DAS-1800ST/HR Series User's Guide

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Preface

This guide is intended to help you understand the installation, interface requirements, functions and operation of the DAS-1801ST, DAS-1802ST, and DAS-1802HR boards. Unless this guide refers specifically to the DAS-1801ST, DAS-1802ST, or DAS-1802HR board, it refers to all boards collectively as the DAS-1800ST/HR Series boards. At the same time, the term *DAS-1800 Series* refers to all members of the DAS-1800 family of data acquisition boards.

This guide focuses primarily on describing the DAS-1800ST/HR Series boards and their capabilities, setting up the boards and their associated software, making typical hookups, and operating the Control Panel software. There are also chapters on calibration and troubleshooting. To follow the information and instructions contained in this manual, you must be familiar with the operation of an IBM™ PC AT® (or equivalent) in the MS-DOS® or Windows™ environments. You must also be familiar with data-acquisition principles and their application.

The *DAS-1800ST/HR Series User's Guide* is organized as follows:

- Chapter 1 describes the boards' features, accessories, and software options.
- Chapter 2 describes operating features of the boards in more detail. This chapter contains a block diagram and brief descriptions of the features as they relate to your options for setting up and using the boards.
- Chapter 3 contains instructions for inspection, software installation, configuration, and board installation.
- Chapter 4 shows the preferred methods of making I/O (Input/Output) connections, using the available accessories and cables.

- Chapter 5 briefly describes the Control Panel program and gives instructions for starting up the program from both DOS and Windows.
- Chapter 6 discusses calibration requirements and gives instructions for starting the calibration program from DOS.
- Chapter 7 contains information on isolating and determining the source of operating problems.
- Appendix A contains specifications for the DAS-1800ST/HR Series boards.
- Appendix B contains pin assignments for the main I/O connector of DAS-1800ST/HR Series boards and for the I/O and accessory connectors of STA-1800U Screw Terminal accessories.
- Appendix C discusses the External Driver for the VIEWDAC® and ASYST® programs.
- Appendix D discusses the Keithley Memory Manager and its use.
- An index completes the manual.

1

Overview

The DAS-1800ST/HR Series boards perform data acquisition in IBM PC AT, or compatible, computers. The DAS-1801ST is a 12-bit, high-gain board, while the DAS-1802ST is a 12-bit, low-gain board. The DAS-1802HR is a 16-bit, low-gain board. Major features of these boards are as follows:

- The boards make 16-bit data transfers on the AT bus.
- The boards are software-configurable for 16 single-ended or 8 differential analog input, onboard channels or up to 256 single-ended or 128 differential channels using expansion accessories.
- Channels are individually software-configurable for gain.
- DAS-1800ST Series boards acquire data at up to 333 ksamples/s and 12-bit resolution.
- DAS-1802HR boards acquire data at up to 100 ksamples/s and 16-bit resolution.
- A 1024-location FIFO (First In First Out) data buffer ensures data integrity at all sampling rates.
- A 256-location channel/gain queue supports high-speed sampling at the same or different gains and in sequential or non-sequential channel order.
- Burst-mode data acquisition emulates simultaneous-sample-and-hold (SSH) capability.
- The boards support external SSH hardware and EXP-1800 expansion accessories.

- External expansion accessories allow a board to acquire data from up to 256 channels at the board's maximum acquisition rate.
- Dual-channel DMA (Direct Memory Access) operation allows the acquisition of more than 64 ksamples.
- Pulsed interrupts allow multiple DAS-1800 Series boards to share interrupt levels.
- Hardware trigger and gate for A/D (analog-to-digital) conversions have software-selectable polarity.
- Triggering capabilities support pre-, post-, and about-trigger acquisitions.
- The boards have four digital inputs.
- The boards have four digital outputs with a latch strobe.
- All user connections are made through a 50-pin I/O connector at the rear panel of the computer.
- All features are software-programmable except for a board's base address switch.
- The boards provide ±15 V power for external circuitry.

For more information on these features, refer to the functional description in Chapter 2.

Supporting Software

The following software for DAS-1800ST/HR Series boards supports all currently available DAS-1800 Series boards:

- **DAS-1800 Series standard software** - This software, which is provided on 3.5-inch and 5.25-inch diskettes, includes function libraries for writing application programs under DOS in a high-level language such as Microsoft® QuickBasic™, Microsoft Professional BASIC, and Microsoft Visual Basic™ for DOS, support files, example programs, and the following utility programs:
  - *Control Panel* - The Control Panel (CTL1800.EXE) is a DOS-based program. This program provides access to all DAS-1800 Series board operations without programming. Operations include acquiring analog inputs and controlling digital I/O. The Control Panel is a means of testing the board and your application; it is also a means of performing simple applications and saving data to a disk file. Refer to Chapter 5 for more information about the Control Panel.
  - *Configuration Utility* - The configuration utility (CFG1800.EXE) is a program for creating or modifying a DAS-1800 Series configuration file. A configuration file contains the configuration settings for use by the DAS-1800 Series Function Call Driver and other software. For more information on the configuration utility, refer to "Configuring the Board" on page 3-4.
  - *Calibration Utility* - The calibration utility (CAL1800.EXE) is a DOS-based program for calibrating the analog I/O circuitry of DAS-1800 Series boards. Refer to Chapter 6 for more information about this utility.

Refer to the *DAS-1800 Series Function Call Driver User's Guide* for more information on programming with the standard software.

- **ASO-1800** - Advanced Software Option. This option is provided in Windows and DOS versions; both versions are supplied on 3.5-inch and 5.25-inch diskettes. The ASO-1800 includes function libraries for application programs you write for MS-DOS and Windows environments in Microsoft C/C++, Borland® C/C++, Borland Turbo

Pascal®, Microsoft Visual Basic for Windows, Microsoft QuickC®, and Microsoft Visual C++™. The ASO-1800 package also contains miscellaneous support files, example programs, and the following utilities:

- *Control Panel* - The Control Panel is a stand-alone program supplied in a DOS version (CTL1800.EXE) and a Windows version (CTL1800W.EXE). This program provides access to all DAS-1800 Series board operations without programming. Control Panel operations include acquiring analog inputs, controlling analog outputs, and controlling digital I/O. The Control Panel is a means of testing the board and your application; it is also a means of performing simple applications and saving data to a disk file. The Windows version allows you to transfer acquired data to other Windows applications through the Windows DDE (Dynamic Data Exchange) feature and supports the graphing of up to eight channels on the display. Refer to Chapter 5 for more information about the Control Panel.

- *Configuration Utility* - The configuration utility (CFG1800.EXE) is a program for creating or modifying a DAS-1800 Series configuration file. A configuration file contains the configuration settings for use by the DAS-1800 Series Function Call Driver and other driver software. For more information on the configuration utility, refer to "Configuring the Board" on page 3-4.

- *Calibration Utility* - The calibration utility (CAL1800.EXE) is a DOS-based program for calibrating the analog I/O circuitry of DAS-1800 Series boards. Refer to Chapter 6 for more information about this utility.

Refer to the *DAS-1800 Series Function Call Driver User's Guide* for more information on programming with the ASO-1800.

- **VDAS-1800** - VisualDAS Custom Controls for Visual Basic for Windows for DAS-1800 Series boards. VisualDAS virtually reduces setting up data acquisition operations to filling in a table. The package includes a comprehensive user's guide, offers extensive on-line help, and furnishes software on 3.5-inch and 5.25-inch diskettes.

- **Data acquisition and analysis application software** - VIEWDAC is an integrated software package available for the DAS-1800 Series boards. Programming tools, such as ASYST scientific and engineering programming language, are also available to help you in writing your application programs.

Note: If you use VIEWDAC or ASYST to program your DAS-1800 Series board, you must use the DAS-1800 Series External Driver. This driver is included in the DAS-1800 Series standard software package. Refer to Appendix C for information on the external driver.

Accessories

The following accessories are available for use with DAS-1800ST/HR Series boards.

- **STA-1800U** - screw terminal accessory. This accessory connects to the main I/O connector of a DAS-1800ST/HR Series board through a CDAS-2000 cable to make all I/O signals accessible through labeled screw terminals.
- **STP-50** - screw terminal panel. This accessory provides general-purpose screw-terminal connections in a compact form factor.
- **RMT-02** - rack mount enclosure for the STA-1800U accessory.
- **SSH-8** - An 8-channel simultaneous sample and hold accessory for the DAS-1800ST/HR Series boards. Refer to the *SSH-8 User's Guide* for more information.
- **MB Series modules and MB02 backplanes** - Plug-in, isolated, signal-conditioning modules and backplanes (Refer to the *MB Series User's Guide* for more information.)
- **EXP-1800** - 16-channel expansion accessory that connects directly to DAS-1800ST/HR Series boards. Refer to the *EXP-1800 User's Guide* for more information.

- **PG-408A** - DC/DC converter. This accessory must be installed on EXP-1800 accessories that use external power.
- **C-2600** - A 24-inch cable for connecting an STA-1800U accessory to an MB02 signal-conditioning backplane.
- **CDAS-2000** - A 24-inch ribbon cable for connecting a DAS-1800ST/HR Series board to an STA-1800U, an STP-50, or an EXP-1800.
- **CACC-2000** - A 24-inch ribbon cable for daisy chaining additional STA-1800U accessories to the first STA-1800U or additional EXP-1800 accessories to the first EXP-1800.
- **C-1800** - An 18-inch ribbon cable with two 37-pin female type D connectors for connecting an STA-1800U accessory to an SSH-8 accessory.

2

Functional Description

This chapter describes the features of the analog input and digital I/O sections of the DAS-1800ST/HR Series boards. These descriptions are provided to familiarize you with the operating options and to enable you to make the best use of your board. The block diagram in Figure 2-1 on page 2-2 represents both the DAS-1800ST Series and the DAS-1802HR boards.

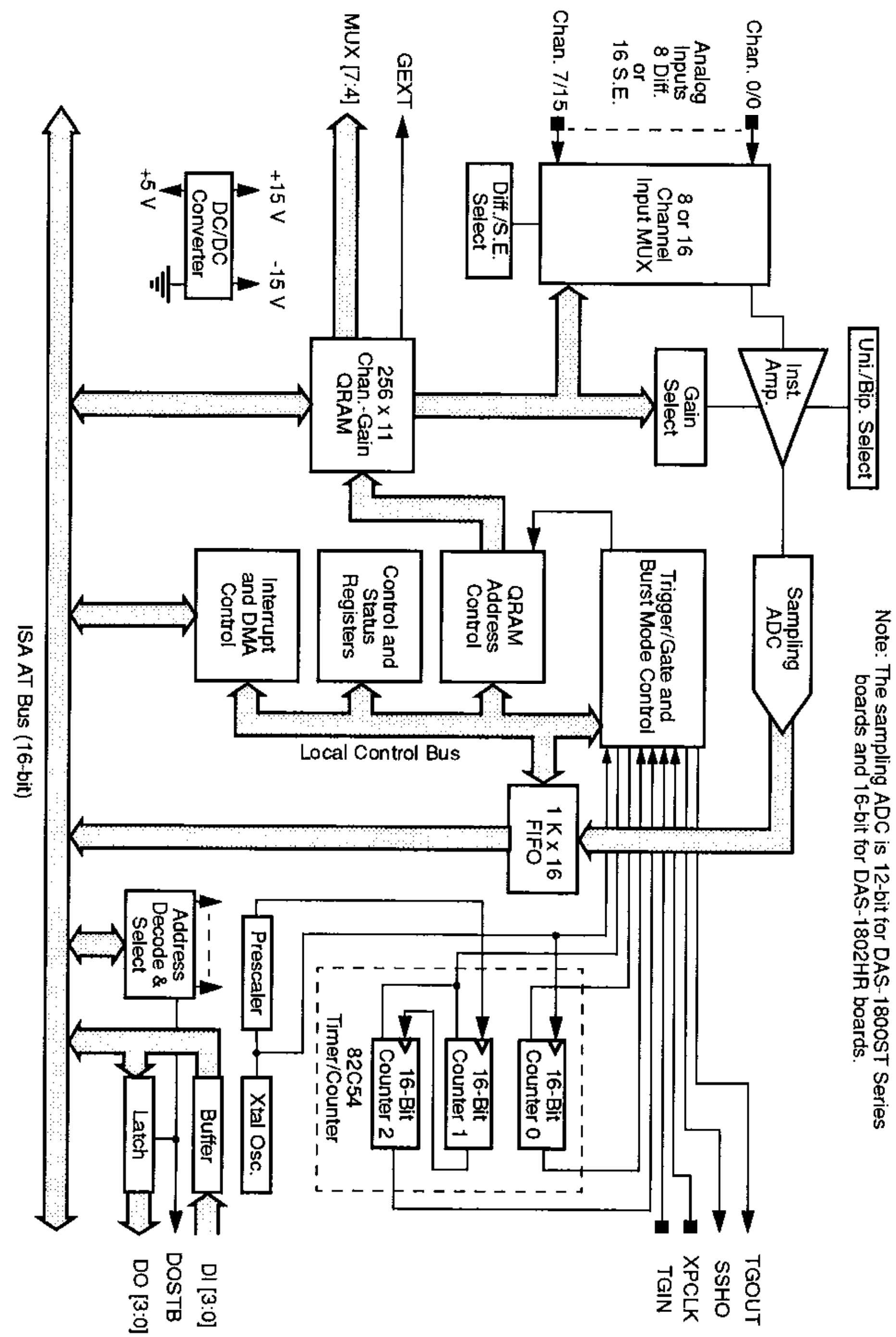

Figure 2-1. Block Diagram of DAS-1800ST/HR Series Boards

Analog Input Features

The analog input section of a DAS-1800ST/HR Series board multiplexes all the active input channels (up to 16 single-ended or 8 differential) down to a single, sampling ADC (analog-to-digital converter). Sampling resolution of the ADC is 12-bit (one part in 4096) for DAS-1800ST Series boards and 16-bit (one part in 65,536) for the DAS-1802HR board. Other features of the analog input section include software-configurable inputs, a channel-gain queue, data conversion modes, data transfer modes, and trigger and gate control, and clock sources. These features are described in the following subsections.

Differential/Single-Ended Selection

Using the configuration software, you can set DAS-1800ST/HR Series boards to operate with either differential or single-ended inputs (see "Configuring the Board" on page 3-4). Differential inputs measure the difference between two signals. Single-ended inputs are referred to a common ground, also called *common-mode ground reference.*

When you connect single-ended inputs to an STA-1800U accessory, you can use the accessory's LLGND or U_CM MD screw terminals for your common-mode ground reference. You specify your choice using the configuration utility (see Chapter 2).

Generally, you want to use differential inputs for low-level signals whose noise component is a significant part of the signal or if the signal has a non-ground common mode. You want to use single-ended inputs for high-level signals whose noise component is not significant.

The specific level at which one of these input configurations becomes more effective than the other depends on the application. However, you should use differential inputs for voltage ranges of 100 mV and below.

Ground Selection for Single-Ended Inputs

When you use single-ended inputs, you have two ways of grounding input signals: the analog ground (default) and the user-common ground. The two schemes differ in how the low side of the instrumentation amplifier is connected. In the default mode, the low side of the amplifier is connected to analog ground (LL GND). In the user-common mode, the low side of the amplifier is connected to a pin on the connecter for user-common ground (U_CM MD).

The user-common mode provides a means for eliminating ground loops in the system by connecting the reference ground for inputs to the U_CM MD input pin. Since the U_CM MD connection connects to the high input impedance of the instrumentation amplifier, the signal contains no power-supply return current.

The user-common mode also provides a means for making single-ended measurements of signals referred to a voltage that is not ground or whose output range does not include ground. For example, a common way to perform 4 to 20 mA current monitoring is to connect a loop with a 250 ohm resistor to ground; the resistor yields a 1 to 5 V output in this current range. This method works but uses only 80% of the input range when connected to a 0 to 5 V range. A better way is to use a 312.5 ohm resistor and refer all measurements to 1.25 V. The actual output voltage then ranges from 1.25 V to 6.25 V; however, since the amplifier low side is connected to 1.25 V, the measurement range is now a span of 5 V, making the entire input range available and increasing resolution of the measurements by 20%.

If you use single-ended input configurations, the user-common mode is the recommended alternative. Use the default mode only if you want the convenience of not having to connect a separate wire for low input.

Unipolar/Bipolar Selection

Using the configuration software, you can set the DAS-1800ST/HR Series boards to operate in either the unipolar or bipolar input mode (see “Configuring the Board” on page 3-4). A unipolar signal is always positive (0 to 5 V, for example), while a bipolar signal can swing up and down between positive and negative peak values (±5 V, for example).

The DAS-1800ST/HR Series boards use positive magnitude to represent unipolar signals and twos complement for bipolar signals. In a given input range with the same peak-voltage capacity for both modes, the unipolar mode doubles the converter’s resolution.

Channel-Gain Selection

The DAS-1800ST/HR Series boards offer up to 16 single-ended or 8 differential onboard analog input channels. Using expansion accessories, you can increase the number of available channels to 256 differential. To accommodate channel and gain settings for up to 256 channels, the DAS-1800ST/HR Series boards contain a RAM storage circuit for a 256-position channel-gain queue. Each of the 256 queue positions holds your choice of a channel number and a corresponding gain. You can enter multiple channels sequentially or non-sequentially and with the same or different gain codes. Channel expansion, channel sequencing control, and available gains and input ranges for DAS-1800ST/HR Series boards are discussed in the following subsections.

Channel Expansion

If you require additional analog input channels, you can configure your DAS-1800ST/HR Series board for single-ended inputs and attach up to 16 EXP-1800 expansion accessories or up to 16 MB02 backplanes. Either option can increase your input capacity to 256 channels.

If you use EXP-1800 accessories, you daisy-chain them directly to the DAS-1800ST/HR Series board using CDAS-2000 cables (see Chapter 4). Since a DAS-1800ST/HR Series board can not power a full complement of EXP-1800 accessories, each EXP-1800 contains screw terminals for attaching external power, a receptacle for a DC/DC converter, and a switch for changing between internal and external power.

If you use MB02 backplanes, use one STA-1800U for every four backplanes. Connect each group of four backplanes to an STA-1800U as shown in Chapter 4, and daisy-chain any additional STA-1800U accessories to the first STA-1800U.

Sampling sequences and gain settings for all expansion-board channels are communicated through the control lines described in the following two subsections.

Multiplexer Control Lines MUX 4 to MUX 7

Multplexer lines MUX 4 to MUX 7 control the channel sequencing of EXP-1800 and MB02 expansion accessories. These lines carry the channel-sequencing information from the channel-gain QRAM through the main I/O connector of DAS-1800ST/HR Series boards.

