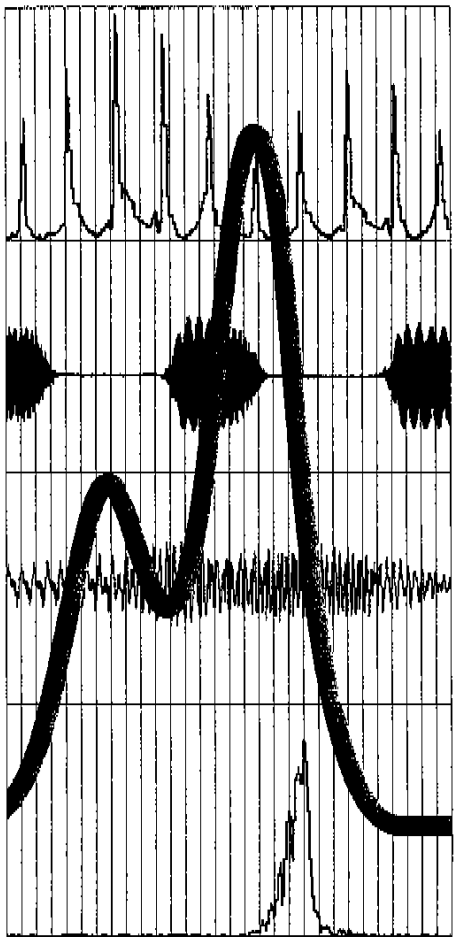
KEITHLEY ASYST
DATA ACQUISITION

External DAS Drivers



Keithley MetraByte

DAS-20

WARNING

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

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DAS-20

Supported Hardware

- Keithley MetraByte DAS-20

Options Supported

- A/D including interrupt and DMA support
  —16 single-ended or 8 differential channels
  —up to 136 channels through EXP-20 and EXP-GP support
- Support for SSH-4 (four channel sample and hold board)
- 2 12-bit D/A channels
- 8 digital input bits
- 8 digital output bits
- Frequency measurement
- Event counting
- Pulse output
- One-shot pulse output
- Time interval measurement
- Timed interrupts
- Time of day

Driver Filename

DAS20.EXE

This file is the DAS driver for the Keithley MetraByte DAS-20. It controls the DAS-20 and allows communication between an application program and the board. The file DAS20.EXE executes as a terminate-and-stay-resident (TSR) program that occupies a small amount of memory in the computer. It is designed to be fully compatible with applications that follow the Keithley Asyst *DAS Driver Specification*.

Quick Start

This section briefly discusses the process of configuring, loading, and accessing the DAS-20 external driver. For information regarding specific aspects of the driver, refer to the appropriate sections of this manual.

Set up the DAS-20 Board

Refer to your DAS-20 owner's manual to set the board switches for base address, A/D input mode (single-ended or differential), and the ranges for analog outputs. Remember these settings for entry into the DAS-20 driver configuration program.

Important DAS-20 connections

External clocking and triggering:	Refer to page 16 for the connections for these functions.
Timer/Counter:	Refer to page 20 for the connections for these functions.

Configure the DAS-20 Driver

Create a \DAS20 directory on your hard disk and copy the DAS20.EXE file from the DAS driver disk into it.

To configure and install the DAS-20 driver using the menu-driven configuration program, enter

```
CD \DAS20
DAS20 -MENU
```

at the DOS prompt. Then set the board parameters from the menu of board parameters displayed. Once in the configuration menu, press [?] at any menu prompt for a description of the current prompt and its options. For specific information about menu prompts see the later section "Running the DAS-20 Configuration Program."

Exit the program by pressing [Esc]. At this point you can choose to save the current configuration. Exiting the configuration program displays the selected configuration and automatically loads the driver into memory.

Use this configuration program any time you make a hardware change to the board or wish to change a software setting.

Install the DAS-20 Driver

The DAS-20 driver is a terminate-and-stay-resident (TSR) program that must be run each time your computer is booted in order for application programs to recognize it. Upon exiting the DAS-20 configuration program via [Esc], the driver is automatically installed into memory. Selecting [Q] exits the configuration program without loading the driver. The driver remains in memory until the computer is turned off or is rebooted.

