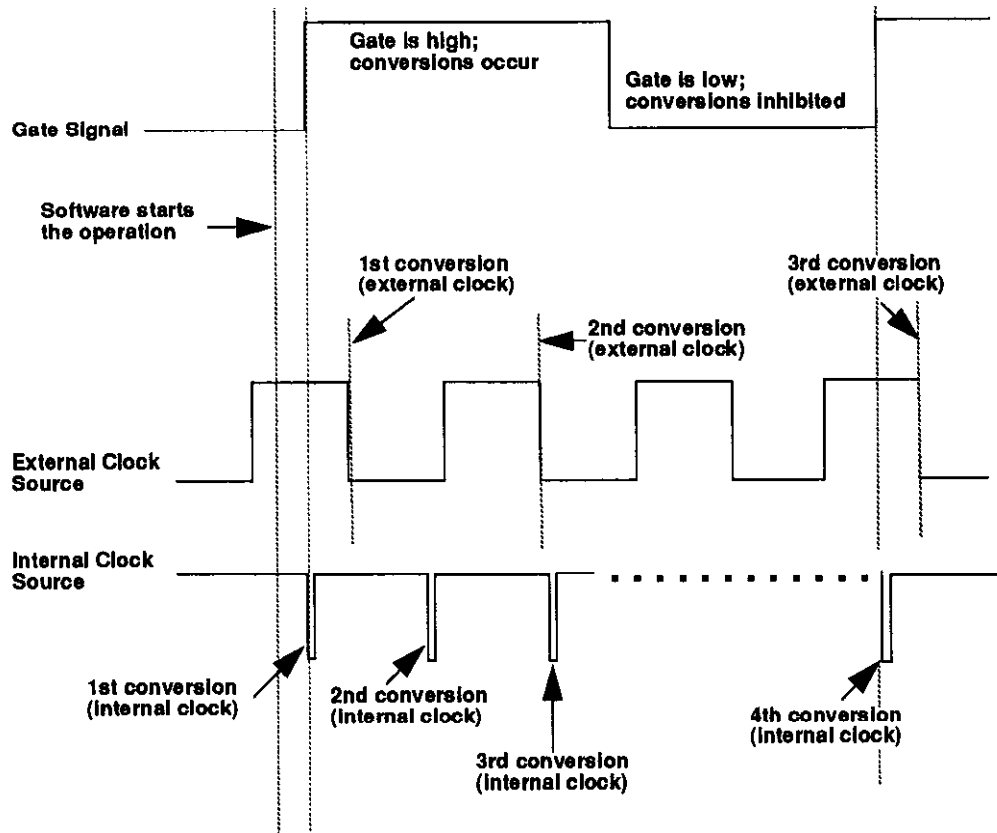


Figure 2-5. Hardware Gate

**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. The DAS-800 Series Function Call Driver provides functions for an analog trigger; refer to the *DAS-800 Series Function Call Driver User's Guide* for more information. The Control Panel also allows you to set up an analog trigger; refer to Chapter 5 for more information. You can also set up an analog trigger using DAS-800 Series custom controls; refer to the *VisualDAS Custom Controls User's Guide* for more information.





## 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 the DAS-800 Series Function Call Driver, Control Panel, or Custom Controls, the operation of the FIFO is transparent. The Function Call Driver, Control Panel, or Custom Controls software performs the data transfer.

---





## 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.







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 k $\Omega$  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.

---

**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.

---





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.

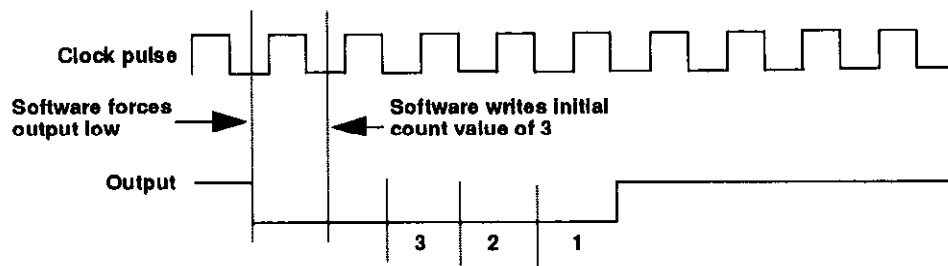


Figure 2-6. Pulse on Terminal Count Mode





- **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.

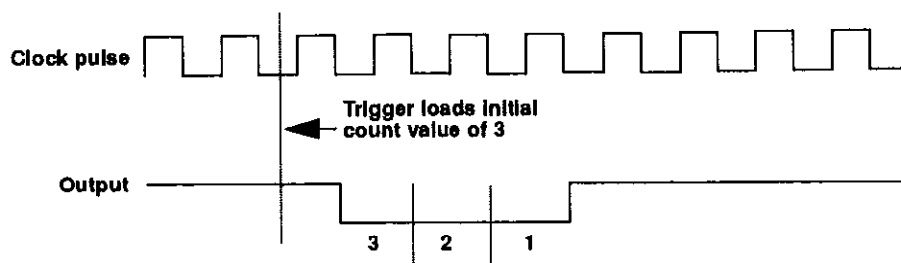


Figure 2-7. Programmable One-Shot Mode





- 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.

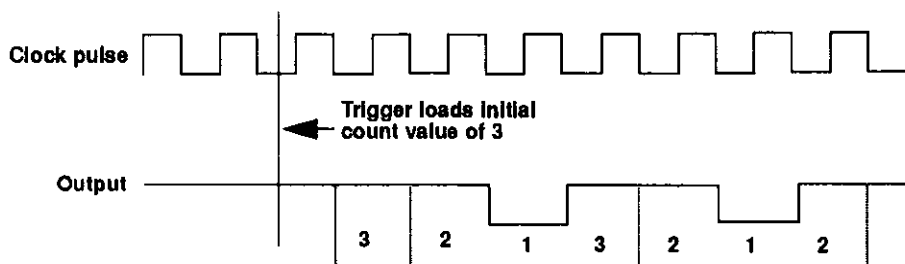


Figure 2-8. Rate Generator Mode





- 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.

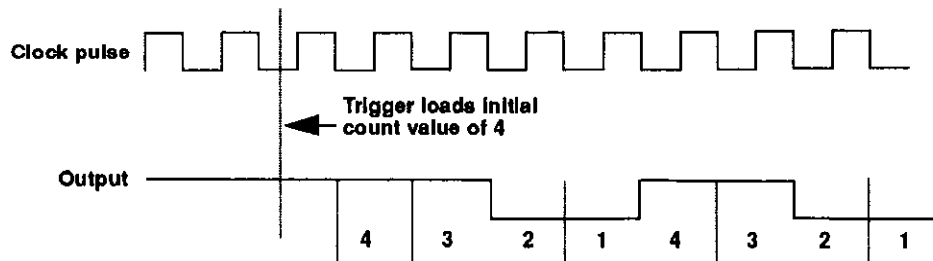


Figure 2-9. Square-Wave Generator Mode





- 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.

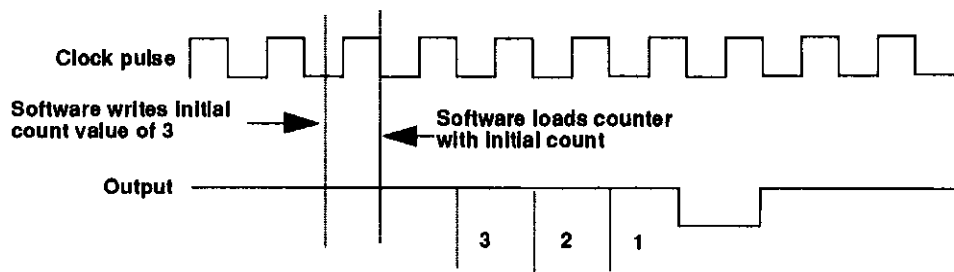


Figure 2-10. Software-Triggered Strobe Mode

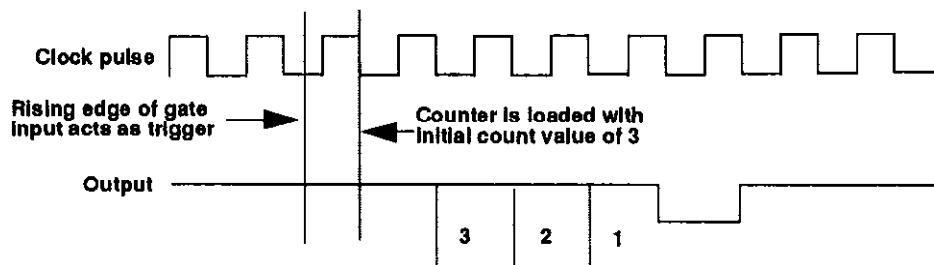




- Hardware-triggered strobe (Mode 5)** - The output is initially high. A rising edge of the gate input acts as a trigger. The counter is loaded with the initial count value on the next clock pulse after the trigger, but the counter does not start counting. At the next clock pulse, the counter starts 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.



**Table 2-2. Sources for 8254 Documentation**

<b>Company</b>	<b>Address and Telephone Number</b>
Intel Corporation	Literature Sales P.O. Box 7641 Mt. Prospect, IL 60056-7641
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.





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 3-17 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  $\pm 12$  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.



**Table 2-3. Expansion Board / Backplane Power Limitations**

<b>Expansion Board / Backplane</b>	<b>Maximum Number Powered by Host</b>
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.





