

PDMA-16/32
External DAS Driver

USER'S GUIDE

PDMA-16/32 External DAS Driver User's Guide

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Preface

The PDMA-16/32 External DAS Driver allows you to use Keithley's PDMA-16 and PDMA-32 digital I/O boards with the following Keithley data acquisition and analysis software:

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

This document provides the information needed to use the PDMA-16/32 External DAS Driver with these software packages. Use this manual in conjunction with your board user's guide and with the documentation for the data acquisition software you are using.

Note: The PDMA-16/32 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 Keithley's Applications Engineering Department between 8 am and 6 pm (Eastern Time), Monday through Friday:

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An applications engineer will help diagnose and resolve your problem by telephone.

Table of Contents

Preface

Using the PDMA-16/32 External DAS Driver

Supported Hardware	1
Options Supported	1
Files on Disk	2
Quick Start	2
Setting up the Board	2
Configuring the PDMA-16/32 External DAS Driver	3
Loading the PDMA-16/32 External DAS Driver	4
Accessing the PDMA-16/32 External DAS Driver	5
Using the Configuration Program	5
Menu Items	5
Configuration Menu Special Keys	7
Exiting the Configuration Program	7
Configuring the PDMA-16/32 Driver from DOS	8
PDMA-16/32 External DAS Driver Characteristics	9
Synchronous Digital I/O Operations	9
Interrupt Digital I/O Operations	9
DMA Digital I/O Operations	9
Pulse Output Operations	10
Internal Clocking	10
External Clocking	10
Channel Numbering	11
Software Interrupt Vectors	11
PDMA-16/32 Driver Error Messages	12

List of Tables

Table 1.	Configuration Program Menu Items	6
Table 2.	Configuration Menu Special Keys	7
Table 3.	Command Line Options	8
Table 4.	Interrupts and Environment Strings	11
Table 5.	Error Messages from the PDMA-16/32 External DAS Driver	12

Using the PDMA-16/32 External DAS Driver

The PDMA-16/32 External DAS Driver allows your VIEWDAC, EASYEST LX, EASYEST AG, or ASYST application program to exchange data with PDMA-16 and PDMA-32 boards. This document describes how to use the PDMA-16/32 External DAS Driver.

Supported Hardware

The PDMA-16/32 External DAS Driver supports the following Keithley digital I/O boards:

- PDMA-16
- PDMA-32 (for PC AT buses only)

Options Supported

The PDMA-16/32 External DAS Driver supports the following options:

- 8- or 16-bit digital I/O in synchronous, interrupt, or DMA mode (external clocking is supported in interrupt and DMA modes only)
- Pulse output
- Timed interrupts

Files on Disk

The PDMA-16/32 External DAS Driver disk contains the file PDMA.EXE. This file controls the PDMA-16 and PDMA-32 boards and allows communication between an application program and the boards. PDMA.EXE executes as a terminate-and-stay-resident (TSR) program that occupies a small amount of memory in the host computer.

Quick Start

This section describes how to set up a PDMA-16 or PDMA-32 board and how to configure, load, and access the PDMA-16/32 External DAS Driver.

Setting up the Board

Referring to the PDMA-16 or PDMA-32 user's guide, set the switches for each board's base address. Remember the base address setting; you will need it when you run the PDMA-16/32 configuration program, described in the next section.

Keep in mind the following important connections for the external clock inputs:

- Pin 1, INTERRUPT IN (for interrupt digital I/O operations)
- Pin 2, XFER REQ (for DMA digital I/O operations)

Configuring the PDMA-16/32 External DAS Driver

The PDMA-16/32 External DAS Driver is set up for the following default configuration:

- Board number = 1
- Board type = PDMA-16
- Base address = 300h
- Digital I/O configuration = 16-bit input
- Interrupt level = disabled
- DMA channel = disabled

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

Note: Each memory-resident image of the PDMA-16/32 External DAS Driver can support two PDMA-16 or PDMA-32 boards. If you are using more than one PDMA-16 or PDMA-32 board, you must configure the parameters for each board, ensuring that the base address and interrupt levels are unique for each board.

Perform the following steps to run the configuration program:

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

```
MKDIR PDMA
```

2. Copy PDMA.EXE from the driver disk into the PDMA directory.

3. Enter the following at the DOS prompt:

```
CD \PDMA  
PDMA -MENU
```

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

Note: If you wish, you can configure the PDMA-16/32 External DAS Driver from DOS instead of using the configuration program; refer to page 8 for more information.

Loading the PDMA-16/32 External DAS Driver

You must load the PDMA-16/32 External DAS Driver each time you start up your computer in order for an application program to recognize it. The external driver remains in memory until the computer is turned off or rebooted.

