DAS-HRES
External DAS Driver

DAS-HRES External DAS Driver
User's Guide

New Contact Information

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Preface

The DAS-HRES External DAS Driver allows you to use Keithley MetraByte DAS-HRES boards with the following Keithley MetraByte data acquisition and analysis software:

- VIEWDAC®
- EASYEST LX®
- EASYEST AG™
- ASYST®

This manual provides the information needed to use the DAS-HRES External DAS Driver with data acquisition and analysis software. Use this manual in conjunction with your board user's guide and with the documentation for the EXP-20 accessories and data acquisition software you are using.

Note: The DAS-HRES External DAS Driver may support options your software does not; likewise, your software may support options this external driver does not.

If you need help, contact your local sales office or the Keithley MetraByte Applications Engineering Department between 8 am and 6 pm (Eastern Time), Monday through Friday:

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The DAS-HRES External DAS Driver allows your VIEWDAC, EASYEST LX, EASYEST AG, or ASYST application program to exchange data with DAS-HRES Series boards. This document describes how to use the DAS-HRES External DAS Driver.

Options Supported

The DAS-HRES External DAS Driver supports the following options:

- **Analog input**

  – Eight differential channels

  – Up to 128 channels through EXP-20 expansion accessories

  – Synchronous-mode, interrupt-mode, and DMA-mode (Direct Memory Access) operations

  – Channel-gain arrays of up to 128 entries

- **Analog output**

  – Two 16-bit analog output channels

  – Synchronous-mode and interrupt-mode operations

- **Digital input**

  – Eight digital input bits

  – Synchronous-mode and interrupt-mode operations

- **Digital output**

  – Eight digital output bits

  – Synchronous-mode and interrupt-mode operations

- **Counter/timer**
  - Timer interrupt generation
  - Event counting
  - Frequency measurement
  - Pulse output

Files on Disk

The driver disk contains the file DAS-HRES.EXE. DAS-HRES.EXE controls the boards and allows communication between an application program and the DAS-HRES board. DAS-HRES.EXE executes as a terminate-and-stay-resident (TSR) program that occupies a small amount of memory in your computer.

Quick Start

This section briefly describes how to configure, load, and access the DAS-HRES External DAS Driver.

Setting up the Board

Refer to your board user's guide for information on setting the jumpers/switches for the base address, input range, DMA channel, clock rate, and (optionally) EXP-20 output channels. Remember these settings when you use the DAS-HRES External DAS Driver configuration program.

Running the Configuration Program

The DAS-HRES External DAS Driver is set up for the following default configuration:

- Base address = 300h
- Clock rate = 1 MHz
- Interrupt level = IRQ 2
- DMA channel = 1
- A/D input mode = Bipolar
- CJR channel = 6
- Number of EXP-20s = 1
- Channel Gains for EXP-20s = x1 for all channels, except the CJR channel, which is set for 20 mV/°C
- Number of boards = 1
- Use Calibration? = Yes
- Use Gain Array? = Yes

You must run the configuration program if your board's settings differ from these default settings. In addition, whenever you change the hardware or software settings, you must run the configuration program in order for the external DAS driver to function properly.

Note: Each memory-resident image of the DAS-HRES External DAS Driver can support two DAS-HRES boards. If you are using more than one DAS-HRES board, you must configure the parameters for each board, ensuring that the base address, interrupt level, and DMA channel do not conflict between the two boards.

Perform the following steps to run the configuration program:

1. Create a DAS-HRES subdirectory on your hard disk. For example, at the DOS prompt, enter the following:

   ```
   MKDIR DAS-HRES
   ```

2. Copy DAS-HRES.EXE from the driver disk into the DAS-HRES directory.

3. Enter the following at the DOS prompt:

```
CD \DAS-HRES
DAS-HRES  -MENU
```

4. Configure the board parameters using the configuration program, as described on page 5.

Loading the DAS-HRES External DAS Driver

You must load the DAS-HRES External DAS Driver each time you start up your computer in order for an application program to recognize it. The external DAS driver remains in memory until the computer is turned off or rebooted.

To load the DAS-HRES External DAS Driver, access the directory containing DAS-HRES.EXE and enter the following at the DOS prompt:

```
DAS-HRES
```

Notes: You can also load the DAS-HRES External DAS Driver automatically whenever you start the computer by adding the preceding line to your AUTOEXEC.BAT file.

