

DASCard-PIO12

USER'S GUIDE

DASCard-PIO12

User's Guide

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New Contact Information

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, OH 44139

Technical Support: 1-888-KEITHLEY
Monday – Friday 8:00 a.m. to 5:00 p.m (EST)
Fax: (440) 248-6168

Visit our website at <http://www.keithley.com>

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Keithley MetraByte Division

Keithley Instruments, Inc.

440 Myles Standish Blvd. Taunton, MA 02780

Telephone: (508) 880-3000 • FAX: (508) 880-0179

Preface

The *DASCard-PIO12 User's Guide* describes how to set up, install, and program the DASCard-PIO12 digital I/O interface card.

This guide serves data acquisition system designers, engineers, programmers, and other users responsible for setting up, cabling and wiring signals to a DASCard-PIO12 in a notebook or desktop computer with a Type II, PCMCIA (Personal Computer Memory Card International Association) socket. User are assumed to be familiar with data acquisition principles, with their applications, and with their computers.

The *DASCard-PIO12 User's Guide* is organized as follows:

- Chapter 1 provides an overview of the hardware and descriptions of features, applications, supporting software, and accessories.
- Chapter 2 provides a block diagram and descriptions of major features.
- Chapter 3 describes how to unpack, install, and start up the card.
- Chapter 4 describes how to connect accessories.
- Chapter 5 describes how to start up and use the Control Panel.
- Chapter 6 describes programming requirements of the card.
- Chapter 7 describes how to isolate common problems, how to troubleshoot your system, and how to obtain technical support.
- Appendix A contains DASCard-PIO12 specifications.
- Appendix B contains pin assignments for the main I/O connector of the DASCard-PIO12 cable.
- An index completes the manual.

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1

Overview

The DASCARD-PIO12 is a digital I/O PC Card that you can use with any notebook or desktop computer that contains a Type II, PCMCIA (Personal Computer Memory Card International Association) socket. This chapter describes features and applications of the DASCARD-PIO12, supporting software, and available accessories.

Features

Major features of DASCARD-PIO12 are as follows:

- Contains 24 TTL/NMOS/CMOS-compatible digital I/O lines.
- Provides programmable unidirectional, bidirectional, and strobed I/O (bidirectional and strobed I/O are not supported by the ASO-PIO software package).
- Provides an interrupt input line.
- Provides direct interface with a wide range of accessory products, including instruments, displays, and user-assembled systems.
- Is software- and register-compatible with the Keithley MetraByte PIO-12, the predecessor product for IBM® PC/XT™, PC AT®, or equivalent computers that use an ISA (Industry Standard Architecture) bus.

Applications

Typical applications for the DASCARD-PIO12 are as follows:

- Contact closure monitoring
- Digital I/O control
- Alarm monitoring
- Display driving
- Relay control

Supporting Software

The DASCARD-PIO12 and industry-standard PIO-12 are software- and register-compatible. The following software is, therefore, available for operating a DASCARD-PIO12 or a PIO-12:

- **ASO-PIO package** - This package contains the following programs:
 - The PIO Series Function Call Driver and DLLs (Dynamic Link Libraries) that allow you to write custom programs in Microsoft[®] and Borland[®] C/C++ for Windows[™] and in Microsoft Visual Basic[™] for Windows. This driver is also required if you use Visual Test Extensions[™], described on page 1-3. Refer to the online help of the PIO Series Function Call Driver for more information.
 - ASO-PIO Control Panel - The Control Panel (CTLPIO.EXE) runs under Windows and allows you to perform operations on DASCARD-PIO12 cards without programming. This program also provides a quick way to test your card and monitor your operation. Refer to Chapter 5 and to the online help for more information.
 - ASO-PIO configuration utility - This utility allows you to create configuration files for use with the PIO Series Function Call Driver. Refer to “Using the Configuration Utility” on page 3-4 and to the online help for more information.

- **Keithley MetraByte Enabler utility**- The Enabler (KMENABLE.EXE) is a DOS-based program that requests system resources for your DASCARD-PIO12. Refer to “Loading the Keithley MetraByte Enabler Utility” on page 3-6 for more information
- **Keithley MetraByte diagnostics utility**- The diagnostics utility (KMINFO.EXE for DOS, KMINFOW.EXE for Windows) is a program that allows you to check the status of your DASCARD-PIO12; refer to “Using the Keithley MetraByte Diagnostics Utility” on page 3-10 for more information.
- **Visual Test Extensions (VTX)** - This optional Visual Basic custom control software package helps you write Windows application programs for the DASCARD-PIO12. Refer to the Keithley MetraByte product catalog for more information.
- **Data acquisition and analysis application software** - Refer to the Keithley MetraByte product catalog for information on data acquisition and analysis software available for the DASCARD-PIO12.

Accessories

The following accessories are available for use with your DASCARD-PIO12:

- **SSIO-24** - This accessory is a 24-channel mounting panel for up to 24 solid-state, miniature I/O modules with functions of DC input, DC output, AC input, and AC output. The SSIO-24 connects to the main I/O connector of the DASCARD-PIO12 cable. This accessory requires external power (+5 VDC) when used with the DASCARD-PIO12.
- **ERB-24** - This accessory is a relay board that provides 24 electromechanical double-pole, double-throw relays for controlling and switching up to 3 A at 120 V_{rms}. The ERB-24 connects to the main I/O connector of the DASCARD-PIO12 cable. This accessory has a built-in power supply requiring 115/230 VAC.
- **ERA-01** - This accessory is an electrical relay board containing eight single-pole, double-throw relays that can switch up to 3 A at 120 V_{rms}. The ERA-01 requires external power (+5 VDC) when used with the DASCARD-PIO12.

- **SRA-01** - This accessory is an 8-channel, solid-state, mounting panel for industry-standard I/O modules used in sensing and controlling AC and DC circuits. The SRA-01 requires external power (+5 VDC) when used with the DASCARD-PIO12.
- **STP-37** - This accessory is a screw-terminal panel for general-purpose connections in a compact form factor.
- **STA-U** is a universal screw-terminal accessory that connects to the main I/O connector of the DASCARD-PIO12 to bring the card's I/O signals to convenient screw terminals.

Refer to the Keithley MetraByte catalog or contact your local sales office for information on obtaining these accessories.

