UM-11717-C

Fulcrum™

Installation Guide

for DT3801 Series and DT3818 Series
Digital Signal Processing Boards

Third Edition
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Radio and Television Interference

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by Data Translation could void your authority to operate the equipment under Part 15 of the FCC Rules.

Note *This product was FCC-certified under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.*

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

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How to Use This Manual

This manual describes how to install Data Translation's Fulcrum boards for real-time, mixed-signal test, measurement, and processing. Fulcrum provides configurable analog and digital I/O along with front-end digital signal processing (DSP) capability. Complemented by extensive software support, Fulcrum offers a comprehensive DSP development environment.

To use Fulcrum, it is assumed that you have a general understanding of data acquisition and digital signal processing concepts, and that you possess enough proficiency in software to write your own application programs.

Listed below is an overview of the information presented in this manual.

Installing and Using

Chapter 1, "**Introduction**," introduces the major features of the Fulcrum Series of boards and describes the available software support and hardware accessories.

Chapter 2, "**Installing the Board**," explains how to install Fulcrum in your host computer and connect the EP265 cable assembly between Fulcrum and the Texas Instruments XDS-510 emulator.

Chapter 3, "**Connecting Accessories**," describes how to connect external devices to the board.

Reference

Reference A, "**Diagnostics**," describes how to run the diagnostic program shipped with the Fulcrum board.

Reference B, "**Connector Pinouts**," lists the pin assignments for the Fulcrum connectors.

Reference C, "**Specifications**," lists the electrical and mechanical specifications for all Fulcrum models.

Reference D, "**Product Support**," explains what to do if you have difficulty using Fulcrum.

Related Documents

The following documents provide additional reference information:

Documentation provided with DSP LAB

- *Getting Started with DSP LAB*, UM-13581, Data Translation, Inc.
- *DSP LAB Programmer's Reference*, UM-11715, Data Translation, Inc.
- *DSP LAB Host Communications Interface*, UM-12625, Data Translation, Inc.
- *Fulcrum Hardware Reference and Real-Time Control Library*, UM-11784, Data Translation, Inc.
- *The C Programming Language, Kernighan and Ritchie*, Prentice Hall Software Series, 1988, ISBN 0-13-115817-1
- *SPOX Application Programming Guide*, Document Number 82031-C, Spectron Microsystems, Inc.
- *TMS320 Floating Point C Compiler Reference Guide*, Document Number 2576391-9721, Texas Instruments.
- *TMS320 Floating Point DSP Assembly Language Tools User's Guide*, Document Number 2576328-9721, Texas Instruments.

Documentation provided with Texas Instruments Emulator

- *TMS320C4x C Source Debugger User's Guide*, Document Number 2547275-9721, Texas Instruments.

Documentation provided with DT746 and DT748 interface panels

- *DT746 User Manual*, Document Number UM-11364, Data Translation, Inc.
- *DT748 User Manual*, Document Number UM-13583, Data Translation, Inc.

Suggested documentation available from Texas Instruments

- *TMS320C4x Users Guide*, Document Number 2564090-9761, Texas Instruments

Suggested documentation for Microsoft Windows programming

- *Programming Windows 3.1*, Charles Petzold, Microsoft Press, 1992, ISBN 1-55615-395-3
- *Microsoft Windows Software Development Kit*, Document No. SY0302-300-R00-1089, Microsoft Corporation

Conventions Used in This Manual

The term “Fulcrum” is used in this manual to refer to all Fulcrum models, which includes the DT3801 Series and DT3818 Series boards. Where information applies only to a particular model, that model is referenced explicitly.

Where to Get Help

If you are having difficulty installing Fulcrum, refer to “Product Support” on page 85.

1

About Fulcrum

About Fulcrum

Fulcrum is a mixed-signal test, measurement, and processing board for the IBM PC AT and compatible computers. Fulcrum currently has several models: the DT3801 Series boards consisting of the DT3801-G, DT3808, and DT3809, and the DT3818 Series boards which include the DT3818 and DT3814.

Fulcrum is optimized for real-time, synchronous mixed-signal measurement and processing. It provides software-configurable analog and digital I/O along with front-end digital signal processing. Fulcrum can operate completely independently of the host, freeing the IBM PC AT for other operations.

Fulcrum provides the key features listed in Table 1 below.

Table 1: Fulcrum Features

Feature	DT3801-G	DT3808	DT3809	DT3818	DT3814
Processor	TMS320C40	TMS320C40	TMS320C40	TMS320C40	TMS320C40
Onboard memory	512 kB SRAM 4 MB DRAM	512 kB SRAM 4 MB DRAM	512 kB SRAM 4 MB DRAM	1 MB SRAM DRAM SIMM socket for 4 MB, 8 MB, 16 MB SIMMs‘	512 kB SRAM DRAM SIMM socket for 4 MB, 8 MB, 16 MB SIMMs
Analog inputs	see Table 2	see Table 2	see Table 2	see Table 2	see Table 2
Analog outputs	two 16-bit DACs	two 16-bit DACs	two 16-bit DACs	two Delta-Sigma DACs	–
Digital I/O	two 8-bit ports[1]	two 8-bit ports[1]	two 8-bit ports[1]	three 8-bit static ports	three 8-bit static ports
Clocks internal and external	separate for A/D and D/A	separate for A/D and D/A	separate for A/D and D/A	simultaneous A/D and D/A (internal)	simultaneous A/D and D/A (internal)
Counter-Timers	2	2	2	3	3

[1]Has an additional 4 bits static DIO

A/D modules on the different Fulcrum models provide varying resolution, throughput rate, input channels, and programmable gain settings. The analog input features of each Fulcrum model are summarized in Table 2 below.

Note *"Specifications" on page 59 provides complete specifications for all Fulcrum models.*

Table 2: Fulcrum Models

Model	Resolution	Throughput	Channels	Gain
DT3801-G	12 bits	250kHz	8 DI	1, 2, 4, 8
DT3808	16 bits	160kHz	8 DI, SS&H	1 (fixed)
DT3809	12 bits	1 MHz[1]	16 SE / 8 DI	1, 2, 4, 8
DT3818	16 bits	416 kHz[2]	8 DI	1 (fixed)
DT3814	16 bits	104 kHz[2]	2 DI	1 (fixed)

[1]Single channel operation at a gain of 1. Channel scan to 500kHz at a gain of 1. Channel scan to 320kHz at any gain.

[2]52kHz maximum each channel. You cannot add channel throughputs together to have a higher throughput for one channel link you can on other Fulcrum boards.

Software Support

Fulcrum provides a totally open software architecture that allows developers to fully customize the board for their applications by writing both host and Fulcrum applications. Built on the industry-standard SPOX operating system from Spectron Microsystems, Fulcrum features simplified programming, a consistent device interface, and device-independent operation.

DSP LAB Developer's Kit

To simplify application development, the DSP LAB Software Developer's Kit (product number SP0312) is available from Data Translation. It offers a complete line of support software, including libraries for host and Fulcrum development, program loader, diagnostics, and examples. DSP LAB provides the following software:

- Program loader
- SPOX C40 operating system
- SPOX subsystem device drivers
- DSP/math library
- Host development library
- Fulcrum development library
- C40 ANSI-compatible, optimizing C compiler
- Assembler
- Linker
- Librarian
- Comprehensive diagnostics
- Demo software
- Robust examples in source code

DSP LAB also includes complete documentation, and a cable assembly to connect Fulcrum to the XDS-510 emulator.

Texas Instruments XDS-510 Emulator

The XDS-510 emulator package offers tools for effectively using the Texas Instruments development/debug systems. It includes the Texas Instruments XDS-510 emulator and a C source debugger.

The XDS-510 emulator is a scan-based, PC plug-in board that attaches to Fulcrum's JTAG emulation port to provide full hardware emulation and debugging for Fulcrum applications. The emulator attaches to Fulcrum via a cable assembly (EP265) shipped with DSP LAB.

Hardware Accessories

DT746 Screw Terminal Panel (DT3801, DT3808, DT3809)

The DT746 is a general-purpose screw terminal panel that permits all user connections (A/D, D/A, digital I/O, and counter/timer) to DT3801 Series boards to be made on screw terminals.

The DT746 accommodates the shielded D-shell connectors used on DT3801 Series boards. A dual-shielded cable set is included to connect the screw terminal panel to the board.

DT748 Screw Terminal Panel (DT3818, DT3814)

The DT748 is a general-purpose screw terminal panel that permits all user connections (A/D, D/A, digital I/O, and counter/timer) to the DT3818 Series boards to be made on screw terminals.

The DT748 accommodates the shielded D-shell connectors used on the DT3818 Series boards. A dual-shielded cable set is included to connect the screw terminal panel to the board.

EP254 Enclosure

This rugged plastic enclosure protects the DT746 or DT748 screw terminal panel and connections. It provides protection against RFI (radio frequency interference) and EMI (electromagnetic interference).

2

Installing the Board

System Requirements

The minimum system requirements for Fulcrum are as follows:

- IBM Personal Computer AT (or 100%-compatible) with at least one 3.5-inch or 5.25-inch high-capacity floppy disk drive and a minimum of 1 Mbyte of RAM

> ***Note*** *The 3.5-inch drive is necessary for Data Translation software. The 5.25-inch drive is necessary for Texas Instrument software.*

- 80386/80486 or compatible processor
- MS-DOS operating syste, version 3.3 or higher

In addition, DSP LAB requires that the system also have:

- A hard disk with a minimum of 10 Mbytes of available space
- MS-DOS operating system, version 5.0 or higher
- 4MB RAM minimum

Unpacking

The following items are included in the Fulcrum package:

- Fulcrum board
- *Fulcrum Installation Guide* (UM-11717)
- Warranty and service policy

If an item is missing or damaged, call Data Translation's Customer Service Department at (508) 481-3700. They will guide you through the appropriate steps for replacing missing or damaged items.

Notes *Keep Fulcrum in its protective anti-static bag until you are ready to install it. When you remove the board from the bag, hold it by the edges and do not touch the components.*

Save the original packing material in the unlikely event that your board requires servicing in the future.

Installation Procedure

Install Fulcrum in your computer and connect any external devices following the steps below. These steps are described in detail on the following pages.

Note *Be sure to read the directions in each step carefully before attempting it. Follow these steps in the order given.*

Step 1: Check the I/O base address

Step 2: Install the board

Step 3: Install the EP265 emulator cable (optional)

Step 4: Power up the system

Warning *To prevent electro-static damage that can occur when handling electronic equipment, use a ground strap or similar device when performing this installation procedure.*

Step 1: Check the I/O Base Address

Important *The board's I/O base address must not be set to an address used by another device in the system. If you are using multiple Fulcrum boards, each Fulcrum board must have a unique I/O base address. Any changes to the switch settings should be made before you install the board in your system.*

The I/O base address is the lowest address used by the Fulcrum board. You can configure Fulcrum to select an I/O base address from 200 (hex) to 3F0 (hex) in increments of 10 (hex). *The default selection is 270 (hex).*

Note *Some new PC systems use addresses 26E and 26F (hex). Therefore, Data Translation has changed the default base address for the Fulcrum boards to 270 (hex) so as to not conflict with these addresses.*

The I/O base address is configured via a bank of six switches, labeled "SW1." These switches represent bits 4 through 8 of the address. Bit 9 is always 1. Bits 0 through 3 are decoded on the board to select the Fulcrum registers. Figure 1 shows its location on the board.