External Gain Control Line GEXT

External gain line GEXT sets channel gains on EXP-1800 accessories to 1 or 50. This line carries the channel gain settings from the channel-gain QRAM through the main I/O connector of the DAS-1800ST/HR Series boards.

Gains and Ranges

The available gains and their corresponding input ranges are listed in Table 2-1 for the DAS-1801ST and Table 2-2 for the DAS-1802ST and DAS-1802HR.

Table 2-1. DAS-1801ST Gains and Ranges for Unipolar and Bipolar Modes

Gain	Unipolar Range	Bipolar Range
1	0 to 5 V	−5.0 to +5.0 V
5	0 to 1 V	−1.0 to +1.0 V
50	0 to 100 mV	−100 to +100 mV
250	0 to 20 mV	−20 to +20 mV

Table 2-2. DAS-1802ST and DAS-1802HR Gains and Ranges for Unipolar and Bipolar Modes

Gain	Unipolar Range	Bipolar Range
1	0.0 to +10.0 V	−10 to +10 V
2	0.0 to +5.0 V	−5.0 to +5.0 V
4	0 to 2.5 V	−2.5 to + 2.5 V
8	0 to 1.25 V	−1.25 to +1.25 V

Maximum Achievable Throughput Rates

Because you can change input ranges on a per-channel basis, throughput is likely to drop if you group channels with varying gains in sequence. The drop occurs because the channels with low-level inputs (magnitude of 100 mV or less) are slower than those with high-level inputs and because the channels with low-level inputs must drive out the residual signals left by the high-level inputs. The best way to maximize throughput is to use a combination of sensible channel grouping and external signal conditioning. When using the channel-gain queue, consider the following suggestions:

- Keep all channels configured for a particular range together, even if you have to arrange the channels out of sequence.
- If your application requires high-speed scanning of low-level signals, use external signal conditioning to amplify the signal to ±5 V or 0 to 5 V. This method offers the advantages of increasing total system throughput and reducing noise.
- If you are not using all the channels, you can make a particular channel-gain entry twice to allow for settling time. In this case, you want to ignore the results of the first entry.
- If you are measuring steady-state signals, do not use the channel-gain queue. Instead, use software to step through the channels and perform single-channel acquisitions. For example, using software-controlled single-channel acquisitions to acquire 1000 samples on channel 0 at a gain of 1 and then 2000 samples on channel 1 at a gain of 250 virtually eliminates interference. This method is the best for

measuring steady-state signals even if all the channels are at the same gain.

You must give special consideration to the direct measurement of low-level signals with the DAS-1801ST board. When using the ±20 mV, 0 to 20 mV, ±100 mV, or 0 to 100 mV ranges, measurement throughput drops for two reasons:

- The amplifier cannot settle quickly enough (particularly the ±20 mV and 0 to 20 mV ranges).
- Noise in the measurements is higher and thus can require post-acquisition filtering (averaging) to achieve accurate results.

The DAS-1801ST has best noise performance if presented with a perfect signal in these ranges, but perfect signals are virtually non-existent in the real world. Since the DAS-1801ST has very high bandwidth (bandwidth for low-level signals is about 8 to 10 MHz) any noise is amplified and digitized. As a result, you must carry out the measurement of low-level signals carefully to minimize noise effects.

Low-level transducers are best used with signal conditioning. Use the ±20 mV, 0 to 20 mV, ±100 mV, and 0 to 100 mV ranges with the differential input mode.

The tables below show throughput for various configurations. Note that these throughputs are based on driving the input with an ideal voltage source. The output impedance and drive of the source are far more critical when making large gain changes between two channels whose inputs are at opposite extremes of their input ranges, as when a signal near -20 mV is measured after a signal at near +5 V. You will get better performance driving adjacent channels at the same gain. The source needs to be able to drive both the capacitance of the cable and the RC (resistor-capacitor) product of the multiplexer resistance and the output capacitance of the multiplexer and board. The multiplexer is typically about 360 Ω (1 kΩ maximum) in series with 90 pF output capacitance.

On DAS-1800ST Series boards, the maximum throughput for sampling one channel at any gain is 333 ksamples/s. The throughput for channel-to-channel sampling with fixed gain in bipolar mode (0.024% maximum error) is shown in Table 2-3.

Table 2-3. DAS-1800ST Series Board Throughput for Channel-to-Channel Sampling in Bipolar Mode with Fixed Gain

DAS-1801ST Input Range	DAS-1802ST Input Range	Throughput
—	±10.0 V	312.5 ksamples/s
±5.00 V	±5.00 V	312.5 ksamples/s
—	±2.50 V	312.5 ksamples/s
—	±1.25 V	312.5 ksamples/s
±1.00 V	—	312.5 ksamples/s
±100 mV	—	312.5 ksamples/s
±20 mV	—	75 ksamples/s

The throughput for channel-to-channel sampling with fixed gain in unipolar mode (0.024% maximum error) is shown in Table 2-4.

Table 2-4. DAS-1800ST Series Board Throughput for Channel-to-Channel Sampling in Unipolar Mode with Fixed Gain

DAS-1801ST Input Range	DAS-1802ST Input Range	Throughput
—	0 to 10.0 V	312.5 ksamples/s
0 to 5.00 V	0 to 5.00 V	312.5 ksamples/s
—	0 to 2.50 V	312.5 ksamples/s
—	0 to 1.25 V	312.5 ksamples/s
0 to 1.00 V	—	312.5 ksamples/s
0 to 100 mV	—	250 ksamples/s
0 to 20 mV	—	60 ksamples/s

The maximum throughput for a DAS-1801ST board, operating in bipolar mode and having less than 1 LSB of error when driven from an ideal voltage source, is shown in Table 2-5.

Table 2-5. Maximum Throughput for DAS-1801ST in Bipolar Mode

	Maximum Throughput			
	To ±5 V	**To ±1.0 V**	**To ±100 mV**	**To ±20 mV**
From ±5.0 V	312.5 ksamples/s	250 ksamples/s	200 ksamples/s	70 ksamples/s
From ±1.0 V	250 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	70 ksamples/s
From ±100 mV	200 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	70 ksamples/s
From ±20 mV	70 ksamples/s	70 ksamples/s	70 ksamples/s	75 ksamples/s

The maximum throughput for a DAS-1801ST board, operating in unipolar mode and having less than 1 LSB of error when driven from an ideal voltage source, is shown in Table 2-6.

Table 2-6. Maximum Throughput for DAS-1801ST in Unipolar Mode

	Maximum Throughput			
	To 0 to 5 V	**To 0 to 1.0 V**	**To 0 to 100 mV**	**To 0 to 20 mV**
From 0 to 5.0 V	312.5 ksamples/s	200 ksamples/s	200 ksamples/s	50 ksamples/s
From 0 to 1.0 V	200 ksamples/s	312.5 ksamples/s	250 ksamples/s	60 ksamples/s
From 0 to 100 mV	200 ksamples/s	250 ksamples/s	250 ksamples/s	60 ksamples/s
From 0 to 20 mV	50 ksamples/s	60 ksamples/s	60 ksamples/s	60 ksamples/s

The maximum throughput for a DAS-1802ST board, operating in bipolar mode and having less than 1 LSB of error when driven from an ideal voltage source, is shown in Table 2-7.

Table 2-7. Maximum Throughput for DAS-1802ST in Bipolar Mode

	Maximum Throughput			
	To ±10.0 V	**To ±5.0 V**	**To ±2.50 V**	**To ±1.25 V**
From ±10.0 V	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s
From ±5.0 V	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s
From ±2.50 V	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s
From ±1.25 V	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s	312.5 ksamples/s

The maximum throughput for a DAS-1802ST board, operating in unipolar mode and having less than 1 LSB of error when driven from an ideal voltage source, is shown in Table 2-8.

Table 2-8. Maximum Throughput for DAS-1802ST in Unipolar Mode

	Maximum Throughput			
	To 0 to 10.0 V	**To 0 to 5.0 V**	**To 0 to 2.5 V**	**To 0 to 1.25 V**
From 0 to 10.0 V	312.5 ksamples/s	312.5 ksamples/s	250 ksamples/s	200 ksamples/s
From 0 to 5.0 V	312.5 ksamples/s	312.5 ksamples/s	250 ksamples/s	200 ksamples/s
From 0 to 2.5 V	250 ksamples/s	250 ksamples/s	312.5 ksamples/s	200 ksamples/s
From 0 to 1.25 V	200 ksamples/s	200 ksamples/s	200 ksamples/s	312.5 ksamples/s

On DAS-1802HR boards, the maximum throughput for single-channel operation is 100 ksamples/s. The maximum throughput for a DAS-1802HR board, operating in bipolar mode and having less than 2 LSBs of error when driven from an ideal voltage source, is shown in Table 2-9.

Table 2-9. Maximum Throughput for DAS-1802HR in Bipolar Mode

	Maximum Throughput			
	To ±10.0 V	**To ±5.0 V**	**To ±2.50 V**	**To ±1.25 V**
From ±10.0 V	98 ksamples/s	60 ksamples/s	60 ksamples/s	60 ksamples/s
From ±5.0 V	60 ksamples/s	98 ksamples/s	60 ksamples/s	60 ksamples/s
From ±2.50 V	60 ksamples/s	60 ksamples/s	98 ksamples/s	60 ksamples/s
From ±1.25 V	60 ksamples/s	60 ksamples/s	60 ksamples/s	98 ksamples/s

The maximum throughput for a DAS-1802HR board, operating in unipolar mode and having less than 2 LSBs of error when driven from an ideal voltage source, is shown in Table 2-10.

Table 2-10. Maximum Throughput for DAS-1802HR in Unipolar Mode

	Maximum Throughput			
	To 0 to 10.0 V	**To 0 to 5.0 V**	**To 0 to 2.5 V**	**To 0 to 1.25 V**
From 0 to 10.0 V	98 ksamples/s	60 ksamples/s	60 ksamples/s	60 ksamples/s
From 0 to 5.0 V	60 ksamples/s	98 ksamples/s	60 ksamples/s	60 ksamples/s
From 0 to 2.5 V	60 ksamples/s	60 ksamples/s	98 ksamples/s	60 ksamples/s
From 0 to 1.25 V	60 ksamples/s	60 ksamples/s	60 ksamples/s	98 ksamples/s

The worst-case error limit is the sum of the front-end settling time and the effect of converter non-linearity. In many measurement situations, this error is tolerable. Note, however, that driving the inputs of channels to a reasonable level of accuracy is often impractical because of the effects of transducer output impedance and cable and interconnect impedance. For best results, particularly with 16-bit systems, you should acquire all data without changing the channel.

Data Conversion Modes

DAS-1800ST/HR Series boards support two modes of data conversion: paced and burst. The conversion rate for each of these two modes is controlled by a different clock: the pacer clock for paced mode and the burst mode conversion clock for burst mode. Other differences between the two data conversion modes are as follows:

- **Paced mode** - Paced mode is the default data conversion mode and is the mode best-suited for continuous scanning of a queue of channels at a constant rate. In the paced mode, the conversion rate equals the pacer clock rate. The sample rate, which is the rate at which a single channel is sampled, is the pacer clock rate divided by the number of channels in the queue.
- **Burst mode** - In the burst mode, each pulse from the pacer clock starts a scan of an entire queue of channels. The conversion rate during a burst mode scan is equal to the rate of the burst mode conversion clock. The sample rate, which is the rate at which a single channel is sampled, is equal to the pacer clock rate.

  Burst mode can also be used for pseudo-simultaneous sample-and-hold in conjunction with DMA or interrupt operations.

Figure 2-2 shows the timing relationships of the paced and burst modes for a queue of channel 4 to channel 7.

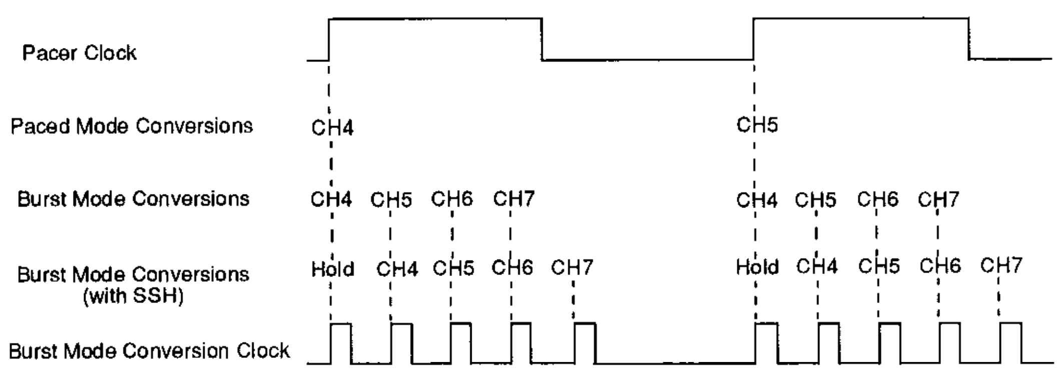

Figure 2-2. Timing of Conversion Modes for a Queue of Channels 4 to 7

Clock Sources

DAS-1800ST/HR Series boards provide two clocks: a pacer clock and a burst mode conversion clock. In paced mode, the pacer clock works alone to time interrupt-mode and DMA-mode operations, as shown in Figure 2-2. In burst mode and burst mode with SSH, the pacer clock and the burst mode conversion clock work together to time interrupt-mode and DMA-mode operations, as shown in Figure 2-2. These clock sources are described in the following subsections.

Pacer Clock

In paced mode, the pacer clock determines the conversion rate. The following clock sources are available for paced mode conversions on DAS-1800ST/HR Series boards:

- **Software** - DAS-1800ST/HR Series boards allow you to acquire single samples under program control.
- **Hardware (internal clock source)** - The internal pacer clock source uses the onboard 82C54 counter/timer and a crystal-controlled 5 MHz time base. The onboard pacer clock uses two cascaded counters of the 82C54. The maximum allowable rate is 333 kHz for DAS-1800ST Series boards and 100 kHz for the DAS-1802HR; the minimum available rate is 0.0012 Hz. When not used to pace the analog input, the internal clock source can serve to pace other events such as the digital I/O through the use of interrupts.
- **Hardware (external clock source)** - The external pacer clock source must be an externally applied TTL-compatible signal attached to XPCLK (pin 44) of the main I/O connector (pin 44 of the main I/O connector is accessible through pin 38 of STA-1800U connectors J1 and J2). The active edge for this clock is programmable.

  An external clock source is useful if you want to pace at rates not available with the 82C54 counter/timer, if you want to pace at uneven intervals, or if you want to pace on the basis of an external event. An external clock also allows you to synchronize multiple boards with a common timing source.

Note: The ADC acquires samples at a maximum of 333 ksamples/s (one sample every 3.0 µs) for DAS-1800ST Series boards and 100 ksamples/s (one sample every 10 µs) for the DAS-1802HR. If you are using an external clock, make sure that it does not initiate conversions at a faster rate than the ADC can handle.

If you are acquiring samples from multiple channels, the maximum sampling rate for each channel is equal to the maximum allowable conversion rate divided by the number of channels (see "Maximum Achievable Throughput Rates" on page 2-7).

Burst Mode Conversion Clock

In burst mode and burst mode with SSH, the burst mode conversion clock determines the conversion rate, while the pacer clock determines the rate at which bursts occur. In this manual, the conversion rate during burst mode conversion is referred to as the *burst mode conversion rate*, and the rate at which bursts occur is referred to as the *scan rate*.

DAS-1800 Series software utilities allow you to program the pacer clock to adjust the interval between burst mode scans. This software also allows you to adjust the burst mode conversion rate. The burst mode conversion clock frequency is programmable for a range of 15.625 to 333 kHz (64 µs to 3 µs in 1 µs increments) for the DAS-1800ST Series boards and 15.625 to 100 kHz (64 µs to 10 µs in 1 µs increments) for the DAS-1802HR.

The sample rate (pacer clock rate) should be set for no more than the burst mode conversion clock rate divided by the number of channels in the burst. The maximum burst mode conversion clock rate is gain-sensitive, as explained in "Maximum Achievable Throughput Rates" on page 2-7.

With SSH hardware attached to a DAS-1800ST/HR Series board, the sample rate (pacer clock rate) can be no more than the burst mode conversion rate divided by the sum of one plus the number of channels in the burst. For information on the signal interface between a DAS-1800ST/HR Series board and SSH hardware, refer to "Using Digital Control Signal SSHO" on page 2-24.

Triggers

A trigger starts or stops an interrupt-mode or DMA-mode analog input operation. An operation can use either one or two triggers. Every operation must have a *start trigger* that marks the beginning of an operation. You can use an optional second trigger, the *about trigger*, to define when an operation stops. You can use one of the following trigger sources to start an analog input operation:

- **Internal** - When you enable the analog input operation, conversions begin immediately.

- **External Analog** - While a hardware analog trigger is not a hardware function of the DAS-1800ST/HR Series boards, you can program an analog trigger using one of the analog input channels as the trigger channel. The DAS-1800 Series Function Call Driver provides functions for an analog trigger; refer to the *DAS-1800 Series Function Call Driver User's Guide* for more information.

- **External Digital** - Connect the digital trigger to TGIN (pin 46) of the main I/O connector, J1 (pin 46 of the main I/O connector J1 is accessible through pin 42 of STA-1800U connectors J1 and J2). Trigger types are as follows:

  - *Positive-edge trigger* - Triggering occurs on the rising edge of the trigger signal.

  - *Negative-edge trigger* - Triggering occurs on the falling edge of the trigger signal.

The actual points at which conversions begin depend on whether the clock source is internal or external clock, as follows:

- **Internal clock source** - The 82C54 counter/timer is idle until the trigger occurs. Within 400 ns, the first conversion begins. Subsequent conversions are synchronized to the internal clock.

- **External clock source** - Conversions are armed when the trigger occurs; they begin with the next active edge of the external clock source and continue with subsequent active edges.

The polarity of external triggers in the DAS-1800ST/HR Series boards is software-selectable. Figure 2-3 illustrates the enabling of conversions with software triggering/gating and with internal and external clock sources. In the diagram, the software enabling of the conversion process represents the point at which the computer issues a write to allow conversions. The delay shown between that point and startup of the onboard clock is less than 1 μs. Figure 2-4 illustrates the enabling of conversions with a hardware trigger.