# 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 3-8.



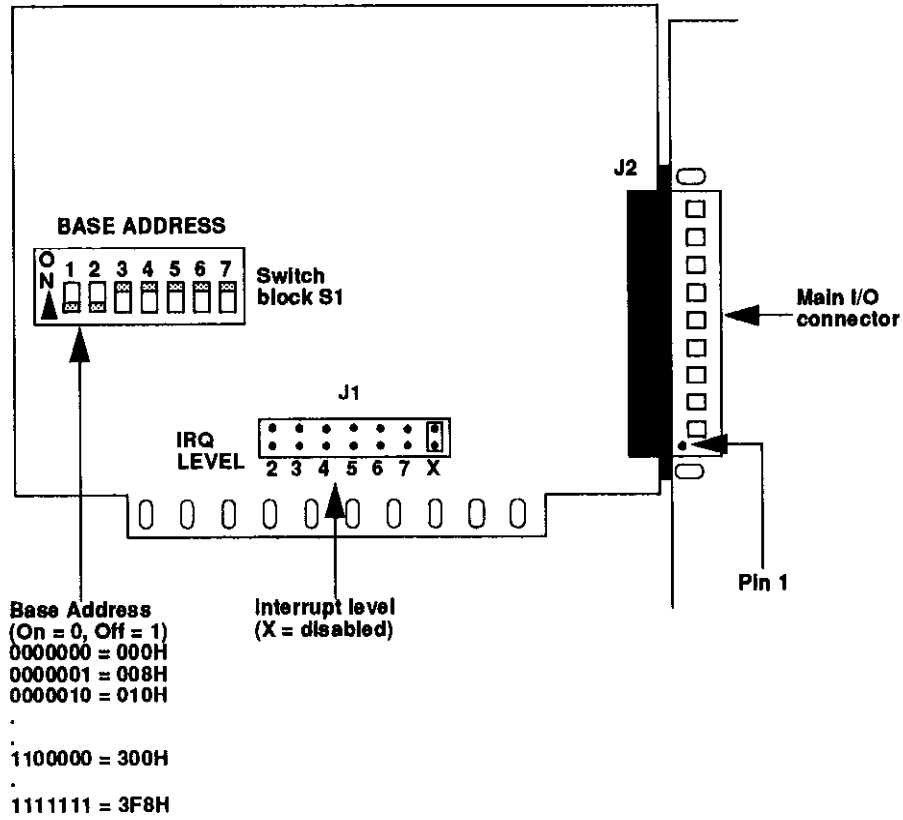


Figure 3-1. DAS-800 Board

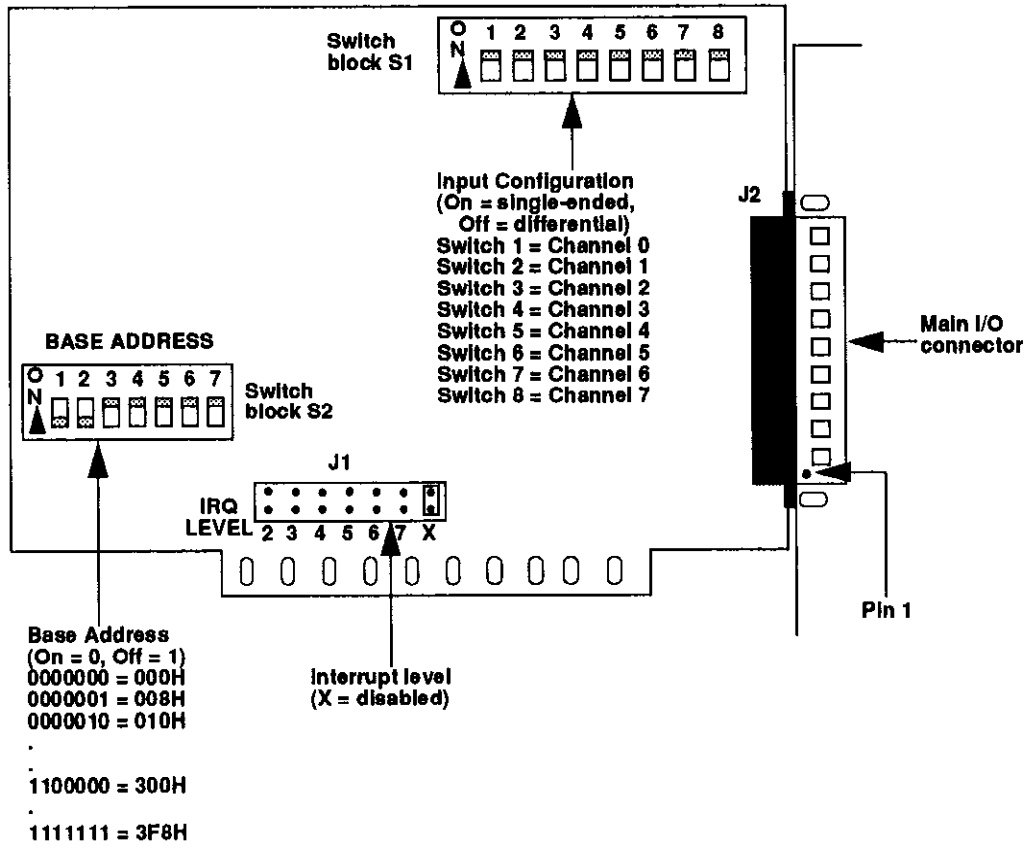


Figure 3-2. DAS-801/802 Board



## Installing the Software

---

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

- **DAS-800 Series standard software package** - This is the software package that is shipped with DAS-800 Series boards; it includes the following:
  - The Control Panel, running under DOS, which allows you to test all features of DAS-800 Series boards before programming.
  - Libraries of functions for Microsoft QuickBasic, Microsoft Professional Basic, and Microsoft Visual Basic for DOS.
  - Support files, containing such program elements as function prototypes and definitions of variable types, which are required by the functions.
  - Utility programs, running under DOS, that allow you to configure and calibrate DAS-800 Series boards.
  - Language-specific example programs.
  - The External Driver, which is required for programming with VIEWDAC, EASYEST LX / AG, and ASYST.
- **ASO-800 software package** - This is the optional Advanced Software Option for DAS-800 Series boards. You purchase the ASO-800 software package separately from the board; it includes the following:
  - The Control Panel, running under DOS and Windows, which allows you to test all features of DAS-800 Series boards before programming.
  - Libraries of functions for Microsoft C/C++, Borland C/C++, and Borland Turbo Pascal.





- Dynamic Link Libraries (DLLs) of functions for Microsoft Visual Basic for Windows, Microsoft QuickC for Windows, Microsoft Visual C++, and Borland Turbo Pascal for Windows.
- Support files, containing program elements, such as function prototypes and definitions of variable types, that are required by the functions.
- Utility programs, running under DOS and Windows, that allow you to configure and calibrate DAS-800 Series boards.
- Language-specific example programs.

---

**Note:** To install other software packages, refer to the documentation supplied with the software package.

---

## Installing the DAS-800 Series Standard Software Package

To install the DAS-800 Series standard software package, perform the following steps:

1. Make a back-up copy of the supplied disks.
2. Insert disk #1 into the disk drive.
3. Assuming that you are using disk drive A, enter the following at the DOS prompt:

```
A:install
```

The installation program prompts you for your installation preferences, including the name of the directory you want to copy the software to. It also prompts you to insert additional disks, as necessary.

4. Continue to insert disks and respond to prompts, as appropriate.

The installation program expands any files that are stored in a compressed format and copies all files to the directory you specified (DAS800 directory on hard disk C if you do not specify otherwise).







5. Review the following files:
  - FILES.TXT lists and describes all the files copied to the hard disk by the installation program.
  - README.TXT contains information that was not available when this manual was printed.

## Installing the ASO-800 Software Package

This section describes how to install the ASO-800 software package from both DOS and Windows.

### *DOS Installation*

To install the ASO-800 software package from DOS, perform the following steps:

1. Make a back-up copy of the supplied disks.
2. Insert disk #1 into the disk drive.
3. Assuming that you are using disk drive A, enter the following at the DOS prompt:

```
A:install
```

The installation program prompts you for your installation preferences, including the name of the directory you want to copy the software to. It also prompts you to insert additional disks, as necessary.

4. Continue to insert disks and respond to prompts, as appropriate.

The installation program expands any files that are stored in a compressed format and copies all files to the directory you specified (ASO800 directory on hard drive C if you do not specify otherwise).

5. Review the following files:
  - FILES.TXT lists and describes all the files copied to the hard disk by the installation program.





- README.TXT contains information that was not available when this manual was printed.

### **Windows Installation**

To install the ASO-800 software package from Windows, perform the following steps:

1. Make a back-up copy of the ASO-Windows disk.
2. Insert the ASO-Windows disk into the disk drive.
3. Start Windows.
4. From the Program Manager menu, choose File and then choose Run.
5. Assuming that you are using disk drive A, type the following at the command line in the Run dialog box, and then select OK:

A:SETUP

The installation program prompts you for your installation preferences, including the name of the directory you want to copy the software to.

6. Type the path name and select Continue.

The installation program expands any files that are stored in a compressed format and copies all files to the directory you specified (ASO800\WINDOWS directory on hard drive C if you do not specify otherwise).

The installation program also creates a DAS-800 Series family group; this group includes example Windows programs and help files.

7. Review the following files:
  - FILES.TXT lists and describes all the files copied to the hard disk by the installation program.
  - README.TXT contains information that was not available when this manual was printed.





## 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.

## Configuring the Board

---

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

- Board type (DAS-800, DAS-801, or DAS-802).
- Base address (required by the DAS-800 Series Function Call Driver 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.

---

You must specify the base address and input configuration by setting switches on the board and the interrupt level by setting a jumper on the board. In addition, if you intend to use your DAS-800 Series board with the DAS-800 Series Function Call Driver, Control Panel, custom controls, or External Driver or with any application program that requires a configuration file, you must indicate all your configuration options in a configuration file.

The following sections describe how to create a configuration file and how to set the base address, input configuration, and interrupt level.

## Creating a Configuration File

A default configuration file called DAS800.CFG is provided in both the DAS-800 Series standard software package and the AS0-800 software package. The factory-default settings in DAS800.CFG are shown in Table 3-1.



**Table 3-1. Default Configuration**

Attribute	Default Configuration
Board type	DAS-800
Base address <sup>1</sup>	300H <sup>2</sup>
8254 C/T2 usage	Cascaded
Input range type	Bipolar
Channel 0 input configuration <sup>1</sup>	Single-ended
Channel 1 input configuration <sup>1</sup>	Single-ended
Channel 2 input configuration <sup>1</sup>	Single-ended
Channel 3 input configuration <sup>1</sup>	Single-ended
Channel 4 input configuration <sup>1</sup>	Single-ended
Channel 5 input configuration <sup>1</sup>	Single-ended
Channel 6 input configuration <sup>1</sup>	Single-ended
Channel 7 input configuration <sup>1</sup>	Single-ended
Interrupt level <sup>1</sup>	X (Disabled)
Number of EXP-16s <sup>3</sup>	0
Gain of EXP-16s <sup>4</sup>	[N/A]
Number of EXP-GPs	0
Gain of EXP-GPs	[N/A]
CJR channel	-1 (Disabled)

**Notes**

<sup>1</sup> The setting in the configuration file must match the settings of the switches and jumper on the board.

<sup>2</sup> The default base address for board 0 is 300H. If you are using multiple DAS-800 Series boards, the default base address for board 1 is 308H, the default base address for board 2 is 310H, and the default base address for board 3 is 318H.

<sup>3</sup> For the purposes of the configuration file, an MB-02 backplane is the same as an EXP-16 expansion board. Therefore, if you are using MB-02 backplanes instead of EXP-16 or EXP-16/A expansion boards, specify the number of MB-02 backplanes here.



<sup>4</sup> If you are using MB-02 backplanes instead of EXP-16 or EXP-16/A expansion boards, make sure that the gains of all channels are set to 1.

If the default settings are appropriate for your application and match the settings of the switches and jumper on the board, you can skip the rest of this section and proceed directly with installing the board. Refer to page 3-19 for information on installing the board.