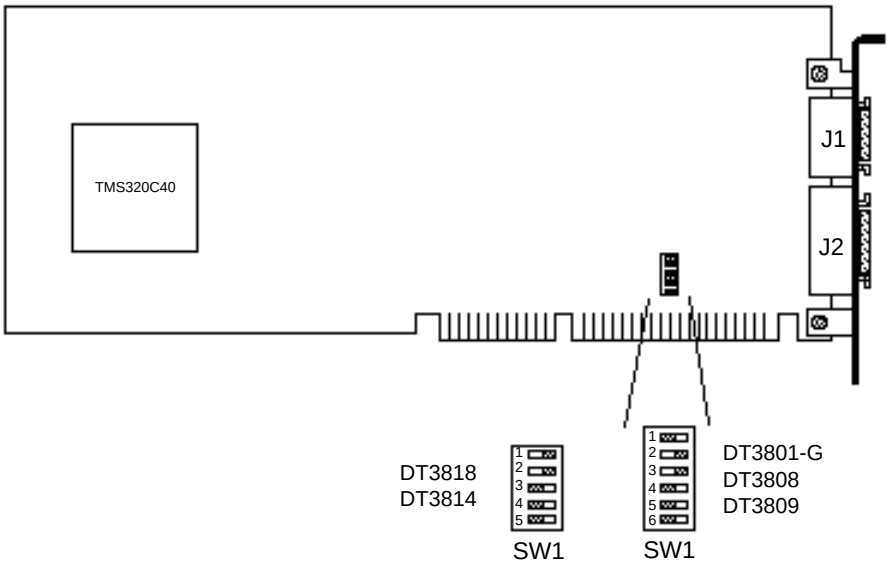

Figure 1: DIP Switch Location

A switch setting is changed by flipping a switch to the alternate setting. A switch in the “on” (right) position selects a 0 for the bit it represents. A switch in the “off” (left) position selects a 1 for the bit it represents. Figure 2 illustrates the default switch setting.

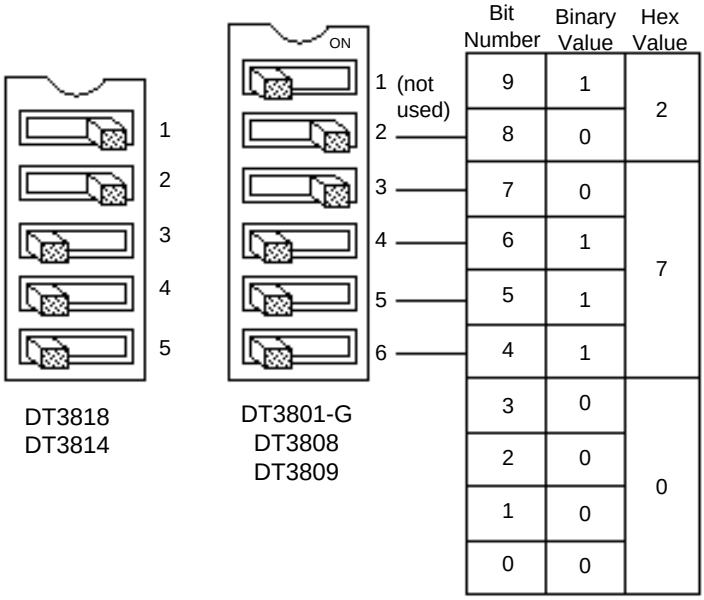

Figure 2: Default I/O Base Address Switch Setting

If necessary, make any changes to the I/O base address switch settings at this time.

Step 2: Install the Board

Follow the instructions below to install Fulcrum in any available 16-bit expansion slot in the IBM PC AT.

Note *This section illustrates how to install Fulcrum in the IBM PC AT. If you are using a compatible computer, refer to your system's user manual for instructions on how to remove the system unit cover and access the expansion slots.*

1. Turn off the computer.
2. Turn off all accessories (printer, modem, monitor, etc.) connected to the computer.
3. Unplug the computer and all accessories from their power outlets.
4. Unscrew the five cover mounting screws on the rear panel of the computer. (See Figure 3.)

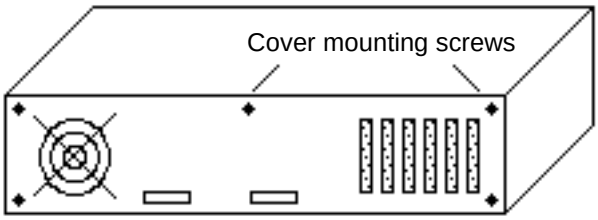

Figure 3: IBM PC AT - rear view

5. Remove the cover by sliding it to the front of the computer until it stops, and tilt it down and off.
6. Select a 16-bit expansion slot in which to install the board. Figure 4 illustrates the expansion slots in the IBM PC AT.

Note *If you are using the XDS-510 emulator, install Fulcrum where an adjacent expansion slot is available to install the EP265 cable assembly. (See "Step 3: Install the EP265 Emulator Cable (optional)" on page 17 for the cable installation procedure.)*

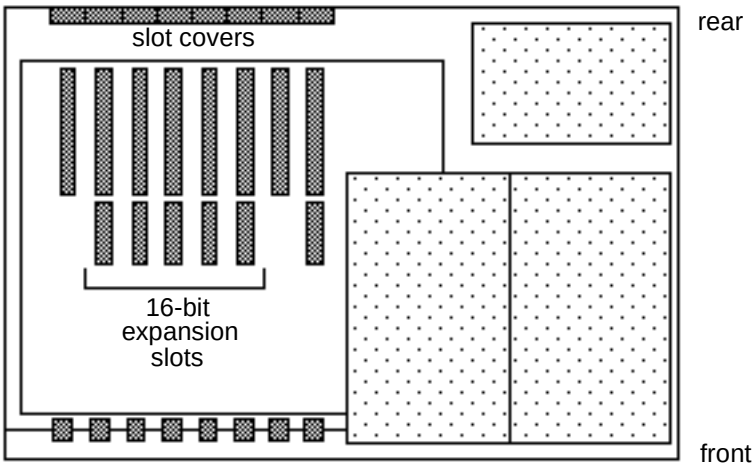

Figure 4: IBM PC AT - top view

7. Remove the slot cover from the selected expansion slot, saving the screw that held it in place.

8. Remove Fulcrum from its protective anti-static bag. Holding the board by its edges, position it so that the rear panel connectors (J1 and J2) face the rear of the computer, as shown in Figure 5 on the following page.

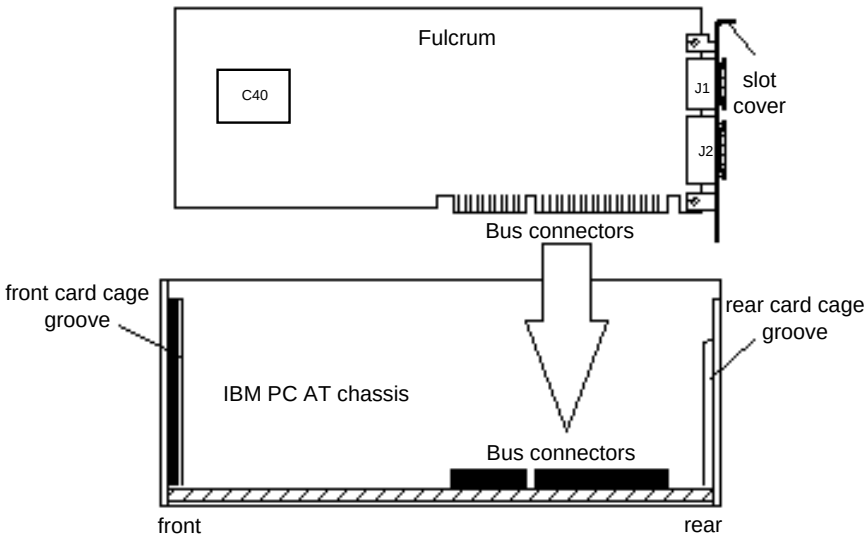

Figure 5: Installing the Board

9. Carefully lower the board into the expansion slot using the grooves in the card cage to properly align the board in the slot. When the bottom of the board contacts the bus connectors, gently press down on the board until it clicks into place.

Caution *Do not force the board into place. If you meet much resistance when inserting the board, pull it out and try again. Do not wiggle the board from side to side during installation as this may damage the bus connectors.*

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10. Gently lift the board to determine if it is properly connected. If the board stays in place, it is installed correctly. If it exhibits no resistance, press down firmly on the board to seat it in the connector.

11. Secure the board in place at the rear panel of the system unit using the screw removed from the slot cover.

Step 3: Install the EP265 Emulator Cable (optional)

Note *The XDS-510 emulator is an optional accessory to Fulcrum. You can skip this chapter if you are not using this accessory.*

The EP265 cable assembly (included with the DSP LAB software package) allows you to connect a Texas Instruments XDS-510 emulator board to Fulcrum. The cable assembly consists of two connectors attached to a 14-pin flat ribbon cable. One connector plugs into the J3 connector on Fulcrum; the other connector attaches to the rear panel of the computer.

Note *The EP265 cable assembly is required only when developing and debugging software using the XDS-510 emulator. The cable can be removed to free the expansion slot when you have completed development.*

The following steps explain how to connect the EP265 cable between Fulcrum and the emulator.

1. Connect the 14-pin connector on the cable to connector J3 on Fulcrum, as shown in Figure 6 on the following page.

   Make sure that the stripe on the cable is facing up!

2. Remove the slot cover from the adjacent expansion slot.

3. Using the screw removed from the slot cover, install the connector faceplate so that it fastens the bracket to the rear panel chassis.

