HP 75000 SERIES C

C-Size VXIbus Register Based Breadboard Module HP E1490B

Developer's Manual

Enclosed is the Developer's Manual for the HP E1490B Breadboard Module. Insert this manual, plus any other VXIbus manuals that you may have, into the binder that came with your Hewlett-Packard mainframe.

E1490-90003
E0592

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Safety: IEC 1010
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IEC 801-3, EN 50082-1, 3 V/M
IEC 801-4, EN 50082-1, 1kV

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May 1992

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Printing History

The Printing History shown below lists all Editions and Updates of this manual and the printing date(s). The first printing of the manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct the current Edition of the manual. Updates are numbered sequentially starting with Update 1. When a new Edition is created, it contains all the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this printing history page. Many product updates or revisions do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

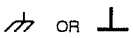
Edition 1 (Part Number E1490-90002) ..... December 1990

Edition 2 (Part Number E1490-90003) ..... May 1992

Safety Symbols

Instruction manual symbol affixed to product. Indicates that the user must refer to the manual for specific Warning or Caution information to avoid personal injury or damage to the product.

Indicates the field wiring terminal that must be connected to earth ground before operating the equipment—protects against electrical shock in case of fault.



Frame or chassis ground terminal—typically connects to the equipment's metal frame.

Alternating current (AC).

Direct current (DC).

Indicates hazardous voltages.

WARNING Calls attention to a procedure, practice, or condition that could cause bodily injury or death.

CAUTION Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

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DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.

For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuseholders.

Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

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MANUAL COMMENT SHEET

HP E1490B C-Size VXIbus Register Based Breadboard Module Developer's Manual
Manual Part Number E1490-90003
Edition 2 (May 1992)

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Please describe the system controller, operating system, and programming language you are using to program this product.

_____

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Please pencil-in one circle for each statement below as it applies to this documentation:

	Disagree				Agree
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Table of Contents

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Introduction

Manual Contents

This manual has three chapters and two appendixes:

- **Chapter 1 - Introduction** summarizes manual contents, warranty status, specification compliance, and includes a description of the module.
- **Chapter 2 - Configuring the HP E1490B** describes module hardware and dimensions, and discusses operation of the backplane interface circuits on the module. It also provides a typical application example showing user circuits connected to the backplane interface circuits.
- **Chapter 3 - Using the HP E1490B** shows how to use the module in a VXIbus system.
- **Appendix A - E1490B** Breadboard Specifications lists the hardware specifications for the HP E1490B module.
- **Appendix B - Parts List/Component Locator/Schematic** provides HP part numbers and descriptions of all parts supplied by HP. A complete component locator and schematic of the E1490B digital backplane interface is included.

Warning

To prevent shock, use only wire rated for the highest input voltage and disconnect all field power before removing terminal block cover or assembly. Do not exceed 125VACrms or 150VDC on terminal block connector.

Specification Compliance/Warranty

The HP E1490B Breadboard Module is designed in full compliance with the VMEbus Specification (Revision C.1) and the VXIbus specification (Revision 1.3).

The HP E1490B warranty is different than the standard Hewlett-Packard warranty statement, located at the front of this manual. While Hewlett-Packard is responsible for defects in materials and workmanship of the blank circuit board and supplied hardware, Hewlett-Packard is not responsible for the performance of your custom-designed circuitry. In addition, Hewlett-Packard is not responsible for damage to or improper operation of your VXI mainframe or other plug-in modules caused by the HP E1490B Breadboard Module.

HP E1490B Description

The HP E1490B Breadboard Module is a C-size register-based device that provides a convenient interface to a VXI mainframe backplane. It allows you to construct your own custom hardware for use with the mainframe.

General Module Features

The module provides VXI A16/D16 Register-based backplane interface circuitry and metal shields to enclose the circuit board.

Backplane Interface Features

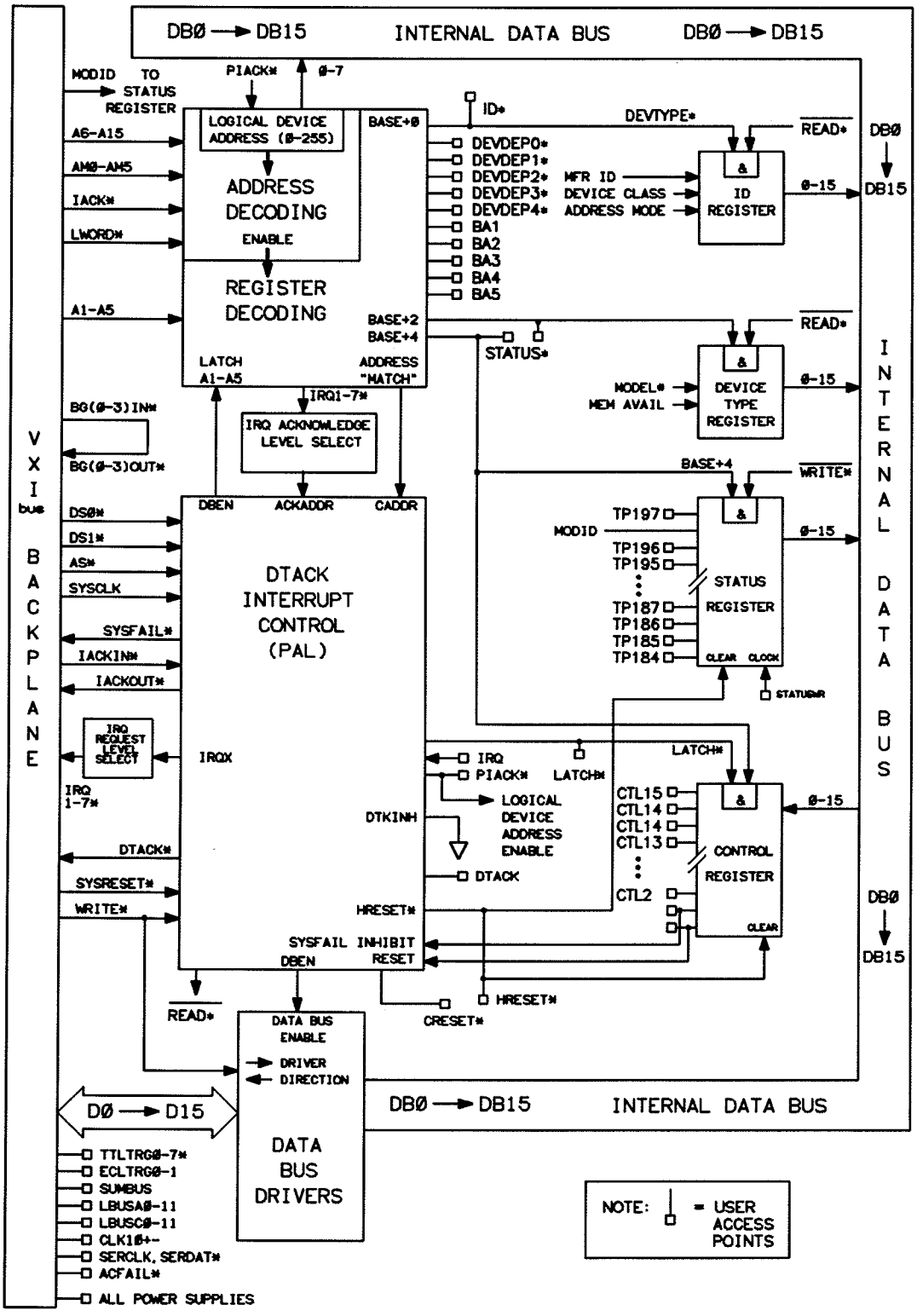
An overview of the HP E1490B interface features follows. See Figure 1-1.

Note

For hardware operation, a mnemonic suffixed with an asterisk (such as WRITE*) indicates inverse logic (0 or low = true; 1 or high = false). A high state (1) is defined as a positive voltage (usually + 5 V) and a low state (0) is defined as zero V (ground) at the specified signal point.

The HP E1490B interface features are:

- **Address Lines and Register Decoding**. The module implements 15 address lines (A1-A15) allowing (1) decoding one of 255 switch-selectable logical device addresses in the upper fourth of the A16 VME address space, and (2) selecting one of the breadboard configuration registers for read/write operations. The module decodes the Address Modifier lines AM0-AM5 and acts on codes 29_{16} and $2D_{16}$ only.
- **Data Lines.** Data lines D0-D15 are available for use on the Breadboard module. These 16 lines are buffered by data bus drivers and used for writing to, and reading from, the configuration registers (Status, ID, Device Type, and Control) via an internal data bus (DB0-DB15).
- **Status Register**. A read of this 16-bit register provides information about the status of the Breadboard module. Implemented signals are "A24/A32 Active", "MODID*", "Extended*" and "Passed". There are also provisions for implementing device-dependent status bits.
- **ID Register**. A read of this 16-bit register identifies the Manufacturer ID number, the Device Class, and the addressing mode of the Breadboard. By using the DIP switches, the user selects hardwired configurations for these items.
- **Device Type Register**. A read of this 16-bit register identifies the unique card model as defined by the device manufacturer. It also indicates the amount of memory available on the card in bytes (for A24 and A32 devices only). By using the DIP switches, the user selects hardwired configurations for these items.
- **Control Register**. A write to this 16-bit register causes specific actions to be executed by the device. "Reset" and "System Fail Inhibit" are implemented. Other device-dependent control bits may be implemented by using the remaining device dependent bits.



(ACAD) E1468:BLOCK

Figure 1-1. Digital Backplane Interface Block Diagram

- **Read/Write Operations**. Using the backplane interface circuitry provided, it is possible to read the contents of the Status, ID, or Device Type Registers onto the data bus (D0-D15), or to write information into the Control Register from the data bus.

- **DTACK**. The interface contains the circuitry required for generating a delayed DTACK* (data transfer acknowledge) signal.

- **Interrupt Interface**. The Breadboard Module has D16 **interrupter** capability. It does not contain an **interrupt handler**. Interrupt priority is jumper-selectable for pulling the appropriate interrupt request line IRQ1* - IRQ7*. Interrupts are generated by the IRQ state machine on the PAL. The daisy-chained IACKIN*/IACKOUT* signal pair is implemented.

- **Module Reset**. Both hardware and software reset signals are provided to initialize the backplane interface circuitry and your own custom-designed circuitry to a known state.

- **Backplane Buffering**. Buffering is provided for all signals that interface with the VXIbus backplane.

- **Power Supply**. + 5 Vdc from the backplane is fused at 4A and filtered for use on the module. The -5.2Vdc is also filtered. Other backplane voltage stubs are available.

HP E1490B Hardware Features

An overview of the HP E1490B hardware features follows.

- **Connectors**. A 96-pin DIN connector connects to the Terminal Module.

- **Component Area.** An area of approximately 460 cm^2 (72 in^2) is available on the module to install your own custom circuitry. This area does not include the portion of the circuit board required by the backplane interface components.

- **Component Height/Lead Length**. The maximum component height allowed above the circuit board is 18.0 mm (0.71 in). The maximum component lead length allowed below the circuit board is 3.2 mm (0.125 in).

2

Configuring the HP E1490B

This chapter contains a detailed hardware description of the breadboard module and discusses the backplane interface circuitry. It also shows a sample application to control sixteen relays on the module.

Handling Precautions

WARNINGS, CAUTIONS, and guidelines to reduce the risk of static discharge damage to the HP E1490B follow.

WARNING

SHOCK HAZARD. Only qualified, service-trained personnel who are aware of the hazards involved should install, remove, or configure any module. Before you touch any installed module, turn off all power to the mainframe and to all external devices connected to the mainframe or to any of the modules.

CAUTION

STATIC SENSITIVITY. The backplane interface circuitry described in this chapter uses static-sensitive CMOS integrated circuit devices. If you implement the circuitry described herein, you must use clean-handling and anti-static techniques when handling the module to protect the sensitive components from damage due to electrostatic discharge (ESD).

Reducing Static Discharge Damage Risk

The smallest static voltage most people can feel is about 3500 V. It takes less than one-tenth of that (about 300 V) to destroy or severely damage static-sensitive circuits. Often, static damage does not immediately cause a malfunction, but significantly reduces the component's life. Adhering to the following precautions will reduce the risk of static discharge damage.

- Keep the module in its conductive plastic bag when not installed in a VXIbus mainframe. Save the bag for future module storage.
- Before handling the module, select a work area where potential static sources are minimized. Avoid working in carpeted areas and non-conductive chairs. Keep body movement to a minimum. If possible, use a controlled-static workstation.
- Handle the module only by the metal cover plate. Avoid touching any components or edge connectors. When you are ready to configure the module, remove it from its protective bag and lay it on top of the bag while keeping your free hand in contact with the bag. This technique maintains your body and the module at the same static potential.

- When you install the module, keep one hand in contact with the protective bag as you pick up the module with your other hand. Then, before installing the module, move your free hand to a metal surface on the mainframe, thus bringing you, the module, and the mainframe to the same static potential.
- Do not install a module without its metal shields attached. (While the module is installed, it is protected from static discharge damage.)

Hardware Description

Figure 2-1 shows the module with the metal shields removed. As shown, the module consists of a circuit board with two backplane connectors (P1 and P2), a front panel DIN connector (J2), and a front panel.

Common traces are provided at the upper and lower edges of the circuit board to form power supply or ground buses. Do not mount components where they will cross these buses.

Terminal Module Connection

Figure 2-1 also shows the User Connections and the Terminal block. Ignore the pin numbers molded on the terminal block connectors; trace your connection through the terminal card connector to ensure proper wiring. The silkscreened pin numbers on the terminal block corresspond to the silk screened pin numbers on the breadboard module.

Backplane Connections

The breadboard module allows you to interface your custom circuits to any standard C-size VXIbus backplane (connectors J1/P1 and J2/P2). This enables you to access the backplane control signals, data lines, address lines, trigger buses, and power supplies.

Table 2-1 lists backplane connector P1 (top connector) pins which connect to the VXIbus backplane. Table 2-2 lists backplane connector P2 (bottom connector) pins which also connect to the VXIbus backplane. Address memory or anything requiring A24-A31 can't be accessed because there are no pins for the center row on the P2 connector. Data wider than 16 bits can't be sent because the D16-D31 lines are also on the center row.

Terminal block connector J2 connects the breadboard module to the terminal block. The silk screened numbers on the component side of the breadboard (columns A, B, and C; row numbers 1 through 32) correspond to the pin numbers on the J2 connector and the silkscreened numbers on the terminal block (A20, B25, etc.). For example, A20 on the terminal block matches to column A, row 20 on the breadboard module. Refer to the breadboard schematics for additional pin wiring information.