If the default settings are not appropriate for your application, you must create a new configuration file or modify an existing configuration file to specify the correct configuration options. The D800CFG.EXE configuration utility, shipped with both the DAS-800 Series standard software package and the ASO-800 software package, is provided for this purpose.

To create or modify a configuration file, perform the following steps:

1. Invoke the configuration utility from DOS or Windows, as follows:
  - *If you are running under DOS*, from the directory containing the D800CFG.EXE configuration utility, enter the following at the DOS prompt:

```
D800CFG filename
```

where *filename* is the name of the configuration file you wish to create or modify.

- *If you are running under Windows*, choose Run from the Program Manager File menu. Enter the following in the box and select OK:

```
D800CFG filename
```

where *filename* is the name of the configuration file you wish to create or modify.

Make sure that you enter the correct path to D800CFG.EXE, or use the Browse button to find this file.

If the utility finds a configuration file named *filename*, it displays the opening menu screen with the name of the existing configuration file shown. If the utility does not find a configuration file named





*filename*, it displays the opening menu screen with *filename* shown; this file contains the default configuration options. If you do not enter a file name, the utility assumes that you want to modify the default configuration file DAS800.CFG.

---

**Note:** The example programs, provided with both the DAS-800 Series standard software package and the ASO-800 software package, use the default configuration file DAS800.CFG. If you intend to use the example programs, make sure that DAS800.CFG exists and that the settings in DAS800.CFG match the settings of your board.

---

2. On the opening menu screen, enter the number of DAS-800 Series boards you plan to configure (1 to 4).

The utility displays the configuration options for the first board (board 0). The number of the board is shown in the upper-left corner of the menu box.

3. To modify any of the configuration options, use the arrow keys to highlight the option you want to change, press [Enter] to display a list of available settings, use the arrow keys to highlight the appropriate setting, and press [Enter]. These instructions are summarized in the Commands/Status box at the bottom of the screen.

When the configuration options for this board are correct, press [N] to display the configuration options for the next board.

4. If you modify the base address, input configuration, or interrupt level, you can press [S] to display the corresponding switch or jumper settings. You can use this display as a reference when setting the switches and jumper.

---

**Note:** Information on setting the switches and jumper is also provided in the following sections. Refer to page 3-13 for information on setting the base address; refer to page 3-16 for information on setting the input configuration; refer to page 3-17 for information on setting the interrupt level.

---





5. After you modify the appropriate configuration options for all boards, press [Esc]. The utility asks if you want to save the new settings.
6. Press [Y] to save the settings to the configuration file you specified.

## 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:** The default base address settings in the configuration file are 300H for board 0, 308H for board 1, 310H for board 2, and 318H for board 3. Make sure that the switch settings for each board match the settings in the configuration file for each board.

---

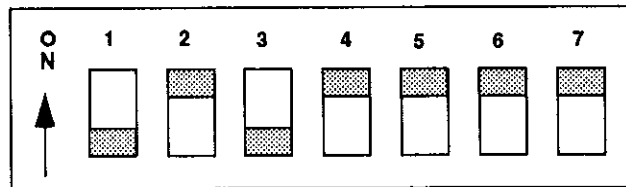
The base address switch block contains seven switches, labeled 1 through 7. Switch 1 corresponds to the most significant bit (MSB) of the base address; switch 7 corresponds to the LSB of the base address. The location of the base address switch block on the DAS-800 board is shown in Figure 3-1 on page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







**Figure 3-3. Setting the Base Address**

Table 3-2 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 3FFH 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 3-2. 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)



Table 3-2. 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



---

**Notes:** The D800CFG.EXE configuration utility allows you to set base addresses between 200H and 3F8H only. Therefore, if you are using your DAS-800 Series board with software that requires a configuration file, you must specify an even boundary of eight I/O addresses within the range of 200H to 3F8H.

If you press [S] after you specify the base address in the configuration file, the configuration utility illustrates the appropriate switch settings for you; refer to page 3-9 for more information about the configuration utility.

---

## 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 configuration file is also single-ended for all channels. Make sure that the switch settings match the settings in the configuration file.

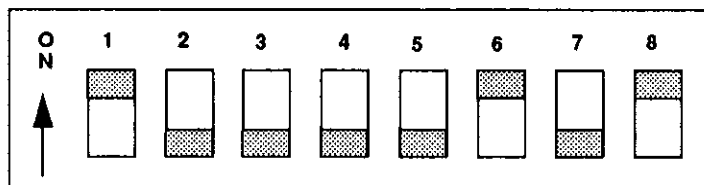
---

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.

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.

If you press [S] after you specify the input configuration in the configuration file, the configuration utility illustrates the appropriate switch settings for you; refer to page 3-9 for more information about the configuration utility.

---

## 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:** The default interrupt level in the configuration file is also disabled. Make sure that the jumper setting matches the setting in the configuration file.

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

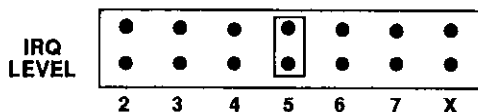
---

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 3-3 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 3-3. 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

**Note:** If you press [S] after you specify the interrupt level in the configuration file, the configuration utility illustrates the appropriate jumper setting for you; refer to page 3-9 for more information about the configuration utility.





## 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 in the configuration file. Refer to page 3-8 for more information.

---

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

---

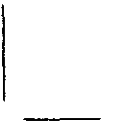
To install the board, perform the following steps:

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 Control Panel under DOS or Windows; refer to Chapter 5 for more information.

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







# 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.

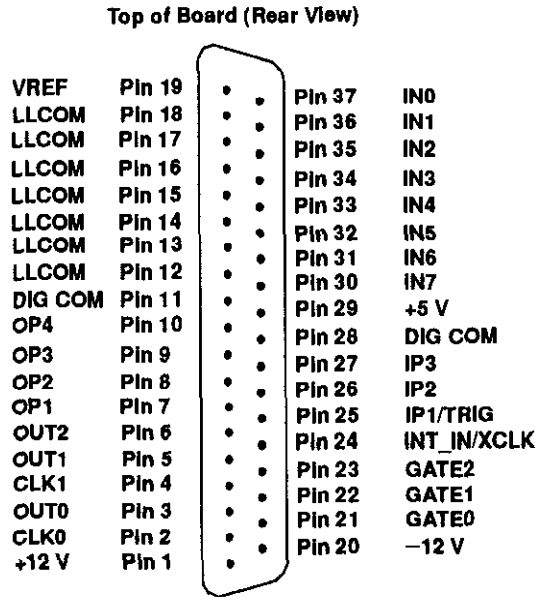
---

### 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.

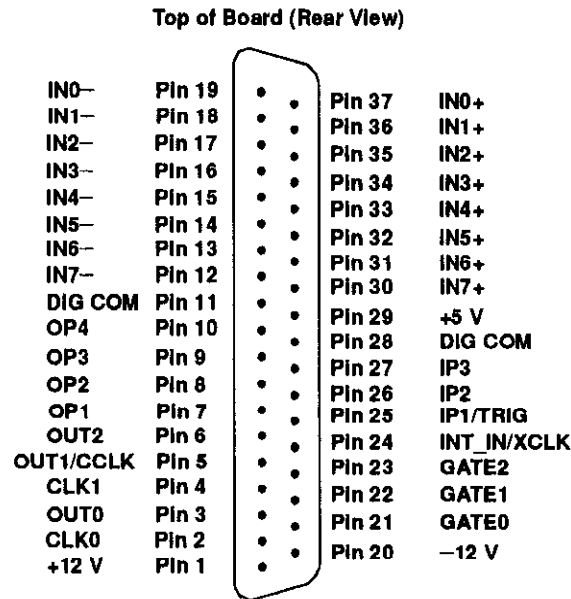






**Figure 4-1. Main I/O Connector on a DAS-800 Board**





**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.





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.

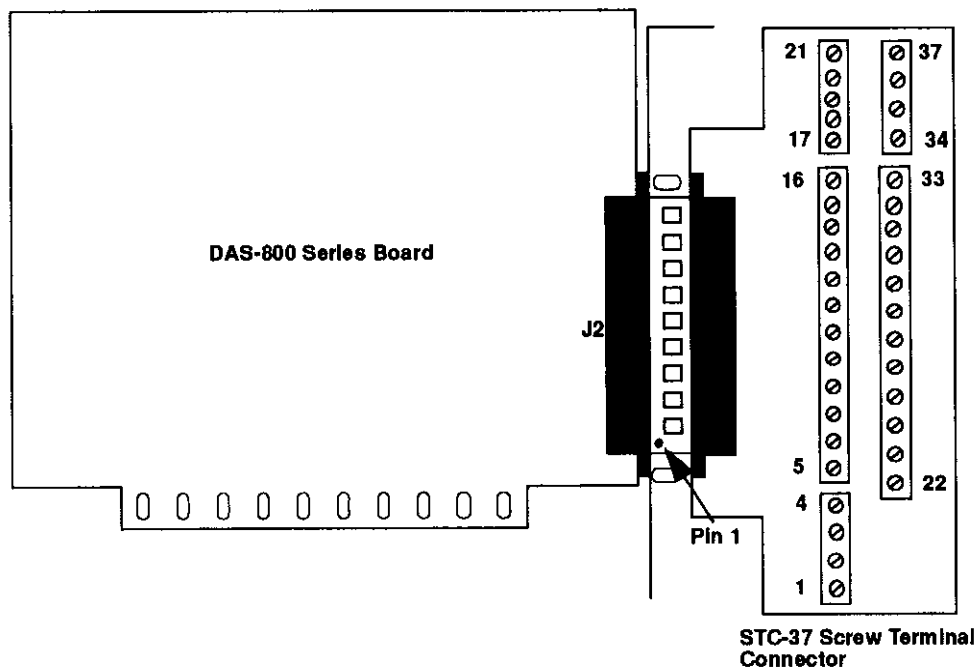


Figure 4-3. Attaching an STC-37 Screw Terminal Connector

### 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.





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.