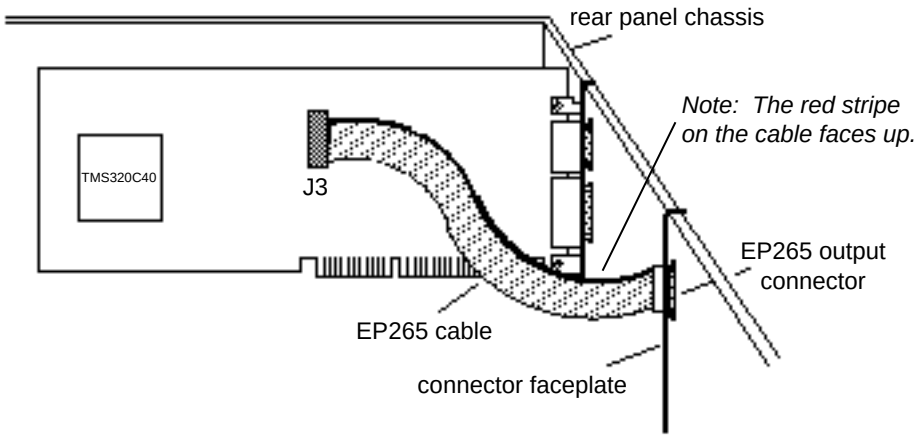

Figure 6: Installing the EP265 Cable Assembly

4. Attach the emulator's cable to the EP265 connector at the rear panel, as shown in Figure 7.

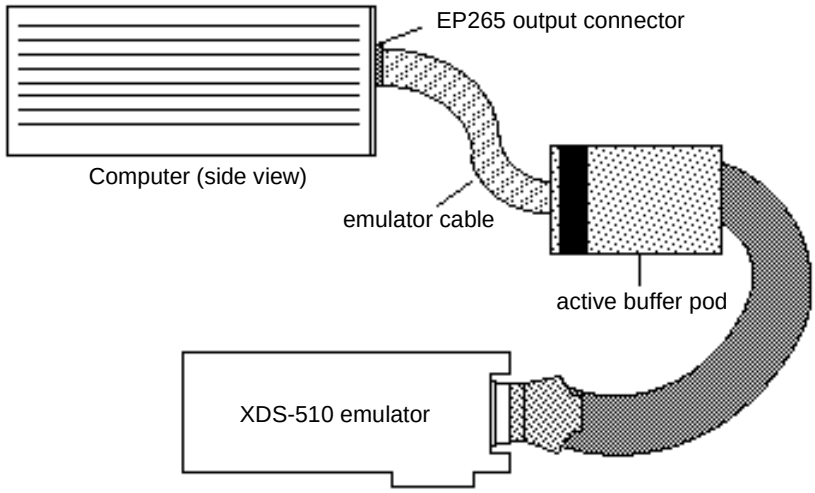

Figure 7: Connecting the Emulator to the EP265 Cable

Note *Refer to the* TMS320C4x C Source Debugger User's Guide *for XDS-510 emulator installation instructions.*

When using the XDS-510 emulator and High Level Language debugger, full symbolic debugging is available for your Fulcrum application.

For large development efforts, the most efficient setup is a dual PC system, with one PC dedicated to running the Microsoft Codeview debugger and interfacing to the host side of Fulcrum, and the other running the Texas Instruments High Level Language debugger and interfacing to the C40 side of Fulcrum. Figure 8 illustrates this setup.

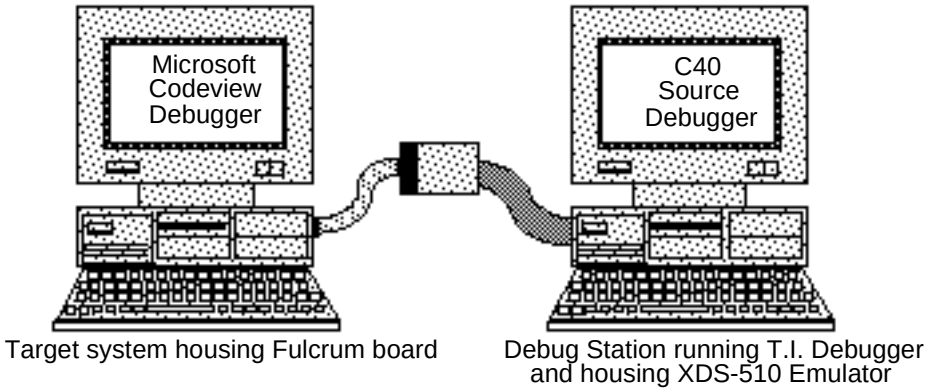

Figure 8: Dual PC Development Environment

If you are using Windows, however, both debuggers may be run simultaneously on the same system.

Step 4: Power Up the System

Once you are satisfied that all connections are secured properly, replace the slot covers that you removed from any expansion slots.

1. Power up the system.

2. Install the software.

Note *Refer to the* Getting Started with DSP LAB *(UM-13581) for software installation instructions.*

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3. Install the diagnostics software, SP8001, shipped with your Fulcrum board and verify its operation. See “Diagnostics” on page 33 for more information.

3

Connecting Accessories

Installation Procedure

Fulcrum is compatible with Data Translation's DT746 screw terminal panel (DT3801-G, DT3808,and DT3809 models) and the DT748 screw terminal panel (DT3818 and DT3814 models).

This chapter takes you through attaching the appropriate screw terminal panel to your Fulcrum board and connecting analog input, analog output, or digital I/O devices.

Note *Be sure to read the directions in each step carefully before attempting it.*

Step 1: Connect the screw terminal panel (if used)

Step 2: Connect the analog input devices

Step 3: Connect the analog output devices

Step 4: Connect the digital I/O devices

Step 5: Power up the system

Warning *To prevent electro-static damage that can occur when handling electronic equipment, use a ground strap or similar device when performing this installation procedure.*

Step 1: Connect the Screw Terminal Panel

If you are using a DT746 or DT748, follow the instructions below to connect it to your board.

1. Turn off the computer and all accessories (printer, modem, monitor, etc.) connected to it.

2. Position the computer so that you can easily access Fulcrum's rear panel connectors (J1 and J2).

3. Attach one end of the 26-conductor cable to the J1 connector on the rear panel of Fulcrum and attach the other end to the J1 connector on the DT746 or DT748, as shown in Figure 9 .

4. Attach one end of the 50-conductor cable to the J2 connector on the rear panel of Fulcrum and attach the other end to the J2 connector on the DT746 or DT748.

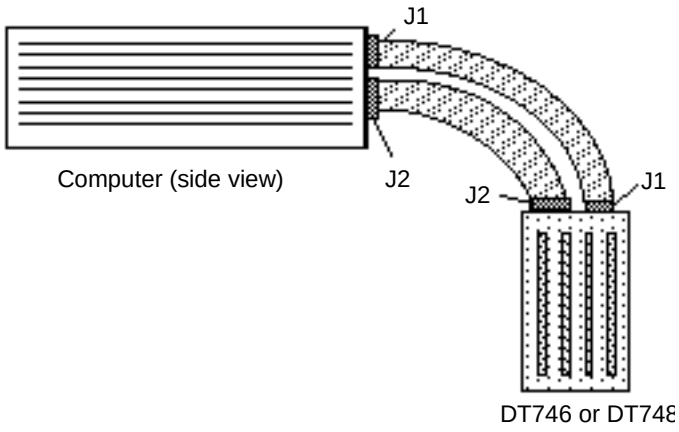

Figure 9: Connecting the Screw Terminal Panel

Notes *During the connection discussions on the following pages (Steps 4 through 8), refer to the* DT746 User Manual *(UM-11364) or* DT748 User Manual *(UM-13583) for screw terminal assignments.*

If you are interfacing your peripheral devices to Fulcrum via another type of device or panel, you must connect the devices to the appropriate pins on the board's J1 and J2 connectors. See Table 5 and Table 5 in Reference B for the J1 and J2 connector pin assignments, respectively.

Step 2: Connect the Analog Input Devices

The DT3809 can be programmed for either single-ended or differential inputs. The DT3801-G, DT3808, DT3818, and DT3814 provide differential inputs only.

The single-ended mode provides 16 input channels. This mode is suitable for applications where the signal levels are significantly larger than the common-mode voltages present in the system. Figure 10 illustrates a single-ended connection.

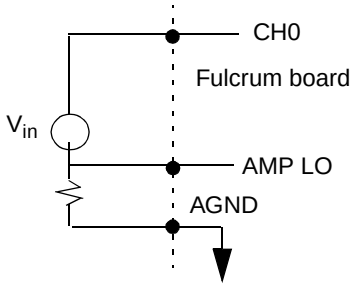

Figure 10: Single-ended Inputs

The differential mode provides eight input channels. Although this mode halves the channel capacity, it permits low-level signal measurement by limiting common-mode input noise. Figure 11 illustrates a differential input connection.

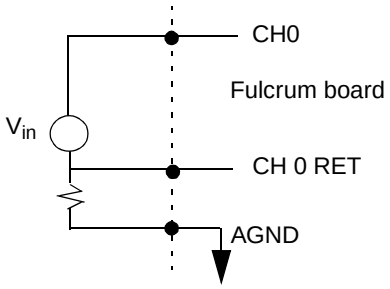

Figure 11: Differential Inputs

Single-ended Analog Inputs (DT3809 only)

1. Connect the high side of each analog input to any available CH0 through CH15 terminal on the DT746 or to the corresponding pin on the J1 connector.

2. Connect the low side of the analog input to any available SGND (signal ground) terminal on the DT746 panel or to Amp Low and A/D Analog Ground on the J1 connector.

Caution *Be sure to connect all unused analog input channels to A/D Analog Ground. Failure to do so can result in inaccurate A/D conversions on all other channels, with those closest to the floating channel(s) being affected the most.*

Do not connect A/D Analog Ground (J1 pin 17) directly to any other grounds because ground loops may result, causing the accuracy of the analog input and output subsystems to be degraded.

The DT746 internally connects the signal ground terminals to analog ground.

Differential Analog Inputs

When using differential inputs, an external return path must be established between the return side of the input channels and analog ground.

- If you are using the DT746 or DT748, install 10k¾ 1/4 watt resistors on the panel. See the *DT746 User Manual* or *DT748 User Manual* for resistor pad locations.

- If you are using another device to connect to Fulcrum, install 10k¾ 1/4 watt resistors between the return side of the channels and A/D Analog Ground.

- For bridge measurements, the 10k¾ resistors are not required if the bridge power supply is returned to signal common.

1. Connect the high side of each analog input to any available CH0 through CH7 terminal on the DT746 or DT748 or to the corresponding pin on the J1 connector.

2. Connect the low side of the analog input to the corresponding return DT746 or DT748 terminal or J1 pin for that channel (DI CH0 RET through DI CH7 RET).

Step 3: Connect the Analog Output Devices

Fulcrum provides two D/A output channels, DAC0 and DAC1.

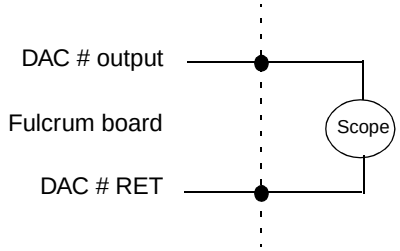

Figure 12: Analog Outputs

1. Connect the high side of the device receiving the analog output signal to the appropriate DAC Analog Output terminal on the DT746 or DT748 or the DAC Analog Output pin on the J1 connector.