Once the driver has been configured and saved you no longer need to go through the configuration process. Instead, you can install the DAS-20 driver by entering

\DAS20\DAS20

at the DOS prompt or by adding this line to your AUTOEXEC.BAT file to install the driver automatically upon booting the computer.

Access the DAS-20 Driver

Some application programs access the DAS-20 driver automatically. For information on accessing external DAS drivers, see the documentation for your application program.

Accessing the DAS-20 driver from the ASYST program

If you are using the ASYST program, follow these steps to access the DAS-20 driver.

After loading the driver, boot ASYST version 2.10 or greater and load permanently the Data Acq Master and the Ext DAS Driver Support system overlays. ASYST will automatically search for and create a DAS device called DAS20. Then, enter

DAS20

at the OK prompt to make DAS-20 the current device.

Running the DAS-20 Configuration Program

The DAS-20 driver has default settings that reflect the factory settings of the DAS-20 board. Whenever you change any of these settings, you must run the DAS-20 configuration program in order for the DAS-20 driver to function properly.

To run the menu-driven DAS-20 configuration program, enter

```
CD \DAS20
DAS20 -MENU
```

at the DOS prompt. A list of menu items, described below, appears.

Note: If you are configuring two DAS-20 boards, use [Tab] to switch between configurations.

Configuration menu special keys

[d] Reset the driver settings to their default values.

[Esc] Exit the configuration program with the option of saving the current settings and loading the driver into memory. This key is also used to exit the Channel Assignments menu.

[q] Quit the configuration program without saving the selected configuration and without loading the driver.

[Tab] Toggle between boards when two boards are being configured.

[w] Write a configuration save file. This option allows you to save the current configuration to a file for future use.

[?] Invoke help on the current menu item.

DAS20.EXE Menu Items

Note that the settings for the menu items denoted with an asterisk (*) are hardware dependent; that is, the driver configuration must match the hardware (board) setting.

Menu Item 1 Base Address*

Configure the address to match the board's address. Pressing [Enter] cycles through the allowable choices, which range from 200h to 3F0h in increments of 10h.

The driver defaults to a base I/O address of 300h.

If you are using more than one DAS-20 board in your system, the base address must be different for each board.

Menu Item 2 IRQ Channel

Configure the IRQ channel to use for DMA and interrupt-driven operations. The choices are 2 through 7, corresponding to IRQ 2 through IRQ 7.

The driver defaults to IRQ channel 2.

If you are using more than one DAS-20 board in your system, the interrupt channel should be different for each board.

Menu Item 3 DMA Channel

Configure the DMA channel to use for DMA activities. The choices are DMA channel 1 or DMA channel 3.

The driver defaults to DMA channel 1.

If you are using more than one DAS-20 board in your system, the DMA channel should be different for each board.

Menu Item 4 A/D Input Range

Configure the A/D input range for either unipolar or bipolar. Depending on which mode you choose, the following gain values and codes will be available.

Unipolar			Bipolar		
Range	*Gain*	*Gain code*	*Range*	*Gain*	*Gain code*
0 – 10V	X1	0	±10V	X0.5	1
0 – 10V	X1	2	±5V	X1	3
0 – 1V	X10	4	±0.5V	X10	5
0 – 100mV	X100	6	±50mV	X100	7

The driver defaults to unipolar mode.

Menu Item 5 A/D Input Mode*

Configure the A/D input mode to match the board's settings. The choices are single-ended (16 A/D channels) or differential (8 A/D channels).

The driver defaults to single-ended mode.

For more information, refer to the Keithley MetraByte DAS-20 manual for a detailed description of differential and single-ended A/D inputs.

Menu Item 6 & 7 D/A Channel Output Range*

Configure the output ranges of the D/A channels to match the board's settings. The choices are 0 – 10, ±5, or ±10 volts.

The driver defaults to 0 – 10V.

For more information and a detailed description of the D/A output ranges, refer to the Keithley MetraByte DAS-20 manual.