2

Functional Description

This chapter describes the features and operating characteristics of the DASCard-PIO12. Figure 2-1 is a block diagram of the DASCard-PIO12.

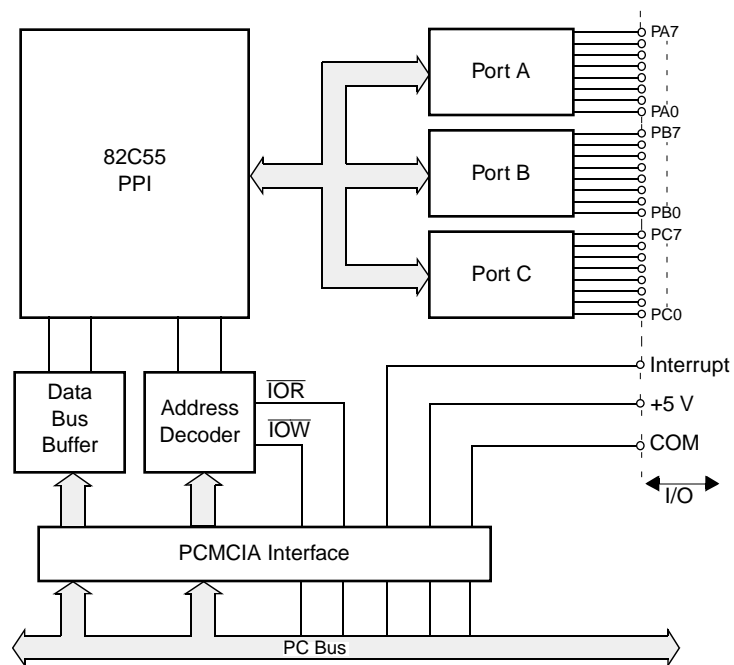


Figure 2-1. DASCard-PIO12 Block Diagram

DASCard-PIO12 features and operating characteristics are described as follows:

- The DASCard-PIO12 has three TTL/NMOS/CMOS-compatible, digital I/O ports: port A, port B, and port C. Ports A and B are both byte-wide (8-bits) and can be inputs or outputs. Port C is also byte-wide but is usable as two separate 4-bit ports (port C Lower and port C Upper), which can be an inputs or outputs.
- The DASCard-PIO12 has an interrupt input channel. During startup, the Keithley MetraByte Enabler program can request any one of the interrupt levels available on the PC bus.
- The Interrupt Controller of the computer handles interrupts and is set by the computer BIOS to respond to positive-edge-triggered (low to high) inputs. You must program the Interrupt Controller to respond to your application by setting up the corresponding interrupt handler.
- The DASCard-PIO12 decodes 2-bit I/O addresses and communicates with the PC bus as an 8-bit peripheral. The address map uses four consecutive I/O addresses. You can install multiple DASCard-PIO12 cards in a computer with each at a different base address.
- The +5 V power level from the computer is available through the main I/O connector of the DASCard-PIO12 cable. If you plan to use power from the PC Card, you should consider the power draw of all system devices and observe current-capacity limits of both the computer and the card.

3

Setup and Installation

This chapter contains the information you need to install and use your DASCard-PIO12.

Assembling Your System

For proper operation of a DASCard-PIO12, your system may require the following items:

- Notebook or desktop computer with a Type II or Type III, PCMCIA socket.
- Windows, Version 3.1 or higher, running in Enhanced mode.
- DOS, Version 5.0 or higher.
- CardSoft™, CardWare™, CardTalk™, Phoenix® CARD Manager Plus, or any other PCMCIA Card and Socket Services (PCMCIA standard 2.10 or higher). Each of these packages allows a DASCard-PIO12 to work in your computer and is typically a DOS-based, terminate-and-stay-resident (TSR) program loaded from your CONFIG.SYS file.

Many notebook computers are shipped with PCMCIA Card and Socket Services already installed. Check your computer documentation or software package for the name of the services and for compliance with PCMCIA standard 2.10 or higher. If you cannot establish this compliance, you should obtain and install one of the PCMCIA Card and Socket Services listed above.

- A Keithley MetraByte Enabler utility (KMENABLE.EXE) and a Keithley MetraByte diagnostics utility (KMINFO.EXE for DOS and KMINFOW.EXE for Windows).

Unpacking and Inspecting Your Card

After opening the shipping carton, perform the following steps to unpack and inspect your DASCARD-PIO12:

1. Carefully remove the card from its plastic case. (Keep the plastic case for future storage or possible shipping needs.)
2. Inspect the card for signs of damage. If any damage is apparent, arrange to return the card to the factory; refer to page 7-6 for more information.
3. Check the remaining contents of your package against the packing list; report any missing items immediately.
4. If the card and remainder of the package are acceptable, set up the software and the card. Refer to the following sections for information.

Overview of Installation and Startup

To install and start a DASCARD-PIO12, perform the following tasks in the order shown:

1. Install PCMCIA Card and Socket services, if required. Refer to the manufacturer's installation instructions.
2. Install the ASO-PIO software package from Windows, if required. Refer to "Installing the Software" on page 3-3 for information.
3. If the default configuration of your card does not suit your application, create a new configuration file. Refer to "Using the Configuration Utility" on page 3-4 for information.
4. If you are working in Windows, exit to DOS, and load the Keithley MetraByte Enabler. Refer to "Loading the Keithley MetraByte Enabler Utility" on page 3-6 for information.

Note: After starting up your computer, you must load the Keithley MetraByte Enabler *before* you load Windows and *before* you install the card.

5. Install your card. Refer to “Installing the Card” on page 3-9 for information.
6. Check the installation of your card using the Keithley MetraByte diagnostics utility. Refer to “Using the Keithley MetraByte Diagnostics Utility” on page 3-10 for information.
7. Test the functions of your card using the Control Panel. Refer to Chapter 5 for information.
8. Write your application program. If you are using the PIO Series Function Call Driver, refer to the online help for information. If you are using VTX, refer to the *Visual Test Extensions™ User’s Guide* and the VTX online help for information.
9. Run your application program.

Installing the Software

To install the ASO-PIO software package, perform the following steps:

1. Make copies of the supplied disks. Use the copies as your working disks, and store the originals as backups.
2. Insert disk 1 into a drive.
3. Start Windows.
4. From the File menu of the Program Manager group, select Run.
5. Choose Browse to locate the SETUP.EXE file on disk 1, and then select OK for the Browse and Run panels.