2. Connect the low side to the corresponding DAC RET terminal on the DT746 or DT748 or the D/A Analog Ground pin on the J1 connector.

Note *If you are connecting via J1, do not connect the DAC ground connections directly to any other grounds, or ground loops may result. This will degrade the accuracy of the analog input and output subsystems. (See Reference D, "Product Support," for more information about preventing ground loops.)*

Step 4: Connect the Digital I/O Devices

Fulcrum has Digital I/O ports (Port 0 and Port 1) that can be programmed for input or output operations. Fulcrum also has trigger , counter/timer clock, and digital inputs.

Connecting Digital Inputs

For a 16-bit input: Connect the input lines to ports 0 and 1. Bit 0 of port 0 is the LSB.

For an 8-bit input: Connect the input lines to port 1. Bit 0 of port 1 is the LSB.

Figure 13 illustrates a digital input connection.

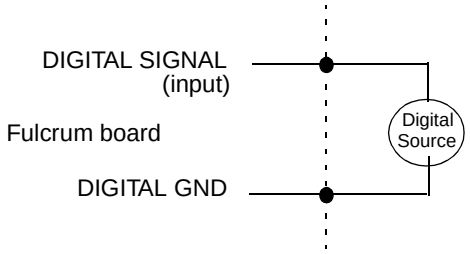

Figure 13: Digital Input

1. Connect the high side from the digital signal source to the corresponding digital input terminal to be used on the DT746 or DT748 or pin on the J2 connector for that port.

2. Connect the low side from the digital signal source to any available DGND (digital ground) terminal or J2 pin representing DGND.

Connecting Digital Outputs

Fulcrum provides a number of miscellaneous outputs. Figure 14 illustrates a digital output connection.

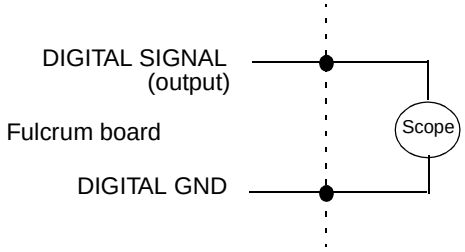

Figure 14: Digital Output

1. Connect the high side of the device receiving the digital signal from Fulcrum to the corresponding terminal on the DT746 or DT748 or pin on the J2 connector for that port.

2. Connect the low side of the device receiving the digital signal from Fulcrum to any available DGND (digital ground) terminal or J2 pin representing DGND.

Step 5: Power Up the System

Once you are satisfied that all connections are secured properly, arrange the system components so you can work comfortably. Plug your computer and all accessories into their power outlets.

1. Power up all accessories.

2. Power up the system.

A

Diagnostics

Introduction

This section describes how to use the diagnostics, SP8001, shipped with the Fulcrum board. Use these diagnostics to verify the integrity of the Fulcrum hardware features.

Run these diagnostics on an IBM PC/AT or 100% compatible computer with the Fulcrum board installed in the unit.

Installing SP8001

Perform the following steps to install the SP8001 diagnostic program files onto your hard drive.

1. Create a new directory or go to the desired directory on the hard disk.

2. Insert the SP8001 diskette into the floppy disk drive.

3. Copy the DIAG3801.exe, DIAG3818.exe, C40*.out, and DT3801.H* files to the directory by typing:

   ```
   COPY <drive>:*.*
   ```

   where `<drive>` is the floppy drive containing the diskette.

Run the Diagnostics

This section describes how to run the diagnostics.

1. Go to the directory containing the SP8001 diagnostic files.

2. Run the diagnostics by entering:

`DIAG3801<CR>`	for DT3801 Series
`DIAG3818<CR>`	for DT3818 Series

3. When the configuration screen appears, review the settings. If all settings are correct for your board, type `Y<CR>`. If you need to change any settings, type `N<CR>` and select the new settings according to the prompts on the screen.

4. When the diagnostics menu appears, choose the Acceptance test from the menu. The Acceptance Test will perform all tests that can be run without an external test fixture.

5. Alternatively, choose the desired test by scrolling through the list until the desired item highlights and press <CR>.

6. Press the F1 key for a description of that test.

   There are several functional and visual tests that require particular fixture and equipment connections. Review the test description for any setup requirements PRIOR to running any test.

   ---

7. Repeat steps 5 and 6 for all additional tests to run.

8. When you are done, choose “Exit to Dos” from the diagnostics menu.

B

Connector Pinouts

DT3801 Series Connector Locations

For DT3818 Series connector locations, go to the next section.

The DT3801 Series models have five connectors: P1, P2, J1, J2, and J3. Figure 15 illustrates the connector locations for these models. Table 3 through Table 7 on the following pages provide the pinouts for each connector.

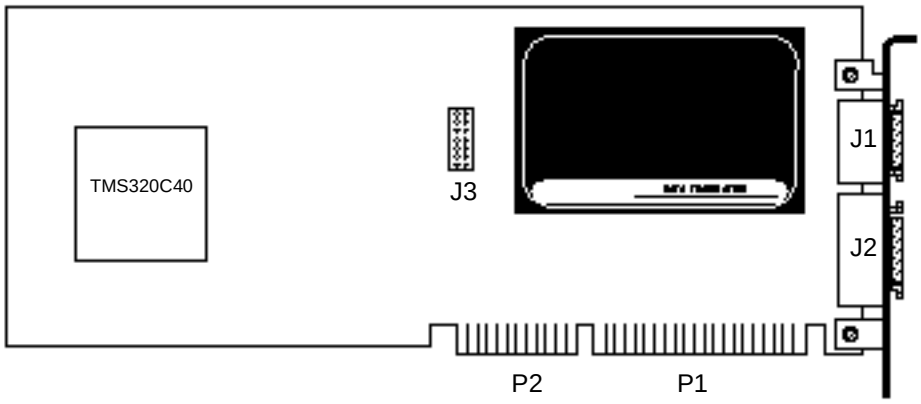

Figure 15: DT3801 Series Connector Locations

P1 and **P2**, located on the bottom of the board, connect Fulcrum to the IBM PC AT bus.

J1, located at the top rear of the board, interfaces all analog I/O connections with Fulcrum.

J2, located at the bottom rear of the board, interfaces all digital I/O, counter/timer, and external trigger connections with Fulcrum.

J3, located to the left of the A/D module, interfaces the XDS-510 emulator with Fulcrum.

P1 and P2 - Bus Connectors

All IBM Personal Computer AT bus connections are made via two connectors on the Fulcrum boards labeled P1 and P2. These connections are made automatically when Fulcrum is installed in the host computer.

P1 is a 62-pin bus connector and P2 is a 36-pin bus connector. Table 3 and Table 4 on the following pages list the P1 and P2 pin assignments.

***Note** s Fulcrum is mechanically EISA-compatible for any available system slot.*

The P1 and P2 pin assignments listed in Table 3 and Table 4 apply to all Fulcrum boards.

Table 3: P1 Pin Assignments

Pin	Mnemonic	Description
A01	-/IO CH CK	No connection
A02	SD7	Data Bit 7
A03	SD6	Data Bit 6
A04	SD5	Data Bit 5
A05	SD4	Data Bit 4
A06	SD3	Data Bit 3
A07	SD2	Data Bit 2
A08	SD1	Data Bit 1
A09	SD0	Data Bit 0 (LSB)
A10	-I/O CH RDY	I/O Channel Ready
A11	-AEN	Address Enable
A12	SA19	No connection
A13	SA18	No connection
A14	SA17	No connection
A15	SA16	No connection
A16	SA15	No connection
A17	SA14	No connection
A18	SA13	No connection
A19	SA12	No connection
A20	SA11	No connection
A21	SA10	No connection
A22	SA9	Address Bit 9
A23	SA8	Address Bit 8
A24	SA7	Address Bit 7
A25	SA6	Address Bit 6
A26	SA5	Address Bit 5
A27	SA4	Address Bit 4
A28	SA3	Address Bit 3
A29	SA2	Address Bit 2
A30	SA1	Address Bit 1
A31	SA0	Address Bit 0

continued

Table 3: P1 Pin Assignments (Continued)

Pin	Mnemonic	Description
B01	DGND	Digital Ground
B02	RESET DRV	Reset Drive
B03	+5VDC	+5 Volt Power
B04	IRQ9	No connection
B05	-5VDC	No connection
B06	DRQ2	No connection
B07	-12VDC	No connection
B08	0WS	No connection
B09	+12VDC	No connection
B10	DGND	Digital Ground
B11	-SMEMW	No connection
B12	-SMEMR	No connection
B13	-IOW	I/O Write Command
B14	-IOR	I/O Read Command
B15	-DACK3	No connection
B16	DRQ3	No connection
B17	-DACK1	No connection
B18	DRQ1	No connection
B19	-REFRESH	Refresh Cycle
B20	CLOCK	No connection
B21	IRQ7	No connection
B22	IRQ6	No connection
B23	IRQ5	No connection
B24	IRQ4	No connection
B25	IRQ3	No connection
B26	-DACK2	No connection
B27	T/C	Terminal Count
B28	BALE	No connection
B29	+5VDC	+5 Volt Power
B30	OSC	No connection
B31	DGND	Digital Ground

Table 4: P2 Pin Assignments

Pin	Mnemonic	Description
C01	-SBHE	System Bus High Enable
C02	LA23	No connection
C03	LA22	No connection
C04	LA21	No connection
C05	LA20	No connection
C06	LA19	No connection
C07	LA18	No connection
C08	LA17	No connection
C09	-MEMR	No connection
C10	-MEMW	No connection
C11	SD08	Data Bit 8
C12	SD09	Data Bit 9
C13	SD10	Data Bit 10
C14	SD11	Data Bit 11
C15	SD12	Data Bit 12
C16	SD13	Data Bit 13
C17	SD14	Data Bit 14
C18	SD15	Data Bit 15

continued

Table 4: P2 Pin Assignments (Continued)

Pin	Mnemonic	Description
D01	-MEMCS16	No connection
D02	-I/O CS16	I/O 16-bit Chip Select
D03	IRQ10	Interrupt Request 10
D04	IRQ11	Interrupt Request 11
D05	IRQ12	Interrupt Request 12
D06	IRQ15	Interrupt Request 15
D07	IRQ14	No connection
D08	-DACK0	No connection
D09	DRQ0	No connection
D10	-DACK5	DMA Acknowledge 5
D11	DRQ5	DMA Request 5
D12	-DACK6	DMA Acknowledge 6
D13	DRQ6	DMA Request 6
D14	-DACK7	DMA Acknowledge 7
D15	DRQ7	DMA Request 7
D16	+5VDC	+5Volt Power
D17	-MASTER	No connection
D18	DGND	Digital Ground

J1 - Analog I/O Connector

(DT3801 Series)

The 26-pin J1 connector (Figure 16) is used for analog input and analog output connections.