Menu Item 8 Time Interval Measurement Range

Configure the range for the time interval measurement function. Select one of the five ranges below:

Time interval maximum	*Time interval*	*Resolution*
0.013107 sec	0.0000002 to 0.013107 sec	0.0002 msec
0.209712 sec	0.0000032 to 0.209712 sec	0.0032 msec
3.355392 sec	0.0000512 to 3.355392 sec	0.0512 msec
53.686272 sec	0.0008192 to 53.686272 sec	0.8192 msec
858.980352 sec	0.0131072 to 858.980352 sec	13.1072 msec

The driver defaults to a maximum of 3.35 seconds.

Menu Item 9 Number of EXP-GPs*

Configure the number of EXP-GP modules in the system. The choices are 0 – 8.

The driver defaults to zero EXP-GP modules.

There can be no more than 8 EXP-GPs or EXP-20s in a system (e.g., 4 EXP-GPs and 4 EXP-20s *or* 8 EXP-GPs and 0 EXP-20s).

Menu Item 10 Number of EXP-20s*

Configure the number of EXP-20 modules in the system. The choices are 0 – 8.

The driver defaults to zero EXP-20 modules.

There can be no more than 8 EXP-GPs or EXP-20s in a system (e.g., 4 EXP-GPs and 4 EXP-20s *or* 8 EXP-GPs and 0 EXP-20s).

Menu Item 11 CJR Channel*

Configure the CJR channel to match the board's settings. CJRs are available only if an EXP-20 or an EXP-GP is present. Choices depend on the number of EXP-20s and EXP-GPs selected.

The driver defaults to no CJR channels configured (-1).

Menu Item 12 Set Channel Gains*

Configure individually the user-selectable gains for each EXP-20 or EXP-GP to match the board's settings.

Selecting this item switches control to the channel assignments window. This menu allows the gain of each channel to be selected. To set a channel's gain, first select the module using the up and down arrows and the [Home] and [End] keys and then press [Enter] to open another window.

For EXP-20s, pressing [Enter] cycles through the allowable ranges for the channel type. For EXP-GPs, each channel's gain can be individually set along with a board level gain. If the channel is a CJR channel, three different sensitivities are available between the EXP-20 and EXP-GP modules.

Press [Esc] to return to the channel assignments window. When all channels have been set to the desired gain, press [Esc] again to return to the main menu.

Note: Do not set the channel gains until the number of EXP-GPs and EXP-20s have been entered.

The gains specified in this option are used only if your application software supports *DAS Driver Specification* version 2.00. If your application software does not support version 2.00, set only channel 0's gain. In this case, the gain of all channels is relative to the setting of the A/D range option (unipolar 0 – 10v or bipolar ± 5v) and the gain of channel 0. The user must compensate for gains other than the gain of channel 0 if the gain for other channels differs.

Menu Item 13 Number of Boards*

Configure the number of DAS-20 boards in the computer.

The driver defaults to one board installed.

Each memory resident image of the DAS-20 driver can support two DAS-20 boards. This menu item configures the driver for one or two boards. If you are using more than one DAS-20 board, it is your responsibility to ensure that the base address, DMA channels, and interrupt channels do not conflict between the two boards.

Exiting the DAS-20 Configuration Program

To exit the configuration program immediately, press [q] and no changes will be saved. Otherwise, to exit the configuration program press [Esc]. The following prompt is displayed:

Do you want to permanently save this configuration? [Y/N]

If the configuration is saved it displays the message

Remembering...

Finally you will be prompted

Exit Configuration Program? [Y/N]

DAS-20 Driver Command Line Options

You can also specify a configuration of the DAS-20 driver using DOS command line options. These options and their syntaxes follow.

Command line syntax: DAS-20 [@*xxxx*] [-menu]

Command	*Function*
@*xxxx*	Indicates use of configuration file *xxxx*
-h	This screen, then exit
-menu	Invokes the configuration program

The above information on the command line options can be displayed by entering at the DOS prompt

DAS20 ?

Configuring the DAS-20 Driver for Multiple Boards

The number of DAS-20 boards in your system is limited by the available slots in your computer.