If you want to access more than two boards, load the driver multiple times and use configuration files to recall the configurations.

For example, to access three DAS-HRES boards you could create two configuration files: HRES1.CFG and HRES2.CFG. HRES1.CFG contains the configuration data for two boards at addresses 300h and 310h, and HRES2.CFG contains the configuration data for a single DAS-HRES board at address 340h. To load these drivers, use the @ command line option, as follows:

```
DAS-HRES @HRES1.CFG
DAS-HRES @HRES2.CFG
```

Accessing the DAS-HRES External DAS Driver

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

If you are using the ASYST program, perform the following steps to access the DAS-HRES External DAS Driver:

1. After loading the DAS-HRES External DAS Driver, boot ASYST version 2.10 or greater and permanently load the *Ext DAS Driver Support* system overlay from the Data Acquisition menu. ASYST automatically searches for and creates a DAS device called HRES.

2. Enter the following at the OK prompt to make HRES the current device:

    `HRES`

Using the Configuration Program

This section describes the configuration program's menu items and special purpose keys, and how to exit from the configuration program.

Menu Items

When you run the configuration program, the configuration menu is displayed. The menu options, choices, and default values are listed in Table 1.

Table 1. Configuration Program Menu Items

Menu Item	Choices	Default Value
Base I/O Address	200h to 3F0h (in multiples of 10h)[1,2]	300h
Clock Rate	1 MHz, 8 MHz, 10 MHz[2]	1 MHz
Interrupt Level	IRQ 2, 3, 4, 5, 6, 7[1,2]	IRQ 2
DMA Channel	1, 3[1,2]	1
A/D Input Mode	Unipolar, Bipolar[2]	Bipolar
CJR Channel (for EXP-20)	None or 1 to 7 [2]	6
Number of EXP-20 Accessories	0, 1, 2, 3, 4, 5, 6, 7, 8[2]	1
Set Channel Gains (for EXPs)	x1, x10, x100, x200, x300, x500, x600, x700, x800 [2,3]	x1 (for all channels, except CJR)
Number of Boards	1, 2[2]	1
Use Calibration?	No, Yes[4]	Yes
Use Gain Array?	No, Yes[5]	Yes

Notes

[1] If you are using more than one DAS-HRES board in your system, ensure that the base address, interrupt level, and DMA channel are unique for each board.

[2] Ensure that this value matches your board's setting.

[3] Note that at this time no Keithley MetraByte application software package uses different channel gains; you are allowed to set one channel gain for each EXP.

[4] This option determines whether post-calibration of analog input data is turned off. Acquisition of analog input data may be faster if calibration is turned off, but the accuracy of the data is reduced from .003% to .01%. Note that at this time no Keithley MetraByte software package takes advantage of calibration.

[5] The DAS-HRES External DAS Driver does not support channel-gain arrays for DMA-mode analog input operations and generates an error if they are requested. EASYEST AG and EASYEST LX use channel-gain arrays automatically. By disabling channel-gain array support, EASYEST AG and EASYEST LX can perform DMA-mode analog input operations properly.

The available programmable gains and their corresponding gain codes are shown in Table 2.

Table 2. Gains and Gain Codes

Gain	Gain Code
1	0
2	1
4	2
8	3

Special Purpose Keys

Table 3 describes the keys used for special purposes in the configuration program.

Table 3. Configuration Menu Special Keys

Keys	Description
[w]	Write a configuration save file. This option allows you to save the current configuration to a file for future use.
[q]	Quit the configuration program without loading the driver.
[d]	Reset the driver settings to their default values.
[Esc]	Exit the configuration menu with the option of saving the current settings and loading the driver into memory. This key is also used to exit the Channel Gains menu.
[Tab]	Toggle between boards 1 and 2 when two boards are being configured.
[?]	Invoke help on the current menu item.

Exiting the DAS-HRES Configuration Program

To exit the configuration program without saving any changes, press [q]. Otherwise, to exit the configuration program press [Esc]. The following prompt is displayed:

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

Type [Y] to save the configuration; type [N] if you do not want to save the configuration settings. If the configuration is saved, the program displays the message:

```
Remembering...
```

Then, you are prompted with the following message:

```
Exit Configuration Program? [Y/N]
```

Type [Y] to exit from the configuration program; type [N] to remain in the configuration program.

Command-Line Options

If you wish, you can also access the configuration of the DAS-HRES External DAS Driver using DOS command-line options. The command-line syntax is as follows:

```
DAS-HRES [@filename] [-menu]
```

The command-line options are described in Table 4.