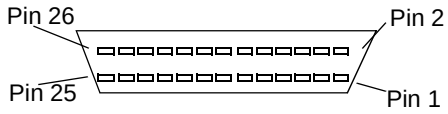

Figure 16: J1 Connector (DT3801 Series)

Table 5 lists the J1 pin assignments.

Table 5: DT3801 Series J1 Pin Assignments

Pin	Description	Pin	Description
1	A/D Input, Ch 0	14	A/D Input, Ch 14 (DI Ch 6 Ret)
2	A/D Input, Ch 8 (DI Ch 0 Ret)	15	A/D Input, Ch 7
3	A/D Input, Ch 1	16	A/D Input, Ch 15 (DI Ch 7 Ret)
4	A/D Input, Ch 9 (DI Ch 1 Ret)	17	A/D Analog Ground
5	A/D Input, Ch 2	18	Amp Low
6	A/D Input, Ch 10 (Di Ch 2 Ret)	19	+15 Volt Power (fused) [1]
7	A/D Input, Ch 3	20	-15 Volt Power (fused) [1]
8	A/D Input, Ch 11 (DI Ch 3 Ret)	21	Power Ground
9	A/D Input, Ch 4	22	Reserved
10	A/D Input, Ch 12 (DI Ch 4 Ret)	23	D/A Analog Output, DAC0
11	A/D Input, Ch 5	24	D/A Analog Ground, DAC0 Ret
12	A/D Input, Ch 13 (DI Ch 5 Ret)	25	D/A Analog Output, DAC1
13	A/D Input, Ch 6	26	D/A Analog Ground, DAC1 Ret

[1] *Maximum current available is 10mA.*

J2 - Digital I/O Connector

DT3801 Series

The 50-pin J2 connector (Figure 17) is used for digital I/O, external trigger, external clock, and counter/timer connections.

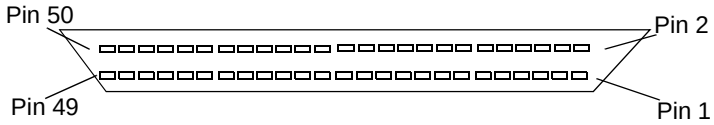

Figure 17: J2 Connector (DT3801 Series)

Table 5 lists the J2 pin assignments.

Table 6: DT3801 Series J2 Pin Assignments

Pin	Description	Pin	Description
1	Clocked DIO Line 0, Port 0	26	DIO Line 1, Port 2
2	Clocked DIO Line 1, Port 0	27	DIO Line 2, Port 2
3	Digital Ground	28	DIO Line 3, Port 2
4	Clocked DIO Line 2, Port 0	29	Digital Ground
5	Clocked DIO Line 3, Port 0	30	Internal A/D Clock Output
6	Digital Ground	31	Digital Ground
7	Clocked DIO Line 4, Port 0	32	External Pre-Trigger
8	Clocked DIO Line 5, Port 0	33	External Trigger 1
9	Digital Ground	34	External Trigger 0
10	Clocked DIO Line 6, Port 0	35	Digital Ground
11	Clocked DIO Line 7, Port 0	36	External Clock Digital Input
12	Digital Ground	37	Digital Ground
13	Clocked DIO Line 0, Port 1	38	External Clock Digital Output
14	Clocked DIO Line 1, Port 1	39	Digital Ground
15	Digital Ground	40	External Clock D/A
16	Clocked DIO Line 2, Port 1	41	Digital Ground
17	Clocked DIO Line 3, Port 1	42	External Clock A/D

Table 6: DT3801 Series J2 Pin Assignments (Continued)

Pin	Description	Pin	Description
18	Digital Ground	43	Digital Ground
19	Clocked DIO Line 4, Port 1	44	Counter 2 Output
20	Clocked DIO Line 5, Port 1	45	Digital Ground
21	Digital Ground	46	Counter 3 Output
22	Clocked DIO Line 6, Port 1	47	Counter 3 Gate Input
23	Clocked DIO Line 7, Port 1	48	Counter 3 Clock Input
24	Digital Ground	49	Digital Ground
25	DIO Line 0, Port 2	50	+5 Volts (fused)[1]

[1] *Maximum current available is 20mA.*

J3 - Emulator Connector

(DT3801 Series)

The 14-pin J3 connector (Figure 18) allows you to attach an XDS-510 emulator board to Fulcrum via a supplied cable assembly.

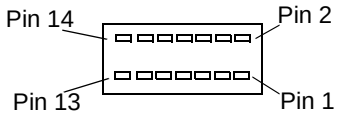

Figure 18: J3 Connector (DT3801 Series)

Table 7 lists the J3 pin assignments.

Table 7: DT3801 Series J3 Pin Assignments

Pin	Description
1	JTAG test mode select
2	JTAG test reset
3	JTAG test data input
4	Digital Ground
5	+5 Volts
6	(Key)
7	JTAG test data output
8	Digital Ground
9	JTAG test clock return
10	Digital Ground
11	JTAG test clock
12	Digital Ground
13	Emulation Pin 0
14	Emulation Pin 1

DT3818 Series Connector Locations

The DT3818 Series models have nine connectors: P1, P2, J1, J2, J3, J4, J5, J6, J7, and J8. Figure 19 illustrates the connector locations. Table 5 through Table 7 on the following pages provide the pinouts for each Jx connector. Table 3 and Table 4 provide the pinouts for P1 and P2.

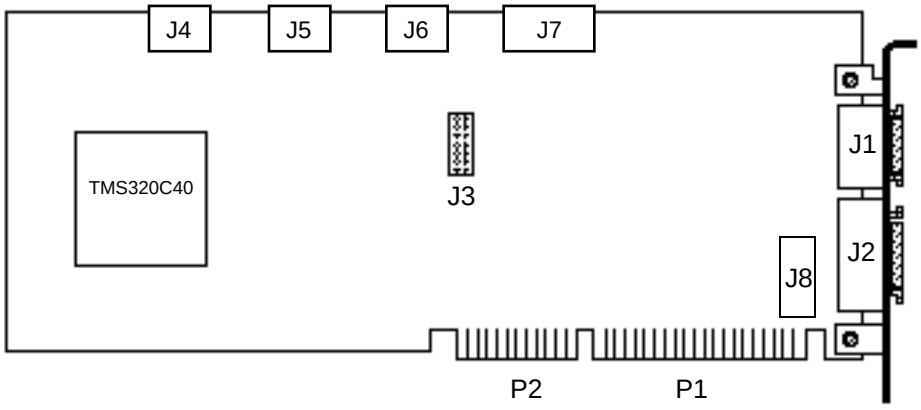

Figure 19: DT3818 Series Connector Locations

P1 and **P2**, located on the bottom of the board, connect Fulcrum to the IBM PC AT bus.

J1, located at the top rear of the board, interfaces all analog I/O connections with Fulcrum.

J2 and **J8**, located at the bottom rear of the board, interfaces all digital I/O, counter/timer, and external trigger connections with Fulcrum.

J3, located towards the center of the board, interfaces the XDS-510 emulator with Fulcrum.

J4, **J5**, and **J6**, located at the top of the board, are for multi-board communication.

J7, located at the top of the board towards the rear, is to synchronize multiple boards.

J1 - Analog I/O Connector

(DT3818 Series)

The 26-pin J1 connector (Figure 20) is used for analog input and analog output connections.

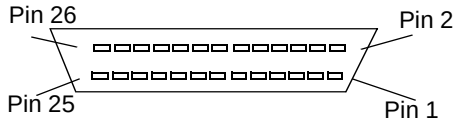

Figure 20: J1 Connector (DT3818 Series)

Table 5 lists the J1 pin assignments.

Table 8: DT3818 Series J1 Pin Assignments

Pin	Description	Pin	Description
1	A/D Input, Ch 0	14	A/D Input, Ch 6 Ret
2	A/D Input, Ch 0 Ret	15	A/D Input, Ch 7
3	A/D Input, Ch 1	16	A/D Input, Ch 7 Ret
4	A/D Input, Ch 1 Ret	17	A/D Analog Ground
5	A/D Input, Ch 2	18	Reserved
6	A/D Input, Ch 2 Ret	19	+15 Volt Power (fused) [1]
7	A/D Input, Ch 3	20	-15 Volt Power (fused) [1]
8	A/D Input, Ch 3 Ret	21	Power Ground
9	A/D Input, Ch 4	22	Reserved
10	A/D Input, Ch 4 Ret	23	D/A Analog Output, DAC0
11	A/D Input, Ch 5	24	D/A Analog Ground, DAC0 Ret
12	A/D Input, Ch 5 Ret	25	D/A Analog Output, DAC1
13	A/D Input, Ch 6	26	D/A Analog Ground, DAC1 Ret

[1] *Maximum current available is 10mA.*

J2 and J8 - Digital I/O Connectors

DT3818 Series

The 50-pin J2 and J8 connectors (Figure 21) are used for digital I/O, external trigger, external clock, and counter/timer connections.

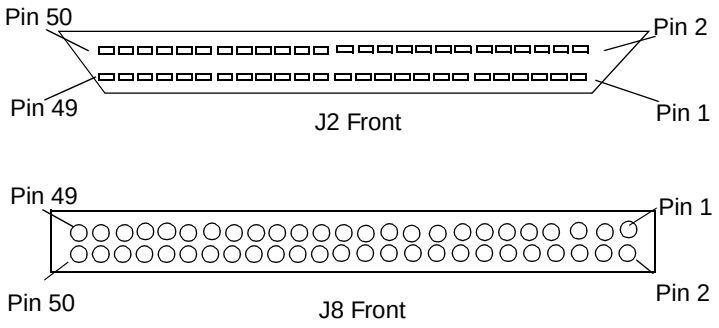

Figure 21: J2 and J8 Connectors (DT3818 Series)

Table 5 lists the J2 and J8 pin assignments.

Table 9: DT3818 Series J2 and J8 Pin Assignments

Pin	Description	Pin	Description
1	DIO Line 0, Port 0	26	Digital Ground
2	DIO Line 1, Port 0	27	DIO Line 0, Port 2
3	DIO Line 2, Port 0	28	DIO Line 1, Port 2
4	DIO Line 3, Port 0	29	DIO Line 2, Port 2
5	Digital Ground	30	DIO Line 3, Port 2
6	DIO Line 4, Port 0	31	Digital Ground
7	DIO Line 5, Port 0	32	DIO Line 4, Port 2
8	DIO Line 6, Port 0	33	DIO Line 5, Port 2
9	DIO Line 7, Port 0	34	DIO Line 6, Port 2
10	Digital Ground	35	DIO Line 7, Port 2
11	DIO Line 0, Port 1	36	Digital Ground
12	DIO Line 1, Port 1	37	AD/DA Conversion Time Output
13	DIO Line 2, Port 1	38	Enable D/A Data Flag High Output

Table 9: DT3818 Series J2 and J8 Pin Assignments (Continued)

Pin	Description	Pin	Description
14	DIO Line 3, Port 1	39	External Trigger D/A Input
15	Digital Ground	40	Digital Ground
16	DIO Line 4, Port 1	41	External Trigger A/D Input
17	DIO Line 5, Port 1	42	A/D Data Enable Flag High Pit[it
18	DIO Line 6, Port 1	43	Digital Ground
19	DIO Line 7, Port 1	44	Reset All Low Output
20	Digital Ground	45	Timer/Counter Output 1
21	External DIO Write Port 0/1 Low Output	46	Timer/Counter Output 0
22	External DIO Write Port 2 Low Output	47	Timer/Counter Gate input 0
23	Digital Ground	48	Timer/Counter Clock Input 0
24	External Interrupt Output Flag Low	49	Digital Ground
25	External interrupt input low	50	+5 Volts (fused)[1]

[1] *Maximum current available is 20mA.*

J3 - Emulator Connector

(DT3818 Series)

The 14-pin J3 connector (Figure 22) allows you to attach an XDS-510 emulator board to Fulcrum via a supplied cable assembly.