The setup program prompts you for your installation preferences and for additional disks, as necessary. The program responds to your entries by creating a directory on the specified drive and copying all files, expanding any compressed files.

6. When the setup program notifies you that the installation is complete, review the following files:
 - FILES.TXT is a text file listing and describing all the files copied to the hard disk by the installation program.
 - README.TXT is a text file containing information that was unavailable when this manual was printed.

Using the Configuration Utility

You need a configuration file to use the Function Call Driver or VTX, provided in your DASCARD-PIO12 software package. The CFGPIO.EXE configuration utility allows you to create a new configuration file or modify an existing configuration file. CFGPIO.EXE also allows you to create a configuration file for multiple PIO devices.

Creating or Modifying a Configuration File

Use CFGPIO.EXE to create or modify a configuration file, as follows:

1. In Windows, select the PIO-Configuration icon in the Keithley PIO program group.
2. To modify an existing configuration file, select the Open option from the File menu, select the configuration file (for demonstration purposes, choose the PIO.CFG file from the ASO-PIO software package), then go to step 3. To create a new configuration file, go to step 5.
3. In the PIO Configuration panel, select the DASCARD-PIO12 from the Board Type scroll bar. The default configuration options for the DASCARD-PIO12 are as shown in Table 3-1.

Table 3-1. Default Configuration Options for the DASCARD-PIO12

Attribute	Options
Card name	DASCARD-PIO12
Base address (hex)	—
Interrupt level	—
Port A, B, CL, and CH	Input
Combine ports	No

4. Use the Save option in the File menu of the PIO Configuration panel to save these options in the PIO.CFG file, making this file your default configuration file for the DASCARD-PIO12.

5. You can create a new configuration file by modifying the default configuration values in the PIO Configuration panel and using the Save As selection from the File menu of the PIO Configuration panel to save the modified values in a file with a new name. For consistency, any name you assign to a configuration file should have a .CFG extension (for example, MYFILE.CFG).

Creating a Configuration File for Multiple PIO Devices

In a laptop computer, CFGPIO.EXE can support a maximum of two DASCARD-PIO12 cards in PCMCIA sockets. In an IBM PC AT (or equivalent), CFGPIO.EXE can support a maximum of 10 PIO devices. Up to two of these PIO devices can be DASCARD-PIO12 cards in PCMCIA sockets; the remaining devices can be any of the various PIO boards in the accessory slots of the computer.

When you are working with multiple PIO boards and cards, you use the configuration utility to assign each board and card a *board number* from a range of 0 to 9. You can assign each of two DASCARD-PIO12 cards any number in this range, so long as you assign a card in PCMCIA socket 0 a lower board number than a card in PCMCIA socket 1 (if you use just one DASCARD-PIO12, you must place the card in socket 0). Use CFGPIO.EXE to configure a mix of PIO boards and cards as follows:

1. In Windows, select Run from the Program Manager File menu, use the Browse button to find CFGPIO.EXE, and choose OK in both the Browse and Run panels.
2. In the Board No. scroll box of the PIO Configuration panel, select board number 0.
3. In the Board Type scroll box of the PIO Configuration panel, select the type of board or card you have designated as board number 0.
4. Modify the configuration options for the board or card designated as board number 0.

Note: Remember that you must set each PIO board for a different base address and interrupt level, and that you must enter the base address and interrupt level for each board in the configuration options for the corresponding board number (the base address and interrupt level for a DASCARD-PIO12 allocated by the Enabler).

5. When the configuration options for board number 0 are complete, repeat steps 2 to 4 for each of the remaining boards/cards.
6. When the configuration options for all boards/cards are complete, use the Save As selection from the File menu of the PIO Configuration panel to save the options in a new or existing configuration file.
7. To exit the configuration utility, choose the Exit option on the PIO Configuration panel.

Loading the Keithley MetraByte Enabler Utility

A PC Card enabler is a TSR whose function is to set up compatibility between the card and the computer bus by requesting PCMCIA Card Services to allocate certain resources for the card. These resources include a base address and an interrupt level for the DASCARD-PIO12.

Most computers equipped to accept PC Cards contain a generic enabler that loads automatically upon startup. However, PC Card manufacturers often provide customized enablers to perform tasks a generic enabler might be unable to handle. Keithley MetraByte provides KMENABLE.EXE, a customized enabler designed to recognize and respond specifically to Keithley MetraByte PC Cards. You *must* use the Keithley MetraByte Enabler for your DASCARD-PIO12 if you intend to use VTX, the Control Panel, or the PIO Series Function Call Driver.

To obtain a base address and interrupt level that are not in use by another device in your system, perform the following steps to load the Keithley MetraByte Enabler:

1. Turn power to your computer off.
2. If your DASCARD-PIO12 is already installed, remove it from its socket.

Note: To prevent conflicts with the generic enabler or with Windows, do not install your card or load Windows until after you load the Keithley MetraByte Enabler.

3. Return power to the computer.

4. If your PCMCIA Card Services allow you to exclude resources from resource allocation, make sure you exclude any base addresses and interrupt levels in use by other devices in your system.
5. If your PCMCIA Card Services allow you to reserve system resources, make sure that you reserve a base address and interrupt level not in use by other devices in your system.
6. Table 3-2 lists the command-line switch options for use with the Enabler. Use these switch options if the default values for base address and interrupt level are already assigned to another device.
7. If the default base addresses and interrupt levels shown in Table 3-2 are available, go to step 9.
8. If the default base addresses and interrupt levels shown in Table 3-2 are unavailable, go to step 10.
9. Load the Keithley MetraByte Enabler using the following statement at the DOS prompt, and then go to step 11:

```
KMENABLE
```

Note: If you prefer to start the Keithley MetraByte Enabler automatically upon power-up, enter the KMENABLE command in your computer's AUTOEXEC.BAT file. Remember, though, to remove your card before power-up.

10. Load the Keithley MetraByte Enabler using one or more of the command-line switch options listed in Table 3-2.

Table 3-2. Switch Options for the Enabler

Switch Syntax	Description
/?	Displays syntax information.
/BA0: <i>baseaddress</i>	Uses the value you enter for <i>baseaddress</i> to specify a base address for card 0. Make sure that &H precedes hexadecimal numbers. If you do not use this switch, the Enabler tries to use a default base address of 300h.