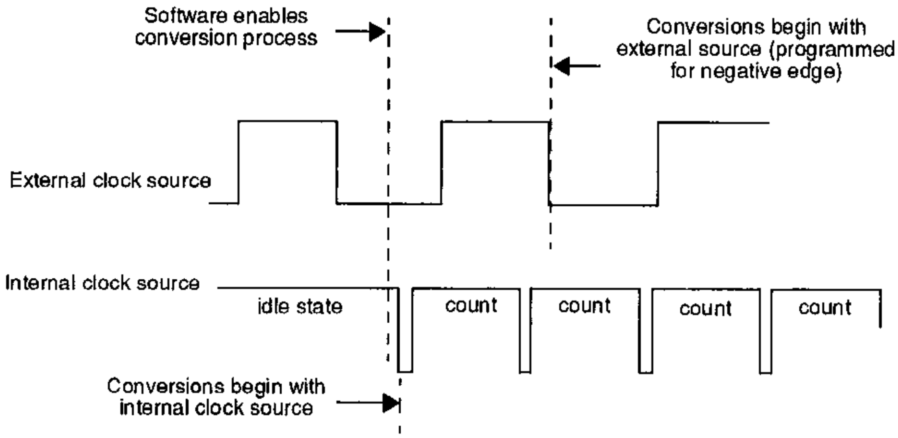

Figure 2-3. Enabling Conversions with Software Triggering/Gating and With Internal and External Clock Sources

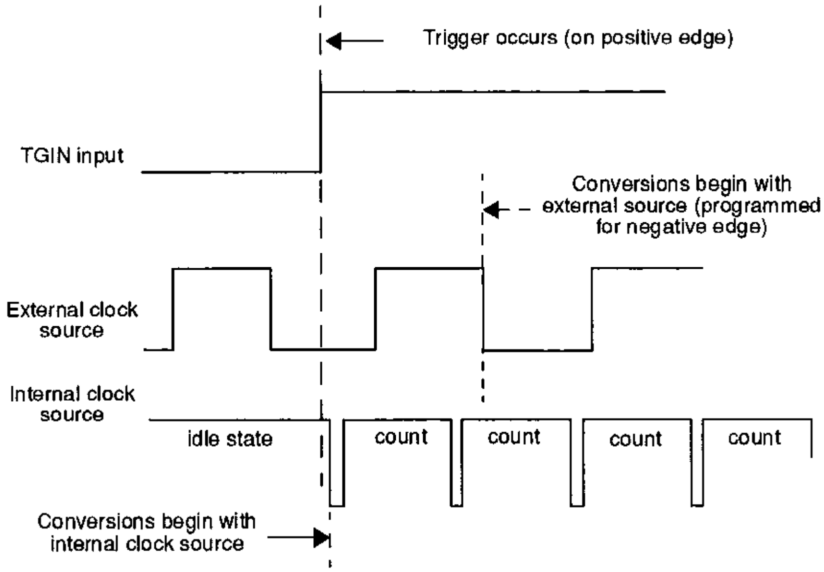

Figure 2-4. Enabling Conversions with a Hardware Trigger

If you specify an about trigger, the operation stops when a specified number of samples has been acquired after the occurrence of the about-trigger event. As described in the following subsections, the availability of the about trigger provides the capability to define operations that acquire data before a trigger event (pre-trigger acquisition), operations that acquire data about (before and after) a trigger event, and operations that acquire data after a trigger event (post-trigger acquisition).

Pre-Trigger Acquisition

In pre-trigger acquisition, the data of interest appears before a specific digital trigger event. Acquisition starts on an internal, analog, or digital trigger event and continues until the digital-trigger event. Pre-trigger acquisition is avaliable with DMA-mode operations only.

About-Trigger Acquisition

In about-trigger acquisition, the data of interest appears both before and after a specific digital trigger event. Acquisition starts on an internal, analog, or digital trigger event and continues until a specified number of samples has been acquired after the the digital trigger event. About-trigger acquisition is avaliable with DMA-mode operations only.

Post-Trigger Acquisition

In post-trigger acquisition, the data of interest appears after a specific event. Acquisition starts on an internal, analog, or digital trigger event and continues until a specified number of samples has been acquired or until the operation is stopped by software.

Gates

A gate allows conversions to proceed while in the active state. Connect the external gate to TGIN (pin 46) of the main I/O connector or to pin 42 of STA-1800U connectors J1 and J2..

The way conversions are synchronized depends on whether you are using an internal or an external clock, as follows:

- **With internal clocking** - The 82C54 stops counting when the gate signal goes inactive. When the gate signal goes active, the 82C54 is reloaded with its initial count value and starts counting again; therefore, with internal clocking, conversions are synchronized to the gate signal.
- **With external clocking** - The signal from the external clock continues uninterrupted while the gate signal is inactive; therefore, with external clocking, conversions are synchronized to the external clock.

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

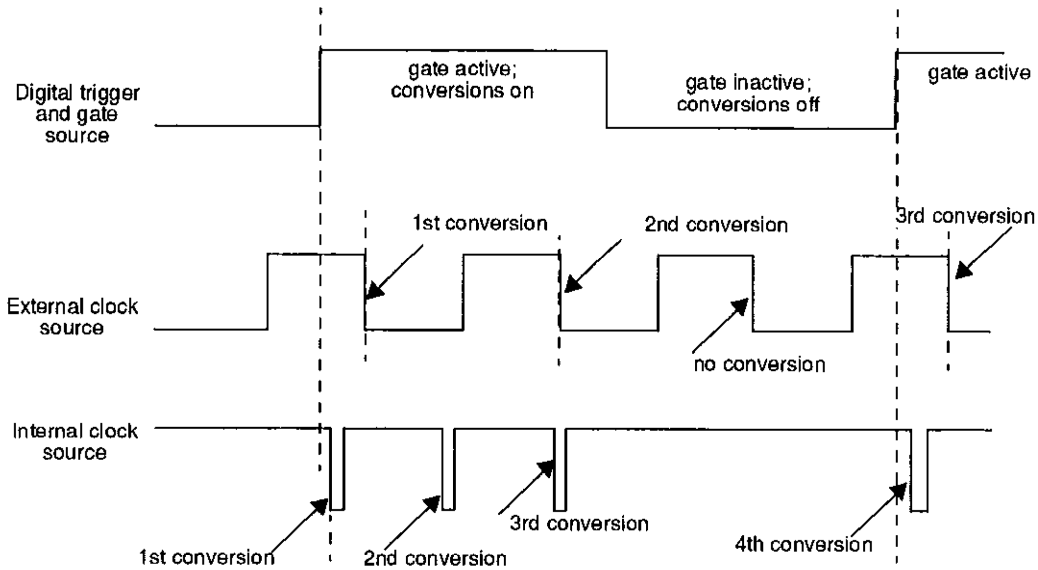

Figure 2-5. Hardware Gate

Data Transfer Modes

Using the provided software, you can transfer data from the DAS-1800ST/HR Series boards to the computer using the following data transfer modes:

- **Interrupt** - You can program the board to generate an interrupt for events such as *FIFO Half Full* or *FIFO Not Empty.* FIFO Half Full occurs after the FIFO accumulates 512 A/D samples for transfer to computer memory. FIFO Not Empty occurs anytime the FIFO buffer contains data.

  An interrupt occurs in the background, allowing the CPU to execute other instructions. The interrupt level is software-selectable.

  Unpredictable interrupt latencies in the Windows environment tend to make maximum board speeds unachievable in the interrupt mode.

When in the Windows environment, you are advised to use single- or dual-channel DMA instead of the interrupt transfer mode.

- **DMA** - DMA is a method of bypassing the CPU to transfer data directly between an I/O device and computer memory. In the IBM PC AT family, DMA is directed by the DMA controllers and can run in the background while the CPU is executing other instructions. The ability to run independent of the CPU and at high-transfer rates makes DMA an attractive method for transferring data in data acquisition systems.

  DAS-1800ST/HR Series boards use DMA channels 5, 6, and 7 to perform single- or dual-channel DMA transfers of A/D data from the board to memory. When you set up your configuration file, you can specify these channels singly for single-channel DMA or in pairs for dual-channel DMA.

  Each DMA channel can transfer up to 65,536 A/D samples before it has to be reprogrammed with a new memory address. When more than 65,536 samples are required by an application, the FIFO automatically buffers the samples while the DMA channel is being re-programmed for another address. In most situations, this FIFO buffering capability allows you to acquire large amounts of *gap-free* data into multiple buffers at up to maximum board speed using a single DMA channel.

  Generally, if you are programming operations in the Windows Enhanced Mode, you should use dual-channel DMA to acquire data reliably at maximum board speeds.

Digital I/O Features

DAS-1800ST/HR Series boards contain four digital inputs (DI0 to DI3) and four digital outputs (DO0 to DO3). Logic 1 on an I/O line indicates that the input/output is high (greater than 2.0 V); logic 0 on an I/O line indicates that the input/output is low (less than 0.8 V). The digital inputs are compatible with TTL-level signals. These inputs are provided with 10 kΩ pull-up resistors to +5 V; therefore, the inputs appear high (logic 1) with no signal connected.

Using Digital Control Signal DOSTB

The DAS-1800ST/HR Series boards provide a strobe signal (DOSTB on pin 19) for the purpose of strobing data through the digital outputs and latching the data into a register in external equipment. Where DAS-1800ST/HR Series boards use the positive edge of the strobe to strobe data out, you must use the negative edge to strobe data into other equipment because the negative edge gives you a 300 ns lag to allow for delays. Data is valid until the next strobe, as shown in Figure 2-6.

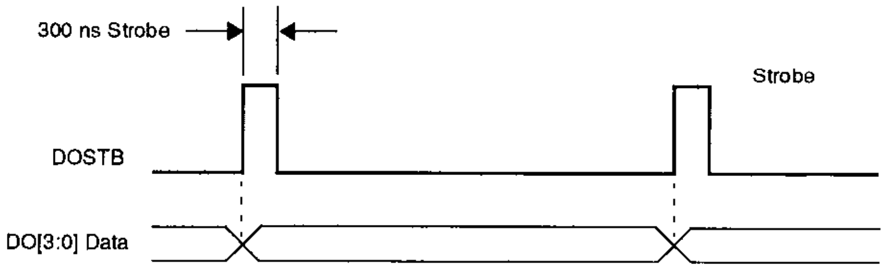

Figure 2-6. Timing Relationship between Data from DO0 to DO3 and Latch Strobe DOSTB

Using Digital Control Signal TGOUT

When using the onboard pacer clock only, you can use the trigger/gate output (TGOUT on pin 20) signal to synchronize other DAS-1800 Series boards or to trigger or gate user-specific events as follows:

- When using digital control signal TGIN as a trigger, TGOUT behaves as shown in Figure 2-7a. Note that when you use this option, TGOUT does not retrigger and thus can not be used with about-trigger acquisitions. Note also that there is a delay of about 200 ns between the active edge of TGIN and the starting edge of TGOUT.
- When using digital control signal TGIN as a gate, TGOUT behaves as shown in Figure 2-7b, note that there is a delay of about 200 ns between the active edge of TGIN and the starting edge of TGOUT.

- When using an internal trigger/gate, TGOUT behaves as shown in Figure 2-7c. Note that the delay between the active edge of the internal trigger/gate and the starting edge of TGOUT is less than 1 µs.

Note: You can use TGOUT only when the onboard pacer clock is used to time conversions.

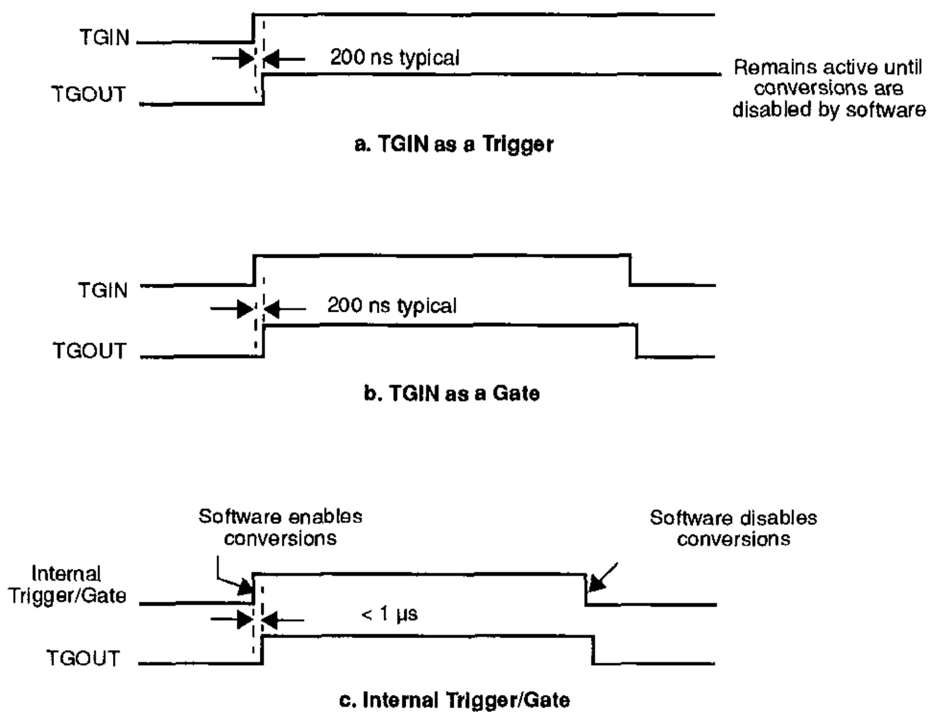

Figure 2-7. Timing for the TGOUT Signal

Using Digital Control Signal SSHO

The SSHO digital control signal is normally generated by DAS-1800ST/HR Series boards to accommodate external SSH hardware. The SSHO signal is initiated by either the onboard counter/timer clock or a user-supplied external clock. Characteristics of the SSHO signal when used for SSH hardware control are as follows:

- SSHO is normally low, signifying that the SSH hardware is in sample mode.
- SSHO goes high (into the Hold mode) about 50 ns after an active edge of the pacer clock and remains there until 200 ns after the ADC starts conversion of the last channel in the burst.
- SSHO remains low until another active edge of the pacer clock. To ensure adequate sample time for the SSH hardware, the pacer clock period should be set as follows:

  Pacer Clock Period ≥ (Number of Channels + 1) × (Burst Period)

  The Burst Period can be 3.0 to 64 μs for the DAS-1800ST Series boards and 10.0 to 64 μs for the DAS-1802HR board. A/D conversion begins one burst period after an active edge of the sample clock. Burst mode must be used when SSH hardware is connected to DAS-1800ST/HR Series boards.

When you are not using the SSHO signal for SSH hardware control, you can use it as a converter clock output signal. SSHO is active only during A/D conversions. The timing for SSHO generation when the DAS-1800ST/HR Series boards are not used for control of SSH hardware is shown in Figure 2-8.

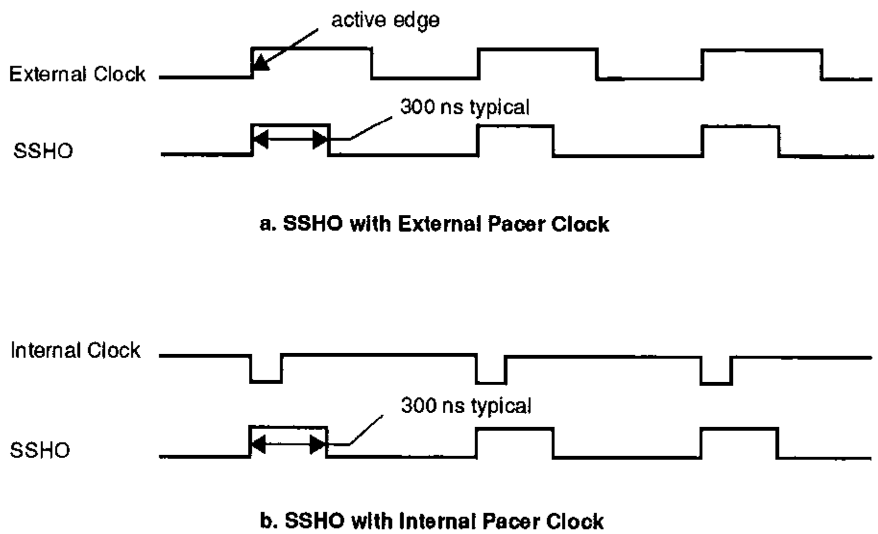

Figure 2-8. Timing for SSHO Signal When Not Used for SSH Hardware

Power

DAS-1800ST/HR Series boards use the +5 V and the +12 V provided by your computer. An onboard DC/DC converter develops ±15 V at a maximum current draw of 70 mA for external use. In addition to the ±15 V, the DAS-1800ST/HR Series boards supply +5 V from the computer to a pin on the main I/O connector at up to a maximum of 1.0 A.

3

Setup and Installation

This chapter describes inspection, software installation, configuration, and hardware installation for the DAS-1800ST/HR Series boards.

Read this chapter before you attempt to install and use your DAS-1800ST/HR Series board.

Unwrapping and Inspecting a Board

After you remove the wrapped board from its outer shipping carton, proceed as follows:

1. The board is packaged at the factory in an anti-static wrapper that must not be removed until you have discharged any static electricity by either of the following methods:
   - If you are equipped with a grounded wrist strap, you discharge static electricity as soon as you hold the wrapped board.
   - If you are not equipped with a grounded wrist strap, discharge static electricity by holding the wrapped board in one hand while placing your other hand firmly on a metal portion of the computer chassis (your computer must be off but grounded).
2. Carefully unwrap the board from its anti-static wrapping material. (You may wish to store the wrapping material for future use.)
3. Inspect the board for signs of damage. If damage is apparent, arrange to return the board to the factory (see "Technical Support" on page 7-5).

4. Check the remaining contents of your package against the packing list to be sure your order is complete. Report any missing items, immediately.

5. When you are satisfied with the inspection, proceed with the software and hardware setup instructions.

Note: DAS-1800ST/HR Series boards are factory calibrated; they require no further adjustment prior to installation. If at a later time you decide to re-calibrate the board, refer to Chapter 6 for instructions.

Installing the Software Package

Before you work with the software from any package, make a copy of all diskettes in the package. Use the copies as your working diskettes, and store the originals as backup diskettes.

This section provides the installation procedures for the DAS-1800 Series standard software package and the ASO-1800 software package. The DAS-1800 Series standard software package is for the DOS environment only. The ASO-1800 software package has a version for DOS and a version for Windows. Use the following procedure to install any or all of these software packages.

Installing a DOS Software Package

Use the following procedure to install the DAS-1800 Series standard software package or the DOS version of the ASO-1800 software package:

1. Insert diskette #1 of the software package into an appropriate floppy-disk drive of your computer.

2. Change to the drive containing the diskette and enter the following at the DOS prompt:

```
INSTALL
```

3. Respond to the installation-program prompts.

4. When the installation program requests a designation for the drive that is to receive your software, enter a designation of your choosing or accept the default designation.

5. When the installation program requests a name for the directory that is to receive your software, enter a name of your choosing or accept the default name.