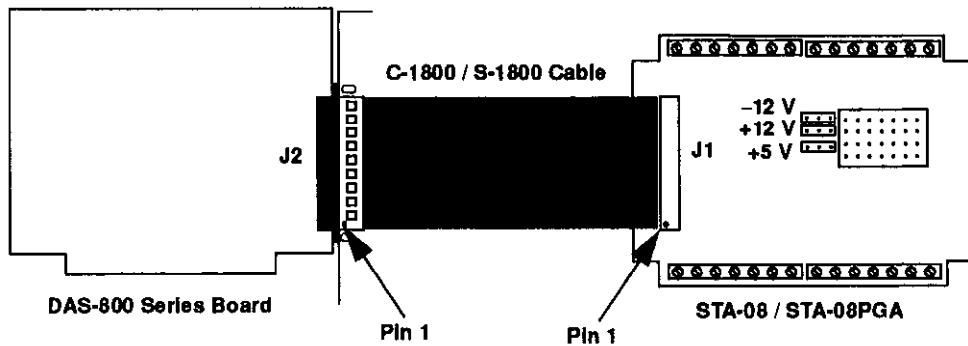


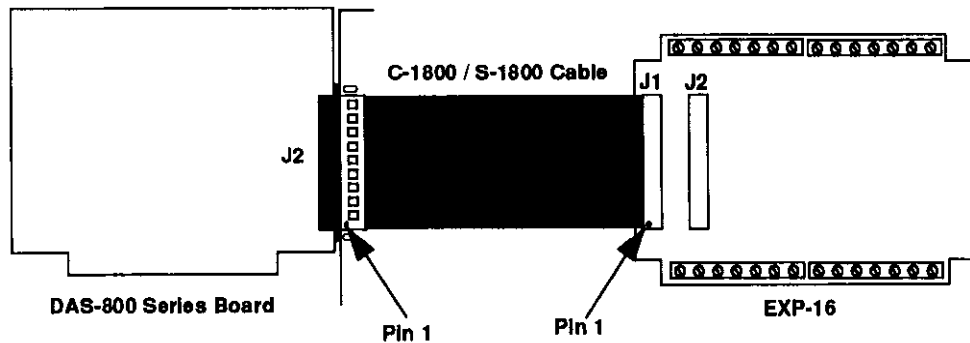
Figure 4-4. Attaching an STA-08 / STA-08PGA Screw Terminal Accessory

## 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.





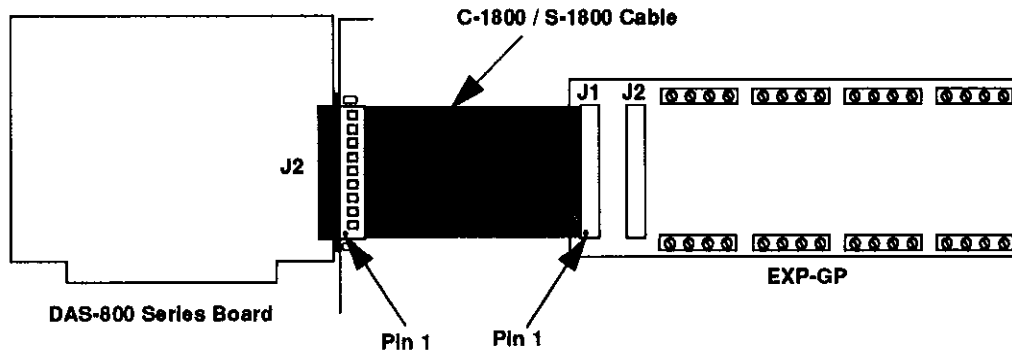
**Figure 4-5. Attaching an EXP-16 or EXP-16/A Expansion Board**

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.



**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.





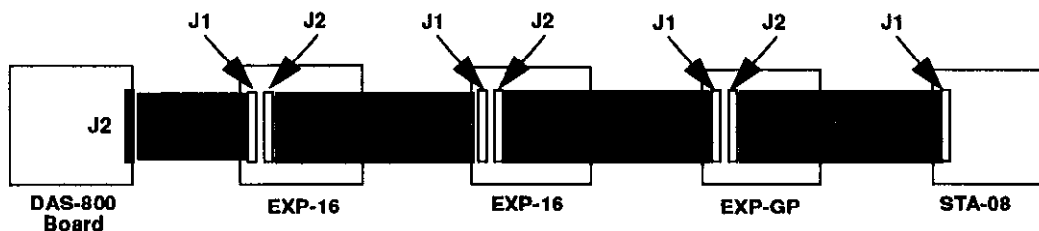

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**Note:** Each EXP-16, EXP-16/A, or EXP-GP expansion board is associated with an analog input channel on the DAS-800 Series board. You specify the associated on-board channel by setting a jumper on the expansion board. Make sure that you use a unique 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.





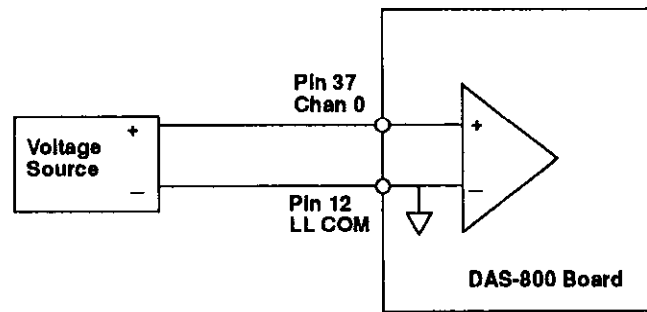


Figure 4-8. Single-Ended Input

## 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  $100\ \Omega$ . Since analog input channel 7 is not used, the bias current return path is connected to the negative side of channel 7.

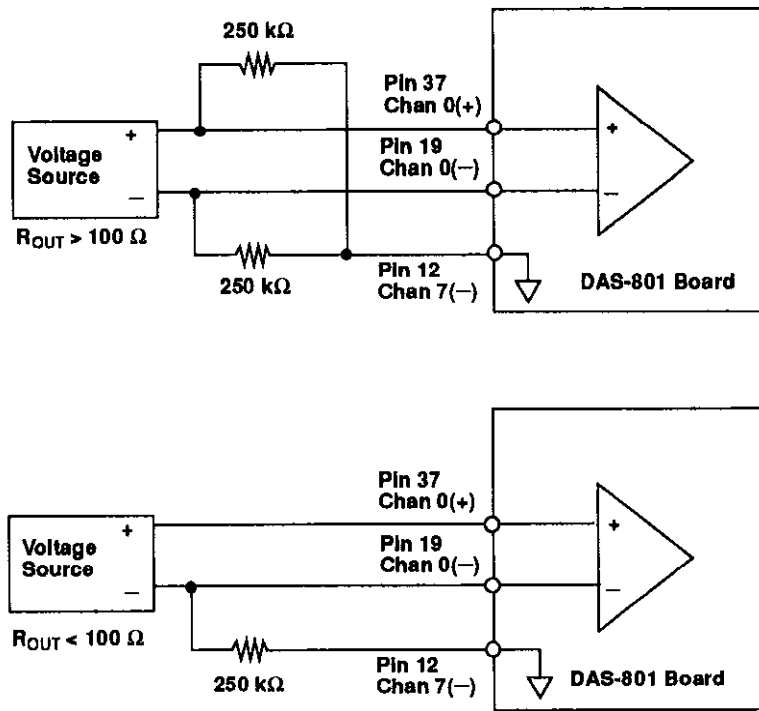


Figure 4-9. Differential Input

---

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

---



## 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.



## 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.

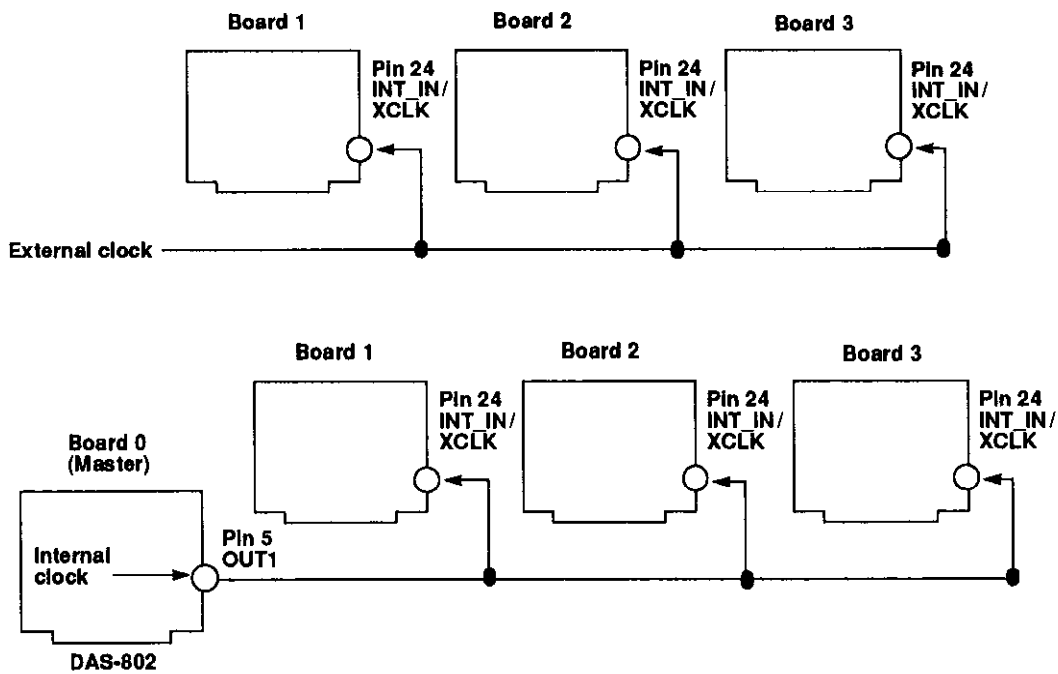


Figure 4-10. Synchronizing Conversions on Multiple Boards



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.

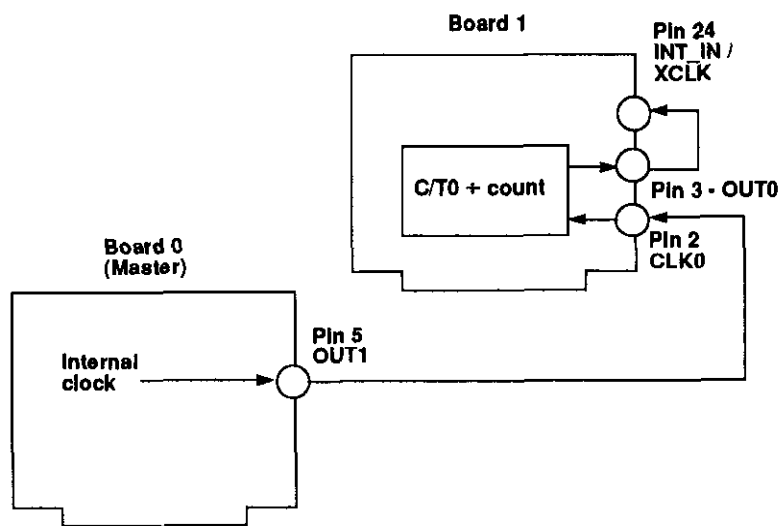


Figure 4-11. Dividing the Rate of the Master Clock





# 5

## The Control Panel

The Control Panel is the utility that allows you to test the functions of DAS-800 Series boards. The Control Panel is shipped in two versions. The DOS version (CTL800.EXE) is shipped with both the DAS-800 Series standard software package and the ASO-800 software package; the Windows version (CTL800W.EXE) is shipped with the ASO-800 software package only.