Table 3-2. Switch Options for the Enabler (cont.)

Switch Syntax	Description
<i>/BA1:baseaddress</i>	Uses the value you enter for <i>baseaddress</i> to specify a base address for card 1. Make sure that &H precedes hexadecimal numbers. If you do not use this switch, the Enabler tries to use a default base address of 308h.
<i>/I0:intlevel</i>	Uses the value you enter for <i>intlevel</i> to specify an interrupt level for card 0. If you do not use this switch, the Enabler tries to use a default level of 5. If you use a value of -1, the Enabler does not allocate any interrupt level.
<i>/I1:intlevel</i>	Uses the value you enter for <i>intlevel</i> to specify an interrupt level for card 1. If you do not use this switch, the Enabler tries to use a default level of 7. If you use a value of -1, the Enabler does not allocate any interrupt level.
<i>/MEM0:memaddress</i>	Not applicable.
<i>/MEM1:memaddress</i>	Not applicable.
<i>/NORETRY</i>	The Enabler detects an error ¹ if the base address or interrupt level you specify is in use by another Keithley MetraByte PC Card. If you do not use this option and specify a resource that is assigned to another Keithley MetraByte PC Card, the Enabler automatically selects the next available resource.
<i>/U</i>	Unloads the Enabler from computer memory.

Notes

¹ An error detected by the Enabler is displayed when you run the diagnostics utility (see page 3-10). If the error is displayed in one of the following 4-digit formats, the error indicates an allocation problem with the named resource: 8xxx indicates base address; 4xxx indicates interrupt level; Cxxx indicates memory.

For example, if the default assignments for card 0 are appropriate but you want to change the assignments for card 1, enter a line similar to the following at the DOS prompt:

```
KMENABLE /BA1:&H310 /I1:11
```

As another example, if you want to change a base address and/or interrupt level without restarting your computer, you can remove the Keithley MetraByte Enabler by entering the following statement at the DOS prompt:

```
KMENABLE /U
```

Then (after removing the card and exiting Windows), you can reload the Enabler using the command-line switch options to specify a new base address, and/or interrupt level. Replace the card after you load the Enabler.

Still another example uses the /NORETRY switch to make sure the same base address and interrupt level are allocated each and every time the card is inserted. This switch allows the use of older PIO-12 boards as well as register-level programming. Use this switch with a command similar to the following:

```
KMENABLE /BA1:&H310 /I1:11 /NORETRY
```

Note: If you use the PCMCIA software to reserve system resources and then use a switch option to specify a base address or interrupt level that was not reserved, the value you specify is ignored.

11. To determine whether the Enabler recognizes your DASCARD-PIO12 and whether suitable resources were allocated, install your card (see the next section) and run the diagnostics utility (see page 3-10).

Installing the Card

To install a DASCARD-PIO12, perform the following steps:

1. Select the appropriate Type II, PCMCIA socket and remove its cover.
2. Insert the card into the selected socket; the card is labeled to show the direction of insertion and keyed to allow only one way of insertion. On some computers, one or more beeps indicate that the card is installed correctly.

If you are using two DASCARD-PIO12 cards, the Keithley MetraByte Enabler recognizes the first card you install as card 0 and the second as card 1, regardless of socket numbers.

3. On most notebook computers, you can hot-swap PC Cards; you are not required to turn computer power off when installing or removing a card. A computer that does not conform to the ExCA (exchange card architecture) Specification cannot support hot swapping; you must turn on the PCMCIA socket with a software utility each time you insert a card. The socket turn-on utility should be described in your computer documentation.
4. Make sure the card is ready for proper operation by running the diagnostics utility; refer to the following section.

When your DASCARD-PIO12 is properly installed, you can attach accessories and wire signals to the card; refer to Chapter 4 for information.

Using the Keithley MetraByte Diagnostics Utility

The diagnostics utility (KMINFO.EXE for DOS or KMINFOW.EXE for Windows) allows you to check the status of your DASCARD-PIO12 after startup and during operation. To check the operation of your DASCARD-PIO12 while running in DOS, enter the following command at the DOS prompt:

```
KMINFO
```

To check the operation of your DASCARD-PIO12 while running in Windows, use KMINFOW.EXE as follows:

1. Choose Run from the File menu of the Program Manager panel to bring up the Run panel.
2. Choose Browse to locate and select KMINFOW.EXE.
3. Choose OK on both the Browse and Run panels to run the utility.

The diagnostics utility displays the following information:

- The PCMCIA Card and Socket Services that are installed
- Whether the Keithley MetraByte Enabler is installed

- The following information for each socket:
 - The manufacturer of the installed card
 - The card type
 - Whether the card is enabled
 - If the card is enabled, the base address and interrupt level
 - If the card is not enabled, Card and Socket Services and the card identification

Note: The diagnostics utility displays a base address as a number preceded by *0x*. The *0x* signifies a hexadecimal number. For example, *0x350* is *350h*.

If any of the fields in the diagnostics display are missing or if an error is displayed, the card is improperly configured. Refer to Chapter 7 for troubleshooting information.

An error displayed in one of the following 4-digit formats indicates an allocation problem with the named resource: 8xxx indicates base address; 4xxx indicates interrupt level; Cxxx indicates memory.

4

Cabling and Wiring

This chapter describes how to wire accessories and signals to your DASCARD-PIO12. The DASCARD-PIO12 and I/O cable appear as shown in Figure 4-1.

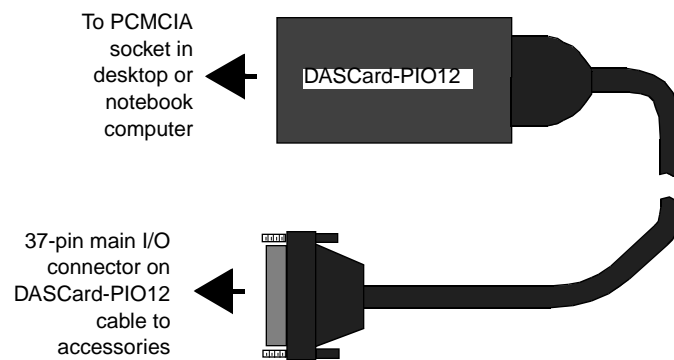


Figure 4-1. DASCARD-PIO12 and Attached I/O Cable

The main I/O connector of the DASCARD-PIO12 cable is a female, 37-pin, D type. Pin assignments for this connector are shown in Appendix B.