   The installation program automatically creates a directory on the specified drive and then copies all files, expanding any compressed files, to the new directory.

6. Insert any additional disks, as required by the installation program.

The installation program notifies you when it completes the installation. After the installation, you may want to view the following files:

- **FILES.TXT** - An ASCII text file that lists and describes all the files written to the directory created by the installation program.

- **README.TXT** - An ASCII text file containing information available after the publication of this manual.

Installing the Windows Software Package

Use the following procedure to install the Windows portion of the ASO-1800 software package:

1. Insert diskette #1 into an appropriate floppy-disk drive of your computer.

2. Run the Windows program.

3. From the Program Manager File menu, select Run.

4. In the Command Line text box, type the letter of the drive containing your Windows diskette and follow with **SETUP**. For example, if your diskette is in drive A, type the following:

   ```
   A:SETUP
   ```

5. Select OK.

6. Respond to the installation-program prompts.
7. When the installation program requests a designation for the drive that is to receive your software, enter a designation of your choosing or accept the default designation of *C*.
8. When the installation program requests a name for the directory that is to receive the software, enter a name of your choosing or accept the default name.

   The installation program automatically creates a directory on the specified drive and then copies all files, expanding any compressed files, to the new directory.

   The installation program also creates a DAS-1800 program manager group containing icons for all DAS-1800 programs and information files.
9. Insert any additional disks, as required by the installation program.

The installation program notifies you when it completes the installation. After the installation, you may want to review the following files:

- **FILES.TXT** - An ASCII text file that lists and describes all the files written to the directory created by the installation program.
- **README.TXT** - An ASCII text file containing information available too late for publication in this manual.

Configuring the Board

Configuration options for your DAS-1800ST/HR Series board are recorded in a configuration file. This file is used by software to configure the board. The entry in the configuration file for base address also serves as a reference when you set the base-address switch on the board. The configuration file is described in the following subsection. The base address switch settings are discussed under "Setting the Base Address" on page 3-7.

Using the Configuration Utility

The configuration file contains a list of the configuration options and a setting for each. When you set up software to operate your DAS-1800ST/HR Series board, you specify the name of the configuration file. The configuration file is then used by the software as a reference for configuring the board.

Both the DAS-1800 Series standard software package and the ASO-1800 software package contain the same default configuration file. However, the settings for configuration options in the default configuration file are for a DAS-1802HC board. Before you can operate a DAS-1800ST/HR Series board, you must have the proper configuration file available. To create a configuration file for a DAS-1800ST/HR Series board, you use the configuration utility.

The configuration utility, CFG1800.EXE, is furnished in both the DAS-1800 Series standard software package and the ASO-1800 software package. This utility enables you to modify an existing configuration file or to create a new configuration file. To modify or create a configuration file, use the following procedure:

1. Start the configuration utility from DOS or Windows as follows:

   – *From DOS*, change to the directory containing CFG1800.EXE and enter the following at the DOS prompt:

     ```
     CFG1800 filename
     ```

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

   – *If you are in the Windows environment*, double click on the icon in the DAS-1800 group window, which is within the Program Manager window.

     Or, if you wish to modify or create a configuration file, select Run from the Program Manager File menu. Enter the following in the command line text box, and select OK:

     ```
     path CFG1800 filename
     ```

where *path* is the complete path to CFG1800.EXE, and *filename* is the name of the configuration file you wish to modify or create.

Whether *filename* is an existing file in the directory containing CFG1800.EXE or a file to be created, it is the name displayed by the configuration utility's opening screen. However, the settings displayed for *filename* may differ as follows:

- If *filename* is an existing file in the directory containing CFG1800.EXE, the configuration utility displays the settings contained in this existing file.
- If *filename* is a file to be created, the configuration utility displays the default configuration settings.
- If no entry was made for *filename*, the configuration utility displays the default configuration file DAS1800.CFG.

2. In the opening screen, enter the number of boards you plan to configure (1 to 3).

   After you make this entry, the utility program displays the menu box for the first board (board 0, which is shown in the upper-left corner of the menu box). The menu box contains the following configuration options:

   - *Board type* - This option is a choice between DAS-1801HC, DAS-1802HC, DAS-1801ST, DAS-1802ST, DAS-1802HR, DAS-1801AO, or DAS-1802AO.
   - *Base address* - This option requires the entry of a 3-digit address.
   - *A/D mode* - This option is a choice between bipolar or unipolar.
   - *A/D configuration* - This option is a choice between differential or single-ended.
   - *A/D common-mode ground reference* - This option is available only during single-ended A/D configuration and is a choice between LL Ground or User-Common Ground.
   - *DMA channel* - This option is a choice between available DMA channels or channel pairs.

- *IRQ level* - This option is a choice between available interrupt levels.
- *# of SSHs* - This option is a choice of a number representing the total of attached SSH-8 boards.
- *SSH Gains* - This option is a choice of a gain value for each channel of the attached SSH hardware.
- # of EXPs - This option is a choice of a number to represent the total of attached EXP-1800 accessories or MB02 backplanes.

3. To change the setting for a configuration option, use the arrow keys to highlight the option, press `[Enter]` to display a list of settings for that option, use the arrow keys to highlight the desired setting, then press `[Enter]` again to select the setting. These instructions are summarized in the Commands/Status box at the bottom of the screen.

Note: If you are using MB02 backplanes or EXP-1800 accessories, you must set the A/D Configuration option for single-ended.

If you are using MB02 backplanes, you must set the # of EXPs option to equal the number of MB02 backplanes.

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4. If you are configuring more than one board, press `[N]` when you wish to see the menu box for the next board.
5. When you complete the changes for all boards, press `[Esc]`.
6. The configuration utility asks whether to save the changes. Press `[Y]` for *yes* or `[N]` for *no*.

Setting the Base Address

The base address switch on DAS-1800ST/HR Series boards is preset at the factory for a value of 300h (768 decimal). If this address appears to conflict with the address of another device in the computer (including other DAS-1800 Series boards), you must reset the base address switch.

The base address switch is a 6-position DIP switch located as shown in Figure 3-1. To reset this switch for another address, use the configuration utility (described on page 3-5) to determine a new address and to see the corresponding switch settings in the menu-box diagram.

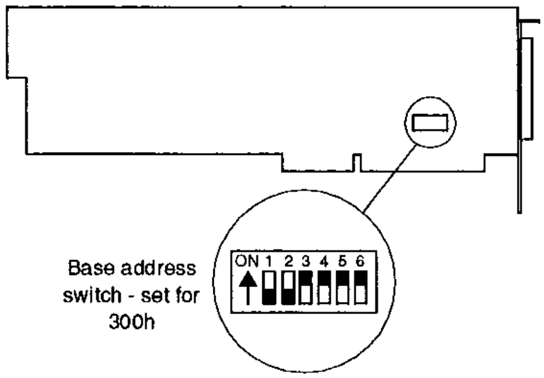

Figure 3-1. Location of Base Address Switch on DAS-1800ST/HR Series Boards

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Note: The settings for the base-address switch must match the settings shown by the switch diagram in the menu box of the configuration utility.

Installing the Board

Caution: Installing or removing a board while power is on can damage your computer.

Use the following steps to install a DAS-1800ST/HR Series board in an accessory slot of your computer:

1. Turn off power to the computer and all attached equipment.
2. Remove the computer chassis cover.

3. Select an unoccupied accessory slot, and remove the corresponding blank plate from the I/O connector panel.

4. Make sure the settings of the base-address switch match the settings shown in the configuration-utility switch diagram.

5. Insert and secure the board in the selected slot.

6. Replace the computer cover.

7. Turn on power to the computer.

You can use the Control Panel (see Chapter 5) to check board operation.

You are now ready to make I/O connections. Refer to Chapter 4 for descriptions of I/O accessories and connections for DAS-1800ST/HR Series boards.

4

Cabling and Wiring

This chapter describes the cabling and wiring required for attaching accessories and I/O lines to your DAS-1800ST/HR Series boards.

Caution: To avoid electrical damage, turn off power to the computer and any attached accessories before making connections to DAS-1800ST/HR Series boards.

Attaching an STA-1800U

The STA-1800U screw terminal accessory is an interface for I/O connections to DAS-1800ST/HR Series boards; it contains the following components:

- Two 50-pin male connectors (J1 and J2). Use J1 for cabling to the main I/O connector of a DAS-1800ST/HR Series board; use J2 for cabling to a second STA-1800U.
- 53 labeled screw terminals for connections from sensor outputs and test equipment
- Four 26-pin male connectors for cabling to MB02 backplanes
- One 37-pin male connector for cabling to SSH-8 accessories

Figure 4-1 shows the connector layout of an STA-1800U accessory.

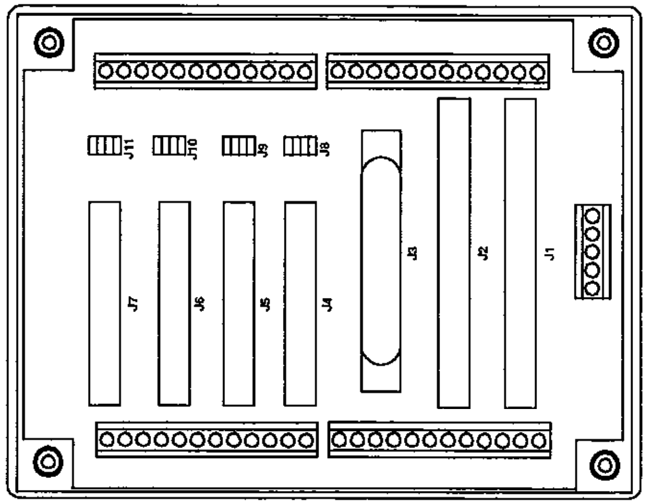

Figure 4-1. Connector Layout of an STA-1800U Accessory

To attach an STA-1800U to a DAS-1800ST/HR Series board, use a CDAS-2000 cable. Connect the cable from the main I/O connector of the DAS-1800ST/HR Series board to connector J1 of the STA-1800U, as shown in Figure 4-2.

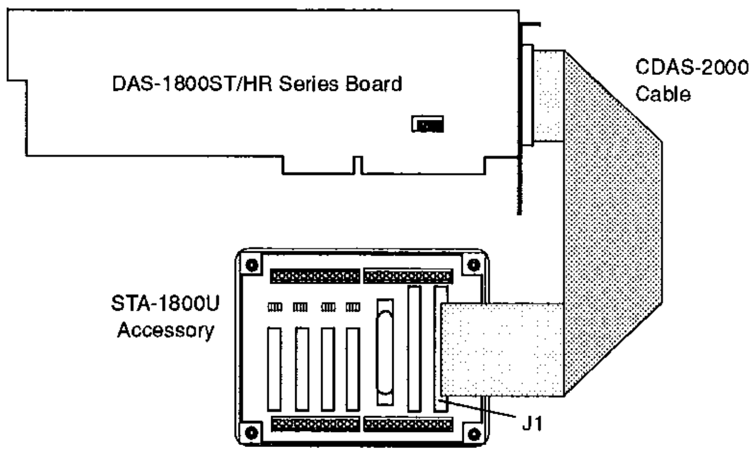

Figure 4-2. Cabling and Connections for Attaching an STA-1800U Accessory to a DAS-1800ST/HR Series Board

Pin assignments for main I/O connectors of DAS-1800ST/HR Series boards are shown in Figure 4-3.

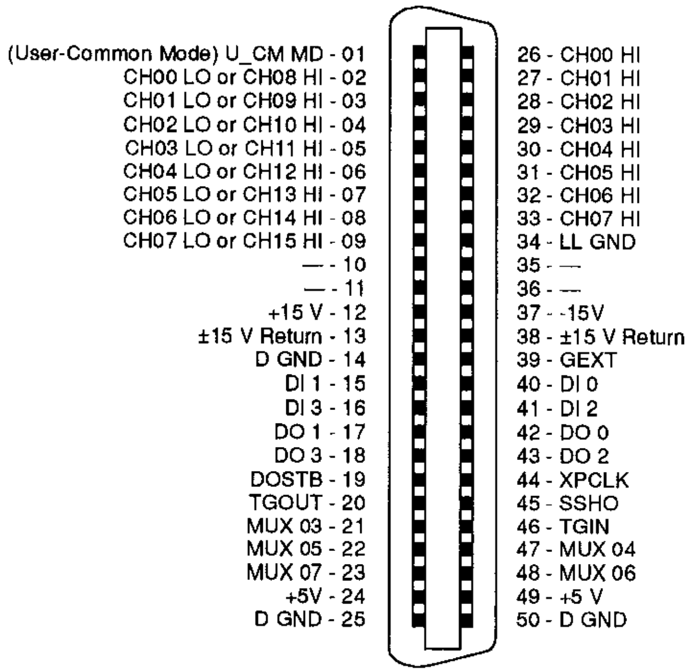

Figure 4-3. Pin Assignments for the Main I/O Connector of a DAS-1800ST/HR Series Board

Pin assignments for I/O conectors J1 and J2 of the STA-1800U accessory are shown in Figure 4-4.

(User-Common Mode) U_CM MD - 01	02 - CH00 HI
CH00 LO or CH08 HI - 03	04 - CH01 HI
CH01 LO or CH09 HI - 05	06 - CH02 HI
CH02 LO or CH10 HI - 07	08 - CH03 HI
CH03 LO or CH11 HI - 09	10 - CH04 HI
CH04 LO or CH12 HI - 11	12 - CH05 HI
CH05 LO or CH13 HI - 13	14 - CH06 HI
CH06 LO or CH14 HI - 15	16 - CH07 HI
CH07 LO or CH15 HI - 17	18 - LL GND
— - 19	20 - —
— - 21	22 - —
+15 V - 23	24 - -15V
±15 V Return - 25	26 - ±15 V Return
D GND - 27	28 - GEXT
DI 1 - 29	30 - DI 0
DI 3 - 31	32 - DI 2
DO 1 - 33	34 - DO 0
DO 3 - 35	36 - DO 2
DOSTB - 37	38 - XPCLK
TGOUT - 39	40 - SSHO
MUX 03 - 41	42 - TGIN
MUX 05 - 43	44 - MUX 04
MUX 07 - 45	46 - MUX 06
+5V - 47	48 - +5 V
D GND - 49	50 - D GND

Figure 4-4. Pin Assignments for Main I/O Connectors J1 and J2 of the STA-1800U Accessory

Attaching an STP-50

The STP-50 is a compact screw-terminal panel that you plug into the main I/O connector of a DAS-1800ST/HR Series board. Terminals of this panel are labeled to correspond to pin assignments shown in Figure 4-4 for the main I/O connectors J1 and J2 of the STA-1800U.

Attaching SSH-8 Accessories

DAS-1800ST/HR Series boards can accept one or two SSH-8 accessories. The SSH-8 is a simultaneous sample-and-hold accessory whose functions and capabilities are described in the *SSH-8 User's Guide.* This accessory can serve as a front-end analog interface for DAS-1800ST/HR Series boards when connected through an STA-1800U. Note that attached SSH-8 accessories must be set as slaves. Attach an SSH-8 to a STA-1800U using a C-1800 cable, as shown in Figure 4-5. Refer to the *SSH-8 User's Guide* for more information.

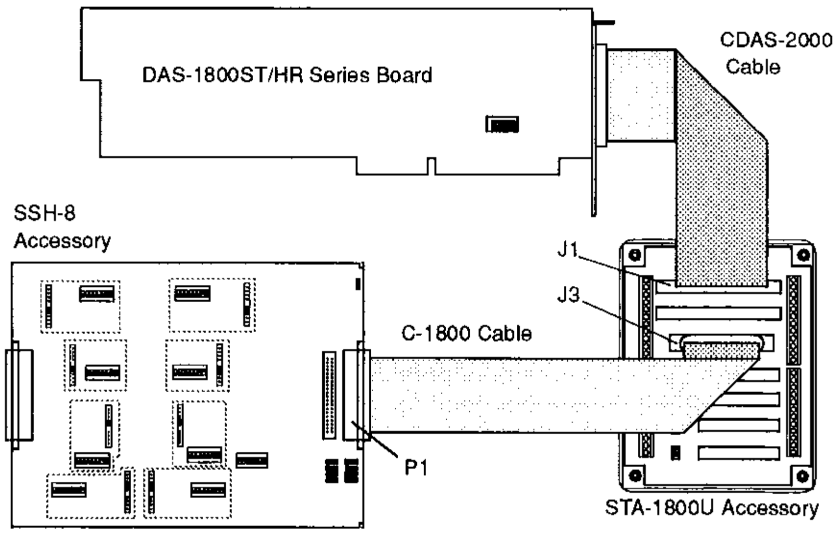

Figure 4-5. Cabling and Connections for Attaching an SSH-8 Accessory to a DAS-1800ST/HR Series Board

Attaching MB02 Backplanes

A DAS-1800ST/HR Series board configured for single-ended inputs and working through multiple STA-1800U accessories can support up to 16 MB02 backplanes. A single STA-1800U contains receptacles (J4 to J7) for up to four MB02 backplane cables. Cabling for the four MB02 backplanes attached to an STA-1800U accessory is shown in Figure 4-6.

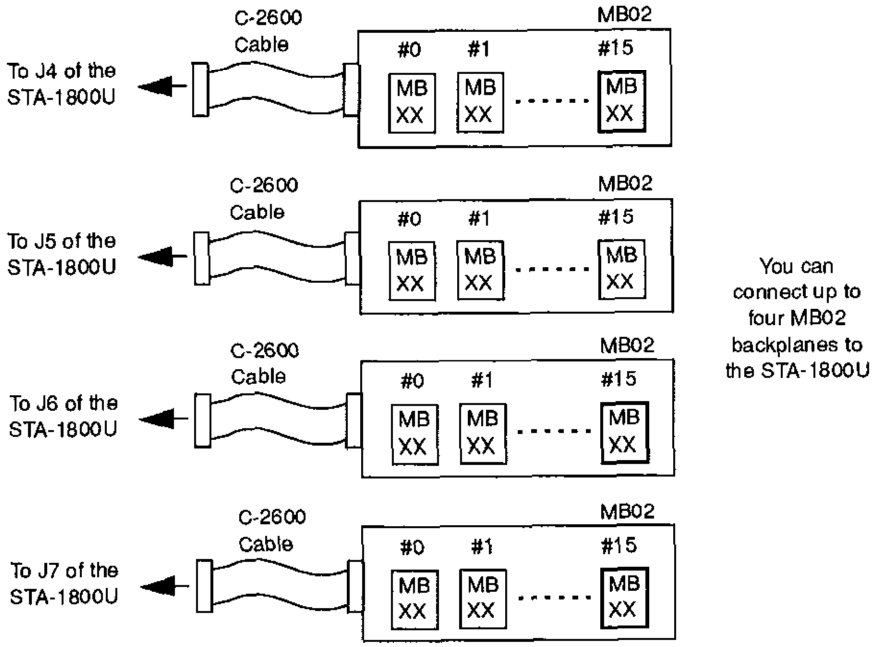

Figure 4-6. Cabling and Connections for Attaching MB02 Backplanes to an STA-1800U Accessory

Use one STA-1800U for every four MB02 backplanes. Additional STA-1800U accessories are daisy-chained to the first STA-1800U, using CACC-2000 cables to connect J2 of one STA-1800U to J1 of the next, as shown in Figure 4-7.