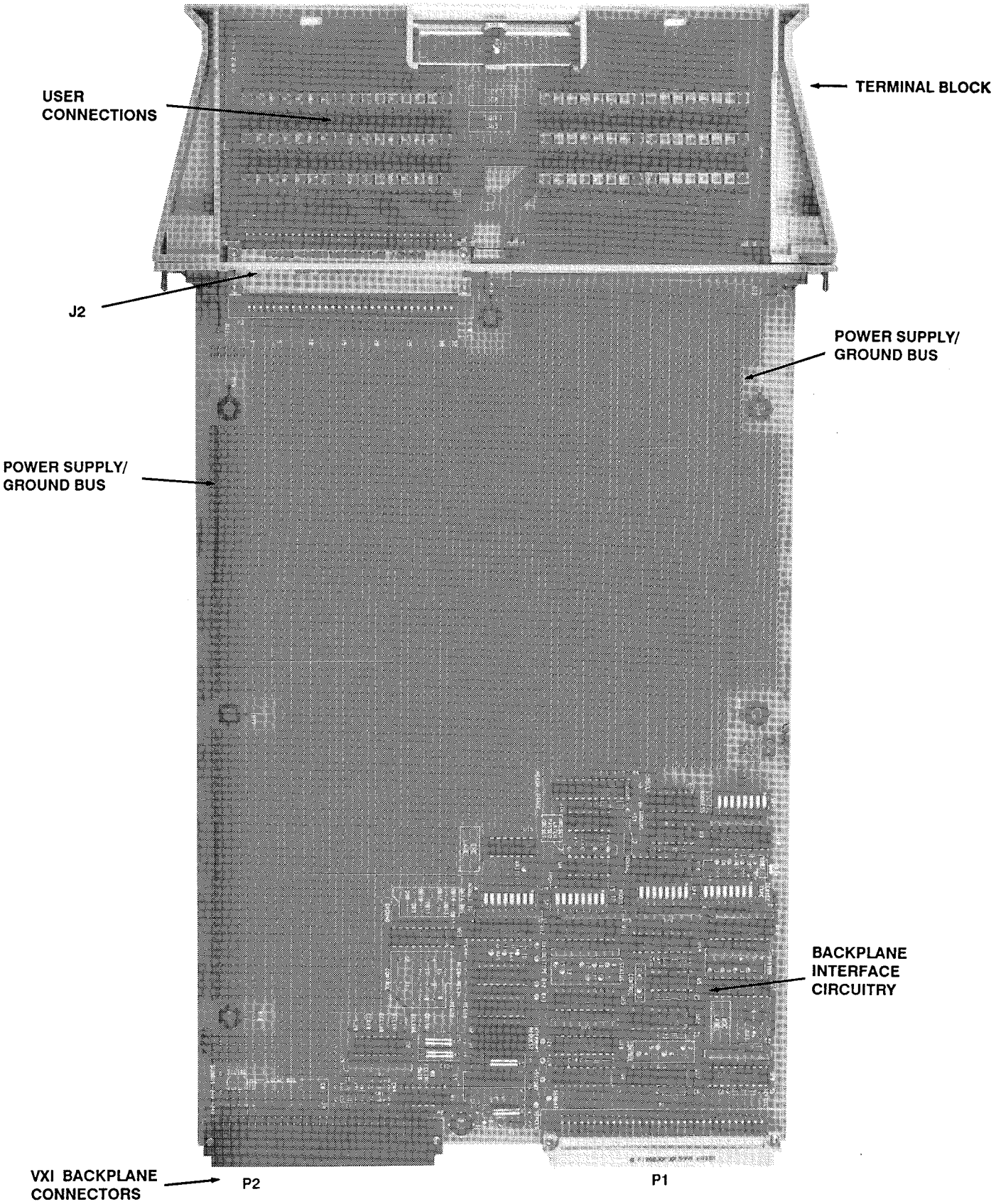


Figure 2-1. HP E1490B Breadboard Module

Table 2-1. Backplane Connector P1

P1 Pin	Row A Mnemonic	Row B Mnemonic	Row C Mnemonic	P1 Pin
1	D0		D08	1
2	D1		D09	2
3	D2	ACFAIL*	D10	3
4	D3	BG0IN*	D11	4
5	D4	BG0OUT*	D12	5
6	D5	BG1IN*	D13	6
7	D6	BG1OUT*	D14	7
8	D7	BG2IN*	D15	8
9	GROUND	BG2OUT*	GROUND	9
10	SYSCLK	BG3IN*	SYSFAIL*	10
11	GROUND	BG3OUT*		11
12	DS1*		SYSRESET*	12
13	DS0*		LWORD*	13
14	WRITE*		AM5	14
15	GROUND			15
16	DTACK*	AM0		16
17	GROUND	AM1		17
18	AS*	AM2		18
19	GROUND	AM3		19
20	IACK*	GROUND		20
21	IACKIN*	SERCLK		21
22	IACKOUT*	SERDAT*		22
23	AM4	GROUND	A15	23
24	A07	IRQ7*	A14	24
25	A06	IRQ6*	A13	25
26	A05	IRQ5*	A12	26
27	A04	IRQ4*	A11	27
28	A03	IRQ3*	A10	28
29	A02	IRQ2*	A09	29
30	A01	IRQ1*	A08	30
31	–12v	+ 5STDBY	+ 12v	31
32	+ 5v	+ 5v	+ 5v	32

Table 2-2. Backplane Connector P2

P2 Pin	Row A Mnemonic	Row C Mnemonic	P2 Pin
1	ECLTRG0	CLK10+	1
2	–2V	CLK10–	2
3	ECLTRG1	GROUND	3
4	GROUND	–5.2V	4
5	LBUSA0	LBUSC0	5
6	LBUSA1	LBUSC1	6
7	–5.2V	GROUND	7
8	LBUSA2	LBUSC2	8
9	LBUSA3	LBUSC3	9
10	GROUND	GROUND	10
11	LBUSA4	LBUSC4	11
12	LBUSA5	LBUSC5	12
13	–5.2V	–2V	13
14	LBUSA6	LBUSC6	14
15	LBUSA7	LBUSC7	15
16	GROUND	GROUND	16
17	LBUSA8	LBUSC8	17
18	LBUSA9	LBUSC9	18
19	–5.2V	–5.2V	19
20	LBUSA10	LBUSC10	20
21	LBUSA11	LBUSC11	21
22	GROUND	GROUND	22
23	TTLTRG0*	TTLTRG1*	23
24	TTLTRG2*	TTLTRG3*	24
25		GROUND	25
26	TTLTRG4*	TTLTRG5*	26
27	TTLTRG6*	TTLTRG7*	27
28	GROUND	GROUND	28
29			29
30	MODID	GROUND	30
31	GROUND	+ 24V	31
32	SUMBUS	–24V	32

Cooling Requirements

The VXIbus Specification requires module manufacturers to establish a cooling specification for each of their modules. The specification is to consist of: (1) the airflow required (in liters/second) for adequate cooling, and (2) the pressure drop that occurs across the module when the specified airflow is applied.

Note

Module cooling requirements are described in the VXIbus Specification (Rev 1.3) in Section B.7.2.4. Mainframe cooling requirements are discussed in Section B.7.3.5.

For ease of integration, you should label the airflow requirements for your finished application circuitry on an outside shield of the module. For example, the label might read: 0.3 liters/sec @ 0.2 mm/H_2O.

Due to the nature of a breadboard module, it is not possible to specify cooling requirements without knowing the application and the amount of power to be dissipated. Given the application, however, cooling requirements may be estimated as follows:

1. Determine the airflow required as a function of power dissipation. To maintain a 10°C rise, approximately 0.08 liters/second are required for every watt dissipated. For example, if a module dissipates 20 watts, 1.6 liter/second of airflow is required for cooling.
2. Establish the relationship between airflow and pressure drop. For a breadboard loaded with typical components (such as ICs, relays, and a few heat sinks), the curve shown in Figure 2-2 may be used to determine the pressure drop across the module. Determine the pressure drop as the intersection of the curve and the required airflow. For example, if the airflow required is 1.6 liter/second, the pressure drop is approximately 0.04 mm H_20.

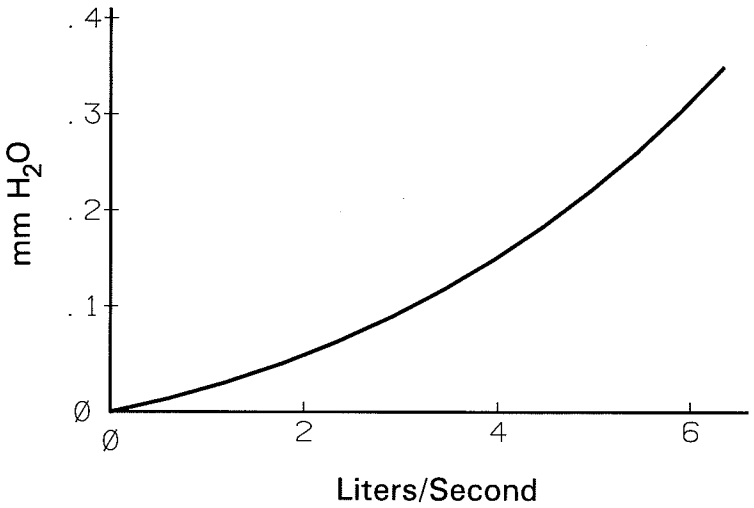


Figure 2-2. Pressure Drop vs. Air Flow

Module Dimensions

Figure 2-3 shows the dimensions of the module and the component height and lead length restrictions. As shown, the maximum component height allowed above the circuit board is 18.0 mm (0.71 in). The maximum component lead length allowed below the circuit board is 3.2 mm (0.125 in). This allows for some shield warp. If you need more lead length, provide insulation or add standoffs as described below. Do not mount components closer than 4 mm (0.16 in) to the extreme upper or lower edges of the circuit board. This space is used for shields and to guide the module into the mainframe module slot. An area of 460 cm^2 (72 in^2) is available on the module to install your own circuitry. This area does not include the portion of the circuit board required to install the backplane interface components.

Metal standoffs (not provided with the module) can be installed to increase the maximum component height above the circuit board or lead length allowed below the circuit board. For example, if you are wire-wrapping components to the circuit board, you can install additional standoffs to compensate for the long lead length of the wire-wrap sockets.

If you are using tall components, you can install additional standoffs to compensate for the extra height requirement. With the standoffs installed, the module will require an additional *one or two* mainframe slots, depending on the length of the standoffs and whether you use standoffs on both sides of the breadboard, or just on one side. Figure 2-4 shows the normal module configuration (Configuration A) and the module with standoffs installed (Configurations B and C).

In Configuration B, the standoffs are installed between the circuit board and the bottom shield. Figure 2-5 shows the dimensions of the 19 mm hex standoff recommended for Configuration B. This standoff does not carry an HP part number but can be ordered from the address shown in Figure 2-6. With the recommended standoffs installed, this configuration extends the maximum component lead length below the circuit board from 3.2 mm (0.125 in) to 22.2 mm (0.9 in). Eight standoffs are required per module (all eight standoffs are installed on the same side of the circuit board).

In Configuration C, the standoffs are installed between the circuit board and the top shield. Figure 2-6 shows the dimensions of the 30 mm hex standoff recommended for Configuration C. This standoff may also be ordered from the address shown in Figure 2-6. With the recommended standoffs installed, this configuration extends the maximum component height above the circuit board from 18.0 mm (0.71 in) to 48.0 mm (1.89 in). Eight standoffs are required per module (all eight standoffs are installed on the same side of the circuit board).

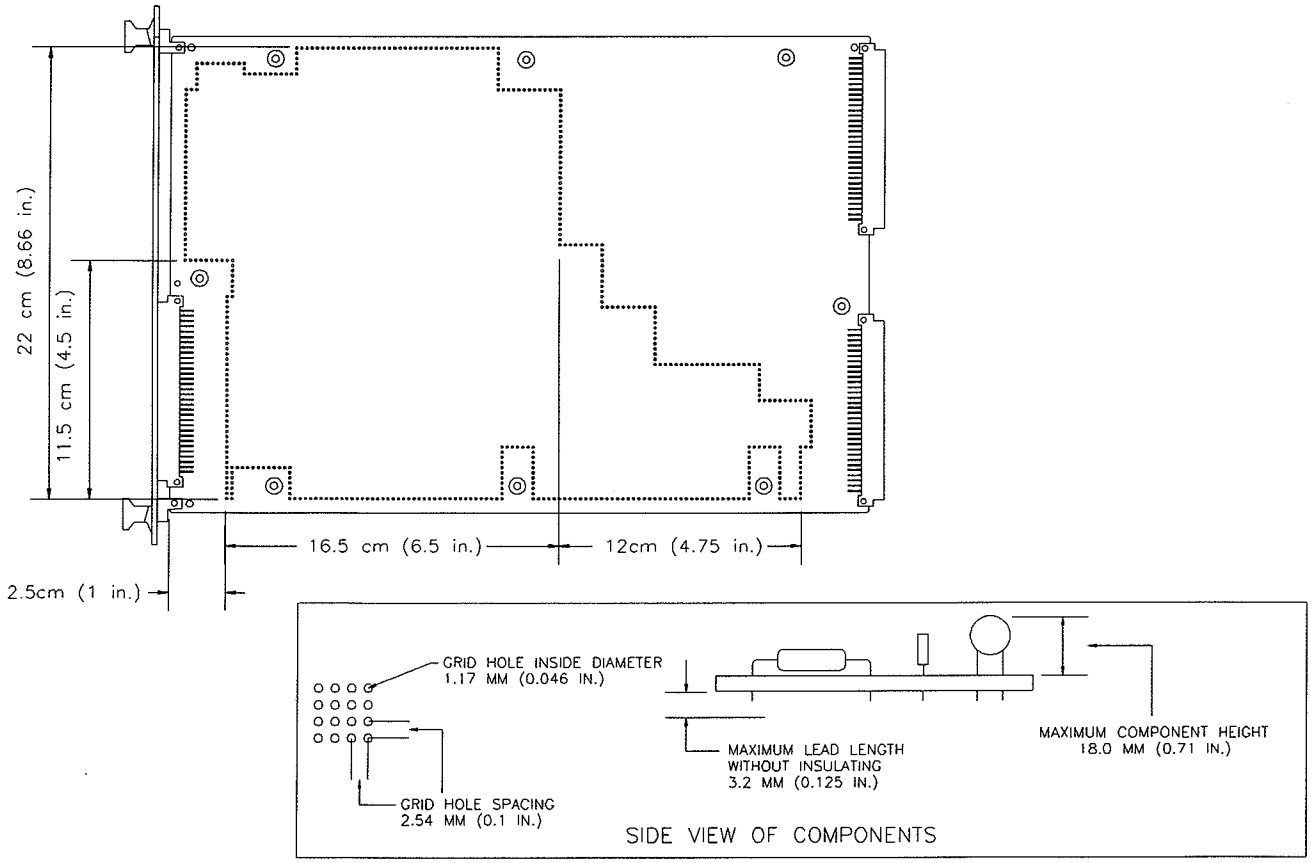
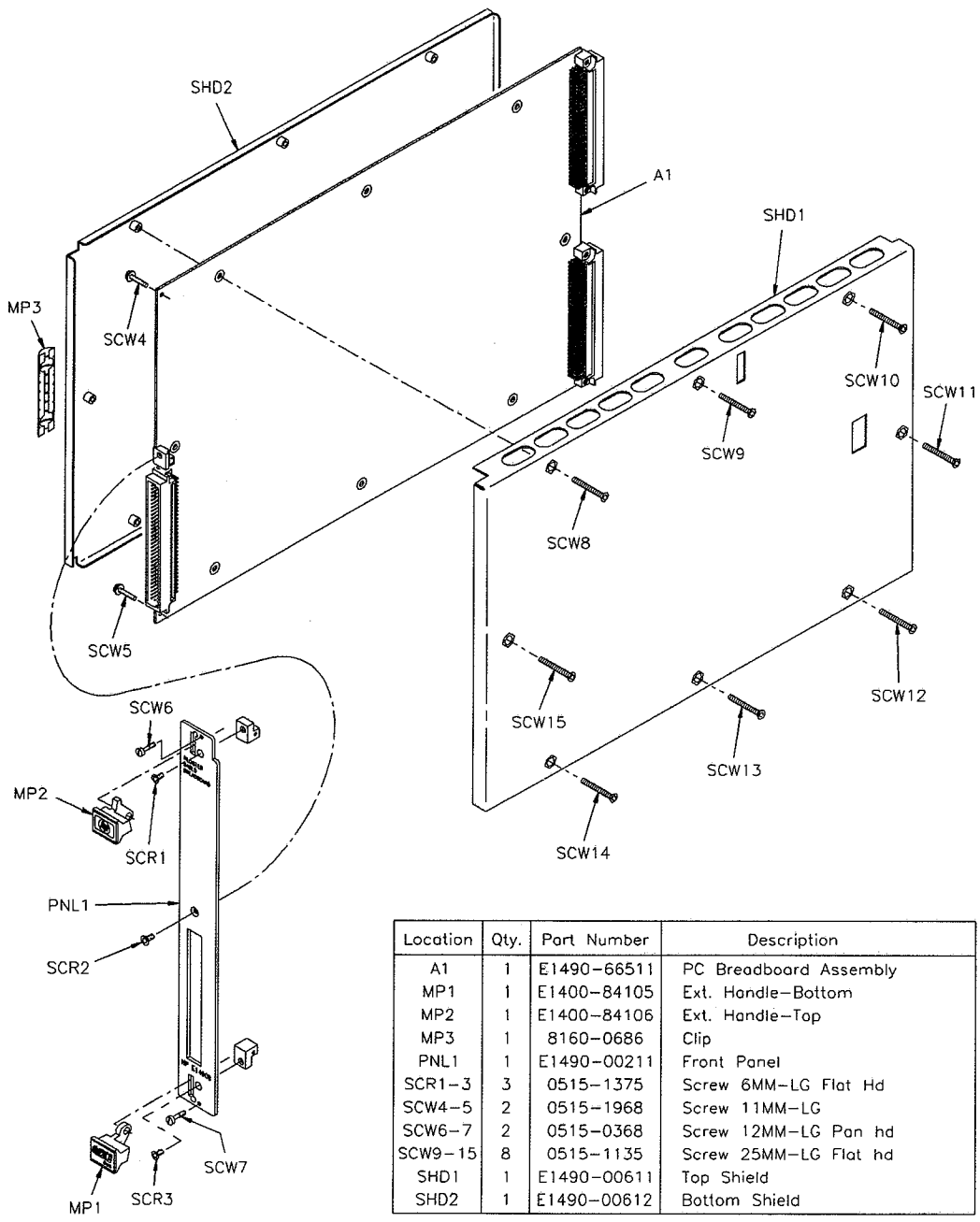