Table 4. Command-Line Options

Command	Function
-h or ?	help
-menu	invoke menu-driven setup
@filename	Reads the configuration file *filename*. This file was written using the menu-driven setup option.

DAS-HRES External DAS Driver Characteristics

The following sections describe the various attributes of the DAS-HRES External DAS Driver and the restrictions imposed by the external DAS driver on various modes of operations and resources.

Interrupt-Mode Operations

Interrupt mode is supported for analog input, analog output, and digital I/O operations on the DAS-HRES board. If any of the interrupt resources is active, the corresponding synchronous-mode or DMA-mode operations are not allowed. For example, if an interrupt-mode analog input operation is active, you cannot start a synchronous-mode analog input operation. Also, you cannot start any other interrupt-mode operation while an interrupt-mode operation is active.

DMA-Mode Operations

DMA-mode operations are allowed only with analog input operations. You cannot start an interrupt-mode or synchronous-mode analog input operation while a DMA-mode operation is active. The use of channel-gain arrays is not valid for DMA-mode operations. You cannot perform DMA-mode operations on EXP-20 channels.

Counter/Timer Operations

The characteristics of the counter/timer operations with the DAS-HRES External DAS Driver are as follows:

- **Timed Interrupts**

  This operation uses Counter 2 on the DAS-HRES board. Operations that use this channel cannot be executed concurrently.

- **Event Counting**

  To perform event counting, connect the output of the event to be counted to CTR 0 CK. The minimum count available is 2 (if only one count is detected, a count of zero is returned). The maximum count available is 65,535; any count greater than 65,535 causes driver error 17, "Event counter overflow."

- **Frequency Measurement**

  Counters 0, 1, and 2 are used for frequency measurement. CTR 0 CK input is used for counting the pulses of the input signal. Counters 1 and 2 are internally cascaded to provide gate periods that range from a few microseconds to over 1/2 hour. You must connect CTR 2 OUT to CTR 0 GTE.

  No other operations can run concurrently with frequency measurement operations.

- **Pulse Output**

  The output is taken from CTR 2 OUT. The duty cycle of the pulse train is fixed at 50% due to the nature of the 8254 counter/timer circuitry.

EXP-20 Expansion Accessories

DAS-HRES boards provide eight analog input channels. To increase the number of channels to 128, you can connect up to eight EXP-20 expansion accessories. Each EXP-20 accessory multiplexes 16 differential inputs into one output signal.

When using expansion accessories, ensure that the DAS-HRES board is set up for single-ended operation.

To ensure that the DAS-HRES External DAS Driver reads the channel numbers correctly, you must assign the first EXP-20 accessory to channel 0 of the DAS-HRES board, the second EXP-20 accessory to channel 1 on the DAS-HRES board, and so on. You can use the remaining onboard channels using a screw termination panel. Use jumper W2 on the EXP-20 to assign one of the analog input channels on the DAS-HRES board to the output signal on the EXP-20. Refer to your board and accessory documentation for more information.

To refer to the channels, a scheme of physical and logical channels is used. A physical channel is the analog input channel on the DAS-HRES board to which the expansion accessory is assigned. The logical channel is the channel that the application software uses to access channels on the DAS-HRES board and any EXP-20 accessories. The logical and physical channel assignments are displayed in the configuration program.

Table 5 lists the physical channels on the DAS-HRES board and the corresponding logical channels associated with each expansion accessory.

Table 5. Physical and Logical Channels (Maximum Configuration)

Physical Analog Input Channel on DAS-HRES Board	Logical Channels on EXP-20	EXP-20 Jumper (W20) Selection
0	0 to 15	0, 8
1	16 to 31	1, 9
2	32 to 47	2, 10
3	48 to 63	3. 11
4	64 to 79	4. 12
5	80 to 95	5. 13
6	96 to 111	6. 14
7	112 to 127	7, 15