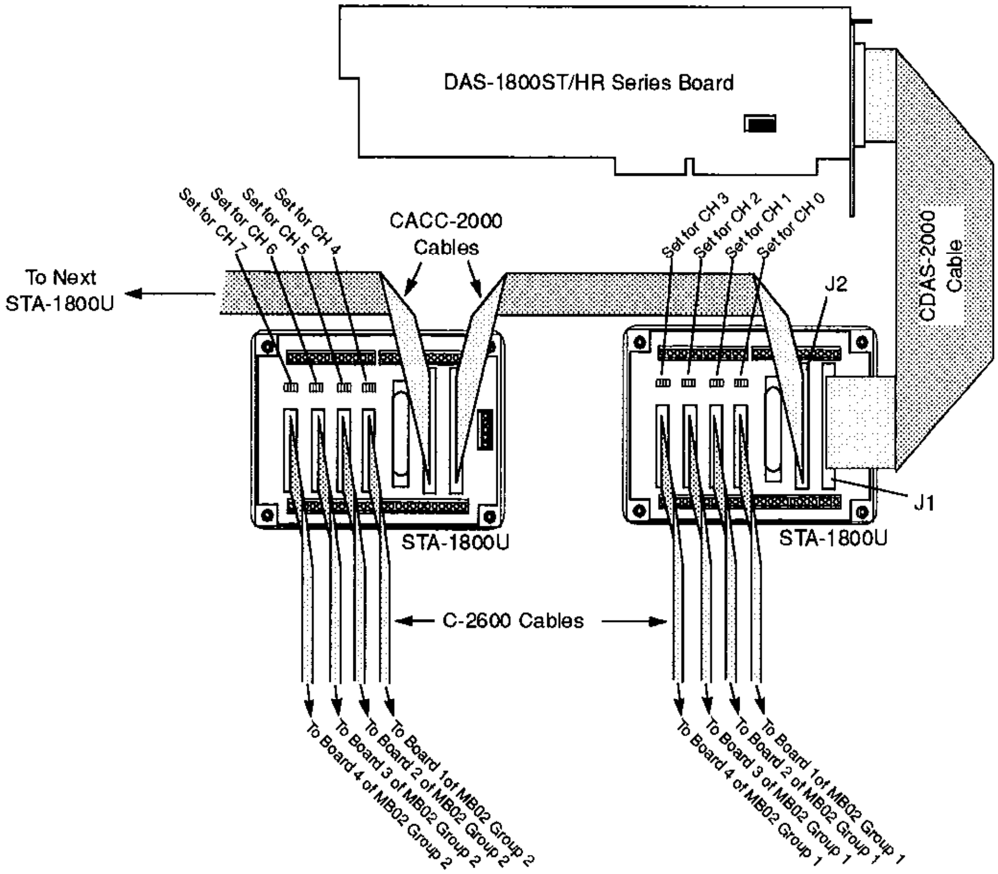

Figure 4-7. Daisy-Chaining STA-1800U Accessories with Attached MB02 Backplanes

The jumper pad beside each STA-1800U receptacle (J4 to J7) selects the channel of the DAS-1800ST/HR Series board that the attached MB02 backplane is to use. On the first STA-1800U, the jumpers connect STA-1800U receptacles J4 to J7 to DAS-1800ST/HR Series channels 0 to 3, respectively (default settings), as shown in the diagram. On a second STA-1800U, you position the jumpers to connect receptacles J4 to J7 to channels 4 to 7, respectively; and so on. Refer to Figure B-3, in Appendix B, for a diagram of receptacles J4 to J7 and their associated jumper pads.

MB02 backplanes are connected to an STA-1800U as shown in Figure 4-6. For more information on MB Series backplanes and modules, refer to the *MB Series User's Guide.*

Attaching EXP-1800 Accessories

An EXP-1800 accessory connects directly to the main I/O connector of a DAS-1800ST/HR Series board through a CDAS-2000 cable, as shown in Figure 4-8. To connect an additional EXP-1800, connect a CACC-2000 cable as shown in Figure 4-8.

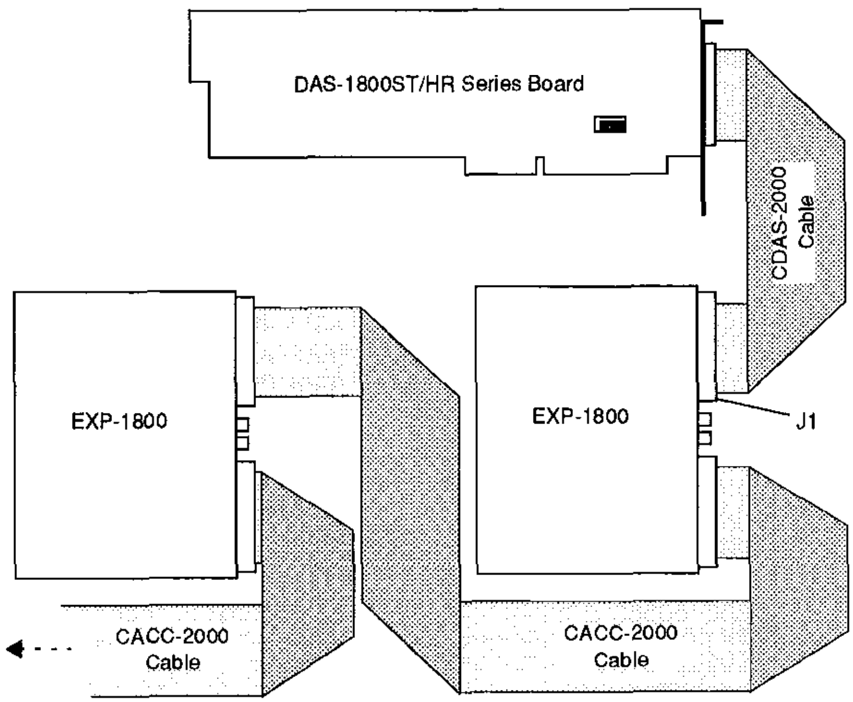

Figure 4-8. Daisy-Chaining EXP-1800 Accessories

You can attach up to 16 EXP-1800 accessories to a DAS-1800ST/HR Series board in this manner. For more information on the EXP-1800, refer to the *EXP-1800 User's Guide.*

Connecting Signals

This section contains precautionary advice to consider before making I/O connections. The section also shows some circuits for wiring signal sources to input channels of DAS-1800ST/HR Series boards.

The circuit diagrams represent a single signal source wired to a single channel (channel *n*). In reality, you can wire 8 separate signal sources to 8 differential inputs or 16 separate signal sources to 16 single-ended inputs.

DAS-1800ST/HR Series boards contain separate grounds for low-level analog, ±15 V power return, and digital signals. An analog ground (LL GND or U_CM MD, depending on the input configuration) is for analog signals, a ±15 V return is for analog power, and a digital ground (DGND) is for digital signals and the +5 V power-supply return. If you are using a differential input configuration, you use LL GND for your analog ground. If you are using single-ended input configuration, you use LL GND or U_CM MD for your analog ground; refer to "Ground Selection for Single-Ended Inputs" on page 2-3 for information on choosing between available analog grounds.

Precautions

If you expect to use a DAS-1801ST board at high gain, read the precautionary information in the following subsection. Other considerations for I/O connections are offered under "Additional Precautions" on page 4-10.

Precautions for Using a DAS-1801ST Board at High Gains

Operating a DAS-1801ST board at gains of 50 or 250 can lead to problems if your application is unable to cope with noise. At a gain of 250, each bit of A/D output corresponds to 10 µV of analog input. Thus, with the high speed and bandwidth of this board, analog noise and performance degradation come easily unless you take precautions to avoid them. The following collection of ideas and suggestions is aimed at avoiding these problems.

- Operate a DAS-1801ST board in 8-channel differential mode. Using the board in 16-channel, single-ended mode at high gains introduces enough ground-loop noise to produce large fluctuations in readings.
- Minimize noise from crosstalk and induced-voltage pickup in the flat cables and screw-terminal accessories by using shielded cable. Connect the shield to LL GND and the inner conductors to Channel LO and HI. Channel LO and LL GND should have a DC return (or connection) at some point; this return should be as close to the signal source as possible. Induced noise from RF and magnetic fields can easily exceed tens of microvolts, even on one- or two-foot cables; shielded cable eliminates this problem.
- Avoid bi-metallic junctions in the input circuitry. For example, the kovar leads, used on reed relays, typically have a thermal emf to copper of 40 μV/°C. Thermals can introduce strange random variations caused by air currents, and so on.
- Consider filtering. This approach can use hardware (resistors, capacitors, and so on) but is often accomplished more easily with software. Instead of reading the channel once, read it 10 or more times in quick succession and average the readings. If the noise is random and gaussian, it will be reduced by the square-root of the number of readings.

Additional Precautions

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

- Avoid direct connections to the AC line.
- Make sure all connections are tight and sound so that signal wires are not likely to come loose and short to high voltages.

- Use isolation amplifiers where necessary.

Connecting a Signal to a Single-Ended Analog Input

Figure 4-9 shows the connections between a signal source and a channel of a DAS-1800ST/HR Series board configured for single-ended input mode. For information on single-ended ground connections, refer to "Ground Selection for Single-Ended Inputs" on page 2-3.

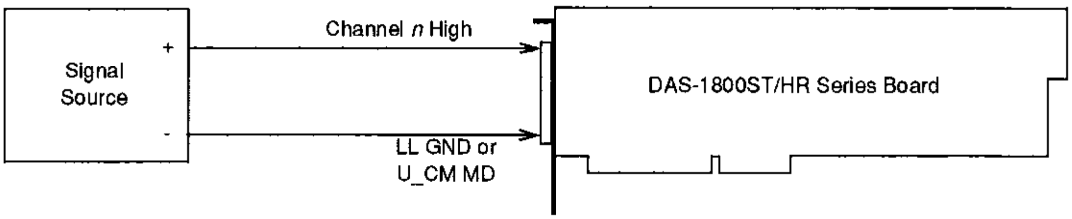

Figure 4-9. Connections for Wiring a Signal Source to a DAS-1800ST/HR Series Board Configured for Single-Ended Inputs

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Note: When you wire signals to the analog input channels, you are advised to wire all unused channels to LL GND or U_CM MD to prevent the input amplifiers from saturating and ensure the accuracy of your data.

Connecting a Signal to a Differential Analog Input

This section describes common connection schemes for differential inputs and discusses the principles for avoiding ground loops.

Common Connection Schemes for Differential Inputs

Figure 4-10 shows three connection schemes for wiring a signal source to a channel of a DAS-1800ST/HR Series board configured for differential input mode.

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

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

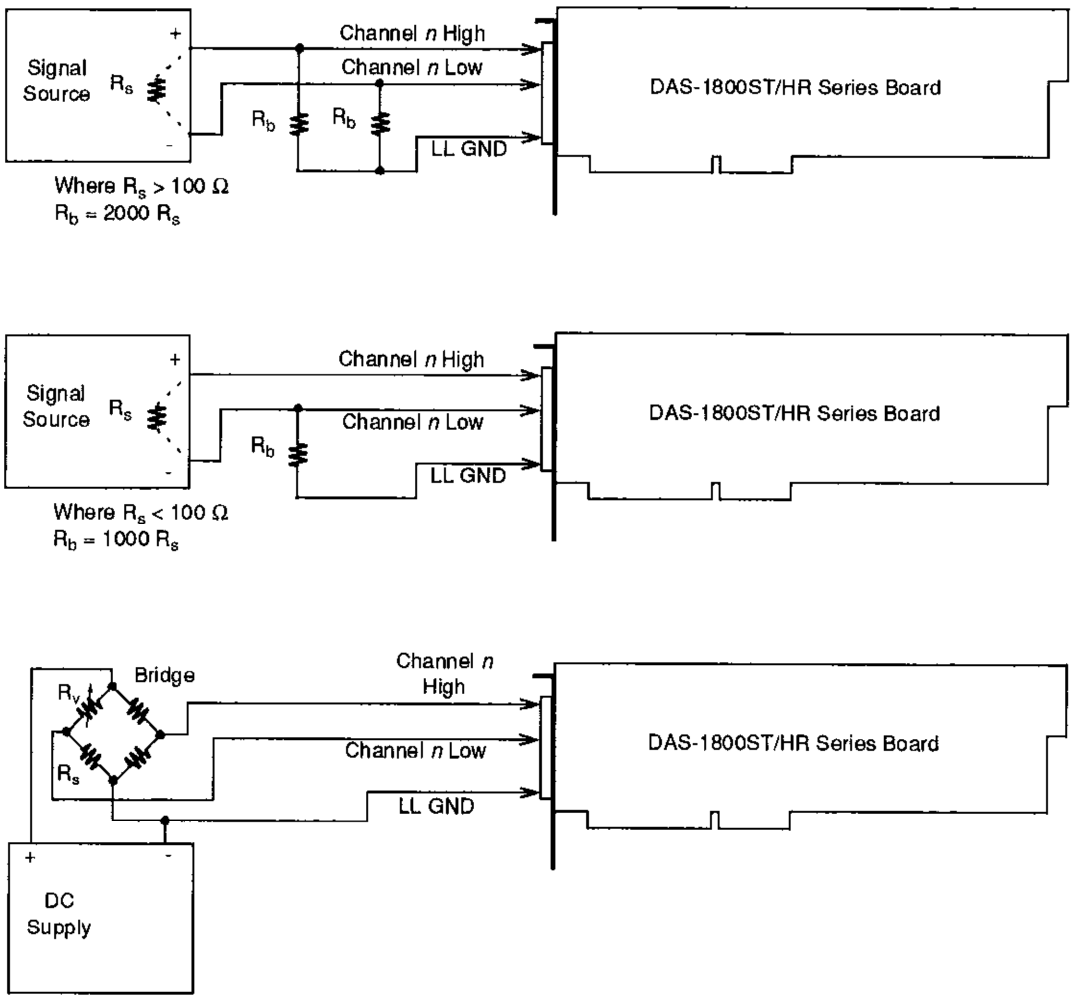

Figure 4-10. Three Types of Connections for Wiring a Signal Source to a DAS-1800ST/HR Series Board Configured for Differential Inputs

In the lower circuit of Figure 4-8, bias current return is inherently provided by the source. The circuit requires no bias resistors. R_s is the signal source resistance while R_v is the resistance required to balance the bridge.

Avoiding Ground Loops with Differential Inputs

Very often, the signal-source ground and the DAS-1800ST/HR Series board ground are not at the same voltage level because of the distances between equipment wiring and the building wiring. This difference is referred to as a *common-mode voltage* (V_{cm}) because it is normally common to both sides of a differential input (it appears between each side and ground). Since a differential input responds only to the difference in the signals at its high and low inputs, its common-mode voltages cancel out and leave only the signal. However, if your input connections contain a ground loop, your input could see the sum of the signal-source and common-mode voltages. Figure 4-11 shows the proper way to connect a differential input while Figure 4-12 illustrates the effect of a ground loop.

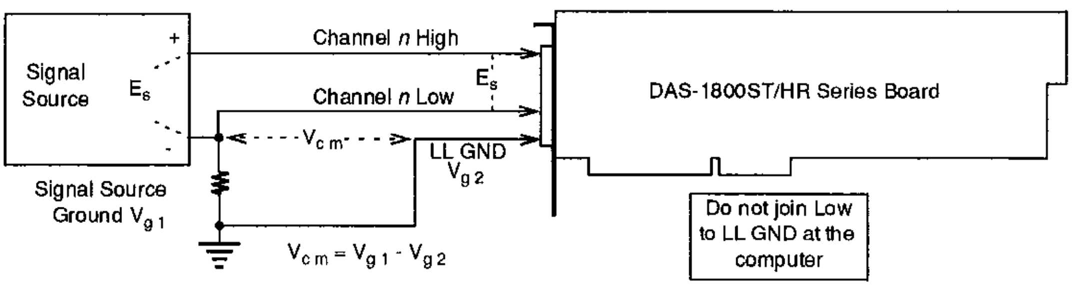

Figure 4-11. A Differential Input Configuration that Avoids a Ground Loop

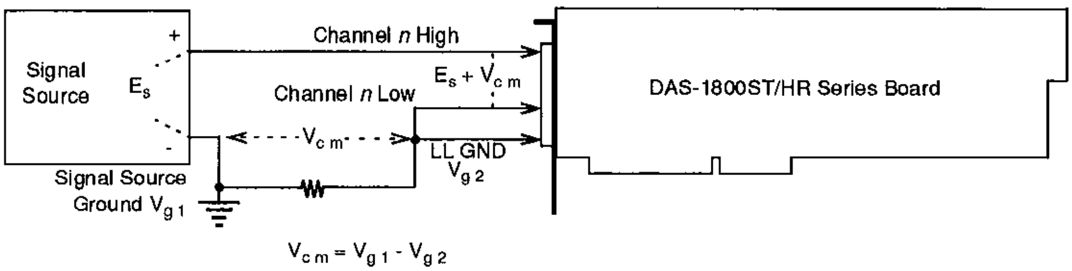

Figure 4-12. Differential Input Configuration with a Ground Loop

Connecting Digital I/O Signals

DAS-1800ST/HR Series boards have four digital inputs and four digital outputs, as described in "Digital I/O Features" on page 2-21. Make your connections to the digital I/O terminals through corresponding terminals of the STA-1800U. The terminals are labeled as follows:

- **Digital input** - The digital input terminals are DI 0 to DI 3.
- **Digital output** - The digital output terminals are DO 0 to DO 3.

Connecting Digital Control Signals

DAS-1800ST/HR Series boards use five digital control signals. Make your connections to the digital control terminals through corresponding terminals of the STA-1800U. The terminals are labeled as follows:

- **SSHO** - The simultaneous sample-and-hold output terminal. This signal is described in "Using Digital Control Signal SSHO" on page 2-24. Use the SSHO terminal for connecting this signal.
- **TGIN** - The trigger/gate input, described in the next section and in "Using Digital Control Signal TGOUT" on page 2-22. Refer also to "Triggers" on page 2-16 and to "Gates" on page 2-19. Use the trigger/gate TGIN for connecting a TGIN signal.