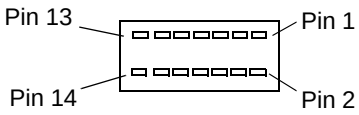

Figure 22: J3 Connector (DT3818 Series)

Table 7 lists the J3 pin assignments.

Table 10: DT3818 Series J3 Pin Assignments

Pin	Description
1	JTAG test mode select (XTMS)
2	JTAG test reset (XTRST)
3	JTAG test data input (XTDI)
4	Digital Ground
5	+5 Volts
6	(Key)
7	JTAG test data output (XTDO)
8	Digital Ground
9	JTAG test clock return (XTCK-RET)
10	Digital Ground
11	JTAG test clock (XTCK)
12	Digital Ground
13	Emulation Pin 0 (EMU0)
14	Emulation Pin 1 (EMU1)

J4 - Comm In Connector (DT3818 Series)

The 20-pin J4 connector (Figure 23), along with the J5, J6, and J7 allows multiple board communication with Fulcrum.

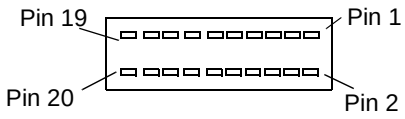

Figure 23: J4 Connector (DT3818 Series)

Table 7 lists the J4 pin assignments. The J4 connector is COMM3, input port.

Table 11: DT3818 Series J4 Pin Assignments

Pin	Description
1	Digital Ground
2	Comm Port 3 Data Bit 0
3	Digital Ground
4	Comm Port 3 Data Bit 1
5	Digital Ground
6	Comm Port 3 Data Bit 2
7	Digital Ground
8	Comm Port 3 Data Bit 3
9	Digital Ground
10	Comm Port 3 Data Bit 4
11	Digital Ground
12	Comm Port 3 Data Bit 5
13	Digital Ground
14	Comm Port 3 Data Bit 6
15	Comm Port Request 3
16	Comm Port 3 Data Bit 7
17	Digital Ground
18	Comm Port Acknowledge 3

Table 11: DT3818 Series J4 Pin Assignments (Continued)

Pin	Description
19	Comm Port Ready 3
20	Comm Port Strobe 3

J5 - Comm Out Connector (DT3818 Series)

The 20-pin J5 connector (Figure 24), along with the J4, J6, and J7 allows multiple board communication with Fulcrum. The J5 connector is COMM1, output port.

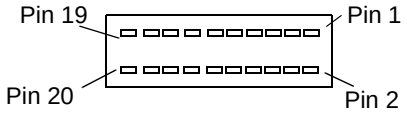

Figure 24: J5 Connector (DT3818 Series)

Table 7 lists the J5 pin assignments.

Table 12: DT3818 Series J5 Pin Assignments

Pin	Description
1	Digital Ground
2	Comm Port 1 Data Bit 0
3	Digital Ground
4	Comm Port 1 Data Bit 1
5	Digital Ground
6	Comm Port 1 Data Bit 2
7	Digital Ground
8	Comm Port 1 Data Bit 3
9	Digital Ground
10	Comm Port 1 Data Bit 4
11	Digital Ground
12	Comm Port 1 Data Bit 5
13	Digital Ground

Table 12: DT3818 Series J5 Pin Assignments (Continued)

Pin	Description
14	Comm Port 1 Data Bit 6
15	Comm Port Request 3
16	Comm Port 1 Data Bit 7
17	Digital Ground
18	Comm Port Acknowledge 1
19	Comm Port Ready 1
20	Comm Port Strobe 1

J6 - Comm In Connector (DT3818 Series)

The 20-pin J6 connector (Figure 25), along with the J4, J5, and J7 allows multiple board communication with Fulcrum. The J6 connector is COMM5, input port.

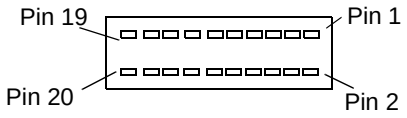

Figure 25: J6 Connector (DT3818 Series)

Table 13 lists the J6 pin assignments.

Table 13: DT3818 Series J6 Pin Assignments

Pin	Description
1	Digital Ground
2	Comm Port 5 Data Bit 0
3	Digital Ground
4	Comm Port 5 Data Bit 1
5	Digital Ground
6	Comm Port 5 Data Bit 2
7	Digital Ground

Table 13: DT3818 Series J6 Pin Assignments (Continued)

Pin	Description
8	Comm Port 5 Data Bit 3
9	Digital Ground
10	Comm Port 5 Data Bit 4
11	Digital Ground
12	Comm Port 5 Data Bit 5
13	Digital Ground
14	Comm Port 5 Data Bit 6
15	Comm Port Request 3
16	Comm Port 5 Data Bit 7
17	Digital Ground
18	Comm Port Acknowledge 1
19	Comm Port Ready 1
20	Comm Port Strobe 1

J7 - Synchronization Bus Connector (DT3818 Series)

The 14-pin J7 connector (Figure 26), along with the J4, J5, and J6 allows multiple board communication with Fulcrum. The J7 connector carries the control signals.

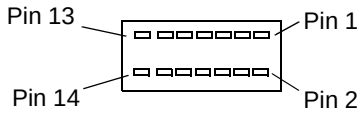

Figure 26: J7 Connector (DT3818 Series)

Table 7 lists the J7 pin assignments.

Table 14: DT3818 Series J7 Pin Assignments

Pin	Description
1	Over the Top Reset for multi-board reset
2	Digital Ground
3	Enable D/A Data Flag high
4	A/D Data Enable A/D Data Flag high
5	Digital Ground
6	Multi-board Flag B
7	Multi-board Flag A
8	Digital Ground
9	reserved
10	Digital Ground
11	External Synchronization for multiple DT3818s
12	Digital Ground
13	External Delta-Sigma Clock for multiple DT3818s
14	Digital Ground

C

Specifications

All specifications are typical at +25°C and rated voltage unless otherwise specified.

Interface Characteristics

Compatible bus	IBM Personal Computer AT bus or EISA
Bus loading	Board presents 1 bus load
Interface type	I/O mapped with 10-bit addressing
Number of locations occupied	16 bytes
I/O base address range	Switch-selectable from 200 hex to 3F0 hex in increments of 10 hex; 270 hex factory-configuration
I/O data transfer	16-bit word access only
Number of interrupts	1
Interrupt level	10, 11, 12, or 15; software-selectable
DMA channel lines	5, 6, or 7; software-selectable

Physical/Environmental

PC Board dimensions	Full-size IBM PC AT card
Card size	4.8” H x 13.25” W
Overall size	5.00” H x 14.00” W x 0.75” D (12.7 x 35.56 x 1.9 cm)
Weight	19 oz. (538.65 g)
Connectors	
J1	26-pin connector, 3M #10226-52B2VE
J2	50-pin connector, 3M #10250-52B2VE
J3	14-pin connector, 3M #3598-6002
J4 (DT3818 Series only)	20-pin connector, AMP No. 104549-7
J5 (DT3818 Series only)	20-pin connector, AMP No. 104549-7
J6 (DT3818 Series only)	20-pin connector, AMP No. 104549-7
J7 (DT3818 Series only)	14-pin connector, AMP No. 104341-2
J8 (DT3818 Series only)	50-pin connector, AMP No. 104069-1
Operating temperature	32 to 158°F (0 to 50°C)
Storage temperature	-13 to 185°F (-25 to 85°C)
Relative humidity	Up to 95%, non-condensing
Power requirements	+5V @ 3.5A typical

DT3801 Series Specifications

This section provides the analog input, analog output, digital I/O, external trigger, and counter/timer specifications for the DT3801 Series boards. For the specifications for the DT3818 Series boards, please go to "DT3818 Series Specifications" on page 75.

DT3801-G Analog Inputs

A/D module	DT5753
Resolution	12 bits (1 part in 4,096)
A/D throughput	250kHz maximum
Number of inputs	8 differential
Input range	
Unipolar	0 to +10V
Bipolar	±10V
Gain (programmable)	1, 2, 4, 8
Input impedance	
On channel	20k¾ minimum, 10pF
Off channel	20k¾ minimum
Maximum input voltage without damage	
Power on	±30V
Power off	±20V
Input bias current	±1nA maximum
Common Mode Rejection Ratio (CMRR)	72dB minimum @ 60Hz
Transition noise	0.3 LSB RMS
Output coding (programmable)	
Unipolar	Straight binary
Bipolar	Offset binary, two's complement

Anti-Aliasing Filters

Filter type	4-pole Butterworth, low-pass filter on each input channel
Cutoff frequencies	5kHz, 10kHz, 20kHz
Attenutation slope	24 dB/octave

DC Accuracy

Integral nonlinearity	0.02% FSR
Differential nonlinearity	±0.012% FSR (±0.5 LSB) max
Inherent quantizing error	±0.5 LSB
System accuracy	
Gain = 1	0.05% FSR maximum
Gain = 2	0.06% FSR maximum
Gain = 4	0.06% FSR maximum
Gain = 8	0.07% FSR maximum
Offset error; any channel, gain, range	0.5 LSB
Gain error	Adjustable to 0V
Monotonicity	Guaranteed

AC Accuracy

Sampling rate	250kHz maximum
Signal/noise ratio @ f_{IN}	
Gain = 1	70 dB @ 40kHz
Gain = 8	65 dB @ 40kHz
Peak harmonic distortion @ f_{IN}	
Gain = 1	-81 dB @ 40kHz
Gain = 8	-75 dB @ 40kHz

Total harmonic distortion @ f_{IN}	
Gain = 1	-78 dB @ 40kHz
Gain = 8	-74 dB @ 40kHz
Channel to channel crosstalk (f_{IN} = 1 kHz)	-85 dB

Dynamic Performance

Channel acquisition time	2µs maximum
A/D conversion time	2.5µs maximum
Sample & Hold aperture uncertainty	±150ps
Sample & Hold acquisition time	0.5µs maximum