To use the Control Panel, perform the following steps:

1. Invoke the Control Panel from DOS or Windows, as follows:

- *If you are running under DOS*, from the directory containing the CTL800.EXE utility, enter the following at the DOS prompt:

```
CTL800
```

- *If you are running under Windows*, choose Run from the Program Manager File menu. Enter the following in the box and select OK:

```
CTL800W
```

Make sure that you enter the correct path to CTL800W.EXE, or use the Browse button to find this file.

After you invoke the Control Panel, the software displays the Open Configuration File panel, asking you to specify the configuration options you want to use.





2. Select the configuration options in one of the following ways:
  - Select Cancel to use the default configuration options. Refer to Table 3-1 on page 3-10 for a list of the default configuration options. If the software does not find a board at the default base address (300H), an error message is displayed and the Control Panel terminates.
  - Highlight the name of a configuration file in the File Name box and select OK. The software uses the configuration options from the selected configuration file.

---

**Note:** You can also specify a configuration file when you invoke the Control Panel from DOS or Windows. Use the */F filename* option, where *filename* is the name of the configuration file you want to use.

---

After you specify the appropriate configuration options, the software displays the DAS-800 TEST & CONTROL panel, which is the main control panel. This panel allows you to acquire, display, and transfer analog input data and set up and display the parameters.

3. Select the appropriate buttons to perform an analog input operation. For information about the meaning of the analog input parameters, use the Online Help provided with the Control Panel or refer to Chapter 2.
4. To perform a digital I/O or counter/timer I/O operation, choose Digital and Counter/Timer from the Panels menu. The software displays the DIGITAL I/O & COUNTER/TIMER panel. This panel controls the output and input of digital signals and acts as an interface to the 8254 counter/timer circuitry.
5. Select the appropriate buttons to perform a digital I/O or counter/timer I/O operation. For information about the meaning of the digital I/O or counter/timer I/O parameters, use the Online Help provided with the Control Panel or refer to Chapter 2.
6. When you have finished the digital I/O or counter/timer I/O operation, select OK or Cancel to return to the DAS-800 TEST & CONTROL panel.





7. *If you are running under Windows*, you can use Dynamic Data Exchange (DDE) to transfer data to another Windows program by choosing DDE from the Panels menu.
8. When you have finished using the Control Panel, choose one or more of the options from the File menu. Choose the Exit option to terminate the program.









# 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  $\pm 0.05\%$ . 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

You need the following equipment to calibrate a DAS-800 Series board:

- A digital voltmeter accurate to 6 1/2 digits on its  $\pm 10$  Vdc range.
- A calibrated DC voltage source with an output voltage range of  $\pm 10$  V, such as the EDC 520 from Electronic Development Corporation.

---

**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.

---





- 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) 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.



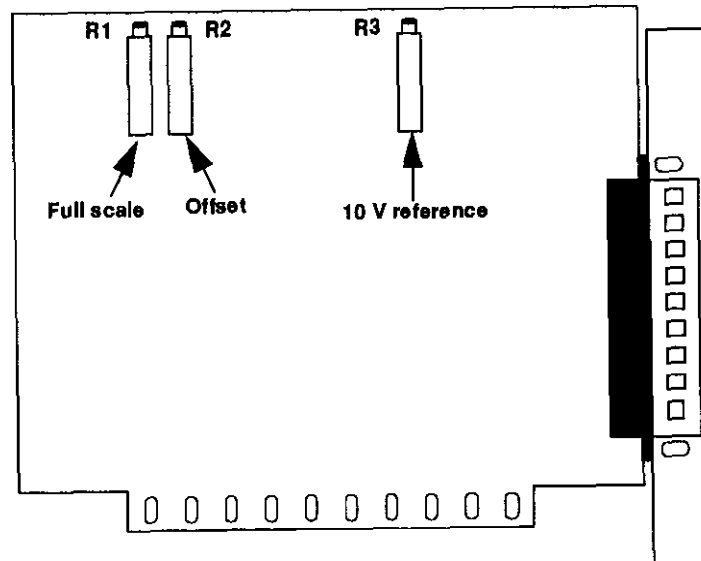


Figure 6-1. Potentiometers (DAS-800)

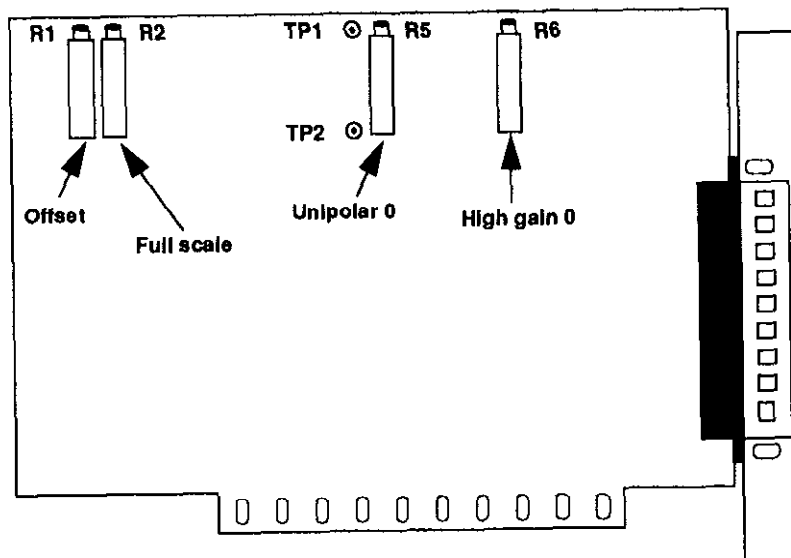


Figure 6-2. Potentiometers (DAS-801 / DAS-802)





## Calibration Utility

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To calibrate a DAS-800 Series board, you use the CAL800.EXE calibration utility, which is shipped with both the DAS-800 Series standard software package and the ASO-800 software package.

You can invoke the calibration utility from DOS or Windows, as follows:

- *If you are running under DOS*, from the directory containing the CAL800.EXE calibration utility, enter the following at the DOS prompt:

```
CAL800
```

- *If you are running under Windows*, choose Run from the Program Manager File menu. Enter the following in the box and select OK:

```
CAL800
```

Make sure that you enter the correct path to CAL800.EXE, or use the Browse button to find this file.

Follow the prompts as they appear on the screen; the program guides you through the calibration process.





# 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 7-4 for information on how to contact an applications engineer.

### **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 7-4 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.
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 7-4 for instructions on getting technical support.

## 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 7-4 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 to page 3-13 for instructions.



**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 3-17 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 factory.
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.





**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 to page 3-13 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].

## Technical Support

Before returning any equipment for repair, contact the factory.

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:

<b>Software package</b>	Name	_____
	Serial #	_____
	Version	_____
	Invoice/order #	_____
<b>Compiler (if applicable)</b>	Language	_____
	Manufacturer	_____
	Version	_____
<b>Operating system</b>	DOS version	_____
	Windows version mode	3.0 3.1 _____ Standard Enhanced





<b>Computer</b>	Manufacturer	_____
	CPU type	8088 286 386 486 ____
	Clock speed (MHz)	8 12 20 25 33 ____
	Math coprocessor	Yes No
	Amount of RAM	_____
	Video system	CGA Hercules EGA VGA
	BIOS type	_____
<b>DAS-800 Series board</b>	Model	800 801 802
	Serial #	_____
	Revision code	_____
	Base address setting	_____
	Interrupt level setting	2 3 4 5 6 7 None
	Input configuration	Single-ended Differential
	Input range type	Unipolar Bipolar
	8254 C/T2 usage	Cascaded Normal
<b>Expansion boards</b>	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 handling it with ground protection. Ship the equipment to the factory.

---

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

---



# 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)	$\pm 5$ V (1)	$\pm 10$ V (0.5), $\pm 5$ V (1), $\pm 500$ mV (10), $\pm 50$ mV (100), $\pm 10$ mV (500), 0 to 10 V (1), 0 to 1 V (10), 0 to 100 mV (100), 0 to 20 mV (500)	$\pm 10$ V (0.5), $\pm 5$ V (1), $\pm 2.5$ V (2), $\pm 1.25$ V (4), $\pm 625$ 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 <sup>1</sup>	0.01% of full scale $\pm 1$ bit	$\pm 0.01\%$ of full scale $\pm 1$ bit, typical; $\pm 0.05\%$ of reading $\pm 1$ bit, worst case	$\pm 0.01\%$ of full scale $\pm 1$ bit, typical; $\pm 0.05\%$ of reading $\pm 1$ bit, worst case

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 <sup>2</sup>	Not applicable	For gains $\leq 100$ : 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	$\pm 35$ V	$\pm 35$ V	$\pm 35$ V
	Input current	$\pm 5$ nA, typical at 25°C  $\pm 200$ nA, max.	$\pm 5$ nA, typical at 25°C  $\pm 200$ nA, max.	$\pm 5$ nA, typical at 25°C  $\pm 200$ nA, max.
	Temperature coefficient of gain drift	$\pm 45$ ppm/°C, maximum	$\pm 50$ ppm/°C, maximum	$\pm 50$ ppm/°C, maximum
	Temperature coefficient of zero drift <sup>3</sup>	$\pm 100$ $\mu$ V/°C, maximum	( $\pm 1 \pm 100$ / gain) $\mu$ V / °C, maximum	( $\pm 1 \pm 100$ / gain) $\mu$ V / °C, maximum
	Common-mode rejection at 60 Hz	Not applicable	For gains $\leq 1$ : 70 dB, min. 75 dB, typical  For gain of 10: 90 dB, min. 95 dB, typical  For gains $\geq 100$ : 100 dB, min. 110 dB, typical	For gains $\leq 1$ : 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)

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

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 $\mu$ A, max. at 2.7 V	25 $\mu$ A, max. at 2.7 V	25 $\mu$ A, 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.

**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	CPU bus clock divided by 2 or 1 MHz internal; software selectable	1 MHz internal	1 MHz internal
	C/T 1	External or cascaded with C/T 2; software selectable	External or cascaded with C/T 2; software selectable	External or cascaded with C/T 2; software selectable
	C/T 0	External	External	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	External, internal (when using internal time base)	External, internal (when using internal time base)	External, internal (when using internal time base)	
C/T 1	External, internal (when using internal time base)	External, internal (when using internal time base)	External, internal (when using internal time base)	
C/T 0	External	External	External	



**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**

<sup>1</sup> 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.

<sup>2</sup> Indicates measurement settling based on the specified accuracy.

<sup>3</sup> Includes ADC and PGA drift.