- **TGOUT** - The trigger/gate output, described in the next section and in "Using Digital Control Signal TGOUT" on page 2-22. Use the TGOUT terminal for connecting this signal.
- **XPCLK** - The external pacer clock input, described in the next section and in "Clock Sources" on page 2-14. Use the external clock terminal XPCLK for connecting this signal.
- **DOSTB** - The digital output strobe, described in "Using Digital Control Signal DOSTB" on page 2-22. Use the DOSTB terminal for connecting this signal.

Connecting and Synchronizing Multiple Boards

You can synchronize up to three DAS-1800 Series boards using trigger and gate signals from the main I/O connectors. Each board can run at the same or a different conversion rate as the other boards in the system.

The onboard pacer clock is designed to be tightly coupled with trigger and gate operations. After each board receives the trigger or gate, conversions begin within a defined period of time. If each board is programmed for a different conversion rate, the first conversion on each board occurs after this time period and subsequent conversions occur at the programmed rate.

Figure 4-13 shows two connection schemes for synchronizing multiple boards. Both schemes are using the onboard pacer clock to time acquisitions.

In Scheme 1, you connect the trigger/gate inputs of the three boards together and supply the trigger or gate input. A/D conversions on each board start 400 ±100 ns from the active edge of the trigger input. All conversions start within 100 ±100 ns of each other from board to board. When using this scheme, you can use the onboard pacer clock or an external pacer clock.

In Scheme 2, you can start conversions in either of two ways: by a hardware trigger/gate input or by software. The board connections are in a master/slave relationship. Board 0 (the master) begins A/D conversions 400 ±100 ns from the active edge of the trigger input or from a software enable. The slave boards begin conversions 300 ±100 ns from the start of conversions in the master. **When using this scheme, you must use the onboard pacer clock only.**

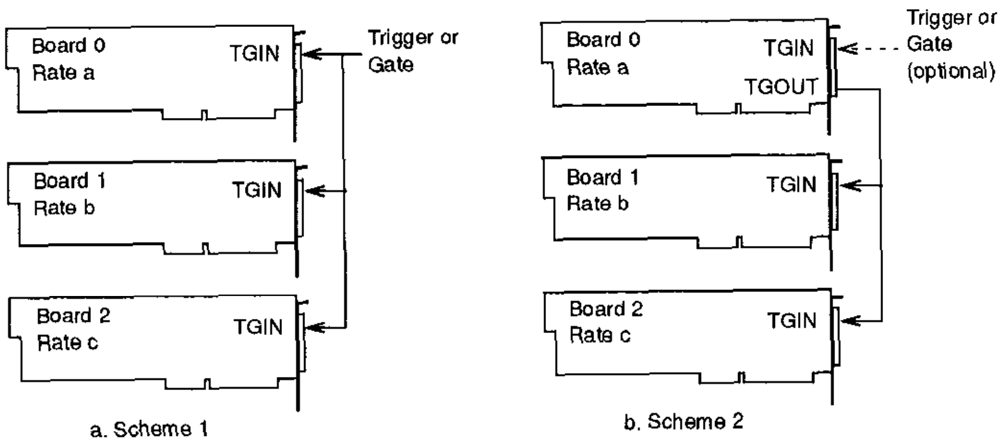

Figure 4-13. Two Connection Schemes for Synchronizing Multiple Boards

Note that TGOUT is an active, high-going signal. Therefore, you must program the slave-board TGIN inputs for a positive-going trigger or gate.

5

The Control Panel

The Control Panel is a utility program for testing the functions of DAS-1800 Series boards; the program is available in a DOS version (CTL1800.EXE) and a Windows version (CTL1800W.EXE). The DOS version is a part of both the DAS-1800 Series standard software package and the ASO-1800 software package. The Windows version is a part of the ASO-1800 software package only.

Note: Before using the Windows version of the Control Panel, you are advised to install the Keithley Memory Manager (VDMAD.386) to ensure the allocation of a memory buffer large enough for Control Panel needs. Refer to Appendix D for details of the Keithley Memory Manager.

To use the Control Panel, perform the following steps:

1. Start the Control Panel from the DOS or Windows environments as follows:

   – *If you are in the DOS environment,* change to the directory containing the CTL1800.EXE program and enter the following at the DOS prompt:

     ```
     CTL1800
     ```

   – *If you are in the Windows environment,* double click on the DAS-1800 Control Panel icon in the DAS-1800 Series Group window, which is within the Program Manager window.

   After the Control Panel starts, it asks you for the name of a configuration file.

2. To use the settings from the default configuration file, select OK. If you prefer to use the settings from another configuration file, enter the name of that file and select OK.

   After the Control Panel accepts the name of a configuration file, it displays the DAS-1800 TEST & CONTROL panel. This panel contains the controls that allow you to acquire, read, and transfer data and to set up and display parameters.

3. To set up and perform an operation, select the appropriate buttons. To obtain information on the setup and performance of an operation, use the Help option in the Control Panel menu. To obtain information on DAS-1800ST/HR Series board functions and parameters, refer to Chapter 2.

4. To set up and perform a digital I/O operation, select Digital I/O from the Control Panel menu. When the Control Panel displays the DIGITAL I/O panel, you can select appropriate buttons to proceed with your operation.

5. *If you are working in the Windows environment,* you can use the Control Panel's Dynamic Data Exchange (DDE) to transfer data to another Windows program by selecting DDE from the Control Panel menu.

6. Use the File menu to open, close, or save a file.

7. When you finish using the Control Panel, select the Exit option from the File menu to terminate the program.

6 Calibration

Your DAS-1800ST/HR Series board is initially calibrated at the factory. You are advised to check the calibration of a board every six months and to calibrate again when necessary. This chapter provides the information you need to calibrate a DAS-1800ST/HR Series board.

Equipment Requirements

The equipment requirements for calibrating a DAS-1800ST/HR Series board are as follows:

- A digital voltmeter accurate to 6 1/2 digits
- An adjustable ±10 V voltage calibrator
- An STA-1800U accessory and a CDAS-2000 cable; or an STP-50; or a user-designed interface
- The appropriate number of CDAS-2000 cables for EXP-1800 accessories, if used

Potentiometers and Test Points

Figure 6-1 shows the locations of the potentiometers and test points involved with the calibration of a DAS-1800ST/HR Series board. In the diagram, the term RTI is *Referred to Input* while RTO is *Referred to Output*. The calibration utility, described in the next section, directs you to these components and explains what to do with them during the calibration process.

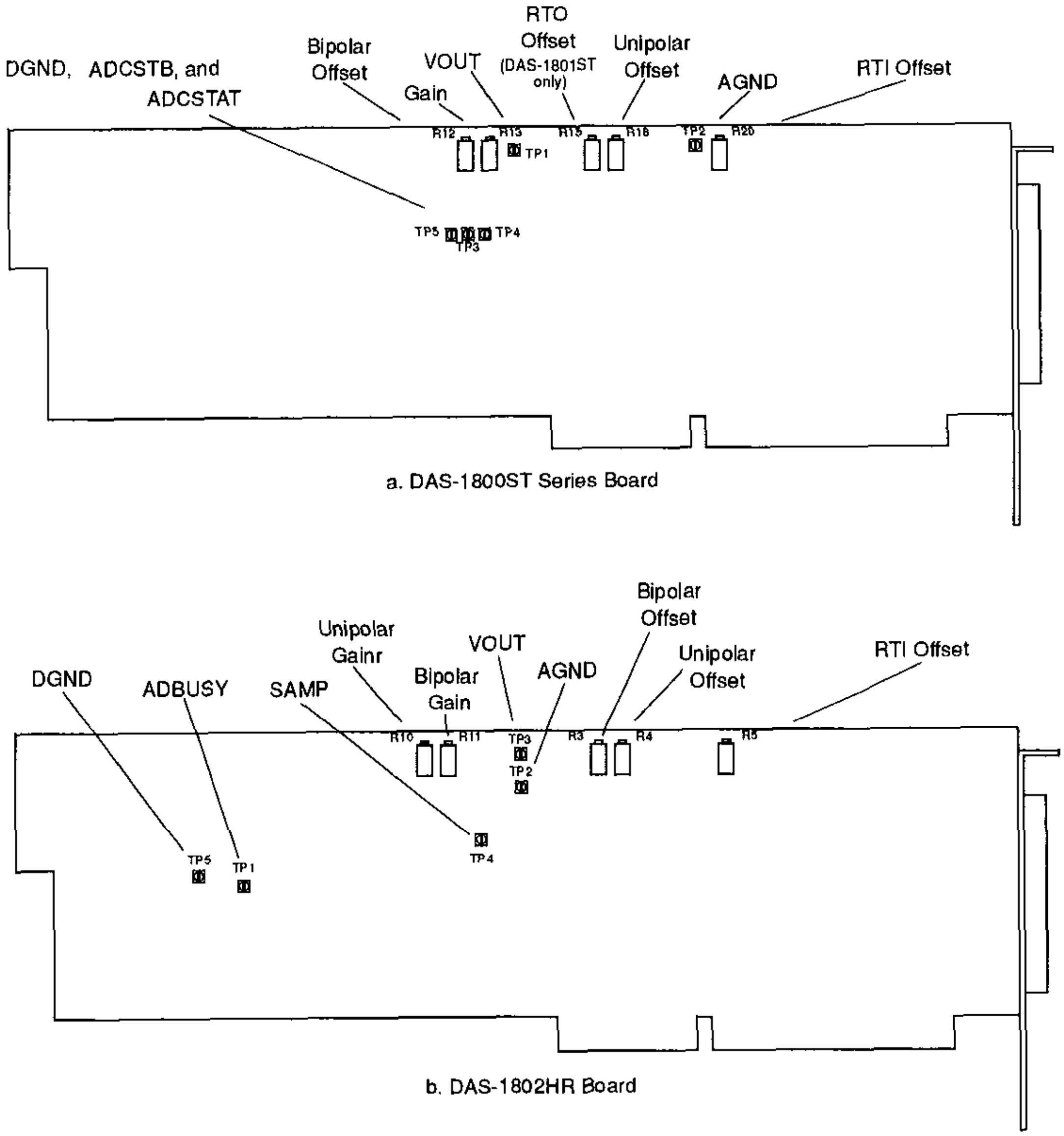

Figure 6-1. Potentiometers and Test Points on the DAS-1800ST/HR Series Boards

Calibration Utility

To calibrate a DAS-1800ST/HR Series board, use the DOS-based CAL1800.EXE calibration utility. This utility is included in both the DAS-1800 Series standard software package and the ASO-1800 software package.

To use the calibration utility, perform the following steps:

1. Start the calibration utility from the DOS or Windows environments as follows:

   – *If you are in the DOS environment*, change to the directory containing the CAL1800.EXE program and enter the following at the DOS prompt:

   ```
   CAL1800
   ```

   – *If you are in the Windows environment*, double click on the DAS-1800 Calibration icon in the DAS-1800 Series Group window, which is within the Program Manager window.

Follow the utility-program prompts as they appear; the program guides you through the calibration process. If you are using EXP-1800 accessories, do not connect them to the DAS-1800ST/HR Series board until you are requested to do so by the calibration utility.

7

Troubleshooting

If your DAS-1800ST/HR Series board is not operating properly, use the information in this chapter to isolate the problem. If the problem appears serious enough to warrant technical support, refer to "Technical Support" on page 7-6.

Problem Isolation

If you encounter a problem with a DAS-1800ST/HR Series board, use the instructions in this section to isolate the cause of the problem before calling the factory.

Identifying Symptoms and Possible Causes

Use the troubleshooting information in Table 7-1 to try to isolate the problem. Table 7-1 lists general symptoms and possible solutions for problems with DAS-1800ST/HR Series boards.

Table 7-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Board does not respond	Base address is incorrect or not consistent with what the program is addressing.	Check the base-address-switch setting on the board against the setting shown in the configuration utility. If the base address is set correctly, make sure no other computer device is using any of the I/O locations beginning at the specified base address. If necessary, reconfigure the base address. Refer to page 3-7 for instructions on setting the base address.
	The interrupt level is incorrect or not consistent with what the program is addressing.	Make sure no other computer device is using the interrupt level specified in your program. If necessary, reset the interrupt level.
	The board configuration is incorrect.	Check the remaining settings in the configuration file.
	The board is incorrectly aligned in the accessory slot.	Check the board for proper seating.
	The board is damaged.	Contact the factory; see page 7-6.
Intermittent operation	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See your computer documentation for instructions on running BIOS setup.
	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature. See the documentation for your computer.
	Electrical noise exists.	Provide better shielding or reroute unshielded wiring.

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See the documentation for your computer for instructions on running BIOS setup.
	An open connection exists.	Check wiring to screw terminal.
	Another system resource is using the specified base address.	Reconfigure the base address of the DAS-1800ST/HR Series board; refer to page 3-5 for more information. Check the I/O assignments of other system resources and reconfigure, if necessary.
	Transducer is not connected to channel being read.	Check the transducer connections.
	Board is set for single-ended mode while transducer is a differential type, or vice versa.	Check transducer specifications and board configuration.
Computer does not boot.	Board not seated properly.	Check the installation of the board.
	The base address setting of the DAS-1800ST/HR Series board conflicts with that of another system resource.	Check the base address settings of your system resources; each address must be unique.
	The power supply of the host computer is too small to handle all the system resources.	Check the needs of all system resources and obtain a larger power supply.
System lockup	A timing error occurred.	Press `[Ctrl]` + `[Break]`.

If your board is not operating properly after using the information in Table 7-1, continue with the next two sections to further isolate the problem.

Testing the Board and Host Computer

To isolate the problem to the DAS-1800ST/HR Series board or to the host computer, use the following steps:

1. Turn the power to the host computer OFF, and remove power connections to the computer.

Caution: Removing a board with the power ON can cause damage to your board and/or computer.

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2. While keeping connections to accessory board intact, unplug the accessory connector or cable from the DAS-1800ST/HR Series board.
3. Remove the DAS-1800ST/HR Series board from the computer and visually check for damage. If a board is obviously damaged, call the factory for information on returning the board.
4. With the DAS-1800ST/HR Series board out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

At this point, if you have another DAS-1800ST/HR Series board that you know is functional, you can test the slot and I/O connections using the instructions in the next section. If you do not have another board, refer to the instructions on page 7-6 before calling the factory.

Testing the Accessory Slot and I/O Connections

When you are sure that the computer is operating properly, test the computer accessory slot and I/O connections using another DAS-1800ST/HR Series board that you know is functional. To test the computer accessory slot and the I/O connections, follow these steps:

1. Remove computer power again, and install a DAS-1800ST/HR Series board that you know is functional. Do not make any I/O connections.

2. Turn computer power ON and check operation with the functional board in place. This test checks the computer accessory slot. If you were using more than one DAS-1800ST/HR Series board when the problem occurred, use the functional board to test the other slot, as well.

3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections, one at a time.

4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.

5. If operation remains normal to this point, the problem is in the DAS-1800ST/HR Series board(s) originally in the computer. If you were using more than one board, try each board one at a time in the computer to determine which is faulty.

6. If you cannot isolate the problem, refer to the next section for instructions on obtaining assistance.

Technical Support

Before returning any equipment for repair, call the factory. Please make sure that you have the following information available before you call::

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

A

Specifications

Tables A-1 to A4 lists the specifications for the DAS-1800ST/HR Series boards.

Table A-1. Analog Input Specifications for DAS-1800ST Series

Attribute	DAS-1801ST	DAS-1802ST
Number of channels	Software-selectable as 8 differential or 16 single-ended	
Input mode	Software-selectable as unipolar or bipolar	
Resolution	12-bit (1 part in 4096)	
Data format	16-bit twos complement	
FIFO size	1024 word	
Channel-gain QRAM size	256 locations	
Gain (range)	1 (0.0 to +5.0 V for unipolar) 1 (±5.0 V for bipolar) 5 (0.0 to +1.0 V for unipolar) 5 (±1.0 V for bipolar) 50 (0 to 100 mV for unipolar) 50 (±100 mV for bipolar) 250 (0 to +20 mV for unipolar) 250 (±20 mV for bipolar)	1 (0.0 to +10 V for unipolar) 1 (±10 V for bipolar) 2 (0.0 to +5.0 V for unipolar) 2 (±5.0 V for bipolar 4 (0.0 to +2.5 V for unipolar) 4 (±2.5 V for bipolar) 8 (0.0 to 1.25 V for unipolar) 8 (±1.25 V for bipolar)

Table A-1. Analog Input Specifications for DAS-1800ST Series (cont.)

Attribute	DAS-1801ST	DAS-1802ST
Absolute accuracy	Typical: 0.01% of reading ±1 LSB for all ranges Maximum error: • 0.02% of reading ±1 LSB max @ 25° C for gain < 250 • 0.03% of reading ±1 LSB max @ 25° C for gain = 250	
Temperature coefficient of accuracy (includes ADC)	Offset: • ±20 μV/ °C ±(12 μV/° C ÷ gain) maximum for bipolar • ±20 μV/ °C ±(14 μV/° C ÷ gain) maximum for unipolar Gain: • ±20 ppm/ °C for gain < 50 • ±30 ppm/° C for gain = 50 • ±35 ppm/° C for gain = 250	
Linearity[1] (Relative accuracy)	• Integral: ±½ LSB typical, ±1 LSB maximum • Differential: ±1 LSB	
Throughput	333 ksamples/s Refer to "Maximum Achievable Throughput Rates" on page 2-7	
Dynamic parameters	• Acquisition time: 0.3 μs • Aperture delay: 13.0 ns • Aperture uncertainty: 150 ps rms • Conversion time: 3.0 μs max. (includes acquisition time)	
Input bias current	• ±40 nA max. @ 25° C • ±60 nA max. over operating range	
Common-mode rejection ratio	• 74 dB for gain = 1 • 80 dB for gain = 5 • 100 dB for gain = 50 • 100 dB for gain = 250	• 74 dB for gain = 1 • 80 dB for gain = 2 • 80 dB for gain = 4 • 86 dB for gain = 8
Input overvoltage	• ±15 V continuous powered • ±15 V continuous unpowered	

Table A-1. Analog Input Specifications for DAS-1800ST Series (cont.)