Each memory resident driver can support two DAS-20 boards. The number of drivers that can be loaded is limited only by the amount of available memory in your computer. To access more than two boards load the driver multiple times and use configuration save files to recall the configurations. For example, to access three boards make two save files—DAS20-1.CFG and DAS20-2.CFG. DAS20-1.CFG contains the configuration data for two boards at addresses 300h and 310h, and DAS20-2.CFG contains the configuration data for a single board at address 340h. To load these drivers use the @ command line option: for example,

DAS20 @DAS20-1.CFG
DAS20 @DAS20-2.CFG

DAS-20 Driver Characteristics

The following sections describe the attributes and operating characteristics of the DAS-20 driver.

EXP-20 Support

Each EXP-20 module multiplexes 16 differential inputs into one output signal. Use jumper W2 on the EXP-20 to assign the output signal to one of the DAS-20's A/D input channels.

If using more than one EXP-20, each one must be assigned to a different DAS-20 A/D input channel. These assignments must begin with DAS-20 input channel 0 for the first EXP-20, channel 1 for the second EXP-20, and so forth.

EXP-GP Support

Each EXP-GP module multiplexes 8 inputs into one output signal. Use jumper J4 on the EXP-GP to assign the output signal to one of the DAS-20's A/D input channels.

If you are using more than one EXP-GP, each one must be assigned to a different DAS-20 A/D input channel. These assignments must begin with the first DAS-20 input channel not used by an EXP-20.

Using EXP-20 and EXP-GP Expansion Modules

The physical channel is the DAS-20 A/D input channel to which the EXP module is assigned. The logical channel is the channel that the application software uses to access different channels on the DAS-20 and any EXP modules. The logical and physical channel assignments are displayed in the configuration program.

Multiple EXP-20 and EXP-GP modules can be cascaded with each EXP module configured to a distinct DAS-20 A/D input channel as discussed above. An STA-20 can be connected to the system to use the remaining DAS-20 A/D channels.

Note: If an STA-20 is to be used with EXP modules, the channels used by the EXP-GPs and EXP-20s will still be available on the STA-20. However, it is important not to connect any signals to these inputs.

Digital outputs DO0 – DO3 are used to select channels on the EXP modules. The driver will still allow you to use the digital outputs even though A/D may change the digital output signals as needed.

Example: DAS-20 & Two EXP-GPs & Two EXP-20s

Logical channel	*Physical channel*	*EXP-20 jumper connections*
0-15	EXP-20: 0	0 , 8*
15-31	EXP-20: 1	1, 9*
32-39	EXP-GP: 2	2
40-47	EXP-GP: 3	3
48-59	DAS-20: 4-15	N/A

* 0 and 1 are applicable for both single-ended and differential modes: 8 and 9 are applicable only for differential mode.

SSH-4 Support

It is possible to use the Keithley MetraByte Simultaneous Sample & Hold Accessory Board with the DAS-20. Since the SSH-4 uses the first conversion in a scan to switch from sample to hold mode, the first point in the scan is not taken simultaneously with the SSH-4 channels. In order to acquire data on all SSH-4 channels, the first channel in the scan cannot be an SSH-4 channel. This first channel can be an EXP channel or an unused channel on the DAS-20. Valid data will be collected on this channel, but it will not be simultaneous with the SSH-4 channels.

It is recommended that a gain/channel array be used to access the SSH-4 with a dummy point as the initial channel.

Channels used by the SSH-4 cannot conflict with channels used by an EXP-20, EXP-GP, or a CJR.

Cable requirements for STA-20, EXP-20, EXP-GP, and SSH-4 combinations

The order of connecting expansion modules is important. From the DAS-20, all modules with the 50 pin connectors (EXP-20, STA-20, SSH-4) must come first. The EXP-GPs must be last in the chain.

To connect an EXP-GP to a 50 pin device, a Keithley MetraByte ADP-5037/GP must be used. If the system contains only EXP-GPs, a CEXP-2000 connects the DAS-20 to the EXP-GP. The C1800 cable connects multiple EXP-GPs. Consult the EXP-GP manual for more information.

DMA and Interrupt-Driven Operations

There can be only one DMA or interrupt-driven task active per board. DMA non-cyclic transfers use the interrupt channel.

Note: If any task is using the interrupt channel, synchronous A/D conversions are disallowed.