# 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.



Top of Board (Rear View)

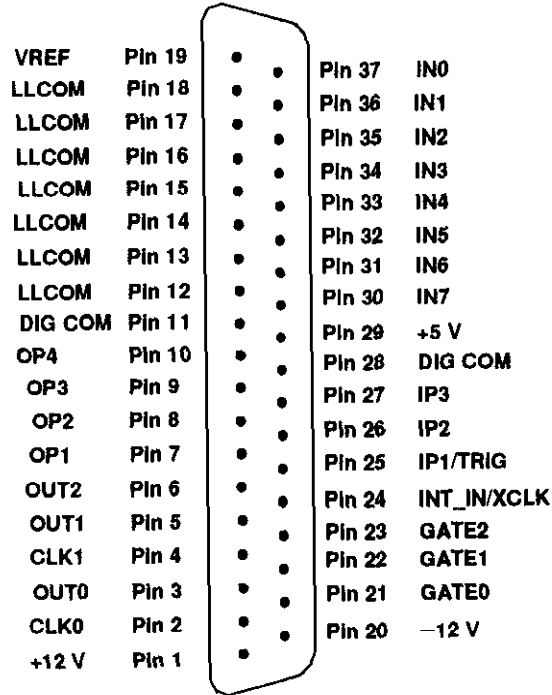


Figure B-1. Main I/O Connector (DAS-800)

**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 ( $\pm 0.1$ 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

**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

Top of Board (Rear View)

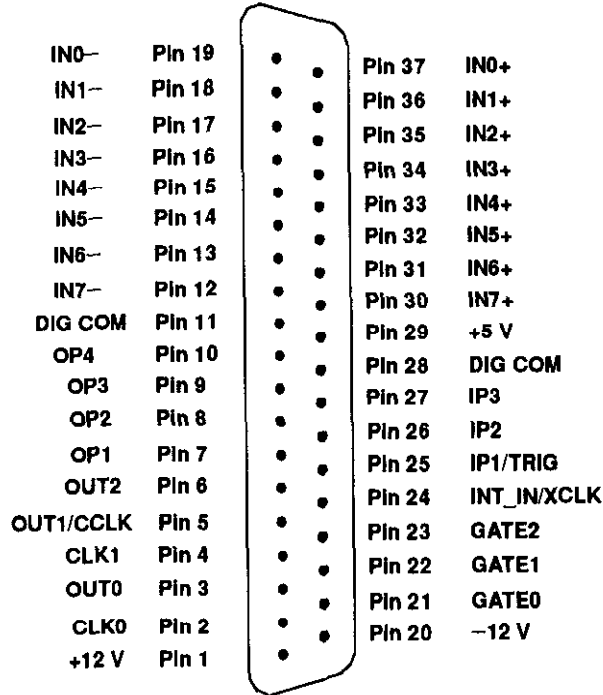


Figure B-2. Main I/O Connector (DAS-801 / DAS-802)

**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

**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 (+)





# C

## DAS-800 Series External Driver

The DAS-800 Series External Driver allows you to use your DAS-800 Series board with the following data acquisition and analysis software:

- VIEWDAC
- EASYEST LX
- EASYEST AG
- ASYST

The DAS-800 Series External Driver (DAS800.EXE) is shipped as part of the DAS-800 Series standard software package. DAS800.EXE executes as a terminate-and- stay-resident (TSR) program that occupies a small amount of memory in the host. It is designed to work with applications that follow the Keithley DAS Driver Specification.

Before you use the DAS-800 Series External Driver, make sure that you have used the D800CFG.EXE utility to create a configuration file for the DAS-800 Series boards you are using. Refer to page 3-9 for information on creating a configuration file.

---

**Note:** Make sure that the switches and jumper on the boards match the settings in the configuration file. Refer to page 3-13, page 3-16, and page 3-17 and to the instructions in the D800CFG.EXE utility for more information.

---



## Running the DAS-800 Series External Driver

---

You must run the DAS-800 Series External Driver, DAS800.EXE, each time you start up your computer in order for your application program to recognize it. The DAS-800 Series External Driver remains in memory until you turn off or restart your computer.

To run the DAS-800 Series External Driver, move to the directory containing DAS800.EXE and enter the following at the DOS prompt:

```
das800 configuration_filename
```

where *configuration\_filename* is the name of the configuration file you are using. If you do not specify a configuration file, the driver searches for the default configuration file, DAS800.CFG, in the current directory.

---

**Note:** You can also run the DAS-800 Series External Driver automatically whenever you start the computer by adding the appropriate lines to your AUTOEXEC.BAT file.

---

## Accessing the DAS-800 Series External Driver

---

VIEWDAC, EASYEST LX, and EASYEST AG application programs access the DAS-800 Series External Driver automatically. If you are using ASYST, perform the following steps to access the DAS-800 Series External Driver:

1. After loading the DAS-800 Series External Driver, start up ASYST version 2.10 or greater and permanently load the Data Acq Master and the Ext DAS Driver Support system overlays from the Data Acquisition menu. ASYST automatically searches for and creates a DAS device called DAS800.
2. Enter the following at the OK prompt to make DAS-800 the current device.

```
DAS800
```





## Special Characteristics

---

Normally, the use of the DAS-800 Series External Driver is transparent to you; if it is installed on the host, the software automatically uses it when necessary. This section contains the special considerations to keep in mind when using the software with DAS-800 Series boards.

### Pseudo-Digital Output: Extended Functions

DAS-800 Series boards provide some features that are not standard features of the software. To access these additional features, the DAS-800 Series External Driver uses pseudo-digital output channels.

Pseudo-digital output channels are digital output channels supported by the software, but not used by DAS-800 Series boards. (DAS-800 Series boards support digital output channel 0 only.)

---

**Note:** Only values written to digital output channel 0 affect the digital output lines on the board. Values written to the pseudo-digital output channels are intercepted by the DAS-800 Series External Driver and are used to set up the non-standard features.

---

Table C-1 lists the pseudo-digital channels available in the DAS-800 Series External Driver and the functions they perform.





**Table C-1. Pseudo-Digital Output Channels**

Digital Output Channel	Function	Description
32	Trigger channel	<p>The channel on which the trigger event occurs. For an analog trigger, the value written to this channel can range from 0 to 127. For a hardware digital trigger, the DAS-800 Series External Driver assumes channel 0 and the value written to this channel is ignored.</p> <p>Refer to page C-6 for more information about analog triggers; refer to page 2-12 for more information about hardware digital triggers.</p>
33	Trigger type	<p>The type of trigger you want to use to begin conversions. The value written to this channel can be one of the following:</p> <p><b>0</b> = a hardware digital trigger. A hardware digital trigger event occurs when the board detects a rising edge on the signal connected to the digital input IP1 / TRIG pin (pin 25).</p> <p><b>1</b> = an analog trigger. An analog trigger event occurs when the conditions specified by digital output channels 35, 38, and 39 are met by the analog input signal on the channel specified by digital output channel 32.</p> <p>Refer to page C-6 for more information about analog triggers; refer to page 2-12 for more information about hardware digital triggers.</p>



Table C-1. Pseudo-Digital Output Channels (cont.)

Digital Output Channel	Function	Description
35	Trigger polarity and sense	<p>The conditions that must be met before the trigger event can occur. For an analog trigger, the value written to this channel can be one of the following:</p> <p><b>0</b> = positive-edge trigger. The analog input signal must rise above the voltage level specified by digital output channel 38 (using the hysteresis value specified by digital output channel 39, if applicable).</p> <p><b>1</b> = negative-edge trigger. The analog input signal must fall below the voltage level specified by digital output channel 38 (using the hysteresis value specified by digital output channel 39, if applicable).</p> <p>For a hardware digital trigger, the DAS-800 Series External Driver assumes a rising edge and the value written to this channel is ignored.</p> <p>Refer to page C-6 for more information about analog triggers; refer to page 2-12 for more information about hardware digital triggers.</p>
38	Analog voltage level	<p>The voltage level at which an analog trigger event occurs. The value written to this channel is a raw count value between 0 and 4095. The voltage equivalent of the raw count value depends on the input range type (unipolar or bipolar). For example, a level of 0 is interpreted as 0 V if the input range type is unipolar, but it is interpreted as -5 V if the input range type is bipolar.</p> <p>Refer to page C-6 for more information about analog triggers. Refer to page C-9 for more information about converting voltage to a raw count value.</p>

**Table C-1. Pseudo-Digital Output Channels (cont.)**

<b>Digital Output Channel</b>	<b>Function</b>	<b>Description</b>
39	Hysteresis value	The amount of hysteresis applied to an analog trigger signal. The value written to this channel is a raw count value between 0 and 4095. A 0 hysteresis value disables the option.  Refer to page C-6 for more information about analog triggers. Refer to page C-9 for more information about converting voltage to a raw count value.
47	Gating	Enables or disables the hardware gate. The value written to this channel can be one of the following:  0 = the hardware gate is disabled.  1 = the hardware gate is enabled.  Refer to page 2-14 for more information about hardware gates.

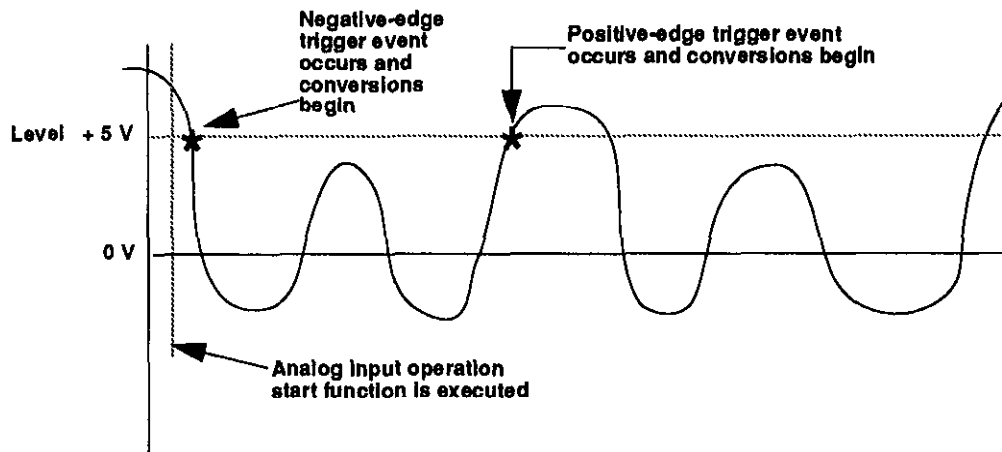
### **Analog Triggers**

An analog trigger event occurs when one of the following conditions is met by the analog input signal on a specified analog trigger channel:

- The analog input signal rises above a specified voltage level (positive-edge trigger).
- The analog input signal falls below a specified voltage level (negative-edge trigger).

You specify the voltage level as a raw count value between 0 and 4095. Refer to page C-9 for information on how to convert a voltage value to a raw count value.

Figure C-1 illustrates these analog trigger conditions, where the specified voltage level is +5 V.