Figure 1 illustrates the use of three EXP-20 expansion accessories and the five remaining onboard channels. The channels on the EXP-20 attached to analog input channel 0 are referred to in software as logical channels 0 to 15; the channels on the EXP-20 attached to analog input channel 1 are referred to in software as logical channels 16 to 31; the channels on the EXP-20 attached to analog input channel 2 are referred to in software as logical channels 32 to 47; the remaining five onboard analog input channels (3, 4, 5, 6, and 7), which you can access using a screw termination panel, are referred to in software as logical channels 48, 49, 50, 51, and 52.
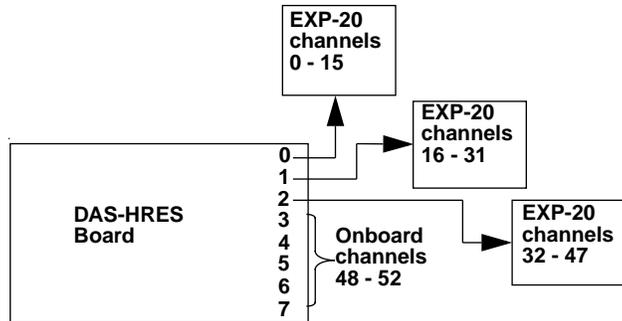
Figure 1. Analog Input Channels

Note: Digital outputs OP0 to OP3 are used to select the current channel on the EXP-20. You cannot use these digital output channels when an analog input operation is running. For example, if an interrupt-mode analog input operation is active, digital output operations are not allowed. Likewise, if an interrupt-mode digital output operation is active, an analog input operation is not allowed.

Internal Clocking

Using the internal clock, the DAS-HRES External DAS driver can perform analog input, analog output, and digital I/O operations at rates ranging from the board's maximum to 1 pulse/hour.

To perform multiple analog output or digital I/O operations, you must connect CTR 2 OUT to digital input DI7 because no internal connections are made from the counter/timer to the analog output or digital I/O circuitry.

With the jumper in the X1 position, the resolution of the clock is 1 μs. With the jumper in the X10 position, the resolution of the clock is 0.1 μs.

External Clocking, External Triggering, and Buffering

The characteristics of external clocking, external triggering, and buffering with the DAS-HRES External DAS Driver are described in the following sections.

Analog Input Operations

To use an external clock for analog input operations, connect the external clock signal to TRG 0 input. Clocking occurs on the rising edge of the input signal.

To use an external trigger for paced analog input operations, connect the external trigger signal to TRG 0 input. To use an external trigger for burst-mode analog input operations, connect the external trigger signal to DI5. The trigger acts as a gate, since acquisition occurs only while a high-level signal is present.

Since TRG 0 input is used for both external clocking and external triggering, conversions that require both external clocking and external triggering are not allowed.

Table 6, Table 7, and Table 8 summarize the clocking, triggering, and buffering support for analog input operations in synchronous, interrupt, and DMA mode.

Table 6. Clocking and Triggering Support for Synchronous-Mode Analog Input Operations

Clocking	Internal Trigger	External Trigger
Internal Clock	Yes	Yes
External Clock	Yes	No

Table 7. Clocking, Triggering, and Buffering Support for Interrupt-Mode Analog Input Operations

Buffering Mode	Internal Clock, Internal Trigger	Internal Clock, External Trigger	External Clock, Internal Trigger	External Clock, External Trigger
Single Buffer/Noncyclic	Yes	Yes	Yes	No
Single Buffer/Cyclic	Yes	Yes	Yes	No
Double Buffer/Noncyclic	Yes	Yes	Yes	No
Double Buffer/Cyclic	Yes	Yes	Yes	No

Table 8. Clocking, Triggering, and Buffering Support for DMA-Mode Analog Input Operations

Buffering Mode	Internal Clock, Internal Trigger	Internal Clock, External Trigger	External Clock, Internal Trigger	External Clock, External Trigger
Single Buffer/Noncyclic	Yes	Yes	Yes	No
Single Buffer/Cyclic	Yes	Yes	Yes	No
Double Buffer/Noncyclic	No	No	No	No
Double Buffer/Cyclic	No	No	No	No

Analog Output and Digital I/O Operations

External clocking is allowed for synchronous analog output and digital I/O operations operations only. To use an external clock, connect the external clock signal to digital input DI7. Clocking occurs on the rising edge of the input signal. When an external clock is used, no limitations are placed on the digital I/O operations; therefore, you can also use DI7 as a digital input bit.

External triggering is allowed for both synchronous-mode and interrupt-mode analog output and digital I/O operations. To use an external trigger, connect the external trigger signal to digital input DI6. Triggering occurs as soon as a high-level signal is present. When external triggering is used, no limitation is placed on the digital I/O operations; therefore, you can also use DI6 as a digital input bit. Note that since the trigger is detected in software, the computer may appear to be hung until a trigger is detected.