Gates, Triggers, and Clocks

You may be confused by what seems to be a conflict in terminology between this manual and the Keithley MetraByte DAS-20 manual. The DAS-20 manual refers to *triggering* of conversions as the starting of individual conversions. In this manual, *clocking* refers to the start of a conversion. Furthermore, the DAS-20 manual refers to *gating* of conversions, whereas this manual refers to *triggering* of conversions.

The concept of gating/triggering as referred to in this manual is the qualification of clock pulses. A qualified clock pulse is a usable clock pulse. In order to qualify a clock pulse, the gating/triggering condition must be met. If external triggering is specified, only those clock pulses that occur while the gate/trigger signal is high will be qualified.

A/D, D/A, and Digital I/O Clocking and Triggering

Internal Clocking and Internal Triggering

For this mode of operation, the conversion will begin without waiting for any external event and will proceed at the specified rate until finished. No external connections to the timer are required.

External Clocking

For this mode of operation, the software will wait for a high edge signal at the clock input before starting each conversion of the acquisition. Acquisition will proceed and be paced by the external signal until the requested amount of data has been acquired.

The clocking signal is TTL edge sensitive. The actual acquisition will occur on successive rising edges of the external clock signal.

Refer to the chart on page 16 for external clocking connections.

External Triggering

For this mode of operation, the software will wait for a logical high signal at the trigger input before starting the acquisition. Acquisition will proceed at the specified rate until finished.

The triggering signal is TTL level-sensitive. If the trigger signal is brought low during the acquisition, acquisition will be halted until the trigger signal is brought high again.

Refer to the chart on page 16 for external triggering connections.

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Clocking and Triggering Connections

A/D Connections

	Synchronous	*DMA*	*Interrupt*
Ext Clocking Input	CTR1 SRC (EXT TRG)	CTR1 SRC (EXT TRG)	CTR1 SRC (EXT TRG)
Ext Triggering Input	CTR1 GTE (EXT GTE)	CTR1 GTE (EXT GTE)	CTR1 GTE (EXT GTE)

D/A Connections

	Synchronous	*DMA*	*Interrupt*
Ext Clocking Input	CTR1 SRC (EXT TRG)	CTR2 GTE	CTR2 GTE
Ext Triggering Input	CTR1 GTE (EXT GTE)	CTR2 GTE	CTR2 GTE

Digital I/O Connections

	Synchronous	*DMA*	*Interrupt*
Ext Clocking Input	CTR1 SRC (EXT TRG)	–	CTR2 GTE
Ext Triggering Input	CTR1 GTE (EXT GTE)	–	CTR2 GTE

Note: When using external triggering with internal clocking the external clock input must be connected to a TTL logical high source for proper operation.

– indicates not supported

Timer/Counter Functions

Timer Resources

The DAS-20 uses a 9513 timer/counter chip as a clocking source. This timer has 5 timer channels. In referring to timer resources, the driver uses the term *channel*. Timer *channels* are zero based (0-4). The DAS-20 hardware uses the term *counter*. Counter numbering is one based (1-5). For example, channel 0 is the same as counter 1.

Channels 2, 3, and 4 are dedicated to the A/D subsection. Timer channels 0 and 1 are general purpose and are used by many driver functions.

The DAS-20 driver maintains a timer channel allocation table that any function can check to see if any given timer channel is currently in use. If the channel is in use, the function will return a "Timer Confliction Error."

Timed Interrupts

This function always uses DAS-20 timer channel 1. Timer channel 0 is also used for rates lower than 77 Hz. Functions that use these resources cannot be executed concurrently.

Frequency Measurement

This function allows you to measure the frequency of an input signal (TTL levels). In order to perform this function you must connect the output of counter 1 (CTR 1 OUT) to the gate of counter 2 (CTR 2 GTE). Then, the signal frequency to be measured must be connected to the source of counter 2 (CTR 2 SRC).

This function always uses DAS-20 timer channels 0 and 1. Functions that use these resources cannot be executed concurrently.

Event Counting

In order to perform this function, the signal to be counted must be connected to the source of counter 1 (CTR 1 SRC).