Connecting an SSIO-24, ERB-24, ERA-01, or SRA-01

The following accessories attach directly to the I/O cable of a DASCARD-PIO12, as shown in Figure 4-2:

- SSIO-24
- ERB-24
- ERA-01
- SRA-01

Note: Each of these accessories requires external power when connected to a DASCARD-PIO12.

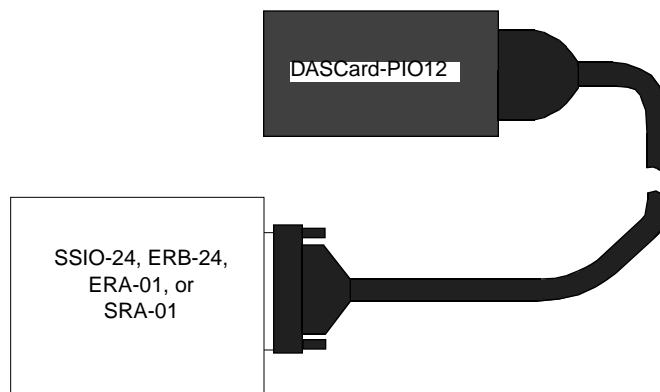


Figure 4-2. Attaching an SSIO-24, an ERB-24, an ERA-01, or an SRA-01 to a DASCARD-PIO12 Cable

Connecting an STP-37 or STA-U

The STP-37 and STA-U are screw-terminal panels that attach to the main I/O connector of a DASCARD-PIO12 cable, as shown in Figure 4-3. The STP-37/C is the STP-37 with a protective bottom cover. While Figure 4-3 shows an STP-37 or STP-37/C, the STA-U attaches to the DASCARD-PIO12 cable in exactly the same manner.

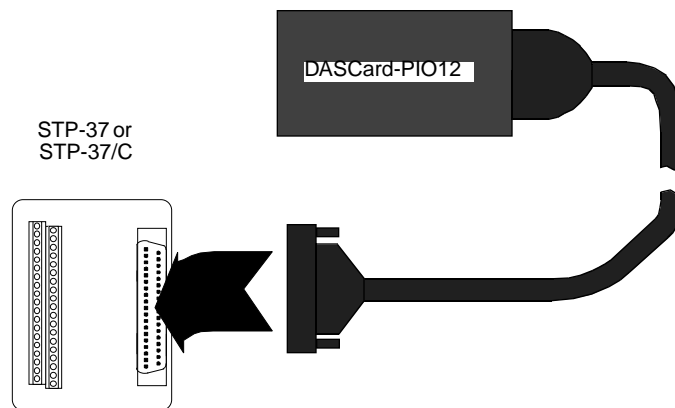


Figure 4-3. Connecting an STP-37 or STP-37/C to a DASCARD-PIO12

The STP-37 and STP-37/C appear as shown in Figure 4-4.

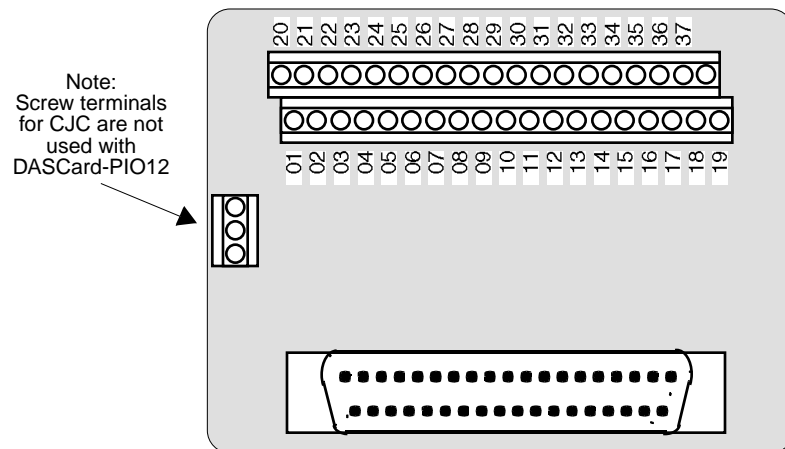


Figure 4-4. Panel Layout of STP-37 and STP-37/C

Connecting Special-Purpose I/O Circuits

The following subsections show commonly used circuits for the inputs or outputs of a DASCard-PIO12.

Connecting a Contact-Closure Monitor to an Input

Figure 4-5 shows a circuit for monitoring contact closure at a DASCard-PIO12 input.

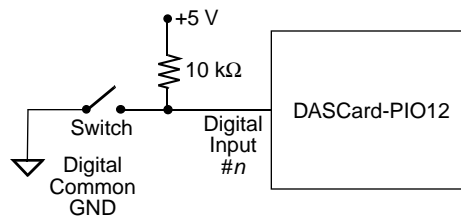


Figure 4-5. Contact-Closure Monitor for a DASCard-PIO12 Input

Note: The circuit in Figure 4-5 does not contain a debounce circuit. Debounce can be handled by your application program or by the circuit in the following subsection.

Connecting an Input to a Debounce Circuit

While debounce can be handled by your application program, Figure 4-6 shows a debounce circuit you can use at an input of a DASCARD-PIO12.

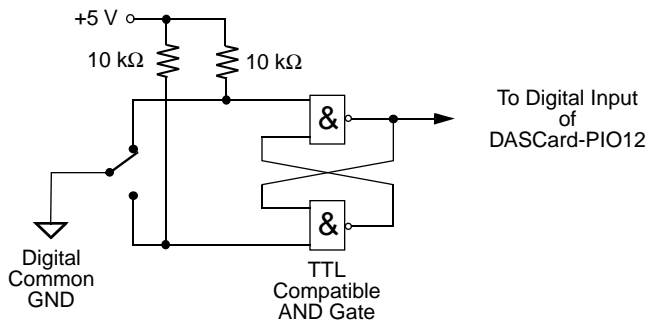


Figure 4-6. Debounce Circuit for a DASCARD-PIO12 Input

Connecting an Output to Darlington NPN for Relay Control

You can achieve relay control at an output of a DASCARD-PIO12 using a Darlington NPN transistor, as shown in Figure 4-7.