Attribute	DAS-1801ST	DAS-1802ST
Noise[2]	Bipolar electrical noise (in counts) • p-p = 1, rms = 0.1 for gain = 1 • p-p = 1, rms = 0.1 for gain = 5 • p-p = 4, rms = 0.5 for gain = 50 • p-p = 8, rms = 1.0 for gain = 250 Unipolar electrical noise (in counts): • p-p = 1, rms = 0.1 for gain = 1 • p-p = 1, rms = 0.1 for gain = 5 • p-p = 6, rms = 0.9for gain = 50 • p-p = 9, rms = 1.4 for gain = 250	Bipolar electrical noise (in counts) • p-p = 1, rms = 0.1 for gain = 1 • p-p = 1, rms = 0.1 for gain = 2 • p-p = 1, rms = 0.1 for gain = 4 • p-p = 1, rms = 0.1 for gain = 8 Unipolar electrical noise (in counts): • p-p = 1, rms = 0.1 for gain = 1 • p-p = 1, rms = 0.1 for gain = 2 • p-p = 1, rms = 0.1 for gain = 4 • p-p = 1, rms = 0.1 for gain = 8
DMA levels	5, 6, and 7	
Interrupt levels	3, 5, 7, 10, 11, and 15	
Minimum external pacer clock pulse width	10 ns	
Maximum external pacer clock rate	333 kHz	
Minimum hardware trigger pulse width	10 ns	

Notes

[1] Monotonicity is guaranteed over the operating range.

[2] The figures in the table show the electrical noise introduced by the analog front end *but do not include the uncertainty inherent in the quantization process.* The inherent quantization noise introduced by any ADC is due to uncertainty at code boundaries and adds a peak-to-peak value of 1 LSB to the electrical noise; it also makes the rms level 0.5 LSBs.

Table A-2. Analog Input Specifications for DAS-1802HR

Attribute	DAS-1802HR
Number of channels	Software-selectable as 8 differential or 16 single-ended
Input mode	Software-selectable as unipolar or bipolar
Resolution	16-bits (1 part in 65,536 or 15 ppm)
Data format	16-bit twos complement
FIFO size	1024 word
Channel-gain QRAM size	256 locations
Range/gain	• 0.0 to +10 V for unipolar for gain = 1 • 0.0 to +5.0 V for unipolar for gain = 2 • 0.0 to +2.5 V for unipolar for gain = 4 • 0.0 to 1.25 V for unipolar for gain = 8
Absolute accuracy	Typical: 0.005% of reading ±1 LSB for all ranges Maximum error: • 0.005% of reading ±1.5 LSB for gain = 1 • 0.01% of reading ±1.5 LSB max all others
Relative Accuracy	Typical: 0.001% of reading ±1 LSB Maximum: 0.001% of reading ±1.5 LSB, range of 0 to 70°C
Temperature coefficient of accuracy (includes ADC)	Offset: • ±5 µV/°C maximum for bipolar • ±5 µV/°C maximum for unipolar Gain: • ±7.5 ppm/°C
Linearity[1]	Differential: ±1 LSB
Throughput	• Single channel: 100 ksamples/s • Multiple channels (no gain change): 98 ksamples/s • Multiple channels (w/gain change): 60 ksamples/s for gains of 1 to 8 Refer to "Maximum Achievable Throughput Rates" on page 2-7
Input Impedance	100 MΩ in parallel with 75 pF

Table A-2. Analog Input Specifications for DAS-1802HR (cont.)

Attribute	DAS-1802HR
Input bias current	• ±2 nA max. @ 25° C • ±100 nA max. over operating range
Dynamic parameters	• Acquisition time: 2 µs • Aperture delay: 6.0 ns • Aperture uncertainty: - 150 ps rms when used with internal pacer clock - 200 ns maximum with external pacer clock • Conversion time: 8.0 µs maximum
Common-mode rejection ratio	• 100 dB for gain = 1 • 100 dB for gain = 2 • 100 dB for gain = 4 • 100 dB for gain = 8
Input overvoltage	• ±15.0 V continuous powered and unpowered
Noise[2]	Bipolar electrical noise (in counts) • p-p = ±2.0, rms = 0.5 for gain = 1 • p-p = ±2.0, rms = 0.5 for gain = 2 • p-p = ±2.5, rms = 0.6 for gain = 4 • p-p = ±2.5, rms = 0.7 for gain = 8 Unipolar electrical noise (in counts): • p-p = ±2.0, rms = 0.6 for gain = 1 • p-p = ±2.0, rms = 0.6 for gain = 2 • p-p = ±2.5, rms = 0.7 for gain = 4 • p-p = ±3.0, rms = 0.8 for gain = 8
DMA levels	5, 6, and 7
Interrupt levels	3, 5, 7, 10, 11, and 15
Minimum external pacer clock pulse width	10 ns
Maximum external pacer clock rate	98 kHz
Minimum hardware trigger pulse width	10 ns

Notes

[1] Monotonicity is guaranteed over the operating range.
[2] The figures in the table show the electrical noise introduced by the analog front end and include the quantization noise.

Table A-3. Digital I/O Specifications

Attributes	DAS-1800ST/HR Series Boards
Digital output signals DOSTB, SSHO, and TGOUT	• V_{OH} (min.) = 2.4 V @ I_{OH} = -3 mA • V_{OL} (max.) = 0.5 V @ I_{OL} = 24 mA
Digital output signals DO 0 to DO 3, GEXT, and MUX 3 to MUX 7	• V_{OH} (min.) = 2.7 V @ I_{OH} = −400 μA V_{OL} (max.) = 0.5 V @ I_{OL} = 8 mA
Digital input signals DI 0 to DI 3, XPCLK, and TGIN	• V_{IH} (min.) = 2.0 V; I_{IH} (max.) = 20 μA • V_{IL} (max.) = 0.8 V; I_{IL} (max.) = −0.2 mA
Digital output strobe pulse width	300 ns typical; data is latched on the rising edge of DOSTB

Note: Digital inputs DI0 to DI3 are pulled up with a 10 kΩ resistor. Inputs TGIN and XPCLK are not pulled up.

Table A-4. Power Supply Requirements

Attribute	DAS-1800ST Series	DAS-1802HR
+5 VDC input	520 mA typical; 870 mA maximum	500 mA typical; 870 mA maximum
+12 VDC input	190 mA typical; 550 mA maximum	200 mA typical; 550 mA maximum
Maximum current available at the ±15 V outputs	70 mA	70 mA
Maximum current available at the +5 V output	1.0 A	1.0 A

B

Connector Pin Assignments

This appendix contains pin assignments for connectors of the DAS-1800ST/HR Series boards and the STA-1800U accessory.

Main I/O Connector of DAS-1800ST/HR Series Boards

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

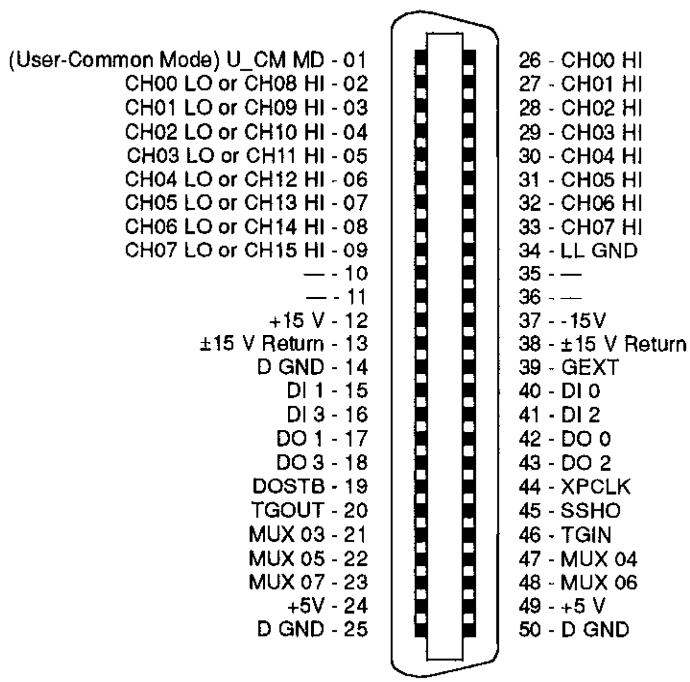


Figure B-1. Pin Assignments for the Main I/O Connector of a DAS-1800ST/HR Series Board

I/O Connectors J1 and J2 of the STA-1800U Accessory

Pin assignments for I/O conectors J1 and J2 of the STA-1800U accessory are shown in Figure B-2.

(User-Common Mode) U_CM MD - 01	02 - CH00 HI
CH00 LO or CH08 HI - 03	04 - CH01 HI
CH01 LO or CH09 HI - 05	06 - CH02 HI
CH02 LO or CH10 HI - 07	08 - CH03 HI
CH03 LO or CH11 HI - 09	10 - CH04 HI
CH04 LO or CH12 HI - 11	12 - CH05 HI
CH05 LO or CH13 HI - 13	14 - CH06 HI
CH06 LO or CH14 HI - 15	16 - CH07 HI
CH07 LO or CH15 HI - 17	18 - LL GND
— - 19	20 - —
— - 21	22 - —
+15 V - 23	24 - -15V
±15 V Return - 25	26 - ±15 V Return
D GND - 27	28 - GEXT
DI 1 - 29	30 - DI 0
DI 3 - 31	32 - DI 2
DO 1 - 33	34 - DO 0
DO 3 - 35	36 - DO 2
DOSTB - 37	38 - XPCLK
TGOUT - 39	40 - SSHO
MUX 03 - 41	42 - TGIN
MUX 05 - 43	44 - MUX 04
MUX 07 - 45	46 - MUX 06
+5V - 47	48 - +5 V
D GND - 49	50 - D GND

Figure B-2. Pin Assignments for Main I/O Connectors J1 and J2 of the STA-1800U Accessory

Connector J3 of the STA-1800U Accessory

Connector J3 of the STA-1800U accessory is a 37-pin male D connector that accepts a C-1800 cable from an SSH-8 accessory. Pin assignments for J3 are shown in Figure B-3.

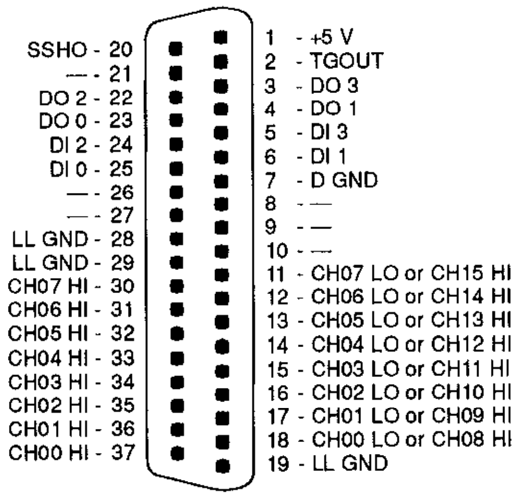
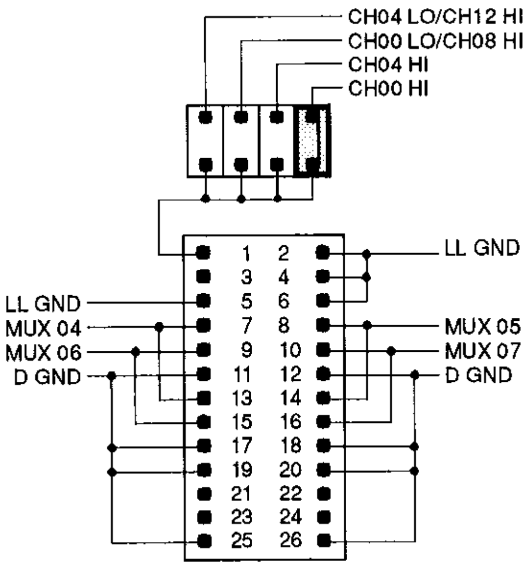


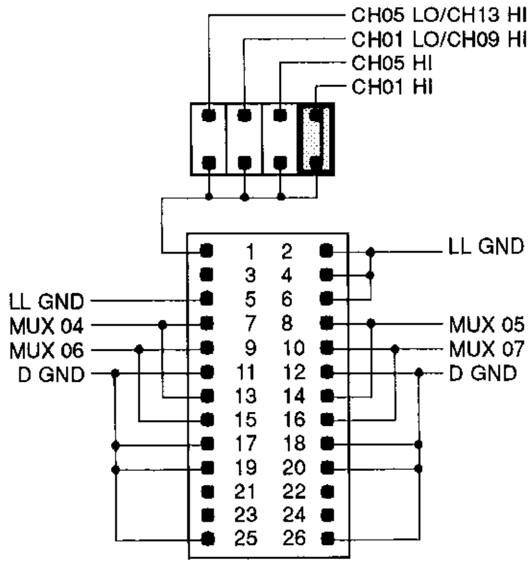
Figure B-3. Pin Assignments for STA-1800U Connector J3

Connectors J4 to J7 and Jumper Pads J8 to J11 of the STA-1800U Accessory

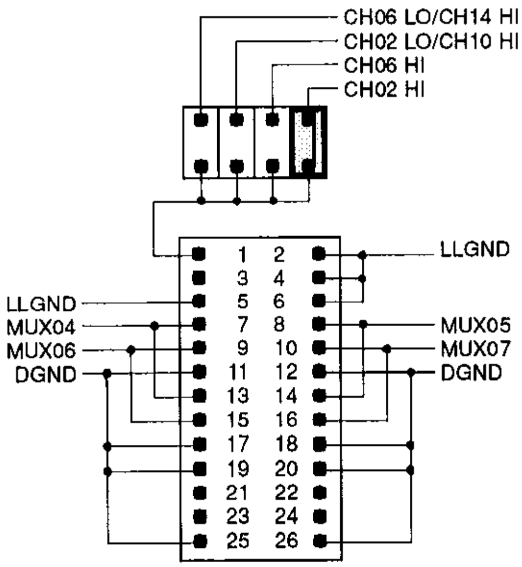
Connectors J4 to J7 of the STA-1800U accessory are 26-pin male connectors that each accept a C-2600 cable from an MB02 backplane. The pin assignments for J4 to J7 are shown in Figure B-4.



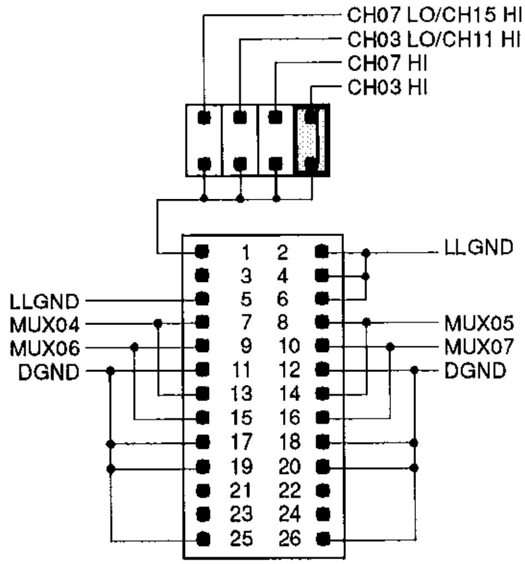
Connector J4 and
Jumper Pad J8



Connector J5 and
Jumper Pad J9



Connector J6 and
Jumper Pad J10



Connector J7 and
Jumper Pad J11

Figure B-4. Pin Layouts and Assignments for STA-1800U Connectors J4 to J7 and Jumper Pads J8 to J11

C

DAS-1800 Series External Driver

The DAS-1800 Series External Driver (DAS1800.EXE) allows the use of a DAS-1800ST/HR Series board with the following data acquisition and analysis software:

- VIEWDAC
- ASYST

DAS1800.EXE is a part of the DAS-1800 Series standard software package and is a terminate-and-stay-resident (TSR) program. As a TSR, DAS1800.EXE occupies a small amount of memory in the computer.

Before you can use the DAS-1800 Series External Driver, you must have a configuration file for the DAS-1800ST/HR Series board you are using. If you need to create a configuration file, refer to "Configuration Utility" in Chapter 3.

Note: The base address switches on the board must match the settings in the configuration utility.

Running the DAS-1800 Series External Driver

Because DAS1800.EXE is a TSR, you must load the program into memory before running your application program. The DAS-1800 Series External Driver remains in memory until you turn off your computer.