Temperature

A/D zero drift	±35µV ± (50µV x Gain)/°C
A/D gain drift	±40ppm of FSR/°C maximum
Differential linearity drift	±2.5ppm of FSR/°C maximum

DT3808 Analog Inputs

A/D module	DT5747
Resolution	16 bits (1 part in 65,536)
A/D throughput	160kHz maximum
Number of inputs	8 differential, simultaneous sample & hold
Input range	
Unipolar	0 to +10V
Bipolar	±10V
Gain (fixed)	1
Input impedance	
On channel	100k¾ minimum, 10pF
Off channel	100k¾ minimum, 10pF
Maximum input voltage without damage	
Power on	±35V
Power off	±20V
Common Mode Rejection Ratio (CMRR)	80 dB minimum @ 60Hz
Transition noise	1.0 LSB RMS
Output coding (programmable)	
Unipolar	Straight binary
Bipolar	Offset binary, two's complement

Simultaneous Sample & Hold

Channel-to-channel offset match	1.5 LSB, ±10V range
Channel-to-cahnnel phase match	0.5° @ 1kHz
Channel-to-channel aperture match	±1 ns

DC Accuracy

Integral nonlinearity	0.0045% FSR maximum
Differential nonlinearity	±0.0015% FSR (±0.5 LSB) maximum
Inherent quantizing error	±0.5 LSB maximum
System accuracy (gain=1)	0.024% FSR maximum
Gain error	Adjustable to 0V
Monotonicity	Guaranteed

Dynamic Performance

Channel acquisition time	6.25µs maximum
A/D conversion time	6.25µs maximum
Sample & Hold aperture uncertainty	±0.10ns
Sample & Hold acquisition time	5µs maximum

Temperature

A/D zero drift	0.1 LSB/°C typical 0.5 LSB/°C maximum
A/D gain drift	±20ppm of FSR/°C maximum
Differential linearity drift	±0.5ppm of FSR/°C maximum

DT3809 Analog Inputs

A/D module	DT5744
Resolution	12 bits (1 part in 4,096)
A/D throughput	to 320kHz, multi-channel, any gain; to 500kHz, multi-channel, gain=1; to 1MHz single channel, gain=1
Number of inputs	16 single-ended/8 differential, software-selectable
Input range	
Unipolar	0 to +10V
Bipolar	±10V
Gain (programmable)	1, 2, 4, or 8
Input impedance	
On channel	100M¾ minimum, 100pF
Off channel	100M¾ minimum, 10pF
Maximum input voltage without damage	
Power on	±20V
Power off	±20V
Bias current	±25 nA
Common Mode Rejection Ratio (CMRR)	70 dB minimum @ 60Hz
Transition noise	0.4 LSB + (100µV x gain) RMS
Output coding (programmable)	
Unipolar	Straight binary
Bipolar	Offset binary, two's complement

DC Accuracy

Integral nonlinearity	0.024% FSR maximum
Differential nonlinearity	±0.018% FSR (±0.5 LSB) maximum

Inherent quantizing error	±0.5 LSB maximum
System accuracy	
Gain = 1	0.03% FSR maximum
Gain = 2	0.04% FSR maximum
Gain = 4	0.06% FSR maximum
Gain = 8	0.09% FSR maximum
Gain error	Adjustable to 0V
Offset voltage error	Adjustable to 0V
Monotonicity	Guaranteed

Dynamic Performance

Channel acquisition time	2.6µs maximum
A/D conversion time	1.0µs maximum
Sample & Hold aperture uncertainty	±0.15ns
Sample & Hold acquisition time	0.5µs maximum

Temperature

A/D zero drift	±20µV/°C (±10µV/°C x gain)
A/D gain drift	±40ppm of FSR/°C maximum
Differential linearity drift	±5.0ppm of FSR/°C maximum

Analog Outputs - DT3801 Series

Number of channels	2 independent
Resolution	16 bits
Nonlinearity	±4 LSBs
Differential nonlinearity	±2 LSBs
Output range (bipolar)	±10V
Throughput	
Full scale	100kHz maximum, single channel 200kHz aggregate
l LSB	400kHz, single channel 800kHz aggregate
Settling time	
Full scale step	10µs to ±1 LSB
1 LSB step	2.5µs typical
Temperature	
Range	0 to 50°C
Monotonicity	15 bits
Gain drift	±15 ppm of FSR/°C
Zero drift	±10 ppm of FSR/°C
Total harmonic distortion	0.009% @ 0 dB, 1001Hz, 100kHz rate
Software-selectable filters	-3dB @ 20kHz
Protection against	Short circuit to analog ground
Input data coding (programmable)	Two's complement, offset binary

Digital Input/Output - DT3801 Series

Number of 8-bit ports	2
Configuration of ports	16 bits in; or 16 bits out; or 8 bits in and 8 bits out

Clocked Digital Inputs

Port configuration	16 bits in: Ports 0 and 1, Port 0 bit 0 = LSB 8 bits in: Port 1, Port 1 bit 0 = LSB Port 1 is high byte and Port 0 is low byte of 16-bit setup.
Input type	Level-sensitive
Logic family	LSTTL
Logic sense	Positive true
Input logic load	1 LSTTL load
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	20µA (maximum)
Low level	-0.4mA (maximum)
Input termination	None, unused inputs float
Throughput	
16-bit non-packed	1.42MHz
8-bit non-packed	1.42MHz
16-bit packed	2.50MHz
8-bit packed	3.33MHz
Data setup time to External Clock	0 ns
Data hold time to External clock	85 ns

Clocked Digital Outputs

Port configuration	16 bits out: Ports 0 and 1, Port 0 bit 0 = LSB 8 bits out: Port 0, Port 0 bit 0 = LSB Port 1 is high byte and Port 0 is low byte of 16-bit setup.
Fanout	10 LSTTL loads
Logic family	LSTTL
Output voltage	
High level	2.4V (minimum)
Low level	0.6V (maximum)
Output current	
High level	-2.4mA (maximum)
Low level	4mA (maximum)
Throughput	
16-bit non-packed	1.42MHz
8-bit non-packed	1.42MHz
16-bit packed	2.50MHz
8-bit packed	3.33MHz
External Clock to data out valid	95ns

Note *The output driver is a 74ALS374 with a 47¾ resistor in series.*

External A/D, D/A, and DIO Triggers - DT3801 Series

Input type	Edge sensitive, programmable edge
Logic family	LSTTL
Logic load	3 LSTTL loads
Input termination	10k¾ pullup to +5V
Minimum pulse width	
Clock high	100ns
Clock low	100ns
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	40µA (maximum)
Low level	1.4mA (maximum)

Note *TTL low-level signals are more susceptible to noise than are more susceptible to noise than TTL high-level signals. For this reason, it is recommended that the A/D, D/A, and DIO External Trigger signals be normally-high, negative-going pulses.*

Maximum delay to first conversion (after falling edge of trigger):

1. External trigger/internal clock
   Max delay = 250ns + 1 conversion period of the clock setting

2. External trigger/external clock
   Max delay = 250ns + external clock period

The following example demonstrates how to calculate the maximum delay to the first conversion. Assume the following:

- External trigger/internal clock mode
- 82C54 source frequency = 10MHz (100ns)
- Conversion clock period = 50kHz (20µs)

Max delay = 250ns + conversion clock period
Max delay = 20.25µs

Counter/Timers (Intel 82C54) - DT3801 Series

Note *Refer to the* Intel Microprocessor and Peripheral Handbook *for information on the 82C54's programmable timer modes.*

Inputs

Input type (CLK3)	Rising edge followed by falling edge
Input type (GATE3)	Dependent on timer mode used
Logic family	LSTTL
Logic load	1 LSTTL load
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	20µA (maximum)
Low level	-0.4mA (maximum)
Termination	None

Outputs (OUT2, OUT3)

Fanout	10 LSTTL loads
Logic family	LSTTL
Output voltage	
High level	2.4V (minimum)
Low level	0.6V (maximum)
Output current	
High level	-2.4mA (maximum)
Low level	4 mA (maximum)
CLK3 to OUT3	100ns (maximum)

DT3818 Series Specifications

This section provides the analog input, analog output, digital I/O, external trigger, and counter/timer specifications for the DT3801 Series boards. For the specifications for the DT3818 Series boards, please go to “DT3801 Series Specifications” on page 62.

DT3818 Analog Inputs

Resolution	16 bits (1 part in 65,536)
A/D throughput	1kHz to 52kHz per channel
Number of inputs	8 differential
Input range	±10V
Gain (fixed)	1
Input impedance	100M¾ minimum, 100pF
Maximum input voltage without damage	
Power on	±25V
Power off	±15V
Input bias current	25 nA maximum
Common Mode Rejection Ratio (CMRR)	80 dB minimum @ 60Hz with 1k¾ imbalance
Output coding	Two’s Complement

Simultaneous Sample & Hold

Channel-to-channel match	
offset	±2mV
phase	0.10 degree @1kHz
aperture	±5nsec

Digital Filters

Filter type	Linear phase
Passband, -3dB	22kHz max, syncrhonized to the sample rate
Stopband	-80 dB @ 26kHz for a 48kHz sample rate
Group delay	18/Throughput

DC Accuracy (20kHz sample rate)

Integral nonlinearity	±0.005% FSR
Differential nonlinearity	±0.0012% of FSR (±0.75 LSB) maximum
Inherent quantizing error	±0.5 LSB
System accuracy (gain=1)	0.05% FSR maximum
Offset voltage error	±5mV maximum
Monotonicity	Guaranteed

AC Accurary (48kHz sample rate)

AC accuracy @f_{in}=1kHz	V_{in}=-5dB, 48kHz sample rate
Signal/noise ratio	84 dB
Total harmonic distortion	-86 dB
Channel-to-channel crosstalk	-85 dB

Temperature

A/D drift	±50 ppm of FSR/°C

DT3814 Analog Inputs

Resolution	16 bits (1 part in 65,536)
A/D throughput	1kHz to 52kHz per channel
Number of inputs	2 differential
Input range	±10V
Gain (fixed)	1
Input impedance	100M¾ minimum, 100pF
Maximum input voltage without damage	
Power on	±25V
Power off	±15V
Input bias current	25 nA maximum
Common Mode Rejection Ratio (CMRR)	80 dB minimum @ 60Hz with 1k¾ imbalance
Output coding	Two's Complement

Simultaneous Sample & Hold

Channel-to-channel match	
offset	±2mV
phase	0.10 degree @1kHz
aperture	±5nsec

Digital Filters

Filter type	Linear phase
Passband, -3dB	22kHz max, syncrhonized to the sample rate
Stopband	-80 dB @ 26kHz for a 48kHz sample rate
Group delay	18/Throughput

DC Accuracy (20kHz sample rate)

Integral nonlinearity	±0.005% FSR
Differential nonlinearity	±0.0012% of FSR (±0.75 LSB) maximum
Inherent quantizing error	±0.5 LSB
System accuracy (gain=1)	0.05% FSR maximum
Offset voltage error	±5mV maximum
Monotonicity	Guaranteed

AC Accurary (48kHz sample rate)

AC accuracy @f_{in}=1kHz	V_{in}=-5dB, 48kHz sample rate
Signal/noise ratio	84 dB
Total harmonic distortion	-86 dB
Channel-to-channel crosstalk	-85 dB

Temperature

A/D drift	±50 ppm of FSR/°C

Analog Outputs - DT3818 Series

These specifications apply to the DT3818 only.