**Figure C-1. Analog Trigger Conditions**

You can specify a hysteresis value to prevent noise from triggering an operation. For a positive-edge trigger, the analog signal must fall below the specified voltage level by at least the amount of the hysteresis value before the trigger event can occur; for a negative-edge trigger, the analog signal must rise above the specified voltage level by at least the amount of the hysteresis value before the trigger event can occur.

The hysteresis value is an absolute number, which you specify as a raw count value between 0 and 4095. When you add the hysteresis value to the voltage level (for a negative-edge trigger) or subtract the hysteresis value from the voltage level (for a positive-edge trigger), the resulting value must also be between 0 and 4095. For example, assume that you are using a negative-edge trigger on a channel configured for a bipolar input range type. If the voltage level is +4.8 V (4014 counts), you can specify a hysteresis value of 0.1 V (41 counts), but you cannot specify a hysteresis value of 0.3 V (123 counts). Refer to page C-9 for information on how to convert a voltage value to a raw count value.

In Figure C-2, the specified voltage level is +5 V and the hysteresis value is 0.1 V. The analog signal must fall below +4.9 V and then rise above +5 V before a positive-edge trigger event occurs; the analog signal must rise above +5.1 V and then fall below +5 V before a negative-edge trigger event occurs.



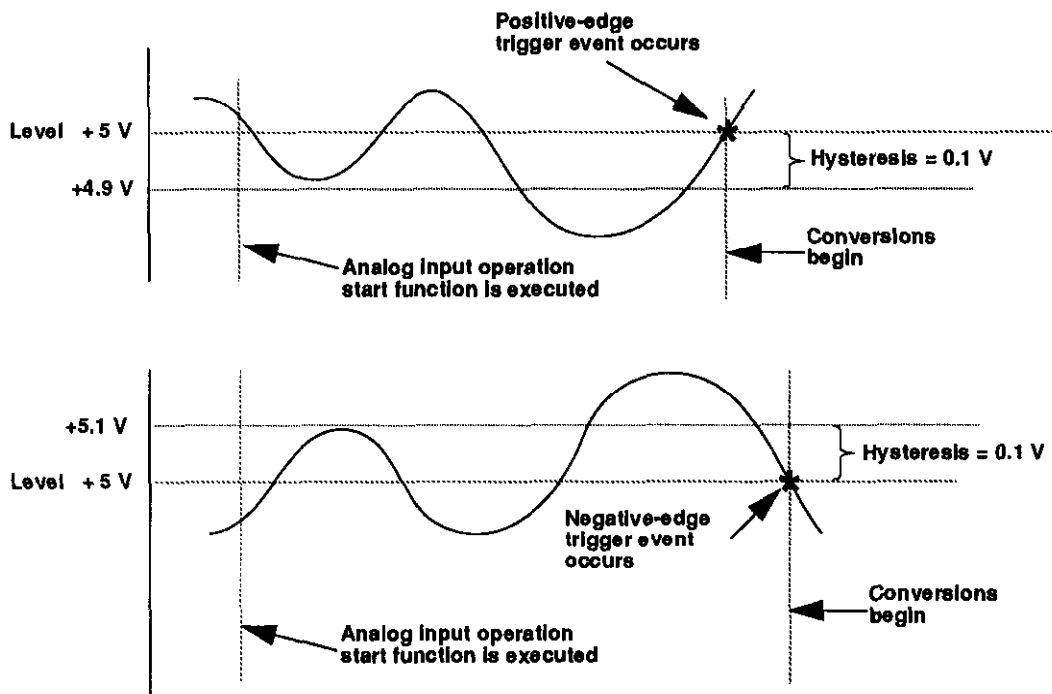


Figure C-2. Using a Hysteresis Value

When using an analog trigger, the software samples the specified analog trigger channel to determine whether the trigger condition has been met. Therefore, a slight time delay may occur between the time the trigger condition is actually met and the time the software realizes that the trigger condition has been met and initiates conversions. In addition, 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 conversions 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 conversions.



Figure C-3 illustrates the initiating of conversions when using an analog trigger.

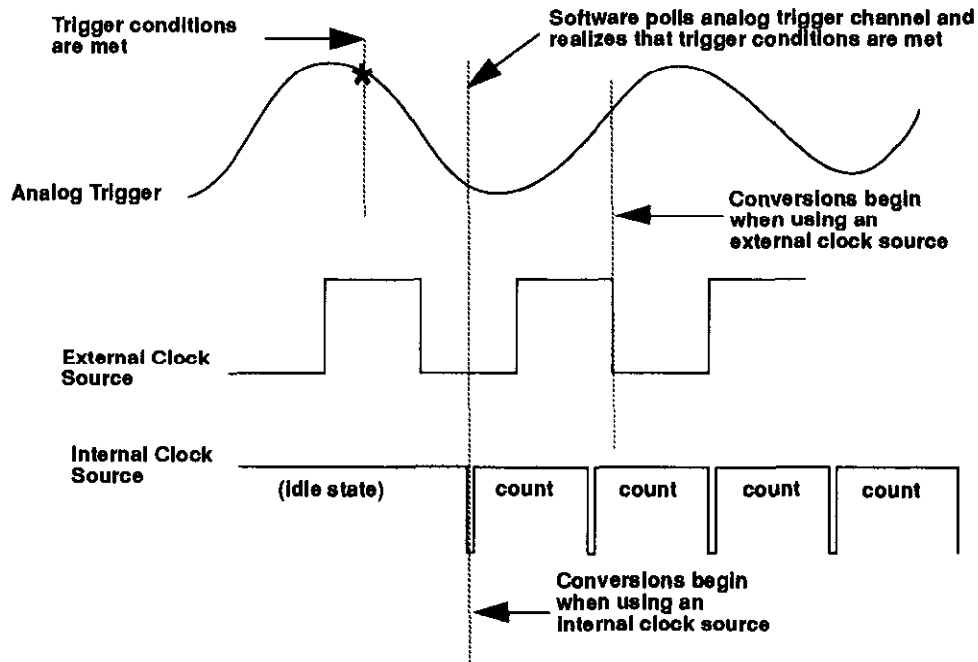


Figure C-3. Initiating Conversions with an Analog Trigger

### Data Formats

When specifying an analog trigger level or hysteresis value, you must convert voltage to raw counts. You specify the voltage value as a 12-bit, right-justified raw count (0 to 4095). Specifying an analog trigger level and hysteresis value are described as follows:

- Specifying an analog trigger level** - To convert a voltage value to a raw count when specifying an analog trigger level, use one of the following equations, where *voltage* is the desired voltage in volts, 10 V is the span of the analog input range, 4096 is the number of counts available in 12 bits, and *gain* is the gain (always 1 in this case).



**DAS-800**

$$\text{Count} = \frac{\text{voltage} \times 4096}{10} + 2048$$

**DAS-801 / DAS-802**

*For unipolar input range type:*

$$\text{Count} = \left( \frac{\text{voltage} \times 4096}{10} \right) \times \text{gain}$$

*For bipolar input range type:*

$$\text{Count} = \left( \left( \frac{\text{voltage} \times 4096}{10} \right) \times \text{gain} \right) + 2048$$

---

**Note:** The DAS-800 Series External Driver always interprets the count value you specify for an analog trigger level as based on a gain of 1 (for unipolar input range type, a count of 0 is interpreted as 0 V and a count of 4095 is interpreted as +9.9976 V; for bipolar input range type, a count of 0 is interpreted as -5 V and a count of 4095 is interpreted as +4.9976 V).

---

For example, assume that you want to specify an analog trigger level of -1.25 V for a channel on a DAS-802 board configured for a bipolar input range type and a gain of 2. The raw count is determined as follows:

$$\left( \left( \frac{-1.25 \times 4096}{10} \right) \times 1 \right) + 2048 = 1536$$

---

**Note:** No matter what the gain of the channel is, always use a gain of 1 in your equation.

---





- **Specifying a hysteresis value** - To convert a voltage value to a raw count when specifying a hysteresis value, use the following equation, where *voltage* is the desired voltage in volts, 10 V is the span of the analog input range, 4096 is the number of counts available in 12 bits, and *gain* is the gain (always 1 in this case).

$$\text{Count} = \left( \frac{\text{voltage} \times 4096}{10} \right) \times \text{gain}$$

---

**Note:** The driver always interprets the count value you specify for a hysteresis value as based on a gain of 1 (the span is 10 V).

---

For example, assume that you want to specify an analog trigger hysteresis value of 0.05 V for a channel on a DAS-801 board configured for a unipolar input range type and a gain of 10. The raw count is determined as follows:

$$\left( \frac{0.05 \times 4096}{10} \right) \times 1 = 20$$

---

**Note:** No matter what the gain of the channel is, always use a gain of 1 in your equation.

---

## Using Expansion Board Gains

When using an EXP-16, EXP-16/A, or EXP-GP expansion board, you set the gain of channel 0 only (channel 0 is on the first EXP-16 or EXP-16/A, or on the first EXP-GP if no EXP-16s or EXP-16/As are configured). The gain of all channels is relative to the setting of the input range type (unipolar or bipolar) and the gain of channel 0. You must compensate for gains other than the gain of channel 0 if the gain for other channels differs.

---

**Note:** When using a gain of 0.5 on the EXP-16 or EXP-16/A, the maximum input range is  $\pm 12$  V not the entire  $\pm 20$  V.

---



## Software Interrupt Vectors

The DAS-800 Series External Driver uses two software interrupt vectors for communicating with the application program. The interrupt vectors used are three of the user interrupts (interrupts 60H to 67H) set aside by DOS. To ensure that conflicts with other devices, hardware, or programs do not exist, you can set each of the interrupt vectors to use an interrupt number that is different from the default.

You can change the interrupt vector numbers by using the SET command from DOS. This command saves a string in the DOS environment that the DAS-800 Series External Driver searches for on loading. These strings are specified in the following table.

**Table C-2. Interrupt Vectors**

Interrupt	Default Interrupt Number	Environment String <sup>1</sup>
Device linking vector	66H	'DAS DS=xx'
Critical error vector	65H	'DAS CE=xx'

**Notes**

<sup>1</sup> where xx ranges from 60H to 67H.

---

**Note:** Do not confuse these software interrupt vectors with the hardware interrupt levels used by DAS-800 Series boards.

---

## Counter/Timer Functions

DAS-800 Series boards provide direct access to the 8254 counter/timer circuitry. However, this feature is not supported by the DAS-800 Series External Driver.

## Error Messages

Table C-3 lists the error/status codes that are returned by the DAS-800 Series External Driver, possible causes for error conditions, and possible solutions for resolving error conditions. The error/status codes are returned in decimal format.

If you cannot resolve an error condition, contact the factory.