This function always uses DAS-20 timer channel 0. Functions that use this resource cannot be executed concurrently.

An error will be generated if the event counter has been overflowed with greater than 65535 events.

Pulse Output

This function will generate a pulse train on the counter 1 output (CTR 1 OUT) pin. Both pulse period and duty cycle are programmatically selectable.

The pulses are output with the low (*period count – on count*) preceding the high (*on count*).

This function always uses DAS-20 timer channel 0. Functions that use this resource cannot be executed concurrently.

One-shot Pulse Output

The pulse will be output on the counter 1 output pin (CTR 1 OUT). The duration of the pulse is determined by the on count. *Period count – on count* defines a delay preceding the pulse. For example, if a 50% duty cycle, 1 second pulse period oneshot is specified, the output signal will be low for 0.5 seconds and then high for 0.5 seconds.

This function always uses DAS-20 timer channel 0. Functions that use this resource cannot be executed concurrently.

Time Interval Measurement

This function will measure the elapsed time between the rising edges of two digital pulses. The pulses can be on the same channel or on different channels. The signals to be measured must be connected to their respective counter gate pins. For example, in order to measure the time interval between signal 1 and signal 2, you must connect signal 1 to counter 1 gate (CTR 1 GTE) and signal 2 to counter 2 gate (CTR 2 GTE). In order to measure the time between two pulses of the same signal the signal must be connected to either counter 1 or counter 2 gate.

The range and resolution of the time interval measurement are configurable via the DAS-20 driver configuration program.

This function uses DAS-20 timer channel 0 or 1 or both. Functions that use these resources cannot be executed concurrently.

Time of Day Measurement

This function uses the 9513a on the DAS-20 to keep the current time. Once a time of day operation is started, it will run independently of the computer. The application can query the board to get the current time. No external connections are required.

This function uses DAS-20 timer channels 0, 1, and 4. Functions that use these resources cannot be executed concurrently.

Timer/Counter Connections

Function	*Connections*
Frequency Measurement	Connect CTR1 OUT to CTR2 GTE Input signal on CTR2 SRC
Event Counting	Input signal on CTR1 SRC
Pulse Output	Output signal on CTR1 OUT
One-shot Pulse Output	Output signal on CTR1 OUT
Time Interval Measurement	Input signal 1 on CTR1 GTE Input signal 2 on CTR2 GTE
Time of Day	None

Software Interrupt Vectors

This driver uses three software interrupt vectors for communication between itself and the application program. The interrupt vectors used are three of the MS-DOS "user interrupts" (interrupts 60h-67h) set aside by DOS. To ensure that conflicts with other devices, hardware, or programs do not exist, each of the interrupt vectors used can be set to use a different interrupt number than the default. Do not confuse these interrupt vectors with the hardware interrupt lines used by the DAS-20.

The interrupt vector numbers can be changed from the default by using the SET command from DOS. This command saves a string in the DOS environment that the driver will search for upon loading. These strings are specified in the following table.

Interrupt	*Default int#*	*Environment string*
Device linking vector	66h	'DAS DS=xx'
Critical error vector	65h	'DAS CE=xx'
Timer interrupt vector	64h	'DAS TI=xx'

where xx is between 60h and 67h

DAS-20 Software Operating Specifications

Analog Input

Gain/Channel array supported—Maximum length: 2048 entries, 256 if EXP modules present

Gain code table

Unipolar		Bipolar	
Gain code	*Gain*	*Gain code*	*Gain*
0	1.0	1	0.5
2	1.0	3	1.0
4	10.0	5	10.0
6	100.0	7	100.0

Synchronous A/D

	Int Trg	*Ext Trg*
Internal Clock	Yes	Yes
External Clock	Yes	Yes

DMA A/D

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/Non-Cyc	Yes	Yes	Yes	Yes
Single Buf/Cyclic	Yes	Yes	Yes	Yes
Double Buf/Non-Cyc	–	–	–	–
Double Buf/Cyclic	–	–	–	–

– indicates not supported

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Interrupt A/D

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	Yes	Yes	Yes	Yes
Single Buf/Cyclic	Yes	Yes	Yes	Yes
Double Buf/ Non-Cyc	Yes	Yes	Yes	Yes
Double Buf/Cyclic	Yes	Yes	Yes	Yes