Number of channels	2 independent
Resolution	16 bits (1 part in 65,536)
Data coding	Two's Complement
Total error	±0.05% of FSR
Output	
Bipolar	±10V
Current	±5mA (2k¾ load)
Capacitive load	10,000 pF (no oscillations)
Protected against short circuit to analog ground	
Throughput	52kHz per DAC
Temperature drift	±100 ppm of FSR/°C typical
Total harmonic distortion	-84 dB @ 48kHz for a 1kHz output signal
Reconstruction filter (selectable)	4 pole Butterworth @ 16kHz

Digital Input/Output - DT3818 Series

Number of 8-bit ports	3
Configuration of ports	16 bits in; or 16 bits out; or 8 bits in and 8 bits out

Clocked Digital Inputs

Port configuration	16 bits in: Ports 0 and 1, Port 0 bit 0 = LSB 8 bits in: Port 1, Port 1 bit 0 = LSB Port 1 is high byte and Port 0 is low byte of 16-bit setup.
Input type	Level-sensitive
Logic family	LSTTL
Logic sense	Positive true
Input logic load	1 LSTTL load
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	20µA (maximum)
Low level	-0.4mA (maximum)
Input termination	None, unused inputs float
Throughput	
16-bit non-packed	1.42MHz
8-bit non-packed	1.42MHz
16-bit packed	2.50MHz
8-bit packed	3.33MHz
Data setup time to External Clock	0 ns
Data hold time to External clock	85 ns

Clocked Digital Outputs

Port configuration	16 bits out: Ports 0 and 1, Port 0 bit 0 = LSB 8 bits out: Port 0, Port 0 bit 0 = LSB Port 1 is high byte and Port 0 is low byte of 16-bit setup.
Fanout	10 LSTTL loads
Logic family	LSTTL
Output voltage	
High level	2.4V (minimum)
Low level	0.6V (maximum)
Output current	
High level	-2.4mA (maximum)
Low level	4mA (maximum)
Throughput	
16-bit non-packed	1.42MHz
8-bit non-packed	1.42MHz
16-bit packed	2.50MHz
8-bit packed	3.33MHz
External Clock to data out valid	95ns

Note *The output driver is a 74ALS374 with a 47¾ resistor in series.*

External A/D, D/A, and DIO Triggers - DT3818 Series

Input type	Edge sensitive, programmable edge
Logic family	LSTTL
Logic load	1 LSTTL load
Input termination	22k¾ pullup to +5V
Minimum pulse width	
Clock high	100ns
Clock low	100ns
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	25µA (maximum)
Low level	-0.25mA (maximum)

Note *TTL low-level signals are more susceptible to noise than are more susceptible to noise than TTL high-level signals. For this reason, it is recommended that the A/D, D/A, and DIO External Trigger signals be normally-high, negative-going pulses.*

Maximum delay to first conversion (after falling edge of trigger)is one conversion cycle because conversion cycle continually runs.

Counter/Timers (Intel 82C54) - DT3818 Series

Note *Refer to the* Intel Microprocessor and Peripheral Handbook *for information on the 82C54's programmable timer modes.*

Inputs

Input type (CLK0)	Rising edge followed by falling edge
Input type (GATE0)	Dependent on timer mode used
Logic family	LSTTL
Logic load	1 LSTTL load
Input voltage	
High level	2.0V (minimum)
Low level	0.8V (maximum)
Input current	
High level	20µA (maximum)
Low level	-0.4mA (maximum)
Termination	None

Outputs (OUT0, OUT1)

Fanout	10 LSTTL loads
Logic family	LSTTL
Output voltage	
High level	2.4V (minimum)
Low level	0.6V (maximum)
Output current	
High level	-2.4mA (maximum)
Low level	4 mA (maximum)
CLK0 to OUT0	100ns (maximum)

D

Product Support

Troubleshooting the Board

Should you experience difficulty using Fulcrum, this section describes some possible problems and suggests steps you can take to correct them. Also try running the diagnostics shipped with your Fulcrum board. Appendix A describes how to run the diagnostics.

If you are experiencing a problem not described here, or have followed the steps suggested and are still having problems, please follow the instructions provided in "Service and Support" later in this chapter.

General Checklist

Go through the following checklist when troubleshooting Fulcrum to help you isolate your problem.

1. Read all appropriate sections of the manual. Make sure that any "Read-This-First" documents have been added to your manual and that you utilize all new information.

2. Verify that the board is firmly seated in the computer.

3. Check that the +5V power supply on the board is between +4.75 and +5.25 volts.

4. Make sure that all analog input connections are made properly.

   Refer to Chapter 2, "Installing the Board," for the appropriate connection scheme.

5. Verify that all cables associated with the board are firmly connected.

6. Make sure that no components on the board are making contact with an adjacent board.

7. Make sure that all unused analog input channels are referenced to analog ground.

Specific Problems

This section describes specific problems that may occur and suggests some possible causes and solutions.

1. The board is not responding.

   - Verify that the board is fully seated in the bus connector.

     Test for a proper board connection by gently lifting it. If it remains in place, the connection is secure. If there isno resistance, the boardis not seated tightly in the connector. Try pressing more firmly on the board to ensure proper connection.

   - Check that the board's I/O base address does not conflict with other boards used in your system.

   - Clean the board connector fingers with a soft eraser.

2. Readings are incorrect due to floating inputs.

   Floating inputs are those signals without a reference to analog ground on Fulcrum.

   - Connect the ground of the input signal to the same ground the computer uses. If you are using the single-ended mode, connect the ground of the input signal to analog ground and then connect analog ground to amp low. If you are using the differential mode, connect the return side of the input signal to analog ground by installing 10k¾ 1/4 watt resistors between the return and analog ground.

3. Readings are inaccurate due to ground loops.

   Ground loops may form if your input is connected in single-ended mode and your input devices (sensors, strain gauges, etc.) use different grounds. This may introduce electrical noise into the input and create inaccurate readings.

   - Connect the inputs in differential mode. (In differential mode, each channel uses a separate ground.)

- If you cannot use differential mode, make sure that all your inputs use the same ground by connecting them to a common terminal strip.

4. Readings are inaccurate due to common mode voltages.

   A common mode voltage appears on both the input signal and its ground, causing inaccurate readings.

   - Connect the inputs in differential mode to allow for common mode rejection (CMR). CMR is a measure of the change in the output voltage when both inputs are offset by equal voltages. When the inputs are connected differentially, equal voltage amounts are subtracted from both the input channel and its ground connection, resulting in accurate output readings.

5. The digital output code is all 1s or 0s.

   - Check for floating inputs. (See problem 2.)

   - Verify that the analog output voltage from any external device connected to the problem channel is within the analog input range selected for the board.

     If the analog output is outside the selected range and a voltage offset is being used, remove or reduce the offset.

   - Make sure that no other inputs are above the power supply voltage (±15V).

6. The first reading on a channel is incorrect.

   Input settling time is budgeted from one linear region to another. If the first reading on a valid channel is erroneous, the input's sample-and-hold circuit may be saturated due to overvoltage on an open channel.

   - Check for floating inputs. (See problem 2.)

   - Make sure that the input cable is not over 3 meters (10 feet) in length.

   - Make sure the source impedance is between 1k¾ and 10k¾.

7. All readings are noisy.

   - Noise may be caused by AC power supplies, fluorescent lights, motors, generators, and other electrical sources. Verify that all cables are routed away from switching power supplies and digital signals.

   - Connect any unused channels to ground. If you are using the board in single-ended mode, connect the high side of each input channel to any signal ground. If you are using differential mode, connect the high side of each input channel to the corresponding return pin for that channel, and then connect the return pin to analog ground.

   - Add RC filters at the inputs to remove high-frequency noise pickup.

8. The input voltages exceed the board's range.

   See Reference C, "Specifications," for voltage limitations.

   - Protect the board from the input spikes by opto-isolating the input channels or by supplying diode protection.

Service and Support

If you have difficulty using your Fulcrum board, Data Translation's Technical Support department is available to provide prompt technical assistance.

Before contacting the Technical Support department, complete the support form on the following page. This information helps to identify specific system and configuration-related problems.

Please specify whether or not the problem has occurred more than once and, if possible, document the sequence of steps that caused the problem. This information helps us to reproduce the problem in-house.

By Phone

The Technical Support department can be reached by calling (508) 481-3700.

For the most efficient service, please be available at your computer and be prepared to provide the information requested on the following page when you call for technical support.

By Fax

To contact the Technical Support department by fax, please photocopy and complete the form on the following page (include additional pages if necessary). Data Translation's fax number is (508) 481-8620.

By Email

For MCI Mail: Data Translation Tech Support/547-1472
For Internet: 547-1472@MCIMAIL.COM

Outside the USA

If you are located outside the USA, call your local distributor. The name and telephone number of your nearest distributor are provided in your Data Translation catalog.

Information Required for Technical Support

Name: _____

Address: _____

_____

Phone: _____

Data Translation hardware product(s): _____

_____

serial number: _____

configuration: _____

Data Translation software product(s):_____

_____

serial number: _____version:_____

PC model: _____

operating system: _____version:_____

processor: _____speed:_____

RAM: _____hard disk space:_____

network: _____memory cache:_____

I have the following boards and applications installed in my system:_____

_____

_____

I am encountering the following problem(s): _____

_____

_____

_____

and have received the following error messages/codes: ____

_____

_____

I have run the board diagnostics with the following results: _____

_____

You can reproduce the problem by performing these steps:

1. _____

_____

2. _____

_____

3. _____

_____

If Your Board Needs Factory Service

If Fulcrum must be returned to Data Translation:

1. Write down the board's serial number, then call the Customer Service Department and obtain a Return Material Authorization (RMA) number.

   All return shipments to Data Translation must be marked with the correct RMA numbers in order to ensure proper processing.

2. Package the board as follows:

   - Wrap the board in an electrically conductive plastic material, handling it with ground protection. A static discharge can destroy components on the board.

   - Pack the board in its original shipping container, if available and in good condition. If it is not available, use any secure shipping container.

3. Return the board to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Outside the USA

If you are located outside the USA, call your local distributor for authorization and shipping instructions. The name and telephone number of your nearest distributor are listed in your Data Translation catalog.

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