To load the PDMA-16/32 External DAS Driver, access the directory containing PDMA.EXE and enter the following at the DOS prompt:

```
\PDMA\PDMA
```

Note: You can also load the PDMA-16/32 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.

Accessing the PDMA-16/32 External DAS Driver

Some application programs access the PDMA-16/32 External DAS Driver automatically. For information on accessing external DAS drivers, see the documentation for your application program.

If you are using ASYST, perform the following steps to access the PDMA-16/32 External DAS Driver:

1. After loading the PDMA-16/32 External DAS Driver, boot ASYST 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 PDMA.
2. Enter the following at the OK prompt to make PDMA the current device:

PDMA

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
Board Type	16 = PDMA-16 32 = PDMA-32	16 = PDMA-16
Base I/O Address ^{1,2}	200h to 3E0h in increments of 10h	300h
Digital I/O Configuration	0 = 16-bit input 1 = 16-bit output 2 = 8-bit input (port A)/ 8-bit input (port B) 3 = 8-bit input (port A)/ 8-bit output (port B) 4 = 8-bit output (port A)/ 8-bit input (port B) 5 = 8 bit output (port A)/ 8-bit output (port B)	0 = 16-bit input
Interrupt Level ²	For the PDMA-16 board: IRQ level 2 through 7 For the PDMA-32 board: IRQ level 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15 0 = interrupts disabled	0 = interrupts disabled
DMA channel	For the PDMA-16: channels 1 and 3 for byte or word DMA transfers For the PDMA-32: channels 1 and 3 for byte transfers; channels 5, 6, and 7 for word transfers 0 = DMA disabled	0 = DMA disabled
Number of Boards ²	1, 2	1

Notes

¹ Switch-selectable.

² If you are using more than one PDMA-16 or PDMA-32 board, ensure that the base address and interrupt levels are unique for each board.

Configuration Menu Special Keys

Table 2 describes the keys used for special purposes in the configuration program.

Table 2. Configuration Menu Special Keys

Keys	Description
[w]	Write a response file. A response file is an ASCII file containing the command line options for the current configuration of the driver.
[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.
[Tab]	Toggle between boards 1 and 2 when two boards are being configured.
[?]	Invoke help on the current menu item.

Exiting the 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]
```

Configuring the PDMA-16/32 Driver from DOS

If you wish, you can also change the configuration of the PDMA-16/32 External DAS Driver using DOS command line options instead of using the configuration program. The command line syntax is as follows:

```
PDMA [bd #1 options],[bd #2 options] [-menu ]
```

The command line options are described in Table 3.

Table 3. Command Line Options

Option	Function
-a###	Board I/O address = ### (200h to 3E0h); see Table 1 on page 6
-b#	Board type = # (16 = PDMA-16; 32 = PDMA-32)
-irq#	Interrupt level = # (see Table 1 on page 6)
-dio#	Digital I/O configuration = # (0 to 5; see Table 1 on page 6)
-dma#	DMA channel = # (see Table 1 on page 6)
-def	Recall original default settings
-h	Help
-menu	Invoke menu-driven setup
@xxx	Indicates use of response file xxx. A response file is an ASCII file containing the command line options for the external driver.

To display command line options, enter the following at the DOS prompt:

```
PDMA ?
```

PDMA-16/32 External DAS Driver Characteristics

The following sections describe various attributes of the PDMA-16/32 External DAS Driver and restrictions imposed by the driver on various modes of operation and resources.

Synchronous Digital I/O Operations

Synchronous mode is supported for both 8- and 16-bit digital I/O conversions. You can use internal clocking and internal triggering in this mode. An 8-bit synchronous I/O operation can run concurrently with an externally clocked 8-bit interrupt I/O operation or with an externally clocked 8-bit DMA digital I/O operation.

Interrupt Digital I/O Operations

Interrupt operations are supported for both 8- and 16-bit digital I/O conversions. Internal and external clocking are supported; single- and double-buffered cyclic and noncyclic modes are also supported.

An interrupt I/O operation can run concurrently with a pulsed output operation only if the interrupt I/O operation is externally clocked.

An externally clocked 8-bit interrupt I/O operation can run concurrently with an 8-bit synchronous I/O operation. An 8-bit interrupt I/O operation can also operate on Port B concurrently with an 8-bit DMA I/O operation on Port A if the DMA I/O operation is cyclic and has a different clock mode (that is, if one operation is internally clocked and the other operation is externally clocked).

DMA Digital I/O Operations

DMA mode is supported for both 8- and 16-bit digital I/O conversions. If you select 8-bit I/O, DMA can operate on Port A only. Internal and external clocking are supported; cyclic and noncyclic modes are also supported. Double-buffered DMA is not supported.

A DMA digital I/O operation can run concurrently with a pulsed output operation only if the DMA digital I/O operation is externally clocked.

An 8-bit DMA digital I/O operation can run concurrently with an 8-bit synchronous I/O operation if the DMA I/O is externally clocked. An 8-bit DMA I/O operation can also operate on Port A concurrently with an 8-bit interrupt I/O operation on Port B if the DMA is cyclic and has a different clock mode (that is, if one operation is internally clocked and the other operation is externally clocked).

Pulse Output Operations

In pulse output operations, the output is taken from counter 1. The duty cycle of the pulse train is fixed at 50% due to the nature of the 8254 counter/timer circuitry. Pulsed output is available only if no other operation is internally clocked.

Internal Clocking

The maximum data transfer rate using the DMA transfer mode is 250K bytes/s for the PDMA-16 and 400K bytes/s for the PDMA-32. The maximum rate that you obtain may be less and depends largely on the computer you are using.

The timer resolution is 0.1 μ s. The minimum data rate is 0.002 Hz using the internal clock. Slower rates can be realized with external clocking.

External Clocking

You can use external clocking in interrupt and DMA mode. In interrupt mode, data transfer occurs on each rising edge of the INTERRUPT IN input (pin 1). In DMA mode, the external clock input is XFER REQ (pin 2).

Caution: When using externally clocked DMA, the first data point transferred may not occur on a rising edge of the clock signal. The effect of this is that the delay between the first and second points is smaller than the external clock period. This problem can be eliminated by starting the clock signal after requesting the DMA transfer. If this is not possible, the problem can be made less severe by using a low duty-cycle clock signal (that is, a signal that is high for very short pulses).

Channel Numbering

When the PDMA-16/32 board is configured for either two 8-bit input ports or two 8-bit output ports (option 2 or 5; see Table 1 on page 6), digital channel 0 corresponds to Port A and digital channel 1 corresponds to Port B.

Software Interrupt Vectors

The PDMA-16/32 External DAS Driver uses three software interrupt vectors to communicate with the application program. The interrupt vectors used are three 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 a different interrupt number than the default.

You change the interrupt vector numbers from the default by using the SET command from DOS. This command saves a string in the DOS environment that the driver searches for when it is loaded. These strings are specified in Table 4.

Table 4. Interrupts and Environment Strings

Interrupt	Default Interrupt Number	Environment String¹
Device linking vector	66h	DAS DS= <i>xx</i>
Critical error vector	65h	DAS CE= <i>xx</i>
Timer interrupt vector	64h	DAS TI= <i>xx</i>

Notes

¹ *xx* is between 60h and 67h.

Note: These interrupt vectors are not the same as the hardware interrupt levels used by the PDMA-16 and PDMA-32 boards.

PDMA-16/32 Driver Error Messages

Table 5 lists the error messages that may occur during operation of the PDMA-16/32 External DAS Driver.

Table 5. Error Messages from the PDMA-16/32 External DAS Driver

Error Number	Error Message	Description
0	No error	No error occurred.
1	Function not supported	A function was requested that is not supported by the PDMA-16/32 External DAS Driver.
2	Function out of bounds	A function number not defined by the PDMA-16/32 External DAS Driver was requested.
3	Non-valid board number	A board number that is out of range of configured boards was requested. This external driver supports up to two boards.
4	Non-valid error number	An invalid error number was detected by external driver function "REPORT ERROR MESSAGE." Only error numbers 0 to 14 are valid for this external driver.
5	Interrupt overrun	An interrupt was generated before the program was ready to handle it. This usually occurs when the interrupt clock is too fast.
6	PDMA-32 hardware error	The PDMA-32 board was not found at the configured address during initialization.
7	PDMA-16 hardware error	The PDMA-16 board was not found at the configured address during initialization.
8	Interrupt in use error	An interrupt-driven activity was attempted and interrupts were already active.
9	DMA in use error	A DMA activity was attempted and DMA was already active.
10	Timer in use error	The internal clock was active and it was requested by a second function.
11	Digital input not initiated	A digital input operation was attempted before the digital ports were initialized.

Table 5. Error Messages from the PDMA-16/32 External DAS Driver (cont.)

Error Number	Error Message	Description
12	Digital output not initiated	A digital output operation was attempted before the digital ports were initialized.
13	Timer not initiated	A function requiring the internal timer was requested before the timer was initialized.
14	Invalid DMA port	An 8-bit DMA operation was attempted on Port B.