Figure 2-3. HP E1490 Dimensions



Location	Qty.	Part Number	Description
A1	1	E1490-66511	PC Breadboard Assembly
MP1	1	E1400-84105	Ext. Handle-Bottom
MP2	1	E1400-84106	Ext. Handle-Top
MP3	1	8160-0686	Clip
PNL1	1	E1490-00211	Front Panel
SCR1-3	3	0515-1375	Screw 6MM-LG Flat Hd
SCW4-5	2	0515-1968	Screw 11MM-LG
SCW6-7	2	0515-0368	Screw 12MM-LG Pan hd
SCW9-15	8	0515-1135	Screw 25MM-LG Flat hd
SHD1	1	E1490-00611	Top Shield
SHD2	1	E1490-00612	Bottom Shield

Figure 2-3-1. E1490B Exploded View

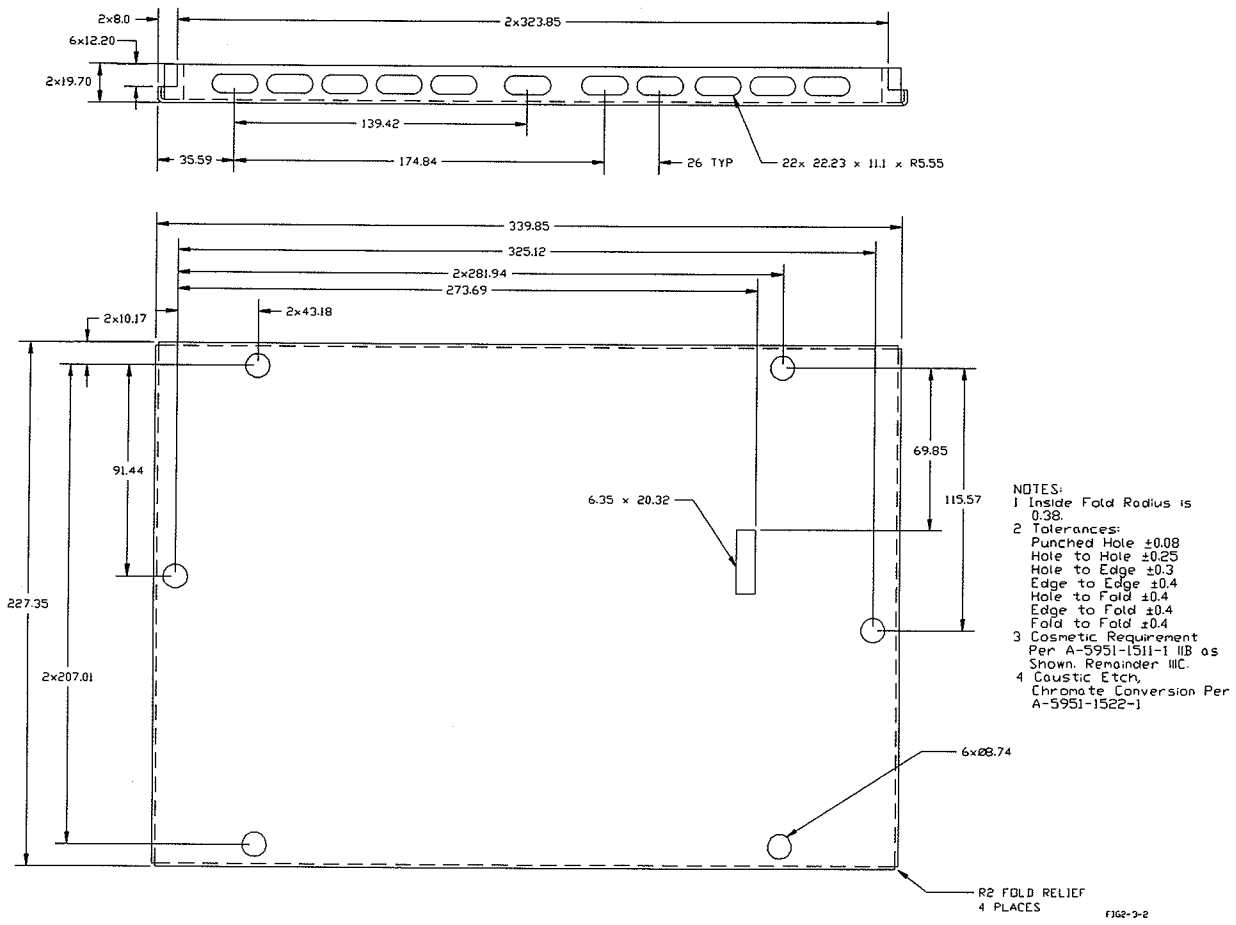


Figure 2-3-2. E1490B Top Shield Dimensions

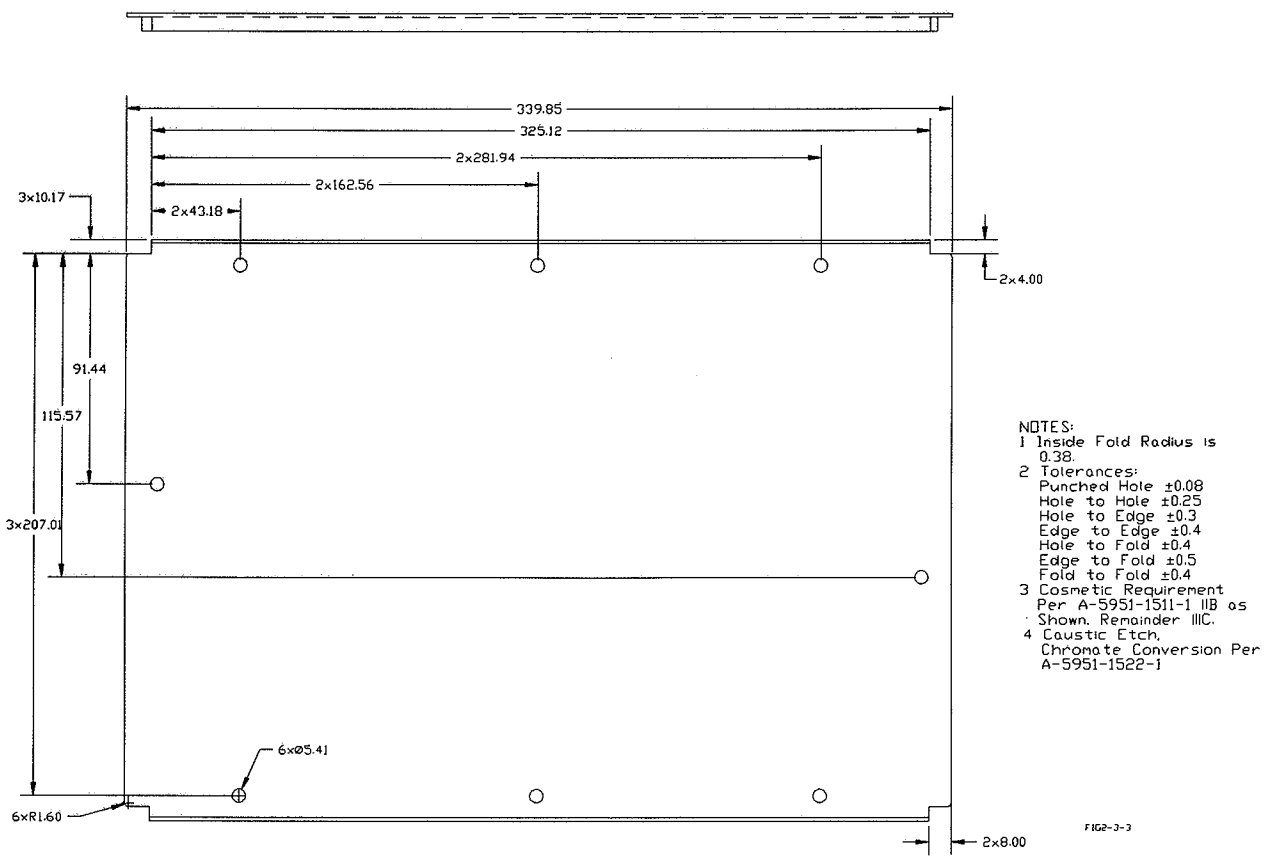


Figure 2-3-3. E1490B Bottom Shield Dimensions

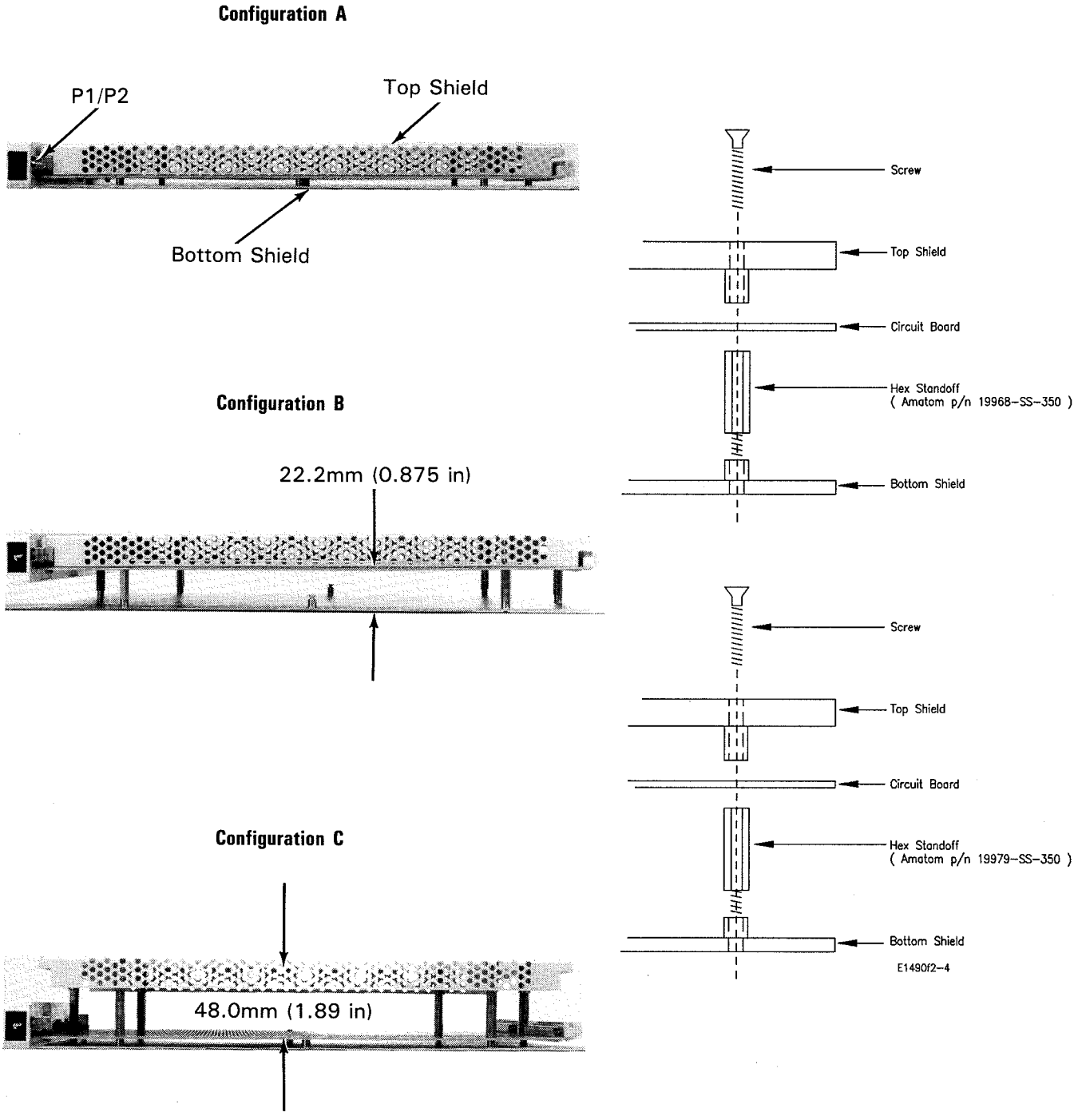


Figure 2-4. HP E1490 with Standoffs Installed

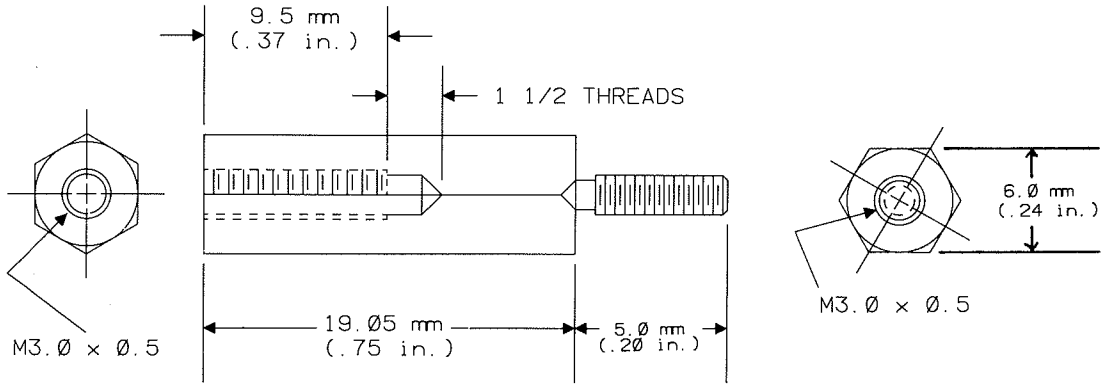
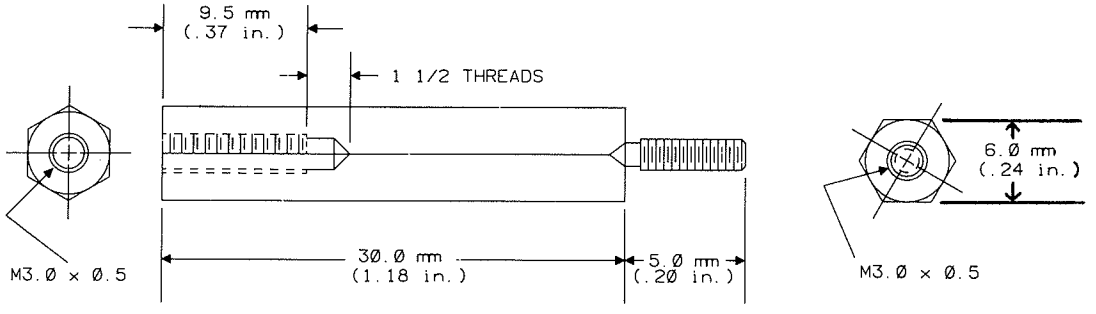


Figure 2-5. Standoff Dimensions for Configuration B



34523:F.12

Manufacturer's Address:
AMATOM ELECTRONIC HARDWARE CO.
Division of MITE Corp.
446 Blake Street
New Haven, CT 06515
1-800-243-6032
Order Part Number: 19979-SS-0350
Quantity Required: 8 Per Module

Figure 2-6. Standoff Dimensions for Configuration C

Backplane Interface Circuitry

The backplane interface circuitry allows you to access the backplane control signals, data lines, address lines, trigger buses, and power supplies. The backplane interface circuitry consists of the following functional groups:

- Address Lines and Register Decoding
- Data Bus Drivers
- Status Register
- ID Register
- Device Type Register
- Control Register
- DTACK, Interrupt and Control
- Backplane Signals and Voltages Available on the Module
- ECL Trigger Circuitry

The following sections discuss the backplane interface functional groups. Each section includes a description, partial schematics, and timing diagrams (where applicable). See Appendix B, "HP E1490B Parts List" for a complete parts list and schematic.

Note

In the following hardware discussion, a high state (1) is indicated by a positive voltage (usually + 5 V) and a low state (0) is indicated by 0V (ground) at the specified signal point. A mnemonic suffixed with an asterisk (such as WRITE*) indicates inverse logic (0 or low = true; 1 or high = false).

Address Lines and Register Decoding

Figure 2-7 shows the address line and register decoding circuitry. The HP E1490B breadboard module is designed to be used as an A16/D16 device. As such, only backplane address lines A1-A15 and data lines D0-D15 have been implemented on the module.

To address the module, the information present on backplane lines A6-A13 must be identical to the logical address as set by address switch SP1(0-7). These eight bits allow up to 255 different VXIbus logical device addresses to be selected in a VXIbus system.

If a logical address match occurs and IACK* is true, equality detector U18 produces a low at its output which enables U17. Next, equality detector U17 compares the information on backplane lines A14, A15, AM0, AM1, and AM3-AM5 to a hardwired code of 11101101_2. Since AM2 is not examined, this hard-wired code will be a match if *all 3* of the following conditions are true:

- a hexadecimal code of either 29_{16} or $2D_{16}$ is present on AM0-AM5.
- A14 and A15 are both high (1).
- LWORD is false (1).

Either of the two address modifier hexadecimal codes indicated above will establish A16 addressing per the VXIbus Specification (Section C.2.1.1.5). In the VXIbus addressing scheme for an A16 device, A14 and A15 are always set to 1 to select the upper 16K of the 64K A16 address space (per the VXIbus Specification, Sections A.2.3.3 and C.2.1.1.1). LWORD* is false when decoding short word (16 bit) transfers.

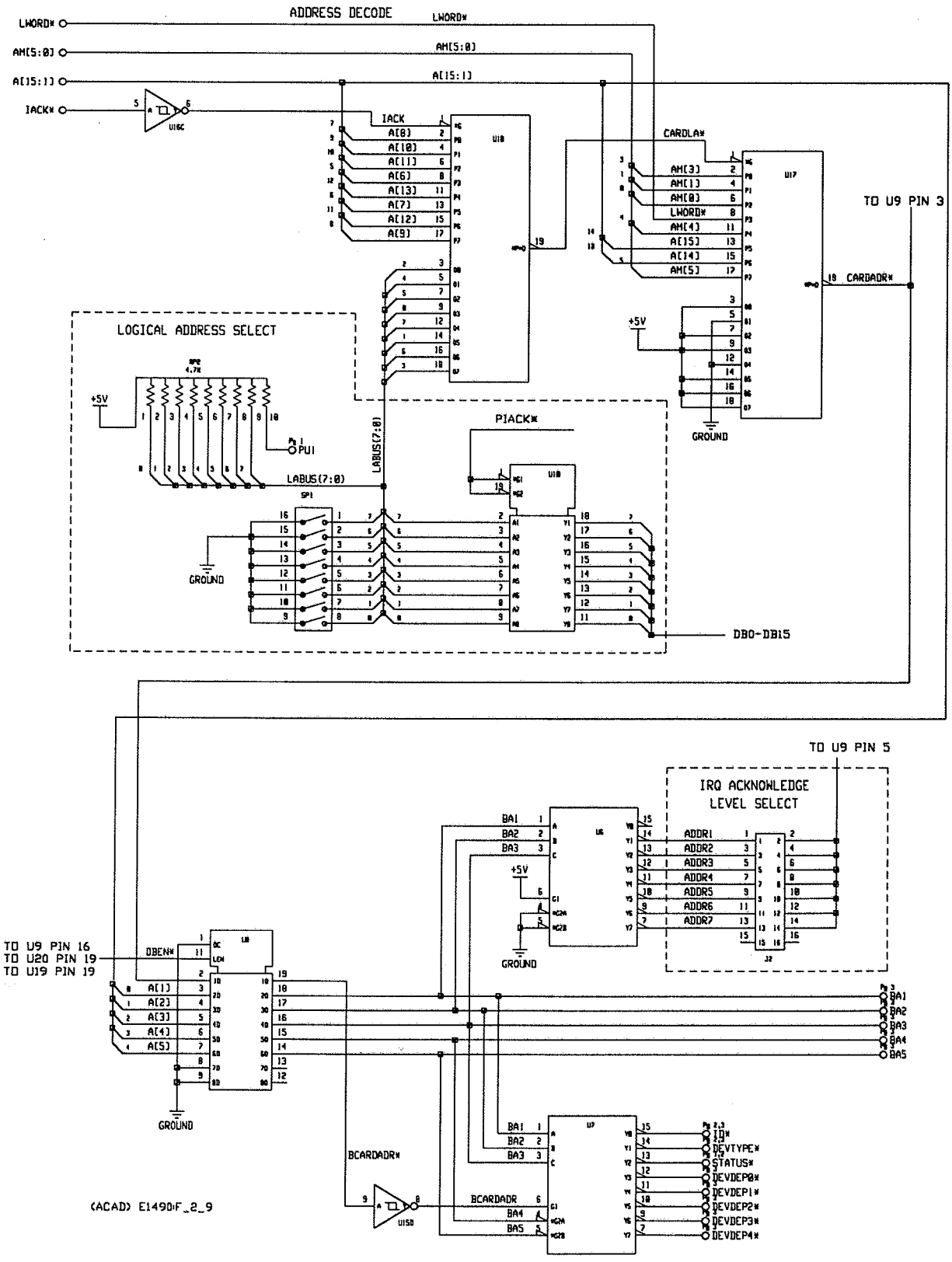


Figure 2-7. Address Lines and Register Decoding

If a second match occurs at U17, its output goes low. This triggers a data transfer cycle using the DTACK state machine in the PAL by the low at U9 input CADDR. See "DTACK, Interrupt, and Control" for more information on the DTACK state machine. As part of the data transfer cycle, U9 sets DBEN low, latching the remaining backplane address lines (A1-A5) at the U8 outputs to the two 3-to-8-line decoders (U7 and U6).

Latch U8 ensures that the address information is held valid until the data strobes go false even though the address lines may no longer be valid.

U7 is enabled if G1 is high and both G2A and G2B are low. Therefore, A4 and A5 must both be low to select a register for connection to the data bus (D0-D15). G1 will be high if there was a match at U18 (via U15D). If U7 is enabled, backplane lines A1-A3 are decoded to specify which register (Status, ID, Device Type, or Control) is to be connected to the data bus.

User-supplied circuitry can decode the entire module address space. This can provide up to 32 registers maximum. If additional decoding is necessary, A4 and A5 are accessible on the module. See Table 2-3.

Table 2-3. Register Selection

A3	A2	A1	Enable Line	Register
0	0	0	Base + 0	ID
0	0	1	Base + 2	Device Type
0	1	0	Base + 4	Status/Control
0	1	1	Base + 6	User Assignable
1	0	0	Base + 8	User Assignable
1	0	1	Base + A	User Assignable
1	1	0	Base + B	User Assignable
1	1	1	Base + C	User Assignable

Data Bus Drivers

The HP E1490B breadboard module is designed to be used as an A16 and a D16 device only. As such, only backplane address lines A1-A15 and data lines D0-D15 have been implemented on the module. VXIbus Backplane connector J1 contains 16 bidirectional data lines labeled D0 through D15. The module connects to these data lines using the circuitry shown in Figure 2-8.

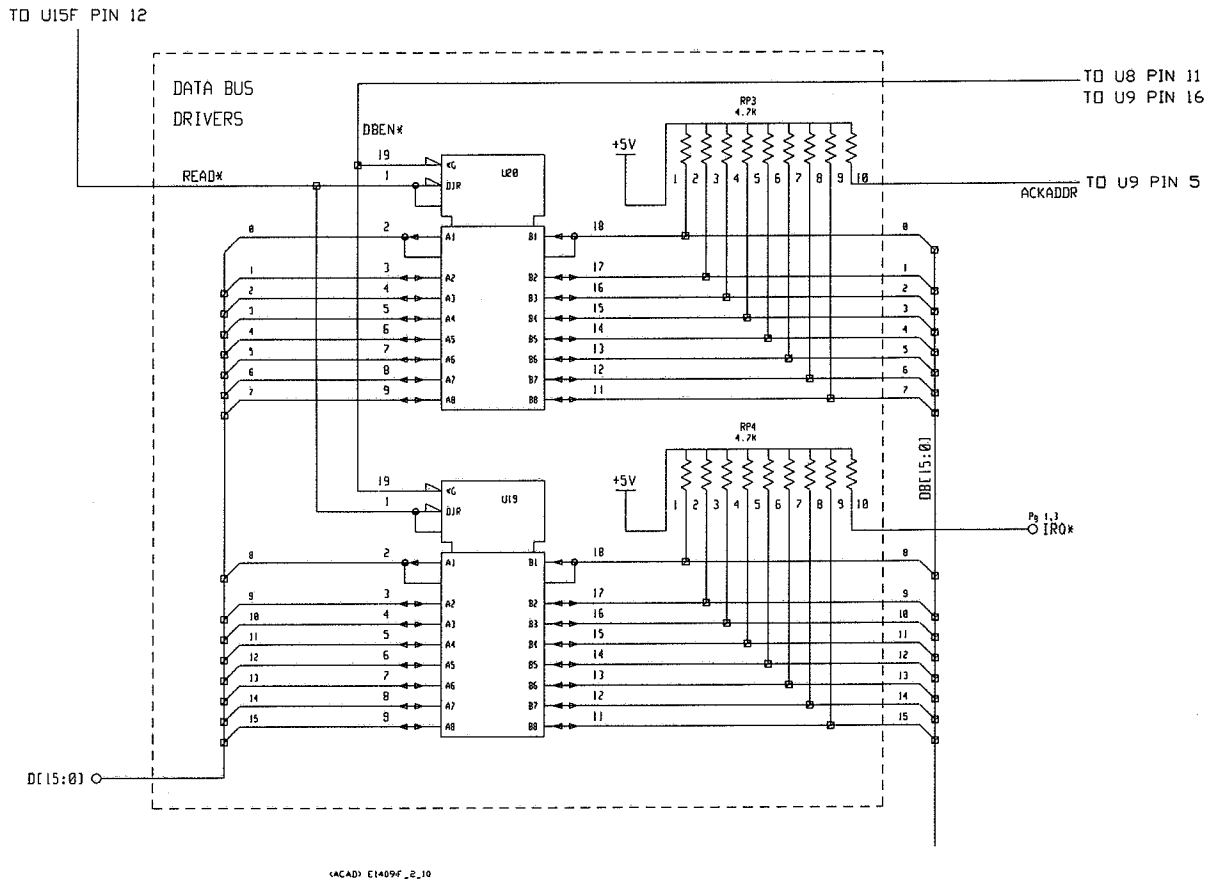


Figure 2-8. Data Bus Drivers

Data buffering is provided for the data lines by two tri-state octal bus transceivers. U20 buffers D0 through D7 and U19 buffers D8 through D15. Note that the data lines are labeled DB0 through DB15 on the module side of the buffers. U19 and U20 are enabled during a data bus transfer cycle when DBEN (Data Bus ENable) goes low. This occurs whenever the breadboard module is correctly addressed by a match of the module's logical address as set by SP1(0-7).