Analog Output

Synchronous D/A

	Int Trg	*Ext Trg*
Internal Clock	Yes	Yes
External Clock	Yes	Yes

DMA D/A

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	Yes	Yes	Yes	–
Single Buf/Cyclic	Yes	Yes	Yes	–
Double Buf/ Non-Cyc	–	–	–	–
Double Buf/Cyclic	–	–	–	–

Interrupt D/A

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	Yes	Yes	Yes	–
Single Buf/Cyclic	Yes	Yes	Yes	–
Double Buf/Non-Cyc	Yes	Yes	Yes	–
Double Buf/Cyclic	Yes	Yes	Yes	–

Digital Input

Synchronous Digital Input

	Int Trg	*Ext Trg*
Internal Clock	Yes	Yes
External Clock	Yes	Yes

DMA Digital Input

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	–	–	–	–
Single Buf/Cyclic	–	–	–	–
Double Buf/Non-Cyc	–	–	–	–
Double Buf/Cyclic	–	–	–	–

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Interrupt Digital Input

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	Yes	Yes	Yes	–
Single Buf/Cyclic	Yes	Yes	Yes	–
Double Buf/ Non-Cyc	Yes	Yes	Yes	–
Double Buf/Cyclic	Yes	Yes	Yes	–

Digital Output

Synchronous Digital Output

	Int Trg	*Ext Trg*
Internal Clock	Yes	Yes
External Clock	Yes	Yes

DMA Digital Output

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	–	–	–	–
Single Buf/Cyclic	–	–	–	–
Double Buf/ Non-Cyc	–	–	–	–
Double Buf/Cyclic	–	–	–	–

Interrupt Digital Output

	Int Clk Int Trg	*Int Clk Ext Trg*	*Ext Clk Int Trg*	*Ext Clk Ext Trg*
Single Buf/ Non-Cyc	Yes	Yes	Yes	–
Single Buf/Cyclic	Yes	Yes	Yes	–
Double Buf/ Non-Cyc	Yes	Yes	Yes	–
Double Buf/Cyclic	Yes	Yes	Yes	–

Counter/Timer Functions

Timer interrupt generation:	Supported
Frequency measurement:	Supported
Event counting:	Supported
Pulse output:	Supported
One-shot pulse output:	Supported
Time interval measurement:	Supported
Time of day:	Supported

DAS-20 Driver Error Messages

The following error messages may occur during operation of the DAS-20 board.

Error Number	Error Message
0	No error No error message.
1	Function not supported A function was requested that is not supported by the DAS driver.
2	Function out of bounds A requested function number was not defined by the *DAS Driver Specification*.
3	Non-valid board number A requested board number is out of the range of configured boards. This DAS driver can support a maximum of two boards.
4	Non-valid error number A non-valid error number was detected by DAS Driver function 0, REPORT ERROR MESSAGE. For this DAS driver, 28 error numbers have been defined. A request for an error message string not defined will return this error code.
5	Interrupt in use error The interrupt channel used by the DAS-20 board is used by many of the DAS driver functions. If a function request that needs to use the interrupt is issued to the DAS driver, and if the interrupt is already being used by another task, this error will be returned. To prevent this error, do not use concurrently functions that use the interrupt channel.

Error Number	Error Message
6	Interrupt overlap error This error is returned by any of the DAS driver interrupt service routines that detect an interrupt overrun condition. To prevent this error, reduce the rate at which the interrupts occur.
7	DMA active error Each DAS-20 board can perform one DMA task at a time. If a function request is issued to the DAS driver that needs to use DMA, this error will be returned if DMA is already engaged by another task. To prevent this error, do not use concurrently functions that use DMA.
8	Odd buffer pointer error This error is returned by either the A/D or D/A DMA start functions when the buffer address supplied is an odd number. To prevent this error, ensure that the buffer addresses supplied to the DAS driver for DMA operations are even numbers.
9	Non-valid channel number(s) error This error will be generated by A/D or D/A functions that detect a start channel greater than a stop channel. To prevent this error, do not request an A/D or D/A function with a start channel greater than the stop channel.
10	Board not initialized error This error will be generated by any function that detects irregularities with the state of the driver. The solution is to execute the DAS driver function DEVICE INIT. This will initialize the DAS-20 driver and the DAS-20 board for subsequent operations.
11	A/D not initialized error This error is returned by any of the A/D start functions when the A/D subsection of the DAS-20 board has not been initialized. The solution is to initialize the A/D subsection of the DAS-20 board.