**Table C-3. Error/Status Codes**

Error Code	Cause	Solution
0	No error has been detected.	Status only; no action is necessary.
28672	<b>No Board Name:</b> The driver did not find a board name in the specified configuration file.	Specify a legal board name in the configuration file: DAS800, DAS801, DAS802
28673	<b>Bad Board Name:</b> The board name in the specified configuration file is illegal.	Specify a legal board name in the configuration file: DAS800, DAS801, DAS802
28674	<b>Bad Board Number:</b> The driver found an illegal board number in the specified configuration file.	Specify a legal board number: 0 to 3
28675	<b>Bad Base Address:</b> The driver found an illegal base address in the specified configuration file.	Specify a base address in the inclusive range 200H (512) to 3F0H (1008) in increments of 8H (8). Make sure that &H precedes hexadecimal numbers.
28676	<b>Bad Interrupt Level:</b> The driver found an illegal interrupt level in the specified configuration file.	Specify a legal interrupt level: 2 to 7, X (disabled)
28677	<b>Bad Counter Configuration:</b> The driver found an illegal counter/timer configuration in the specified configuration file.	Specify a legal counter/timer configuration: cascaded, normal
28678	<b>Bad A/D Gain Mode:</b> The driver found an illegal input range type in the specified configuration file.	Specify a legal A/D mode: bipolar, unipolar

Table C-3. Error/Status Codes (cont.)

Error Code	Cause	Solution
28679	<b>Bad A/D Channel Configuration:</b> The driver found an illegal input configuration in the specified configuration file.	Specify a legal input configuration: single-ended, differential
28680	<b>Bad Number of EXP-16 Expansion Boards:</b> The driver found an illegal number of EXP-16 expansion boards in the specified configuration file.	Specify a legal number of EXP-16 expansion boards: 1 to 8
28681	<b>Bad EXP-16 Expansion Board Number:</b> The driver found an illegal number assigned to one of the EXP-16 expansion boards in the specified configuration file.	Specify a legal number for each EXP-16 expansion board: 0 to 7
28682	<b>Bad EXP-16 Expansion Board Gain:</b> The driver found an illegal gain assigned to one of the EXP-16 expansion boards in the specified configuration file.	Specify a legal gain value for each EXP-16 expansion board: 0.5 to 2000
28683	<b>Bad Number of EXP-GP Expansion Boards:</b> The driver found an illegal number of EXP-GP expansion boards in the specified configuration file.	Specify a legal number of EXP-GP expansion boards: 1 to 8
28684	<b>Bad EXP-GP Expansion Board Number:</b> The driver found an illegal number assigned to one of the EXP-GP expansion boards in the specified configuration file.	Specify a legal number for each EXP-GP expansion board: 0 to 7
28685	<b>Bad EXP-GP Expansion Board Gain:</b> The driver found an illegal gain series assigned to one of the EXP-GP expansion boards in the specified configuration file.	Specify a legal gain series for each EXP-GP expansion board: 1.0 series (1, 10, 100, 1000), 2.5 series (2.5, 25, 250, 2500)

Table C-3. Error/Status Codes (cont.)

Error Code	Cause	Solution
28686	<b>Bad EXP-GP Expansion Board Channel:</b> The driver found an illegal gain assigned to one of the channels on one of the EXP-GP expansion boards in the specified configuration file.	Specify a legal gain for each EXP-GP expansion board channel: 1, 10, 100, 1000 (1.0 series) or 2.5, 25, 250, 2500 (2.5 series)
28687	<b>Bad CJR:</b> The driver found an illegal channel assigned to the cold-junction reference (CJR) value in the specified configuration file.	Specify a legal CJR value: 1 to 7, -1 (unused)
30720	<b>Bad Revision Number:</b> The revision of the driver you are using does not match the revision of the Keithley DAS Driver Specification.	Make sure that you are using the appropriate driver.
30721	<b>Resource Busy:</b> You started an operation while an operation of the same type was still in progress.	Wait and try the operation again later.
30726	<b>Illegal Hysteresis:</b> You specified an illegal hysteresis value.	Make sure that when the hysteresis value is added to or subtracted from the analog trigger level, the resulting value is between 0 and 4095.
30727	<b>Illegal Board:</b> You are attempting to program a board that is not a DAS-800 Series board.	Make sure that you are using the appropriate software for the appropriate board.
30728	<b>Interrupts Not Enabled:</b> You started an interrupt operation, but interrupts were disabled in the configuration file.	Specify an interrupt level in the configuration file: 2, 3, 4, 5, 6, or 7
30729	<b>Illegal Digital Trigger:</b> You specified an illegal trigger polarity and sense value for a digital trigger.	The trigger polarity and sense value must be 0; only a positive-edge trigger can be used.
30730	<b>Illegal Gain Mode:</b> You specified an illegal input range type.	Specify a legal input range type: 0 (unipolar), 1 (bipolar)
30731	<b>Conversion Underflow:</b> You attempted to read data, but there was no data to read.	Check your application program.



Table C-3. Error/Status Codes (cont.)

Error Code	Cause	Solution
30732	<b>Illegal Gate:</b> You enabled the hardware gate while a hardware trigger was enabled.	Disable the digital trigger and try again.
32769	<b>Function Not Supported:</b> You have attempted to use a feature that is not supported by the DAS-800 Series External Driver.	Contact the factory.
32771	<b>Non Valid Board Number:</b> You specified an illegal board number.	Specify a legal board number: 0 to 3
32772	<b>Non Valid Error Number:</b> The driver requested an invalid error message number.	Contact the factory.
32773	<b>Board Not Found at Configured Address:</b> The driver does not detect the presence of a board.	Make sure that the base address setting of the switches on the board matches the base address setting in the configuration file.
32777	<b>Digital Output Not Initialized:</b> You may have expansion boards configured that are using the digital output lines to determine the channel to read.	Disconnect the expansion boards and make the appropriate changes to the configuration file. Do not attempt to use the digital output lines.
32779	<b>Conversion Overrun:</b> Data in the FIFO was overwritten before it was transferred from the FIFO to the computer's memory.	Adjust the clock source to slow down the rate at which the board acquires data. Remove other application programs that are running and using computer resources.
32794	<b>Interrupts Already Active:</b> You have attempted to start an operation whose interrupt level is being used by another system resource.	Wait and try the operation later.
65535	<b>User Aborted Operation</b>	You pressed [Ctrl] [Break] to abort an operation.



# D

## Keithley Memory Manager

The process that Windows uses to allocate memory can limit the amount of memory available to DAS boards operating in Windows Enhanced mode. To reserve a memory heap that is adequate for the needs of your board, you can use the Keithley Memory Manager (KMM), included in the ASO software package.

The reserved memory heap is part of the total physical memory available in your system. When you start up Windows, the KMM reserves the memory heap. Then, whenever your application program requests memory (using `K_DMAAlloc` or `K_IntAlloc`), the memory buffer is allocated from the reserved memory heap instead of from the Windows global heap. The KMM is DAS board independent and can be used by multiple Windows programs simultaneously.

---

**Note:** The memory allocated with the KMM can be used by a DMA controller, if applicable.

---

The following are supplied with the KMM:

- **VDMAD.386** - Customized version of Microsoft's Virtual DMA Driver. This file consists of a copy of Microsoft's Virtual DMA Driver and a group of functions that is added to perform the KMM functions. When you use the KMM to reserve a memory heap, Microsoft's Virtual DMA Driver is replaced by the VDMAD.386 file.

---

**Note:** If you have multiple versions of VDMAD.386, it is recommended that you install the latest version; to determine which version is the latest version, refer to the time stamp of the file.

---





- **KMMSETUP.EXE** - Windows program that helps you set up the VDMAD.386 parameters and then modifies your SYSTEM.INI file accordingly.

## Installing and Setting Up the KMM

---

To install and set up the KMM whenever you start up Windows, you must modify the SYSTEM.INI file. You can modify the SYSTEM.INI file using either the KMMSETUP.EXE program or a text editor.

### Using KMMSETUP.EXE

Using the KMMSETUP.EXE program, you can modify your Windows SYSTEM.INI file as follows:

1. Invoke KMMSETUP.EXE in one of the following ways:
  - From the Program Manager menu, choose File and then Run, and then type the complete path and program name for KMMSETUP.
  - Select the KMMSETUP icon, if installed.
2. In the New VDMAD.386 box, enter the path and name of the VDMAD.386 file, as follows:

C:\WINDOWS\VDMAD.386

The string you enter replaces \*vdmad in the device=\*vdmad line in your SYSTEM.INI file.

---

**Note:** Normally, the VDMAD.386 file is stored in the WINDOWS directory. If it is stored elsewhere, enter the correct path and name or use the Browse button to find the file.

---

3. Notice the Current Setting box. The value specified reflects the current size of the reserved memory heap in KBytes.





4. In the Desired Setting box, enter the desired size of the reserved memory heap in KBytes.

The value you enter replaces the `KEIDMAHEAPSIZE=` line in the [386Enh] section of your SYSTEM.INI file.

---

**Notes:** The memory size you specify is no longer available to Windows. For example, if your computer has 8 MBytes of memory installed and you specify `KEIDMAHEAPSIZE=1000` (1 MByte), Windows can only see and use 7 MBytes.

If you specify a value less than 128, a 128 KByte minimum heap size is assumed. The maximum heap size is limited only by the physical memory installed in your system and by Windows itself.

---

5. Select the Update button to update the SYSTEM.INI file with the changes you have made.
6. Restart Windows to ensure that the system changes take effect.



## Using a Text Editor



Using a text editor, you can modify your Windows SYSTEM.INI file in the [386Enh] section, as follows:

1. Replace the line `device=*vdmad` with the following:

```
device=c:\windows\vdmad.386
```

---

**Note:** Normally, the VDMAD.386 file is stored in the WINDOWS directory. If it is stored elsewhere, enter the correct path and name.

---

2. Add the following line:

```
KEIDMAHEAPSIZE=<size>
```

where *size* indicates the desired size of the reserved memory heap in KBytes.





---

**Notes:** The memory size you specify is no longer available to Windows. For example, if your computer has 8 MBytes of memory installed and you specify `KEIDMAHEAPSIZE=1000` (1 MByte), Windows can only see and use 7 MBytes.

If you do not add the `KEIDMAHEAPSIZE` keyword or if the size you specify is less than 128, a 128 KByte minimum heap size is assumed. The maximum heap size is limited only by the physical memory installed in your system and by Windows itself.

---

3. Restart Windows to ensure that the system changes take effect.

## Removing the KMM

---

If you make changes to the `SYSTEM.INI` file, you can always remove the updated information from the `SYSTEM.INI` file and return all previously reserved memory to Windows.

If you are using `KMMSETUP.EXE`, select the Remove button to remove the updated information. If you are using a text editor, modify and/or delete the appropriate lines in `SYSTEM.INI`. In both cases, make sure that you restart Windows to ensure that the system changes take effect.



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