The direction of data transfer is determined by WRITE*. When WRITE* is true (a "write" operation), information present on backplane lines D0-D15 is transferred to the breadboard module via DB0-DB15. When WRITE* is false (a "read" operation), information present on DB0-DB15 is transferred to backplane lines D0-D15.

During a normal read operation, the information present on DB0-DB15 is selected by the Address Decode circuitry from one of three sources:

- Status Register (U24/U25)
- ID Register (U11/U12)
- Device Type Register (U14/U13)

User-supplied circuitry can decode the entire module address space, allowing for 32 registers, maximum. Refer to Table 2-3 and Figure 2-7.

Status Register

The 16 bit Status Register (Figure 2-9) provides specific status information defined by the VXIbus Specification, and has other bits available for custom (device dependent) status information implemented by the user.

Table 2-4 shows the status register bit definitions. See Chapter 3, "Using the HP E1490B" for additional information on using the status register. Refer to the VXIbus Specification, Section C.2.1.1.2, for detailed information concerning status register implementation restrictions.

The status register is enabled during a "read status register" operation by the STATUS* enable line set low (decoded from address lines A1-A3), and by READ* set low. The status information presented to the data bus line drivers (U24 and U25) must be static. The MODID line (P2, pin A30) controls bit D14 of the status register at all times.

Table 2-4. Status Register Bit Definitions

Data Bit(s)	Definitions
SR0 - SR1	Device Dependent (User Assignable)
SR2	(0 = failed/executing Selftest; 1 = passed Selftest)
SR3	Ready
SR4 - SR13	Device Dependent (User Assignable)
SR14	(0 = module selected by MODID high, 1 = not by MODID)
SR15	Device Dependent for A16 device

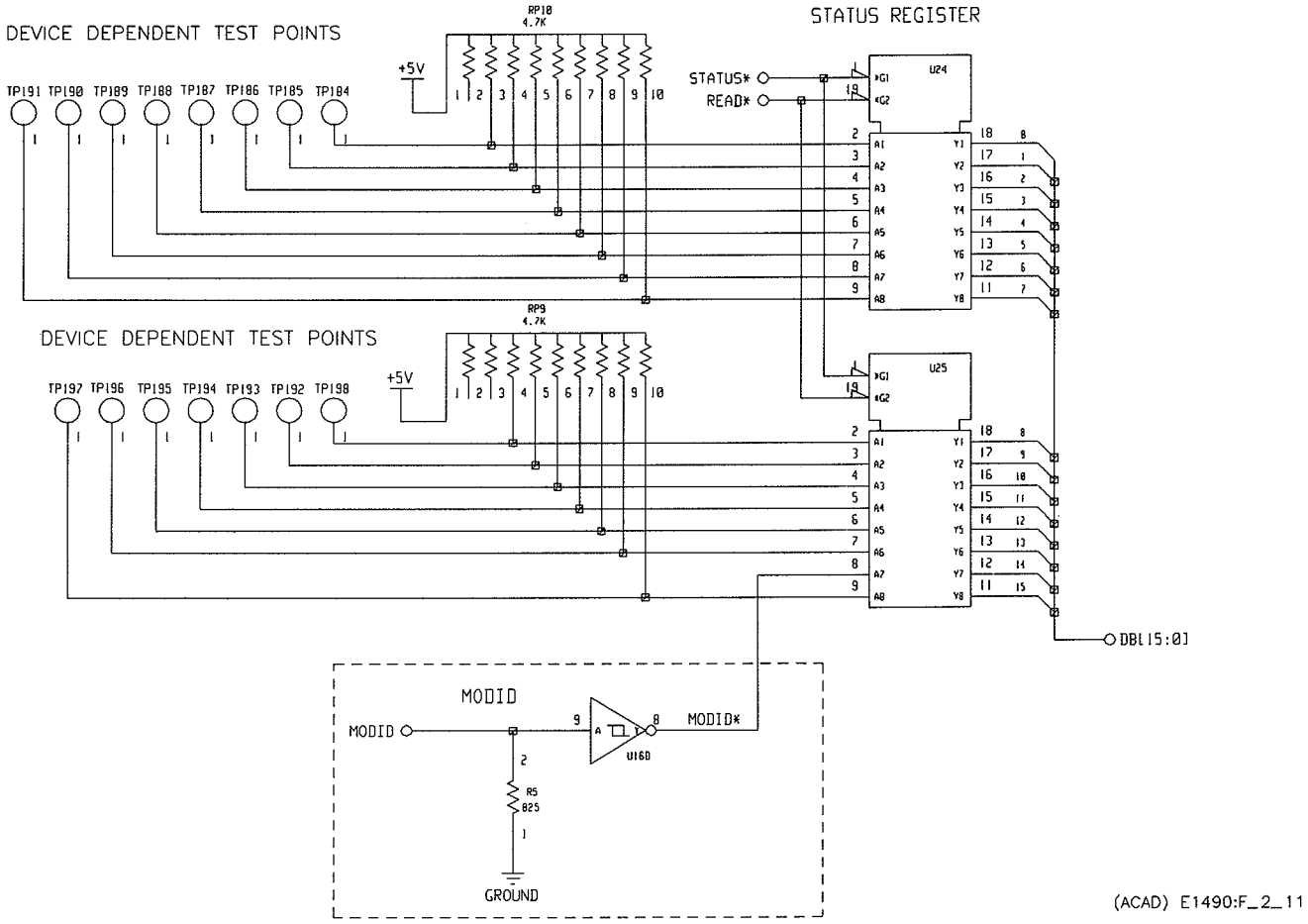


Figure 2-9. Status Register

ID Register

The ID Register is a 16-bit register which identifies the module's manufacturer, addressing mode, and classification. These identification fields are DIP switch selectable on the inputs to the data bus line drivers U11 and U12 as shown in Figure 2-10.

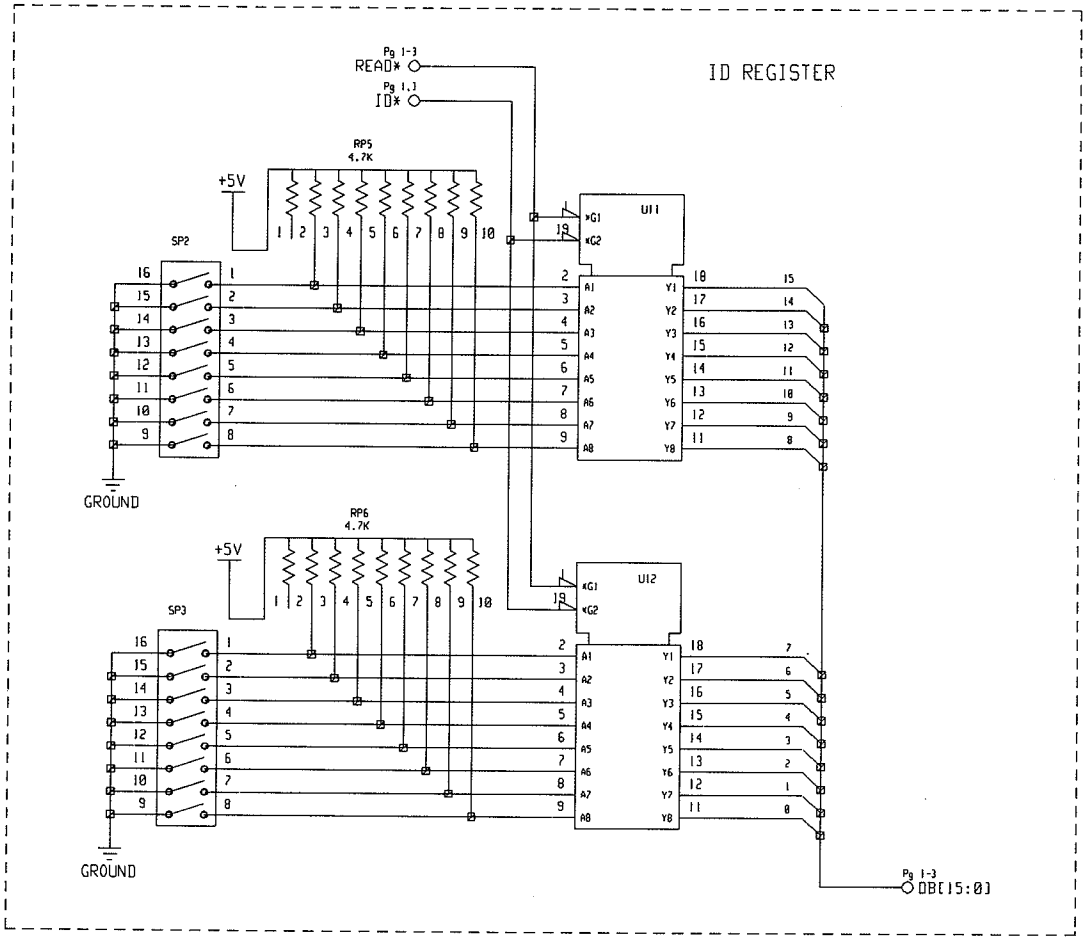


Figure 2-10. ID Register

Table 2-5 shows the ID Register bit definitions, Table 2-6 shows possible Addressing Modes, and Table 2-7 shows the Device Classes as defined in the VXIbus Specification (Section C.2.1.1.2).

Table 2-5. ID Register Bit Definitions

Data Bits	Definitions
DB0 - DB11	VXI Manufacturer ID Code (Range = 0 to 4095)
DB12 - DB13	Addressing Mode (see Table 2-8)
DB14 - DB15	VXIbus Device classification (see Table 2-9)

Each bit in the ID Register is normally pulled high (1) by RP5 and RP6. The bits can be reconfigured low by closing the appropriate switch (SP2 and SP3). If no switches are closed (that is, all bits are high or 1s), from Tables 2-6 and 2-7, the module will be defined as a register-based, A16 device and will have a Manufacturer ID code of 4095 (Hewlett-Packard).

Table 2-6. Breadboard Addressing Modes

Value	Addressing Mode
00	A16/24
01	A16/32
10	RESERVED
11	A16 Only

Table 2-7. Breadboard Device Classification

Value	Device Class
00	Memory
01	Extended
10	Message Based
11	Register Based

See Chapter 3, "Using the HP E1490B" for additional information on using the ID Register. Refer to the VXIbus Specification, Section C.2.1.1.2, for detailed information concerning ID Register implementation restrictions.

Device Type Register

The Device Type Register is a 16-bit register which contains a device-dependent "module type" identifier and a "memory required" field (for A24 and A32 devices only). These two fields are set on the module by the use of switches (SP4, SP5) on the inputs to the data bus line drivers U14 and U13, as shown in Figure 2-11.

Each bit in the Device Type Register is normally pulled high (1) by RP7 and RP8. The bits can be reconfigured by closing switches SP4 and SP5. The range of device types for an A24 or A32 device is 0 - 4095. For an A16 device, all 16 bits are available for specifying the device type for a range of 0 - 65535.

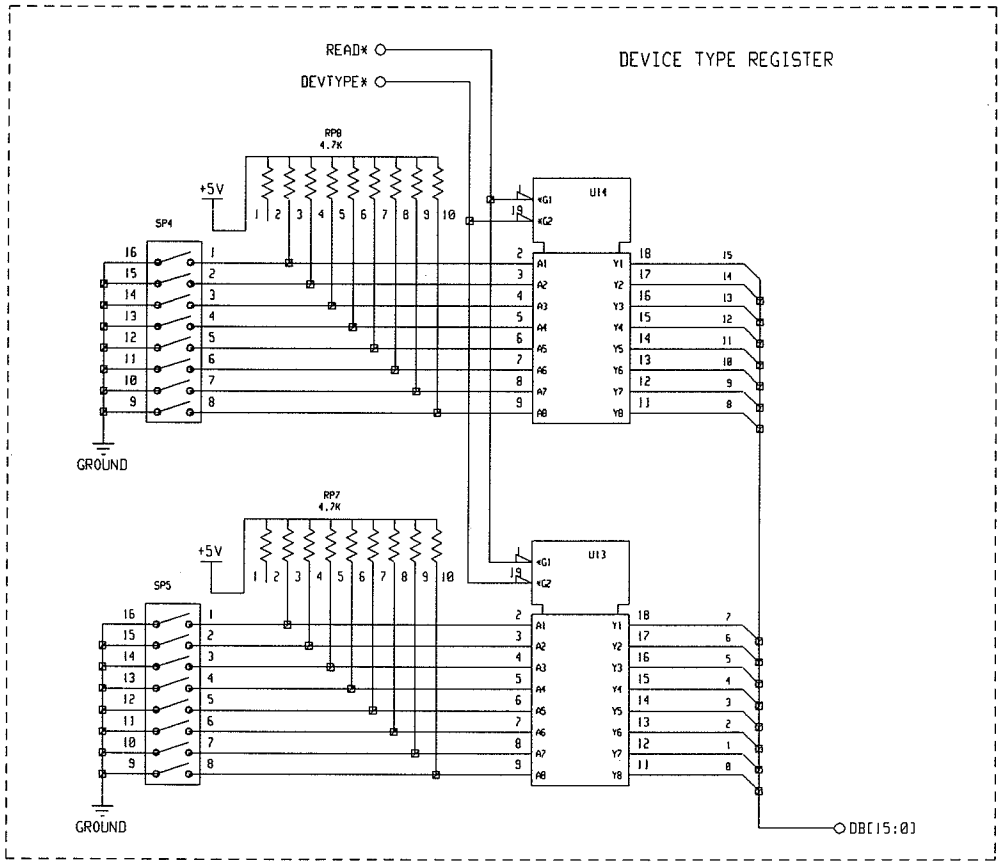


Figure 2-11. Device Type Register

Note

Per the VXIbus Specification (OBSERVATION C.2.6), module codes 0-255 are reserved for Slot 0 devices.

See Chapter 3, "Using the HP E1490B" for additional information on using the Device Type Register. Refer to the VXIbus Specification, Section C.2.1.1.2 for detailed information concerning Device Type Register implementation restrictions. Table 2-8 shows the Device Type Register bit definitions.

Table 2-8. Device Type Register Bit Definitions

Data Bit(s)	Definitions
DB0 - DB11	Device Type or Model Code (Range = 0 to 4095)
DB12 - DB15	Required Memory (A24 and A32 devices only)

Control Register

The Control Register is a 16-bit register which, when written to from the backplane data bus, causes specific actions to be executed by the breadboard module. The primary components of the Control Register are U22 and U23, as shown in Figure 2-12.