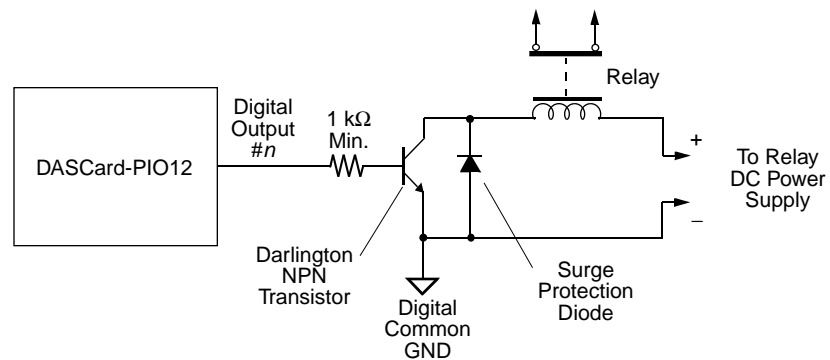


Figure 4-7. Darlington NPN Relay Control for an Output of a DASCARD-PIO12

5

Control Panel

The Control Panel is a utility program for testing the functions of your DASCARD-PIO12; this utility is available for Windows as CTLPIO.EXE. The Control Panel is a part of the ASO-PIO software package.

To use the Control Panel, perform the following steps:

1. From the Windows Program Manager panel, select the Control Panel icon in the Keithley PIO program group.
2. After the Control Panel starts, enter the name of a configuration file, a card type, and a socket number.

The remaining portion of the Control Panel contains the controls that allow you to transfer and monitor data.

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

6

Programming

Note: You can ignore this chapter if you are using ASO-PIO software. If you are not using ASO-PIO software (if you are programming in DOS, or if you are using existing software for the older PIO-12 board, or if you are doing register-level programming), you must use the /NORETRY switch (see Table 3-2 on page 3-7) to make sure you get the same base address and interrupt level each and every time you install your card.

DASCard-PIO12 programmability is provided through the card's 82C55 Programmable Peripheral Interface (PPI) integrated circuit. The 82C55 PPI provides 24 digital I/O lines, which the DASCard-PIO12 uses for the following three ports:

- Port A (abbreviated PA) consists of one 8-bit data output latch/buffer and one 8-bit data input latch.
- Port B (PB) consists of one 8-bit data output latch/buffer and one 8-bit data input buffer.
- Port C (PC) consists of one 8-bit data output latch/buffer and one 8-bit data input buffer. This port can also be used as two 4-bit ports: PC Upper (PC4 to PC7) and PC Lower (PC0 to PC3).

Programming the DASCard-PIO12 involves two fundamental tasks:

1. Setting the port configuration.
2. Reading/writing data from/to the ports.

These tasks are discussed in the sections that follow.

Note: If you need more detailed information on the functionality of the 82C55 PPI, please contact an Intel[®] or Toshiba[®] representative for a complete data sheet. The contact number for Intel technical support is (800)628-8686.

Setting the Port Configuration

You configure each port or half-port as an input or an output according to the value of the control word in the PPI control register. The control word is a 1-byte word programmed at Base Address +3h. Refer to Table 6-1 for the complete 82C55 PPI address map.

Table 6-1. 82C55 PPI Address Map

Address	Function	Type
Base Address +0h	Port A (PA)	Read/Write
Base Address +1h	Port B (PB)	Read/Write
Base Address +2h	Port C (PC)	Read/Write
Base Address +3h	Control Word	Write only

The control word also specifies one of the following three operating modes (for a complete description of the PPI operating modes, refer to the Intel 82C55 data sheet):

- **Mode 0** - Basic I/O; all ports are I/O ports.
- **Mode 1** - Strobed I/O; part of Port C controls data transfer.
- **Mode 2** - Bidirectional I/O on Port A only; part of Port C controls data transfer.

A power-up or reset automatically configures all ports as inputs. This configuration remains intact until changed by a write to the control register. The initialization section of your program should set the port configuration. Table 6-2 illustrates how the port configuration is derived from the control word.

Table 6-2. Derivation of Port Configuration from Control Word

Bit #	Bit Setting	Configuration
7	0 1	Bit set/reset mode for PC0 to PC7 Mode set active for PC0 to PC7
6 and 5	00 01 1X	Mode 0 for PA4 to PA7 and PC4 to PC7 Mode 1 for PA4 to PA7 and PC4 to PC7 Mode 2 for PA4 to PA7 and PC4 to PC7
4	0 1	PA output PA input
3	0 1	PC4 to PC7 output PC4 to PC7 input
2	0 1	PB0 to PB3 and PC0 to PC3 output PB0 to PB3 and PC0 to PC3 input
1	0 1	PB output PB input
0	0 1	PC0 to PC3 output PC0 to PC3 input

Table 6-3 summarizes information from the Intel peripheral data book on control words and their port directions for mode 0.

Table 6-3. Control Word

Control Word	Port A	Port B	Port C Lower 0 to 3	Port C Upper 4 to 7
80h	Out	Out	Out	Out
81h	Out	Out	In	Out
82h	Out	In	Out	Out
83h	Out	In	In	Out
88h	Out	Out	Out	In

Table 6-3. Control Word (cont.)

Control Word	Port A	Port B	Port C Lower 0 to 3	Port C Upper 4 to 7
89h	Out	Out	In	In
8Ah	Out	In	Out	In
8Bh	Out	In	In	In
90h	In	Out	Out	Out
91h	In	Out	In	Out
92h	In	In	Out	Out
93h	In	In	In	Out
98h	In	Out	Out	In
99h	In	Out	In	In
9Ah	In	In	Out	In
9Bh	In	In	In	In

A noteworthy characteristic of the 82C55 PPI is that all port registers are cleared by a write to the control register. Consequently, if your program intends to repeatedly change the port configuration, you may need to make provisions for restoring data to cleared ports.

Reading/Writing Data from/to the Ports

The examples in this section use the QuickBasic programming language to illustrate some common programming tasks.