Table 9 and Table 10 summarize the clocking, triggering, and buffering support for analog output and digital I/O operations in synchronous and interrupt mode.

Table 9. Clocking and Triggering Support for Synchronous-Mode Analog Output and Digital I/O Operations

Clock	Internal Trigger	External Trigger
Internal Clock	Yes	Yes
External Clock	Yes	Yes

Table 10. Buffering, Clocking, and Triggering Support for Interrupt-Mode Analog Output and Digital I/O Operations

Buffering Mode	Internal Clock, Internal Trigger	Internal Clock, External Trigger	External Clock, Internal Trigger	External Clock, External Trigger
Single Buffer/Noncyclic	Yes	Yes	No	No
Single Buffer/Cyclic	Yes	Yes	No	No
Double Buffer/Noncyclic	Yes	Yes	No	No
Double Buffer/Cyclic	Yes	Yes	No	No

Software Interrupt Vectors

The DAS-HRES External DAS Driver uses two software interrupt vectors to communicate with the application program. The interrupt vectors used are two of the MS-DOS "user interrupts" (interrupts 60h to 67h). To ensure that conflicts with other devices, hardware, or programs do not exist, you can set each of the interrupt vectors to use an interrupt number that is different than from the default.

You can change the interrupt vector numbers by using the SET command from DOS. This command saves a string in the DOS environment that the driver searches for on loading. These strings are specified in Table 11.

Table 11. Interrupts and Environment Strings

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

Notes

[1] *xx* is between 60h and 67h.

DAS-HRES External DAS Driver Error Messages

Table 12 lists the error messages that may occur during operation of the DAS-HRES External DAS Driver.

Table 12. Error Messages from the DAS-HRES External DAS Driver

Error Number	Error Message	Description
0	No error	No error message.
1	Function not supported	A function was requested that is not supported by the DAS-HRES External DAS Driver.
2	Function out of bounds	A function number not defined by the DAS-HRES External DAS Driver was requested.
3	Non-valid board number	A board number that is out of the range of configured boards was requested. This driver supports a maximum of two boards.
4	Non-valid error number	A non-valid error number was detected by the external DAS driver function "REPORT ERROR MESSAGE." A request was made for an error message string that is not defined.
5	Interrupt overrun	An interrupt occurred before the program was ready to handle it. This usually occurs when the interrupt generator is running too fast.
6	A/D not initialized	An analog input operation was started before the analog input section of the board was initialized.
7	D/A not initialized	An analog output operation was started before the analog output section of the board was initialized.
8	Digital input not initialized	A digital input operation was started before the digital ports were initialized.
9	Digital output not initialized	A digital output operation was started before the digital ports were initialized.
10	Timer not initialized	A counter/timer operation was started before the counter/timer circuitry was initialized.
11	Timer in use	The internal clock is active and is not available for another operation.
12	Non-valid A/D channel number	An invalid channel number was requested.
13	DMA currently active	Another board operation was attempted before the board's DMA-mode operation was completed.

Table 12. Error Messages from the DAS-HRES External DAS Driver (cont.)

Error Number	Error Message	Description
14	Use of channel-gain array not allowed	A DMA-mode operation was attempted with a channel-gain array or a channel-gain array was attempted with a DAS-HRES board that does not support channel-gain arrays.
15	DMA not allowed on EXP-20 accessories	A DMA-mode operation was attempted on an EXP-20 accessory.
16	Interrupts channel currently in use	An interrupt-driven activity was attempted when interrupts were already active.
17	Event counter overflow	The count exceeded 65535 in an event counting operation.
18	DAS-HRES not present or incorrectly configured	The DAS-HRES driver was unable to find the DAS-HRES board at the configured address.
19	Digital output is not allowed for interrupt A/D with EXP-20	Interrupt-mode analog input operations use the digital output port to multiplex the channels on the EXP-20; therefore, digital output operation are not allowed when EXP-20 accessories are configured.
20	HRES.CFG file error - calibration not used	Either the driver could not find the HRES.CFG file or the driver could not read it.
21	External clock not supported with interrupt D/A or digital I/O operations	The DAS-HRES does not have circuitry to generate interrupts for externally clocked analog output or digital I/O operations.
22	Event count timer in use	The timer resources are being used for event counting.
23	Unable to format data: gain array in use	An operation is currently using a channel-gain array; therefore, the format A/D function cannot be executed.