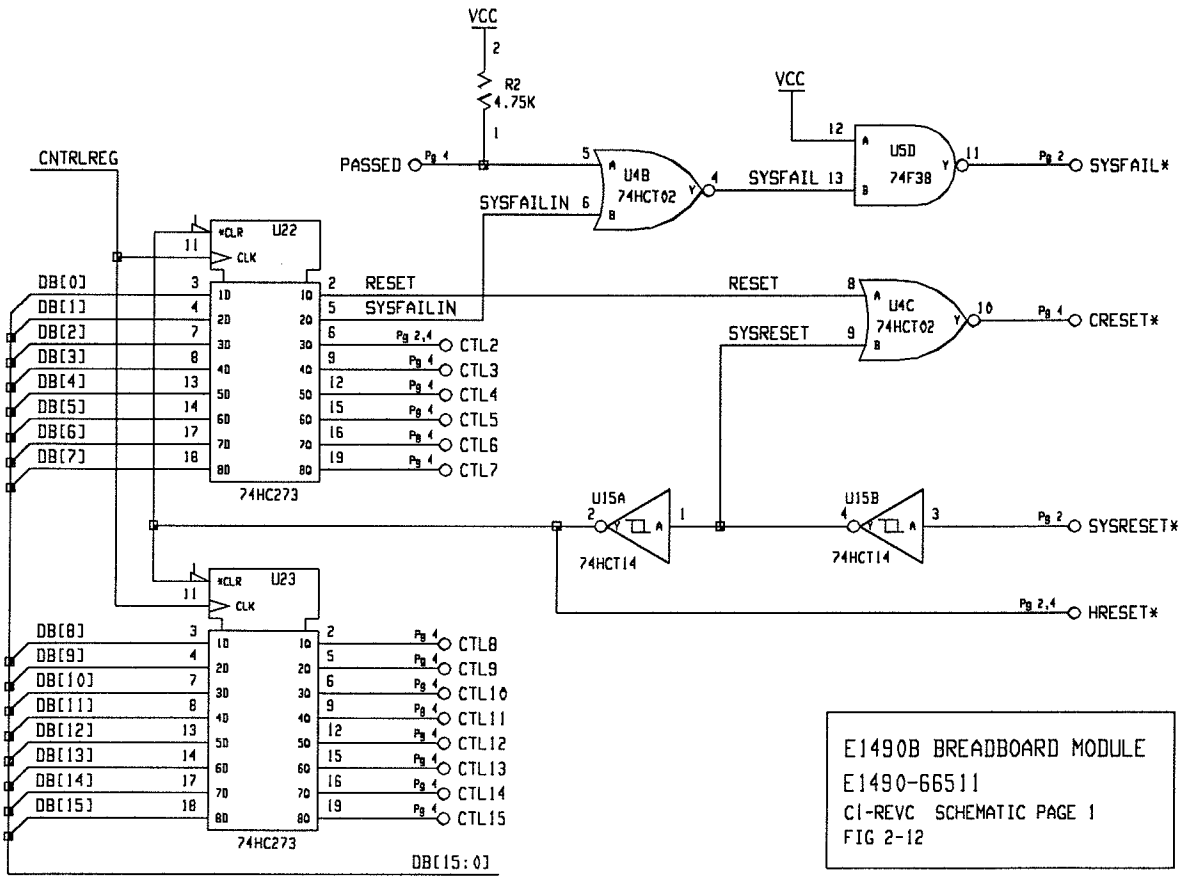


Figure 2-12 Control Register

Table 2-9 shows the Control Register bit definitions. The Control Register is selected for writing to by the BASE+ 4 enable line (see Table 2-3). STATUS* going low at the input of U4A, combined with a negative pulse (for one clock cycle of SYSCLK) from the LATCH* output of U9 (also applied to U4A), provides a positive-going edge clocking pulse to U22/U23. This pulse clocks whatever is present on DB0-DB15 through U22/U23 to the Control Register access points (CTL2-CTL15). CTL0 and CTL1 are reset and sysfail inhibit bits.

The user may connect any or all of these points to his custom circuitry, keeping in mind the pre-defined bit assignments shown in Table 2-9. Data present on DB0-DB15 would have been written there by the same DTACK state machine data transfer cycle that provided the LATCH pulse. See "DTACK" for a discussion of the DTACK state machine operation.

Table 2-9. Control Register Bit Definitions

Data Bit(s)	Definitions
CR0	(1 = Reset the module, User defines reset actions)
CR1	(1 = inhibit setting of SYSFAIL*; if Reset = 1, safe)
CR2 - CR14	Device Dependent (User Assignable)
CR15	(1 = Enable access to A24/A32 Registers; 0 = Disable)

See Chapter 3, "Using the HP E1490B" for additional information on using the Control Register. Refer to the VXIbus Specification, Section C.2.1.1.2 for detailed information concerning Control Register implementation restrictions.

DTACK, Interrupt, and Control

A programmable array logic IC (PAL) provides the timing and control signals for standard data transfer cycles and interrupt requests/acknowledgements. Hardware and software reset signals, together with a card fail signal, have also been implemented.

DTACK

The Data Transfer ACKnowledge (DTACK) circuitry is centered around the PAL (U9). A state machine in the PAL controls all read and write data transfer cycles. Operation begins with the state machine in the idle state. See Figure 2-13 for the following discussion.

In the first part of the transfer cycle, the system controller places the address of the breadboard module on the backplane address lines A1-A15 and address modifier lines AM0-AM5, and then sets the appropriate data stobe lines true (DS0* and DS1* for a D16 device). When the address equality detectors (U17, U18) detect the address match, the output of U17 goes low.

This low is felt at the Card ADDRess (CADDR) input to U9 which, together with the active data strobes, tells the DTACK state machine in the PAL that the module has been addressed for a data transfer cycle. This starts the state machine, with all signals being clocked by SYSCLK (16 MHz).

In the first active state, the data bus drivers (U19,U20) are enabled and the register-specifier part of the address (A1-A5) is latched onto the outputs of U8 using the Data Bus ENable (DBEN) output of U9. If the data transfer cycle is a *read* operation (as indicated by WRITE* false), the decoded output of U7 (enabled by the output of equality detector U17) determines which one of the registers (Status, ID, or Device Type) is enabled to put its contents onto the module's internal data bus (DB0-DB15).

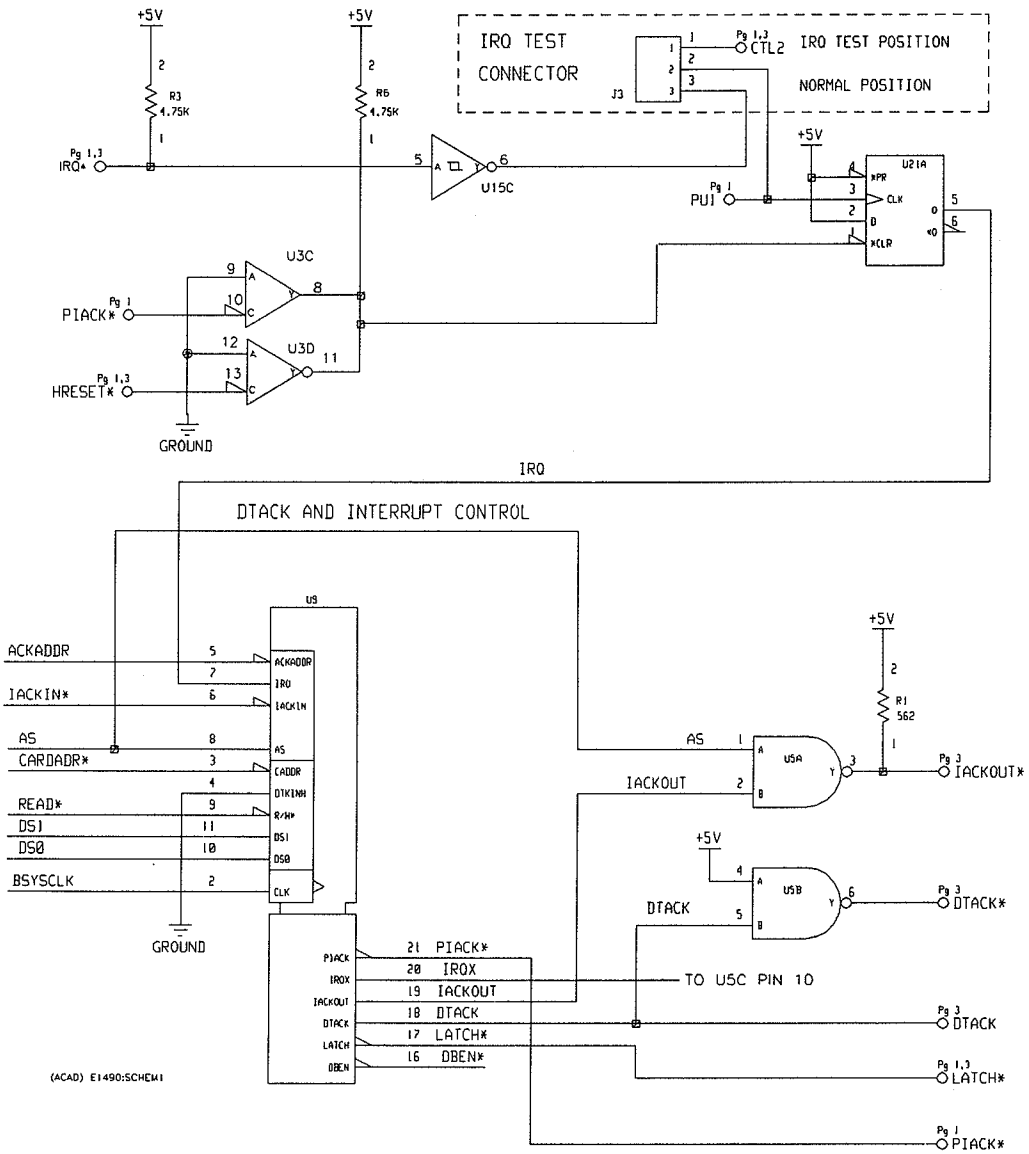


Figure 2-13. DTACK Circuitry

The next state then generates a high at the DTACK output of U9. This forces DTACK* true on the backplane through U5B, acknowledging to the system controller that the module has received the request for data and has placed the contents of the specified register onto the data lines. With U19, U20 enabled, internal data lines DB0-DB15 are connected directly to the backplane data lines D0-D15.

If the data transfer cycle is a *write* operation (as indicated by WRITE* true), an additional state sets the U9 LATCH output low (enabling the Control Register to receive data from the data bus drivers for example) *before* DTACK* is set true. The resulting Control Register outputs (CTL2-CTL15) can then control the user's circuits, as desired.

Again, DTACK* going true tells the system controller that the data transfer cycle is complete. In a write operation, WRITE* going true disables the Status Register, the ID Register, and the Device Type Register.

For both read and write operations, the DTACK state machine holds DTACK* true and the address latched until the data strobes are invalid. After the data strobes go invalid, the data bus drivers are disabled and the address latch is released. In the next state, DTACK* is released and the state machine returns to the idle state. If the DTACK INHibit signal (DTKINH) is set high (hard-wired low on the HP E1490B implementation), the user can hold the state machine in the first state of latched address and enabled data bus drivers.

Interrupt

A priority interrupt scheme has been implemented using the PAL (U9). Another state machine within the PAL controls interrupt request and acknowledge operations. See Figure 2-14 for the following discussion.

The VMEbus interrupt request levels IRQ1*-IRQ7* are jumper-selectable (only one at a time allowed) for both the IRQ REQUEST output line and the IRQ ACKNOWLEDGE input line. The IRQ REQUEST and ACKNOWLEDGE levels must always be the same level (IRQ1* is shown as selected in Figure 2-14). As implemented, to generate an interrupt request to the interrupt handler, the user's custom circuits must provide a low going signal at the IRQ* access point. This latches the IRQ signal. The output of the Latch, U15, drives the IRQ input on PAL U9, starting the IRQ state machine in the PAL.

The IRQ state machine monitors the following interrupt-related lines to determine its actions: IACK*, valid DS0*, IACKIN*, AS*, ACKADDR*. If the module is asserting IRQ and the interrupt-related lines are in the proper state, the IRQ state machine asserts IRQX true on U9.

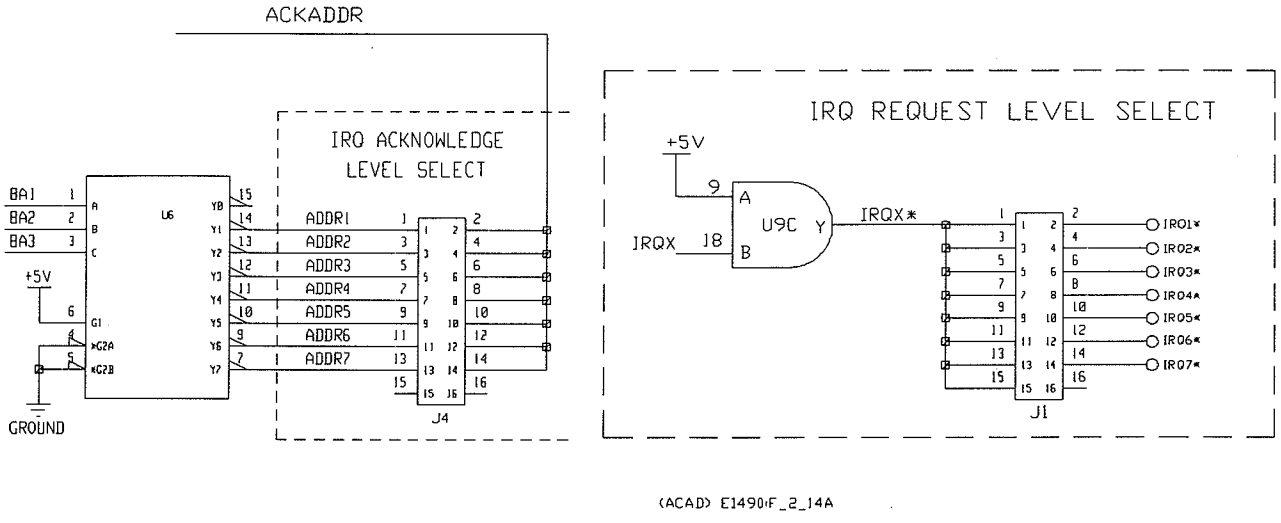


Figure 2-14. Interrupt Circuitry

IRQX true pulls the jumper-selected IRQ1* line true on the backplane. The state machine then waits for the interrupt handler to recognize the interrupt request. When the interrupt handler responds, it places the code for the interrupt request priority level that it is acknowledging onto lines A1-A3. It then sets IACK* true which sets IACKIN* true.

IACK* true starts the interrupt acknowledge cycle, disabling normal address decoding on the breadboard module. When IACKIN* goes true, the IRQ state machine sets DBEN true to latch A1-A3 into U6. Then it checks to see if its own IRQ level has been acknowledged (input line ACKADDR at U9 will be set low by a correct match of U6's decoded output and the jumper selection for IRQ ACKNOWLEDGE).