Writing to the Control Register

The following code configures all of the ports as outputs:

```
OUT BADDR +3, &H80      'Sets all ports to outputs.
```

Performing Fundamental I/O Operations

The following code performs fundamental I/O operations:

```
OUT BADDR, &H22          'Sends 22 Hex to Port A.
OUT BADDR +1, 99        'Sends 99 to Port B.
PRINT INP(BADDR +1)    'Reads and displays
                        'Port B data in decimal.
PRINT HEX$(INP(BADDR)) 'Reads and displays
                        'Port A data in hex.
```

Reading BCD Data

The following code reads 2-digit BCD (Binary Coded Decimal) data:

```
BCD% = INP(BADDR)      'Read data.
                        'Convert to decimal.
BCD% = (BCD% AND &HF0)*10/16 + (BCD% AND &H0F)
```

Performing Bit Operations

Bit operations use the Boolean operators OR, AND, XOR, EQV, IMP, and NOT.

The following code sets bit 3 on Port A to 1 without disturbing the other bits:

```
A% = INP(BADDR)        'Read port A.
OUT BADDR, (A% OR 2^3) 'OR bit 3 and write to
                        'Port A.
```

The following code clears bit 7:

```
A% = INP(BADDR)        'Read port A.
                        'AND the inverse of bit 7,
                        'effectively masking it
                        'to an OFF state.
OUT BADDR, (A% AND NOT(2^7))
```

The following code illustrates the use of the BASIC WAIT command to wait for a particular condition on Port C:

```
WAIT BADDR +2, N%, J%
```

The result of an XOR on the data read at Port BADDR +2 (Port C in this example) and J% is ANDed with N%. If the result is 0, the program loops back and reads the port again; otherwise execution continues with the next line.

7

Troubleshooting

If your DASCard-PIO12 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 page 7-6 for information on how to contact an applications engineer.

Identifying Symptoms and Possible Causes

Table 7-1 lists general symptoms and possible solutions for problems with a DASCard-PIO12.

Table 7-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Data appears to be invalid	An open connection exists. Multiple devices in your system are using the same interrupt level and base address.	Check wiring to screw terminals. Use the diagnostics utility to determine the system resources used; refer to page 3-10. Assign a different system resource to the other device.
Card does not work properly	You used Ctrl Alt Del to restart your computer. (On some computers, Ctrl Alt Del does not reset the socket controller.)	Remove the card and restart your computer by using the reset button or by turning power OFF and then back ON. Reload the Enabler, then replace the card. Refer to your computer documentation.

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
<p>Diagnostics utility indicates that the card is not installed correctly</p>	<p>PCMCIA Card and Socket Services are not installed.</p>	<p>Refer to the documentation supplied with your computer for information on installing PCMCIA Card and Socket Services. If Card and Socket Services were not supplied with your computer, contact your local Keithley MetraByte sales office for information on obtaining them.</p>
	<p>PCMCIA Card and Socket Services are not compliant with PCMCIA standard 2.10 or higher.</p>	<p>Contact your computer manufacturer for information on upgrading to PCMCIA standard 2.10. If PCMCIA Card and Socket Services were not supplied with your computer, contact your local Keithley MetraByte sales office for information on obtaining them.</p>
	<p>The Enabler is not installed.</p>	<p>Exit Windows and try loading the Enabler (KMENABLE.EXE) again from DOS. Refer to page 3-6.</p>
	<p>You loaded the Enabler with a DASCARD-PIO12 already installed; the Enabler does not recognize the card.</p>	<p>Remove the DASCARD-PIO12 and turn power OFF. Turn power back ON, load the Keithley MetraByte Enabler (KMENABLE.EXE), and then re-install the card. If your hardware does not support hot-swapping, you may have to manually reapply power to the card using the appropriate PCMCIA Card Services function.</p>
	<p>PCMCIA Card Services recognizes a DASCARD-PIO12 as another type of device and allocates resources without providing the Keithley MetraByte Enabler with information about the allocated resources.</p>	<p>Remove the DASCARD-PIO12 and turn power OFF. Turn power back ON, load the Keithley MetraByte Enabler (KMENABLE.EXE), and then reinstall the card. If your hardware does not support hot-swapping, you may have to manually reapply power to the card using the appropriate PCMCIA Card Services function.</p>

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
<p>Card does not respond</p>	<p>PCMCIA Card Services cannot check the interrupt level and base address assigned to non-PCMCIA devices and may have selected an interrupt level or base address that is being used by another device, such as a network card, a mouse, or a sound card.</p> <p>The card is not inserted correctly in the PCMCIA socket.</p> <p>The card is damaged.</p>	<p>Use the diagnostics utility to determine the system resources selected by PCMCIA Card Services; refer to page 3-10. If the interrupt level or base address is being used by another device, load the Enabler again using command-line options to select another interrupt level or base address; refer to page 3-6.</p> <p>If your PCMCIA Card Services allow you to reserve system resources when you install the PCMCIA software, make sure that you reserve an unused interrupt level or base address. Refer to the documentation supplied with your PCMCIA Card and Socket Services for information.</p> <p>Assign another interrupt level or base address to the other device.</p> <p>Available interrupt levels depend on the installed devices. Typically, base addresses 300h to 377h are available.</p> <p>Check installation. Make sure that you have inserted the card in a Type II PCMCIA socket (a Type II card also works in a Type III socket). Remove the card and insert again. If your hardware does not support hot-swapping, you may have to manually re-apply power to the card using the appropriate PCMCIA Card Services function.</p> <p>Contact the Keithley MetraByte for technical support; refer to page 7-6.</p>

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
An application program written using the DASCARD-PIO12 Function Call Driver does not run properly	The Keithley MetraByte Enabler (KMENABLE.EXE) did not make your card's base address and interrupt level available to the DASCARD-PIO12 Function Call Driver.	Remove the DASCARD-PIO12 and turn power OFF. Turn power back ON, load the Keithley MetraByte Enabler (KMENABLE.EXE), and then reinstall the card. If your hardware does not support hot-swapping, you may have to manually reapply power to the card using the appropriate PCMCIA Card Services function.
Mouse does not work properly or interferes with other card operations	PCMCIA Card Services may have selected an interrupt level or base address that is being used by the mouse.	Use the diagnostics utility (KMINFO.EXE or KMINFOW.EXE) to determine the system resources used; refer to page 3-10. Assign a different system resource to the mouse. Reserve unused system resources when you install the PCMCIA software, if possible.
Intermittent operation	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
System lockup	A timing error occurred.	Remove the card and restart your computer. Reload the Enabler, then replace the card.