Error Number	Error Message
12	D/A not initialized error This error is returned by any of the D/A start functions when the D/A subsection of the DAS-20 board has not been initialized. The solution is to initialize the D/A subsection of the DAS-20 board.
13	Digital input not initialized error This error is returned by any of the digital input start functions when the digital input subsection of the DAS-20 board has not been initialized. The solution is to initialize the digital input subsection of the DAS-20 board.
14	Digital output not initialized error This error is returned by any of the digital output start functions when the digital output subsection of the DAS-20 board has not been initialized. The solution is to initialize the digital output subsection of the DAS-20 board.
15	Timer confliction error The timer on the DAS-20 board is shared by many of the DAS-20 DAS driver functions. This error code will be returned if a function request is issued to the DAS driver that needs to use a timer channel already in use by another DAS driver function. To prevent this error, do not try to use concurrently functions that use the same timer channels.
16	Timer not initialized error This error is returned by any of the Timer/Counter functions when the timer of the DAS-20 board has not been initialized. To prevent this error, initialize the timer on the DAS-20 board.
17	Frequency measurement not active error This error is returned by the DAS driver functions FREQUENCY MEASUREMENT STATUS/READ and FREQUENCY MEASUREMENT STOP when a frequency measurement task is not active. To prevent this error, activate a frequency measurement task before a status/read or stop function.

Error Number	Error Message
18	Frequency measurement timer overrun error This error is generated by the DAS driver function FREQUENCY MEASUREMENT STATUS/READ when the signal frequency being measured has overflowed the frequency measurement counter. To prevent this error, reduce the gate period of the frequency measurement task.
19	Event counting not active error This error is returned by the DAS driver functions EVENT COUNT READ and EVENT COUNT STOP when an event counting task has not been started. To prevent this error, start an event counting task before executing a read or stop.
20	Event counting overrun error This error is returned by the DAS driver functions EVENT COUNT READ and EVENT COUNT STOP when an event counting channel has overflowed.
21	Pulse output not active error This error is returned by the DAS driver function PULSE OUTPUT STOP when a pulse output task has not been started. To prevent this error, start an pulse output task before executing a stop.
22	Pulse output active error This error is returned by the one-shot pulse output function. To prevent this error, pulse output before executing the one-shot pulse output function.
23	Async time measurement not active error This error is returned by the DAS driver functions ASYNCHRONOUS TIME INTERVAL STATUS/READ and ASYNCHRONOUS TIME INTERVAL STOP when an asynchronous time interval measurement task has not been started. To prevent this error, start an asynchronous time interval measurement task before executing a status/read or stop.

Error Number	Error Message
24	Async time measurement timer overrun error This error is returned by the DAS driver function ASYNCHRONOUS TIME INTERVAL STATUS/READ when an asynchronous time interval measurement task has overflowed one or both timers. To prevent this error, increase the range of the time interval measurement function through the configuration program.
25	Async time measurement active error This error is returned by the DAS driver function ASYNCHRONOUS TIME INTERVAL START when an asynchronous time interval measurement task is already active. To prevent this error, stop the active asynchronous time measurement task before attempting to start another.
26	DMA not allowed on EXP channels This error is returned by the DAS driver function DMA ANALOG INPUT when acquisition is attempted on an EXP Channel. To prevent this error, do not attempt DMA acquisition on an EXP channel.
27	No digital output while EXP modules active This error is returned by the DAS driver function SYNCHRONOUS DIGITAL OUTPUT when INTERRUPT ANALOG INPUT is active and there are EXP modules in the system. The EXP modules use the digital output bits for channel selection. The digital output task would interfere with the proper operation on the analog input task. To prevent this error, stop the analog input task or wait until it is finished before doing digital output.