If its own level is not being acknowledged, or if the module is not asserting IRQ, the state machine passes the daisy-chained IACKIN* signal through IACKOUT on U9. The IACKOUT signal is gated with an inverted AS* to meet release time requirements for IACKOUT* as outlined in the VMEbus Specification. If the acknowledge level matches the request level, the IRQ state machine sets PIACK* true, releases IRQX (and IRQ1*) and starts the DTACK state machine for a read cycle. PIACK* going true also clears the IRQ latch, U15. The interrupt handler initiates the read cycle to get the logical device address from the interrupter when it sees IRQ1* go false. PIACK* true enables U10 to place the module's logical address (from SP1) onto the lower eight bits of the internal data bus (DB0-DB7).

The logical address is then transferred to backplane lines D0-D7 during the read data transfer cycle. In this way, the interrupt handler knows which device is asserting IRQ if more than one device has the same interrupt priority assigned to it.

Control

Table 2-10 shows the control signals which are implemented (see Appendix B):

Table 2-10. Control Signals

Signal	Definition
AS*	Address Strobe, used in the IRQ data transfer cycles.
DS0*, DS1*	Data Strobes, used in the data transfer cycles.
SYSCLK	Provides 16MHz clock signals to the PAL (U1) for clocking the state machines.
SYSFAIL*	The module can assert this line to the backplane by setting bit SR2 low in the status register. If the SYSFAIL INHBT line output of the Control Register (Bit 1) is also low (not inhibited), then SYSFAIL* is asserted.
SYSRESET*	System reset signal used to initialize the backplane interface circuitry (and your own custom circuits) to a known state. Provides a hardware reset capability. As implemented (HRESET*), it clears the Status Register and the Control Register. It also asserts the software reset line (access point CRESET* on the module). CRESET* can also be asserted via software by writing a high signal to the Control Register (Bit 0), providing an input to U2C.

ECL Trigger Logic

Figure 2-15 shows the ECL Trigger Circuitry. The ECLTRG lines provide an intermodule timing resource. Any module, including the Slot 0 module, may drive or receive information from these lines. The asserted state is defined as logical high. Trigger information from the VXI backplane (ECLTRG0 and ECLTRG1) pass through U1 to ECLTRGOUT0* and ECLTRGOUT1* for custom use. Trigger inputs from user custom circuitry must provide ECL level signals (TTL is not compatible) to ECLTRGIN0 and ECLTRGIN1.

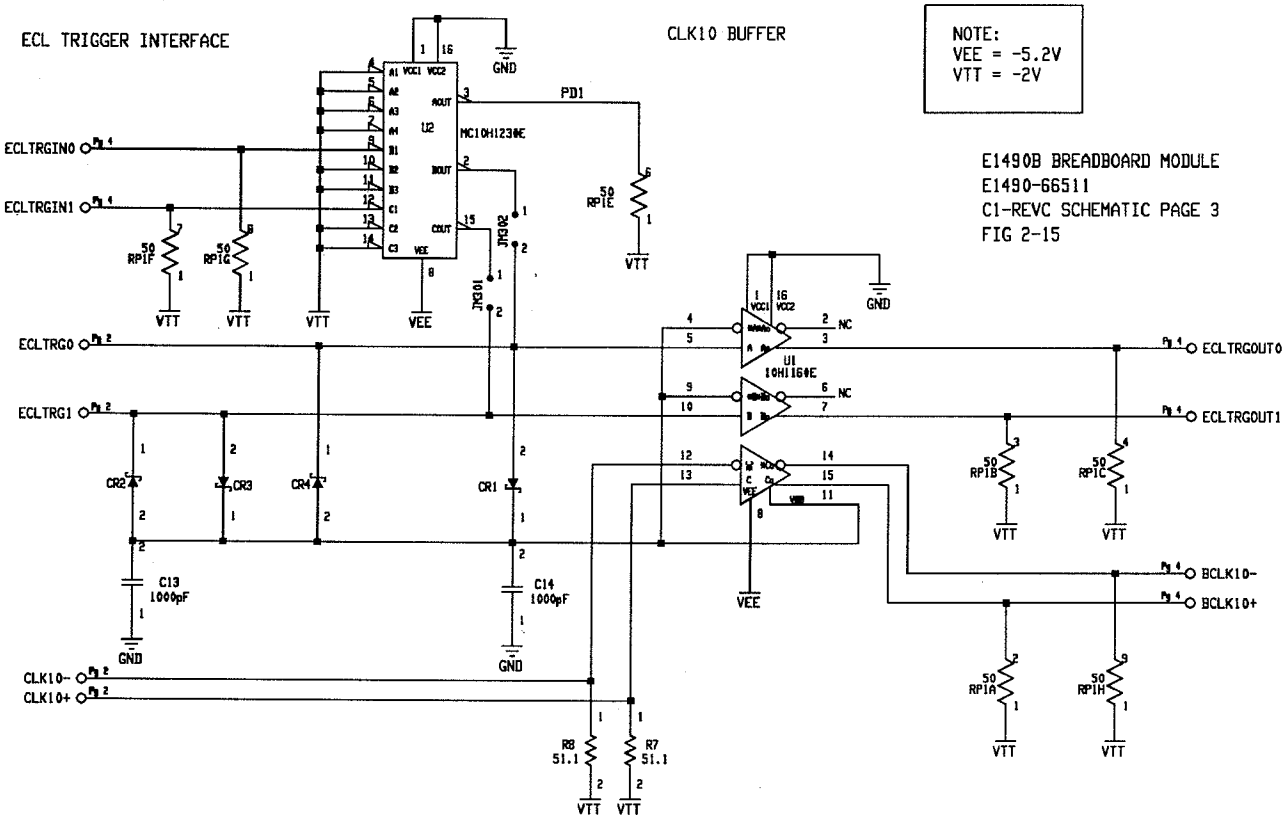


Figure 2-15. ECL Trigger Circuit

User Access Points

The breadboard module contains traces (stubs) for accessing many of the signal lines on backplane connectors P1 and P2. Table 2-11 shows the signal lines that are brought onto the module but not implemented. They are available as signal access points for your custom circuits.

Table 2-11. User Access Points (Stubs)

Signal Lines	Description
ACFAIL*	AC Input Power Fail
LBUSA0-11	Daisy-chained Local Bus A
LBUSC0-11	Daisy-chained Local Bus C
SERCLK	Synchronizes data transmission on the VMEbus
SERDAT*	Used for VMEbus data transmission
SUMBUS	Analog Summing Node
TTLTRG 0*-7*	Intermodule Communication Lines (TTL Level)
+ 5VSTDBY	When implemented in the VXI mainframe, supplies + 5 Vdc to devices needing battery backup.

Table 2-12 shows all of the implemented signal lines available as access points, either as inputs from the backplane to your own custom circuitry, or as outputs to the backplane from your custom circuits.

Table 2-12. User Access Points (Implemented Signals)

Signal Lines	Description
BA1 - BA5	Buffered Backplane Address Lines A1 - A5
ID*	ID Register Enable Line
DEVTYPE*	Device Type Register Enable Line
STATUS*	Status and Control Registers Enable Line
REG0*	User-assignable Enable Line
REG1*	User-assignable Enable Line
REG2*	User-assignable Enable Line
REG3*	User-assignable Enable Line
REG4*	User-assignable Enable Line
CRESET*	Card Reset, software (CTL0) or hardware (SYSRESET*)
CTL2 - CTL15	Control Register Output Lines
DB0 - DB15	Breadboard Module Internal Data Bus Lines
DTACK	Data Transfer Acknowledge (DTACK high = DTACK* low)
HRESET*	Hardware Reset (from SYSRESET*)
IRQ*	Interrupt Request Line - User Implemented
LATCH*	Latches DB0 - DB15 onto user circuitry
PIACK*	Peripheral Interrupt Acknowledge Line
SR0, SR1	Status Register (user assignable)
SR2	Status Register, Passed (defined by VXIbus Spec.)
SR3	Status Register, Ready (defined by VXIbus Spec.)
SR4 - SR14	Status Register (user assignable)
BCLK10 + , BCLK10–	Buffered CLK10+ /–, ECL level, 10MHz clock
READ*	Enables User Data onto BD0 - DB15

Power Supplies

Table 2-13 lists the power supply pins available from the P1 and P2 connectors. The + 5 and –5.2 Vdc interface supplies are fused and filtered (–2 Vdc is used but not fused). You should fuse and filter all other power supplies used.

Table 2-13. Power Supply Voltages and Pin Numbers

Voltage	P1 Connector Pin Numbers		Voltage	P2 Connector Pin Numbers
+ 5Vdc	A32, B32, C32		–5.2Vdc	A7, A13, A19, C4, C19
+ 5Vstdby	B31		+ 24Vdc	C31
+ 12 Vdc	C31		–24Vdc	C32
–12Vdc	A31		–2Vdc	A2, C13

All ground pins connect together; no ground loops are present in the module. The shields are not grounded but access points are provided at the standoffs to connect the shields. The front panel connects to the shields.

Unconnected heavy traces are provided at the circuit board edges for bussing power supplies and ground to custom circuitry.

Custom Circuitry Application Example

This section contains an example which shows one way you can install custom circuitry on the HP E1490B breadboard module. The example shows a 16 channel general purpose relay application. See Figure 2-16 and Appendix B for the following discussion.

Relay Selection

For this sample application, Form C general purpose relays are used that have SET and RESET modes of operation. Writing a "1" to a particular relay driver (U105 or U106) SETs the relay and writing a "0" to the driver RESETs the relay. The system controller specifies which relays are SET and which are RESET by writing an entire 16 bit word of 1s and 0s to the module to identify the desired state of *all* the relays.

The state of all relays must be specified simultaneously. To change just one relay, it is necessary to change the one bit that corresponds to that relay in the stored configuration pattern and send the entire pattern again.

The system controller places the 16 bit "relay configuration" word onto the backplane data bus (D0-D15) and transfers it to the breadboard module during a normal *write* data transfer cycle (as described earlier under "Data Bus Drivers"). The data is passed to the module's internal data bus (DB0-DB15) when the module is correctly addressed. In this application, DB0-DB15 are connected to two drivers (U105,U106) which are clocked by the BASE+ 8 (low) enable line address selection.

Since this is a *write* operation, LATCH* goes true for one clock cycle as part of the data transfer cycle. With both BASE+ 8 and LATCH* set low, the output of U101A briefly goes high, clocking the relay selection bit pattern onto the outputs of U105 and U106, which are not yet enabled. The outputs of U105-U108 are enabled by the following path. The output of U101A is also applied through U101B to U103A, a monostable multivibrator. When LATCH* returns to its normally high state after one clock cycle, U101A output goes low and the U101B output goes high, triggering U103A. U103A produces a low-going output pulse at pin 4 (Q*) that enables the outputs of U105-U108.

The relay configuration bit pattern is then applied through U109 and U110 to the relay SET lines. U109 and U110 invert the bit pattern and provide current sinks for the selected SET relay coils. A "1" at the output of U105/U106 energizes a SET relay coil while a "0" is ignored. The outputs of U105 and U106 are also applied to U107 and U108 which place the inverse of the relay selection bit pattern on the RESET lines of the relays through U111 and U112. U111 and U112 provide current sinks for the RESET relay coils. Since the inverse state is applied to U111 and U112, those relays not SET are RESET.

Notifying the Controller

For this application, only one bit is needed for the Status Register. The pin 13 (Q) output of U103A is connected directly to the SR7 bit line on TP191. This bit is normally always kept low and is used as the module "busy" bit when set high.

When U103A produces its low-going output pulse at pin 4 (Q*), it also produces a high-going output pulse at pin 13 (Q). The duration of these two pulses is controlled by the values of C101 and R101, which for this application is about 11 ms (slightly longer than the settling time of the relays).

The Q pulse sets the "busy" bit high in the status register while the relays are settling. If the system controller polls the module while the relays are still settling (to see if the relays are configured yet), it will see the "busy" indication and can do something else while it is waiting for the relays to settle.

If the user wants the module to notify the interrupt handler when the relays are settled, note that the trailing edge of the Q* output pulse from U103 will also clock U104. This produces a high at IRQ. When the PAL (U1) senses the high at IRQ, it starts the IRQ state machine, notifying the interrupt handler via IRQ1* on the backplane that (in this case) the relays are settled out.

The system controller can then either poll the status register to check the "busy" bit, or it can assume the bit is cleared and proceed. To reset U104 and remove the high on IRQ, the system controller must drive CRESET* true while PIACK* is true as part of the interrupt acknowledge cycle. U102C and U102D accomplish the reset.

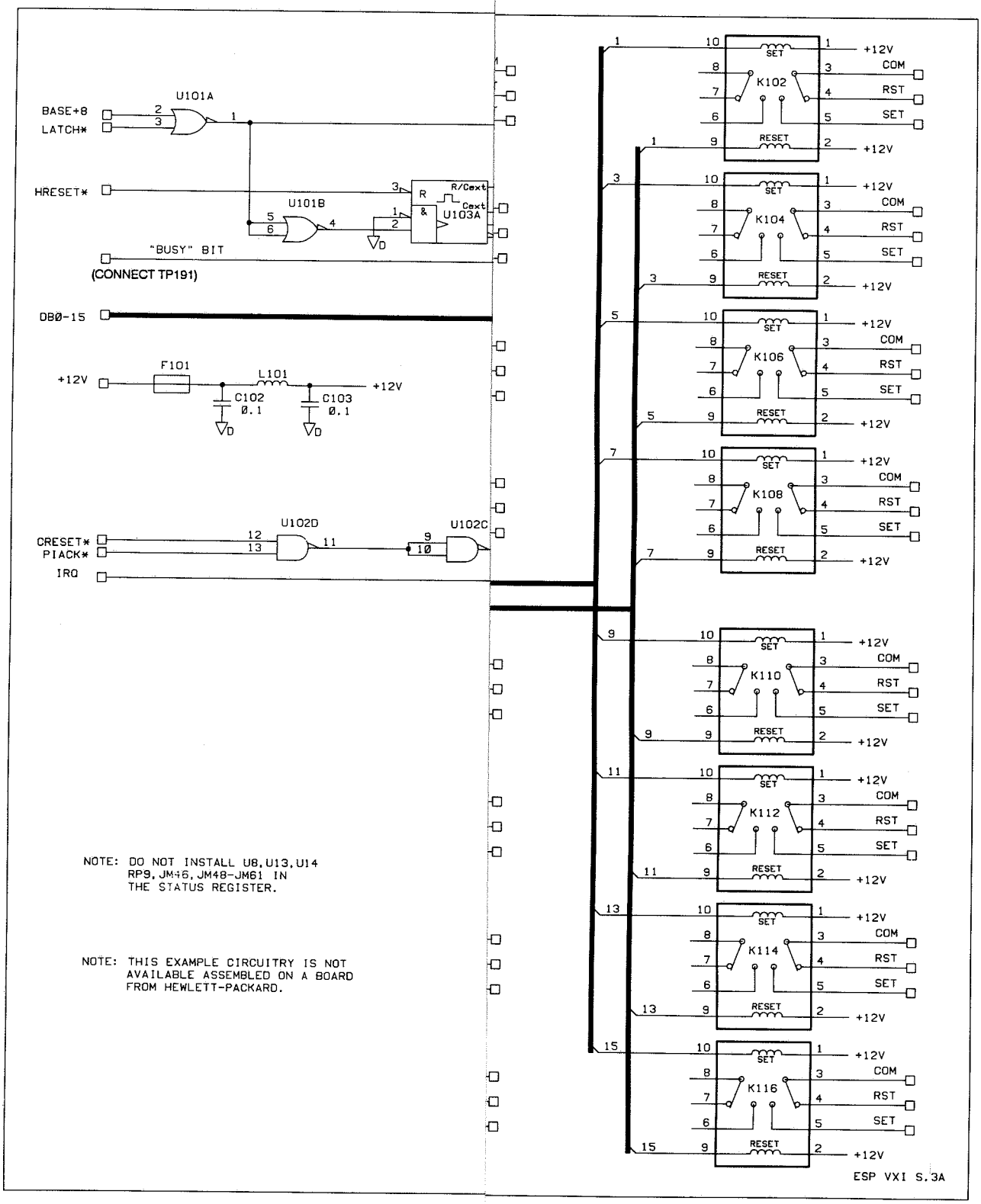


Figure 2-16. 16 Channel Relay Application
Configuring the HP E1490B 2-32

3

Using the HP E1490B

This chapter shows how to use the backplane interface circuitry on the HP E1490B Breadboard Module. This chapter includes:

- Reading Data From Registers
- Writing Data to Registers
- Using Interrupts
- Resetting the Module
- Detecting Errors
- Using Other Power Supplies

Reading Data From Registers

The breadboard module contains circuitry for three readable registers, as defined by the VXIbus Specification:

- Status Register
- ID Register
- Device Type Register

Status Register Bit Definitions

Table 3-1 shows the status register bit definitions. It will be used as an example of how to read from a register on the breadboard module. As shown in Table 3-1, only four of the sixteen bits in the register are predefined by the VXIbus Specification. The other twelve bits are "device dependent". That is, they can represent any condition that you define.