If you cannot identify the problem using the information in Table 7-1, refer to the next section to determine whether the problem is in the computer or in the DASCARD-PIO12.

Testing the Card and the Computer

To determine whether the problem is in the computer or in the DASCARD-PIO12, perform the following steps:

1. Remove power connections to the computer.
2. Unplug the accessory cable from the DASCARD-PIO12, keeping the connections intact on the accessory.
3. Remove the DASCARD-PIO12 from the computer and visually check for damage. If a card is obviously damaged, refer to page 7-6 for information on returning the card.
4. With the DASCARD-PIO12 removed from the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

If you have another DASCARD-PIO12 that is functional, refer to the next section to determine whether the problem is in the PCMCIA socket or in the I/O connections. If you do not have another card, refer to page 7-6 for information on how to contact an applications engineer.

Testing the PCMCIA Socket and I/O Connections

If the computer is operating properly, perform the following steps to determine whether the problem is in the socket or in the I/O connections:

1. Install a DASCARD-PIO12 that is functional. Do not make any I/O connections.
2. Apply computer power and check operation of the functional card. This test checks the socket. If you are using two DASCARD-PIO12 cards, check the other socket, also.
3. If the sockets are functional, check the I/O connections. Connect the accessories, one at a time, and check operation.
4. If operation is normal, the problem is in the DASCARD-PIO12 originally in the computer.
5. If you cannot isolate the problem, refer to the next section for instructions on getting technical support.

Technical Support

Before returning any equipment for repair, call the Keithley MetraByte Applications Engineering Department at:

(508) 880-3000

Monday - Friday, 8:00 A.M. - 6:00 P.M., Eastern Time

An applications engineer will help you diagnose and resolve your problem over the telephone. Please have the following information available before you call:

DASCard-PIO12	Serial #	_____
	Revision code	_____
Computer	Manufacturer	_____
	CPU type	286 386 486 Pentium
	Clock speed (MHz)	20 25 33 66 100 _____
	Math coprocessor	Yes No
	Amount of RAM	_____
	Video system	EGA VGA SVGA
	BIOS type	_____
	PCMCIA controller	_____
Operating system	Memory manager	_____
	DOS version	_____
	Windows version	3.0 3.1 _____
	Windows mode	Standard Enhanced
PCMCIA Card and Socket Services	Type	_____
	Version	_____
Software package	Name	_____
	Serial #	_____
	Version	_____
	Invoice/order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____
Accessories	Type/number	_____
	Type/number	_____
	Type/number	_____

If a telephone resolution is not possible, the applications engineer will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Include the RMA number with any documentation regarding the equipment.

When returning equipment for repair, include the following information:

- Your name, address, and telephone number.
- The invoice or order number and date of equipment purchase.
- A description of the problem or its symptoms.
- The RMA number on the outside of the package.

Repackage and ship the equipment to:

ATTN: RMA # _____
Repair Department
Keithley MetraByte
440 Myles Standish Boulevard
Taunton, Massachusetts 02780

Telephone (508) 880-3000
FAX 508/824-5517

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

A

Specifications

Inputs and outputs of the DASCARD-PIO12 are TTL/DTL-compatible. Outputs can drive one standard TTL (74 series) load or four LSTTL (74LS) loads. CMOS compatibility can be achieved by connecting a 10 k Ω pull-up resistor from the DASCARD-PIO12 output to +5 V. Table A-1 and Table A-3 list DASCARD-PIO12 specifications.

Table A-1. Input and Output Specifications

Logic Inputs and Outputs	Minimum	Maximum
Input logic low voltage	-0.5 V	0.8 V
Input logic high voltage	2.2 V	5.0 V
Input and interrupt input current for the PA, PB, and PC ports ($0 < V_{IN} < 5$ V)	-10 μ A	10 μ A
Output sink current ($V_{OL} = 0.45$ V)	2.5 mA	—
Output high voltage ($I_{OH} = -400$ μ A)	24 V	—
Output high voltage ($I_{OH} = -100$ μ A)	4.2 V	—
Darlington drive current ¹ $V_{EXT} = 1.5$ V $R_{EXT} = 1.1$ k Ω	-1.0 mA	-5 mA

Notes

¹ Applied for optional eight I/O terminals in port B and port C.

Table A-2. Power Requirements

Feature	Specification
+5 V static	21 mA maximum
+5 V operating	26 mA maximum

Table A-3. Environmental Specifications

Feature	Specification
Operating temperature range	0 to 50°C
Storage temperature range	-40 to 100°C
Humidity	0 to 90% non-condensing
Dimensions	Comply with PCMCIA Type II (5.0 mm), standard 2.1
Weight	4 oz. (113 g)

B

Connector Pin Assignments

The connection between an external I/O device and the DASCARD-PIO12 is made at the main I/O connector on the DASCARD cable, which is a standard 37-pin, D-type female connector. Figure B-1 illustrates pin assignments of the main I/O connector on the DASCARD cable.

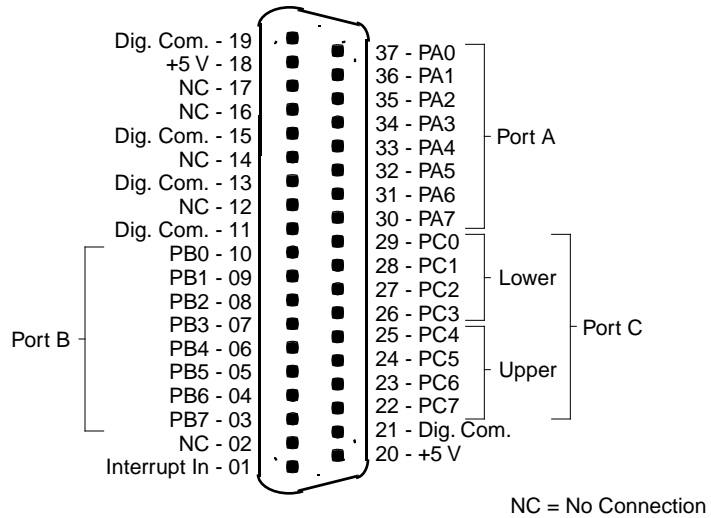


Figure B-1. Main I/O Connector Pin Assignments for the DASCARD Cable

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