To load the DAS-1800 Series External Driver, change to the directory containing DAS1800.EXE and enter the following at the DOS prompt:

```
das1800 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 name, DAS1800.CFG, in the current directory.

Note: You can load the DAS-1800 Series External Driver automatically whenever you start the computer by adding the appropriate lines to your AUTOEXEC.BAT file.

Accessing the DAS-1800 Series External Driver

VIEWDAC application programs access the DAS-1800 Series External Driver automatically. If you are using ASYST, perform the following steps to access the DAS-1800 Series External Driver:

1. After loading the DAS-1800 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 DAS1800.

2. Enter the following at the OK prompt to make DAS-1800 the current device.

   ```
   DAS1800
   ```

Special Characteristics

Normally, the DAS-1800 Series External Driver works transparently and is used automatically by VIEWDAC and ASYST. This section points out considerations to keep in mind when using VIEWDAC and ASYST with DAS-1800ST/HR Series boards.

Note: DAS-1800ST/HR Series boards support multiple-point acquisitions in interrupt and DMA modes. The boards support only single-point, single-channel acquisition in synchronous mode.

Pseudo-Digital Input/Output: Extended Functions

VIEWDAC and ASYST do not have normal access to the non-standard features of DAS-1800ST/HR Series boards (burst mode, burst mode conversion rate, and so on). The DAS-1800 Series External Driver resolves this problem by providing a series of *pseudo-digital input/output channels* through which such software can access these non-standard features.

Note: Do not confuse the pseudo-digital input/output channels of the External Driver with the digital input channel and the digital output channel of DAS-1800ST/HR Series boards. The former are a software means of access to certain features of the board; the latter are a hardware means for handling digital I/O of the board.

Table C-1 and Table C-2 list and describe the pseudo-digital output channels of the DAS-1800 Series External Driver.

Table C-1. Pseudo-Digital Input Channel

Channel #	Function	Description
32	About-trigger index	This channel gets the index (in the acquisition array) of the point at which the trigger occurs for about-trigger mode. Refer to "Analog Triggering" on page C-6 for more information on the about-trigger mode.

Table C-2. Pseudo-Digital Output Channels

Channel #	Function	Description
32	Trigger channel	The channel on which the start-trigger event occurs. For an analog trigger, the value written to this channel can range from 0 to 255. For a hardware digital trigger, the DAS-1800 Series External Driver assumes digital-input channel 0 of the board, and the value written to this channel is ignored. Refer to "Analog Triggering" on page C-6 for more information about analog triggers; refer to Chapter 2 for more information about hardware digital triggers.
33	Trigger type	The type of trigger you want to use to begin conversions. **0** = a hardware digital trigger. A hardware digital trigger occurs when the board detects a rising or falling edge on the signal connected to the digital input TGIN pin (pin 46). **1** = an analog trigger. An analog trigger occurs when the conditions specified by pseudo-digital output channels 35, 38, and 39 are met by the analog input signal on the channel specified by digital output channel 32. Refer to "Analog Triggering" on page C-6 for more information about analog triggers; refer to Chapter 2 for more information about hardware digital triggers.
35	Trigger polarity and sense	The conditions that must be met before an analog or a digital trigger can occur. **0** = positive-edge trigger. For an analog trigger, the 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). For a digital trigger, the signal must rise from low to high. **1** = negative-edge trigger. For an analog trigger, the 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). For a digital trigger, the signal must fall from high to low. Refer to "Analog Triggering" on page C-6 for more information about analog triggers; refer to Chapter 2 for more information about hardware digital triggers.

Table C-2. Pseudo-Digital Output Channels (cont.)

Channel #	Function	Description
38	Analog voltage level	The voltage level at which an analog trigger event occurs. The value written to this channel is a count value in the range of • 0 to 4095 for the DAS-1800ST Series in unipolar mode • 0 to 65535 for the DAS-1802HR in unipolar mode • -2048 to 2047 for the DAS-1800ST Series in bipolar mode • -32767 to 32768 for the DAS-1802HR in bipolar mode Refer to "Analog Triggering" on page C-6 for more information about analog triggers. Refer to "Analog Trigger Parameters" on page C-9 for more information about converting voltage to a count value.
39	Hysteresis value	The amount of hysteresis applied to an analog trigger signal. The value written to this channel is a count value between 0 and 4095 for the DAS-1800ST Series boards or 0 and 32767 for the DAS-1802HR. A zero-hysteresis value disables the option. Refer to "Analog Triggering" on page C-6 for more information about analog triggers. Refer to "Analog Trigger Parameters" on page C-9 for more information about converting voltage to a count value.
41	Conversion mode	0 = Paced (normal) mode 1 = SSH mode (requires SSH-8) Refer to Chapter 2 for information on conversion mode.
42	Enable/disable burst mode	0 = Burst mode Off (disabled) 1 = Burst mode On (enabled) Refer to Chapter 2 for information on conversion mode.
43	Burst mode conversion rate	Sets the burst mode conversion rate for the next analog input operation. Specify a value of 3 to 255 as a divisor for the onboard 1 MHz time base. Refer to "Maximum Achievable Throughput Rates" in Chapter 2 for the maximum allowable burst mode conversion rates at a given gain.

Table C-2. Pseudo-Digital Output Channels (cont.)

Channel #	Function	Description
47	Gating	Enables or disables the hardware gate. **0** = the hardware gate is disabled. **1** = the hardware gate is enabled. Refer to Chapter 2 for more information about hardware gates.
48	About-trigger mode	Enables/disables the about-trigger mode, as follows: 0 = disabled. **1** to ***n*** = enabled, where *n* is the number of samples-per-channel to be acquired after the trigger in the about-trigger mode. The value for *n* cannot be greater than 65535 divided by number-of-channels.
49	External clock edge	Sets the external conversion clock edge. 0 = positive 1 = negative

Analog Triggering

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 count value in the ranges shown in Table C-3.

Table C-3. Count Value Ranges for DAS-1800ST/HR Series Boards

Board	Range of Count Values	
	Unipolar Mode	Bipolar Mode
DAS-1800ST Series	0 to 4095	-2048 to 2047
DAS-1802HR	0 to 65535	-32768 to 32767

Refer to "Analog Trigger Parameters" on page C-9 for information on how to convert a voltage value to a count value. Figure C-1 illustrates these analog trigger conditions, where the specified voltage level is +5 V.

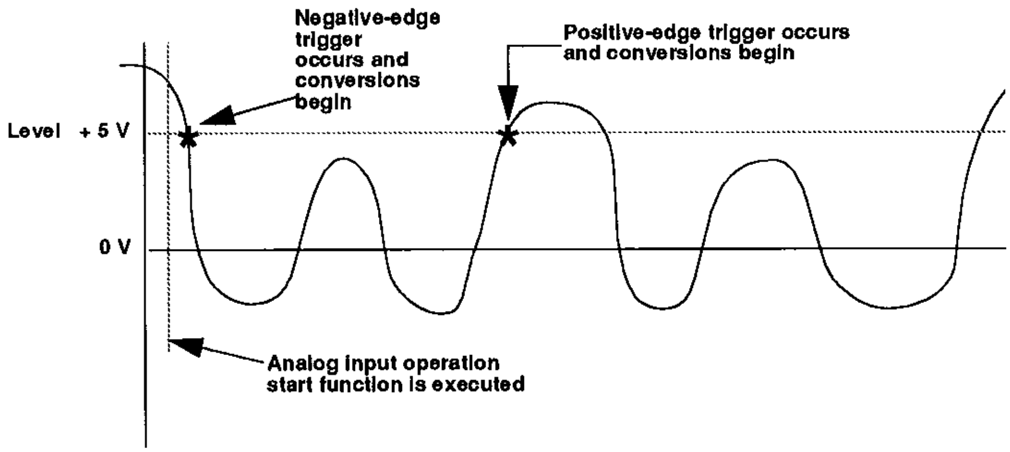


Figure C-1. Analog Trigger Conditions

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 you specify as a unipolar count value from Table C-3 for the DAS-1800ST/HR Series boards. 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 be as shown for unipolar mode in Table C-3. 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, you can specify a hysteresis value of 0.1 V, but you cannot specify a hysteresis value of 0.3 V. Refer to "Analog Trigger Parameters" on page C-9 for information on how to convert a voltage value to a 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 occurs; the analog signal must rise above +5.1 V and then fall below +5 V before a negative-edge trigger occurs.

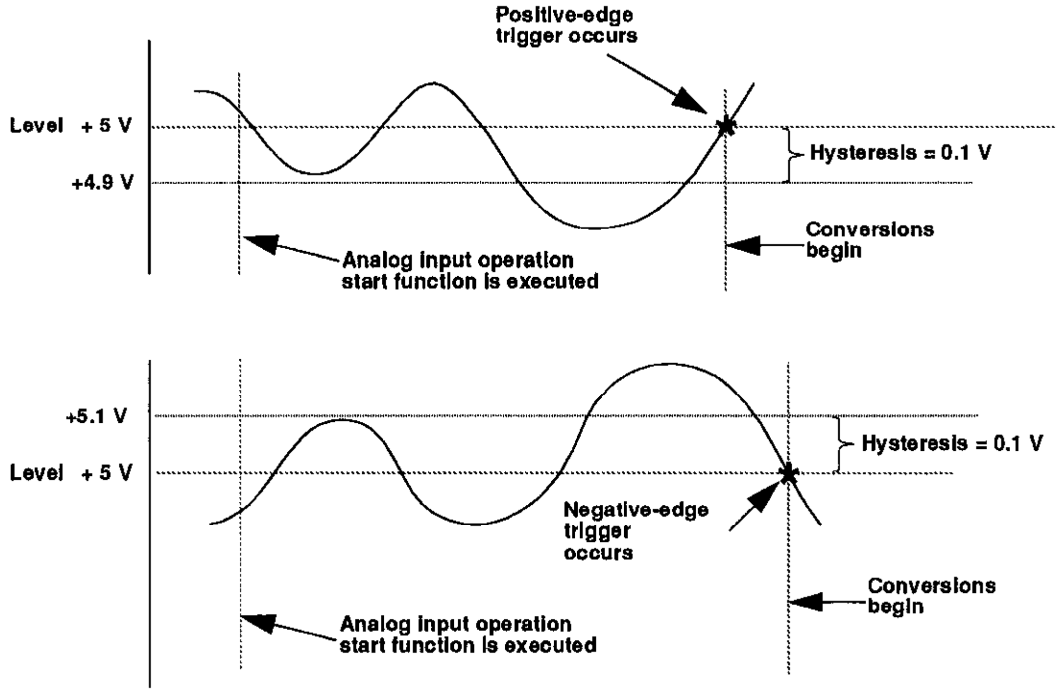


Figure C-2. Using a Hysteresis Value

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 82C54 counter/timer circuitry remains idle until the trigger occurs. When the trigger occurs, the board initiates conversions immediately.
- **External clock source** - Conversions are armed when the trigger occurs. At the next falling edge of the external clock source, the board initiates conversions.

Analog Trigger Parameters

Each time the ADC samples the voltage at an input channel, the ADC sends a corresponding digital signal in the form of a 16-bit binary number to the A/D FIFO. In DAS-1800ST Series boards, the data portion of the 16-bit binary number is actually 12 bits long; in the DAS-1802HR, the data portion of the 16-bit binary number is 16 bits long.

If the input channel is configured for unipolar signals, the 12-bit data portion of the binary number is positive magnitude; the remaining four bits are zero to indicate positive polarity. If the input channel is configured for bipolar signals, the data portion is twos complement.

When you use the DAS-1800 Series External Driver, you can set up an analog trigger for the purpose of starting an interrupt- or DMA-based data acquisition. To set up the analog trigger, you must specify the trigger channel, the trigger polarity, the trigger level, and an optional hysteresis value to apply to the trigger level. Of these four parameters, the trigger channel and polarity are a matter of selection. Trigger level and hysteresis value, however, are parameters you must calculate. The following subsections discuss the requirements for these calculations.

Trigger Level Calculation

When using DAS-1800ST Series boards, you specify the trigger level as a decimal equivalent of the 12-bit data portion of the binary number in the A/D FIFO. This equivalent is an integer of a value shown in Table C-3 for unipolar or bipolar mode.

When using a DAS-1802HR, you specify the trigger level as a decimal equivalent of the 16-bit binary number in the A/D FIFO. This equivalent is an integer of a value shown in Table C-3 for unipolar or bipolar mode. The equivalent is referred to as the *count*. Since the count is based on a 16-bit binary number, it is always within the ranges shown in Table C-3. To determine the count for an analog trigger level, use the following relationship:

$$Count = \frac{Volts}{BitValue}$$

In this equation, which is based on a gain of 1, *Volts* is the desired trigger level in volts and *BitValue* is the current analog input range divided by 4096 for DAS-1800ST Series boards and 65536 for the DAS-1802HR. *BitValue* is shown in Table C-4.

Table C-4. BitValue for Analog Trigger Level and Trigger Hysteresis

Board	Input Mode	Gain	Range	BitValue
DAS-1801ST	Unipolar	1	0 to 5	0.001221
	Bipolar	1	-5 to 5	0.0024414
DAS-1802ST	Unipolar	1	0 to 10	0.0024414
	Bipolar	1	-10 to 10	0.004883
DAS-1802HR	Unipolar	1	0 to 10	0.0001525
	Bipolar	1	-10 to 10	0.0003051

For example, if you are using a DAS-1801ST board in bipolar mode and you want a trigger level of +2.5 V, you calculate the count for the external driver as follows:

$$Count = \frac{2.5}{0.0024414} = 1024$$

Trigger Hysteresis Calculation

The count for a desired level of hysteresis is based on the following relationship at a gain of 1:

$$Count = \frac{Volts}{BitValue}$$

In these equations, *Volts* is the desired hysteresis (magnitude) value in volts, and *BitValue* is the current analog input range divided by 4096 for DAS-1800ST Series boards and 65536 for the DAS-1802HR, as shown in Table C-4.

For example, if you are using a DAS-1802ST in bipolar mode and you want a count for a hysteresis value of +0.1 V, you calculate the count (rounded to the nearest integer) as follows:

$$Count = \frac{0.1}{0.0024414} = 41$$

About Triggering

The about-trigger mode is described under "Triggers" in Chapter 2. In the about-trigger mode, the software or an external trigger starts an acquisition. An about-trigger can stop an acquisition or force the acquisition of a specified number of additional samples. The about-trigger itself is digital and is introduced by way of pin 46 (TGIN) of the main I/O connector.

You set up an about-trigger-mode acquisition by specifying the number of samples-per-channel (*n*) following the about-trigger.

Triggering is available in non-cyclic DMA mode only. With VIEWDAC, this availability limits the total number of samples to 64 KB.

After an about-trigger-mode acquisition begins, it normally continues until one of the following events occur:

- The total number of samples is acquired, even if an about-trigger has not occurred. In this situation, the trigger index is 0.
- The about-trigger occurs and *n* samples are acquired. In this situation, the point at which the about-trigger occurs is the index into the buffer.
- The about-trigger occurs but only some number of samples less than *n* can be acquired before the total acquisition is complete. In this situation, the point at which the about-trigger occurs is the index into the buffer.
- You stop the acquisition manually, or an error occurs.

Software Interrupt Vectors

The DAS-1800 Series External Driver uses two of the software interrupt vectors (interrupts 60H to 67H) set aside by DOS. To insure against conflicts with other devices, hardware, or programs, you can set each of the interrupt vectors to use an interrupt number that is different from the default.

Change the interrupt vector numbers by using the SET command from DOS. This command saves a string in the DOS environment that the DAS-1800 Series External Driver searches for on loading. These strings are specified in Table C-5.

Table C-5. Interrupt Vectors

Interrupt	Default Interrupt Number	Environment String[1]
Device linking vector	66h	'DAS DS=xx'
Critical error vector	65h	'DAS CE=xx'

Notes
[1] where xx ranges from 60h to 67h.

Note: Do not confuse these software interrupt vectors with the hardware interrupt levels used by DAS-1800ST/HR Series boards.

Driver Software Operating Specifications

Tables C-6 to C-10 describe the DAS-1800ST/HR Series board functions supported by the External Driver.

Table C-6. Analog Input Support

Feature	DAS-1801ST	DAS-1802ST/HR
Number of entries	256	
Gain codes	For gain = 1, code = 0 For gain = 5, code = 1 For gain = 50, code = 2 For gain = 250, code = 3	For gain = 1, code = 0 For gain = 2, code = 1 For gain = 4, code = 2 For gain = 8, code = 3
Synchronous A/D	For internal clock - internal trigger: yes - external trigger: no For External clock - internal trigger: no - external trigger: no	
DMA and interrupt A/D	Single buffer/non-cyclic - internal clock, internal trigger: yes - internal clock, external trigger: yes - external clock, internal trigger: yes - external clock, external trigger: yes Single buffer/cyclic - internal clock, internal trigger: yes - internal clock, external trigger: yes - external clock, internal trigger: yes - external clock, external trigger: yes Double buffer/non-cyclic - internal clock, internal trigger: yes - internal clock, external trigger: yes - external clock, internal trigger: yes - external clock, external trigger: yes Double buffer/cyclic - internal clock, internal trigger: yes - internal clock, external trigger: yes - external clock, internal trigger: yes - external clock, external trigger: yes	

Table C-7. Digital Input Support

Feature	DAS-1801ST	DAS-1802ST/HR
Synchronous digital input	For internal clock - internal trigger: yes - external trigger: no For External clock - internal trigger: no - external trigger: no	
Iinterrupt digital output	Single buffer/non-cyclic - internal clock, internal trigger: yes - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Single buffer/cyclic - internal clock, internal trigger: yes - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Double buffer/non-cyclic - internal clock, internal trigger: no - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Double buffer/cyclic - internal clock, internal trigger: no - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no	

Table C-8. Digital Output Support

Feature	DAS-1801ST	DAS-1802ST/HR
Synchronous digital output	For internal clock - internal trigger: yes - external trigger: no For External clock - internal trigger: no - external trigger: no	
Interrupt digital output	Single buffer/non-cyclic - internal clock, internal trigger: yes - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Single buffer/cyclic - internal clock, internal trigger: yes - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Double buffer/non-cyclic - internal clock, internal trigger: no - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no Double buffer/cyclic - internal clock, internal trigger: no - internal clock, external trigger: no - external clock, internal trigger: no - external clock, external trigger: no	

Table C-9. Counter/Timer Function Support

Feature	DAS-1801AO	DAS-1802AO
Timer interrupt generation	Not supported	
Frequency measurement	Not supported	
Event counting	Not supported	
Pulse output	Not supported	
Oneshot pulse output	Not supported	
Time interval measurement	Not supported	

Error Messages

Table C-10 lists the error/status codes returned by the DAS-1800 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-10. Error/Status Codes

Error Code (in Decimal)	Cause	Solution
24576	**Error In Configuration File**: The configuration file you specified in the driver initialization function is corrupt, does not exist, or contains one or more undefined keywords.	Check that the file exists at the specified path. Check for illegal keywords in file; you can avoid illegal keywords by using the configuration utility to create and modify configuration files.
24577	**Illegal Base Address in Configuration File**: The base address specified in the configuration file is invalid.	Use the configuration utility to change the base address in the configuration file. The address must be on a 16-byte boundary between 200h and 3F0h.

Table C-10. Error/Status Codes (cont.)

Error Code (in Decimal)	Cause	Solution
24581	**Illegal Channel Number:** The specified channel is out of range.	Specify a legal channel number: Analog input: 0 to 16; 0 to 256 with EXPs Digital input: 0 or pseudo channel Digital output: 0 or pseudo channels
24582	**Illegal Gain Code:** The gain code specified for an analog input operation is out of range.	Specify a legal gain code: 0 to 3; 0 to 7 with EXPs.
24584	**Illegal Number in Configuration File:** The configuration file contains a numeric value that is not in the correct format.	Check all numeric entries in the configuration file; make sure that &H precedes hexadecimal numbers. Use the configuration utility to modify the configuration file.
28686	**Resource Busy:** The application program attempted to start an operation while a similar operation was in progress.	There should be no interrupt or DMA acquisition in process before another acquisition begins.
28693	**Illegal Number of About-Trigger Samplesl:** Specified number of about-trigger sample is greater than buffer size.	Limit the number of about-trigger samples to the buffer size.
32773	**Board Not Found at Configured Address:** The board initialization function 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.
32779	**Conversion Overrun:** Data was overwritten before it was transferred 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.

Table C-10. Error/Status Codes (cont.)

Error Code (in Decimal)	Cause	Solution
32790	**Interrupt overrun**: During an interrupt-mode analog output or digital I/O operation, an interrupt was detected from a DAS-1800 Series board while the software was servicing a previous interrupt from the same board.	Reduce the acquisition rate. Analog output and digital I/O operations are limited to 5 kHz in DOS.
32794	**Interrupts Already Active:** You have attempted to start an operation whose interrupt level is being used by another system resource.	Stop the first operation before starting the second operation.
32795	**DMA already active:** You attempted to start an DMA-mode analog input operation while another was already in process.	Stop the first operation before starting the second operation.
32800	**FIFO Overflow Event Detected:** During a DMA-mode or interrupt-mode input operation, the onboard data FIFO overflowed; the hardware automatically stopped the acquisition.	The conversion rate you are using is too fast for the operating environment you are in. Reduce your conversion rate and/or reconfigure your board to use dual-DMA if using DMA mode (run the configuration utility and restart your program).

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 large enough for the needs of your application, 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, 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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