The inputs to the status register are provided by the user from the custom circuitry on the module. Access points (STATUS 0 - 15 on the component side of the module and TP184-TP198 on the trace side) are provided on the module to tie into the status register, as shown in Figure 3-1.

Table 3-1. Status Register Bit Definitions

Data Bit(s)	Definitions
SR0 - SR1	Device Dependent (User Assignable)
SR2	(0= failed/Executing Selftest; 1= Passed Selftest).
SR3	Ready
SR4 - SR13	Device Dependent (User Assignable)
SR14	(0 = module selected by MODID high; 1 = not by MODID).
SR15	Device Dependent for A16 devices

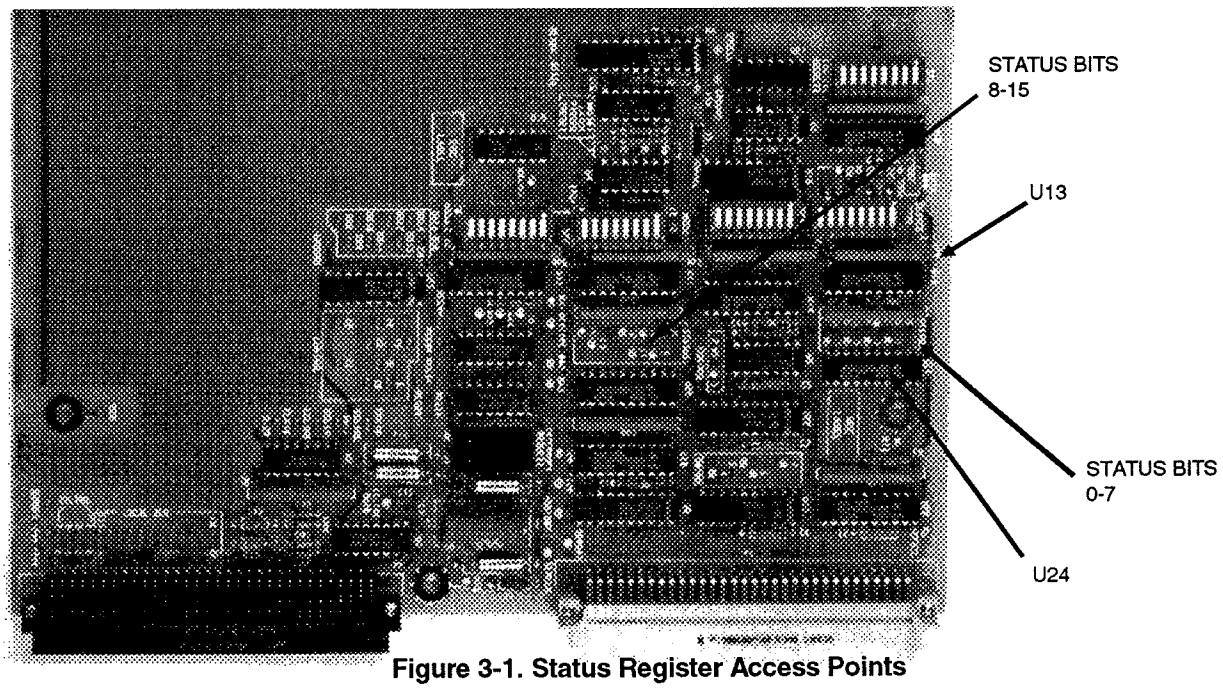


Figure 3-1. Status Register Access Points

Reading the Status Register

For example, assume you need to use up to 16 bits of the status register, including latching the data in both halves of the register. To latch your status data and then read the 16-bit contents of the status register onto the backplane, you must implement the following signal and control lines:

1. Address the module correctly by placing the data shown in Table 3-2 on the backplane address lines:
2. This is a *read* operation, so READ* must remain false (1) to provide the second half of the U24/U25 enable function (WRITE*).
3. Set IACK* false (1) to enable address equality detector U18.
4. Set both data strobes DS0* and DS1* true (0) to indicate a 16 bit data transfer.

Table 3-2. Backplane Address Lines - Status Register

Line(s)	Data Required
Lines A1 - A3	Must be set low/high/low (010) to select the BASE+ 4 enable line. BASE+ 4 provides one half of the enable function for line drivers U7/U8 (See Table 2-2)
Lines A4, A5	Must both be low (0) to enable 3-to-8 line decoder U21.
Lines A6 - A13	Must equal the logical address of the module as set on DIP switch SP1.
Lines A14, A15	Must always be set high (1) to access the upper 16K of address space.
Lines AM0 - AM5	Must be set to either hexadecimal 29 (10 1001) or hexadecimal 2D (10 1101). Refer to the VMEbus Specification (Table 2-3) and the VXIbus Specification (Rule C.2.10).
Line LWORD*	Must always be set false (1) since this is a D16 device (short word transfer = 16 bits).

Figure 3-2 shows timing required for the PAL (U9) control and signal lines.

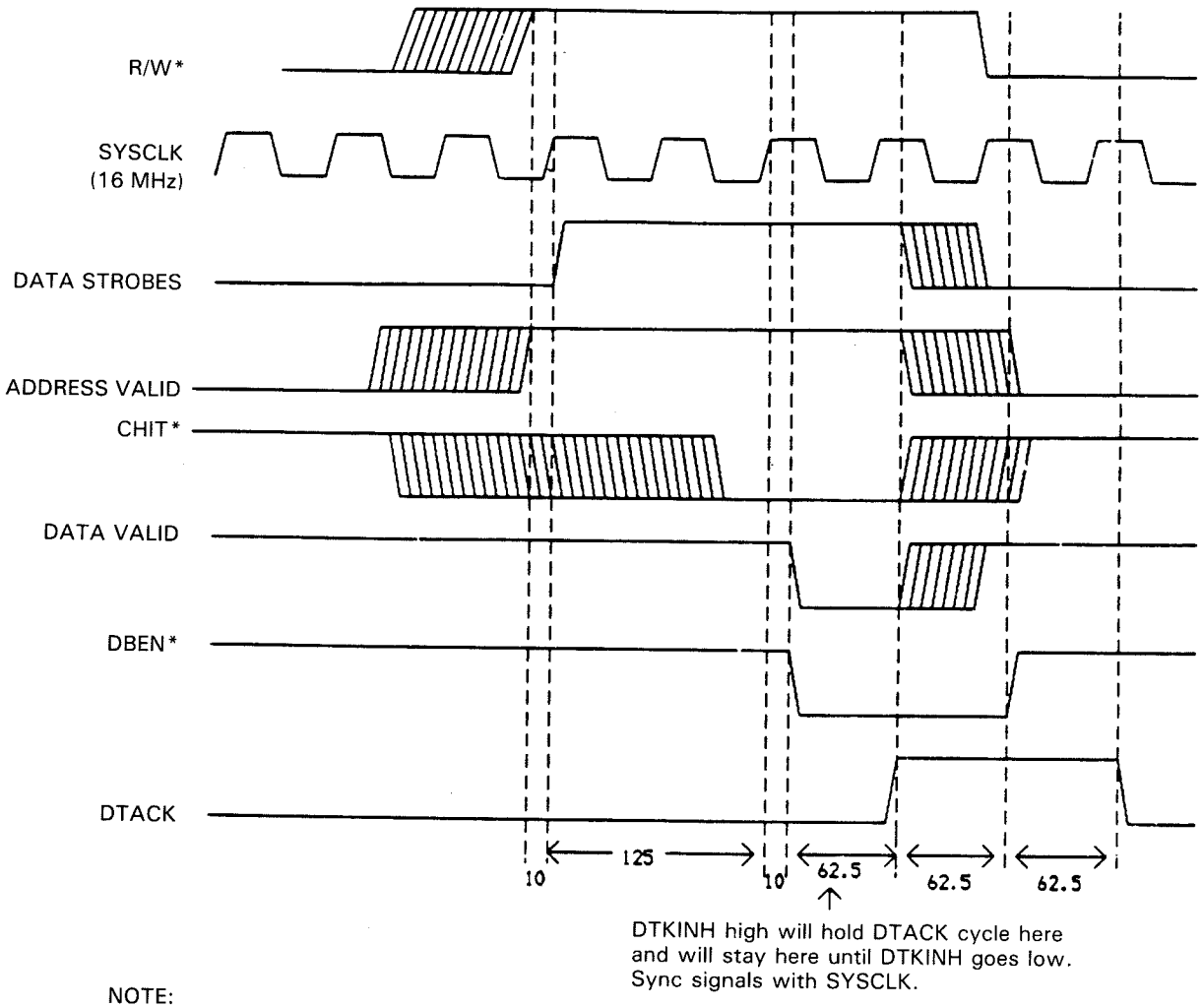


Figure 3-2. Timing for Reading the Status Register

Reading ID and Device Type Registers

The procedure to read the ID and Device Type Registers is the same as that for the Status Register with two exceptions: (1) the contents of these two registers are set by switches; and (2) the address enable line used is different (see Table 2-1 in Chapter 2).

Writing Data to Control Register

The breadboard module contains circuitry for a Control Register. You can write to this register from the backplane over data lines D0-D15. The data is passed to the internal data bus DB0-DB15 and then clocked into the control register for use by the custom circuitry on the breadboard at access points CTL2-CTL15. Don't tie anything here that can't tolerate having a "1" written to it with software reset or don't use software reset. See page 3-9.

Control Register Bit Definitions

Table 3-3 shows the definitions preassigned to control register data bits per the VXIbus Specification (Section C.2.1.1.2).

You may connect any of the control register outputs to your custom circuitry using the control register access points (CR2-CR15) shown in Figure 3-3.

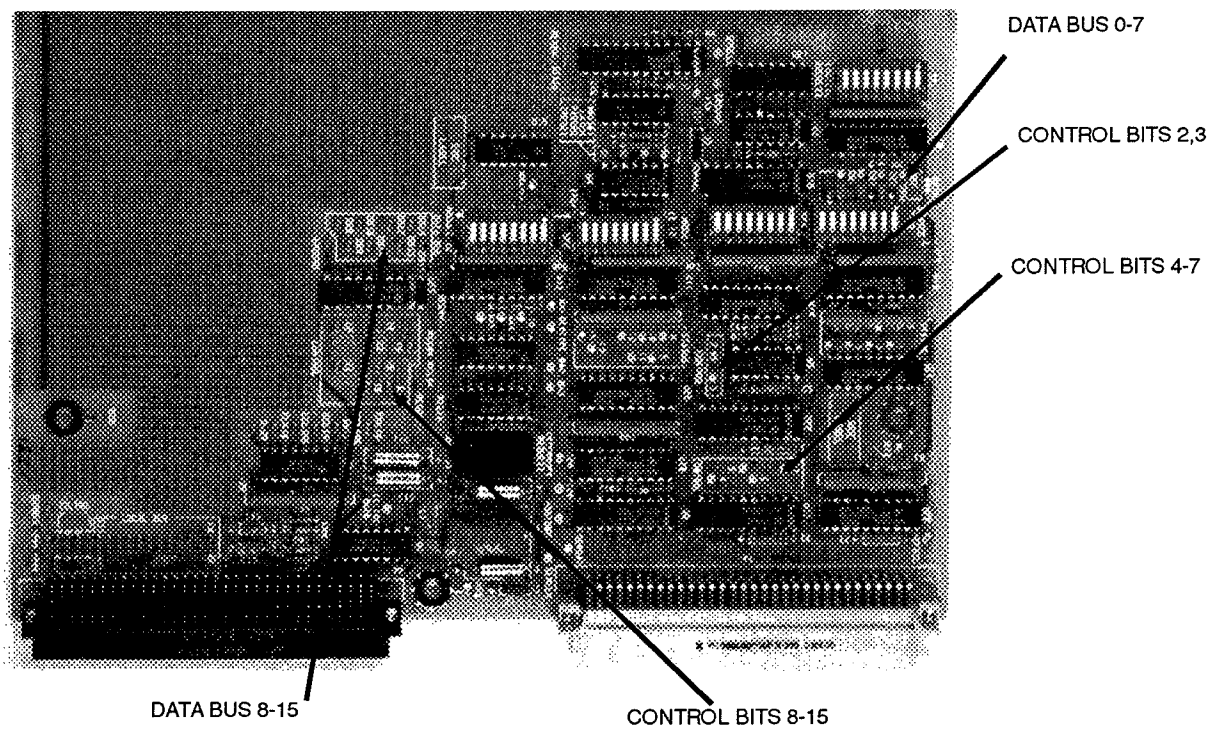


Figure 3-3. Control Register Access Points

Table 3-3. Control Register Bit Definitions

Data Bit(s)	Definitions
CR0	(1= Reset the module; User defines reset actions)
CR1	(1= Inhibit setting of SYSFAIL* Reset= 1, safe)
CR2 - CR14	Device Dependent (User Assignable)
CR15	(1= Enable access to A24/A32 Registers; 0= Disable)

Writing to Control Register

To write to the control register from the backplane data lines, you must implement the following signal and control lines:

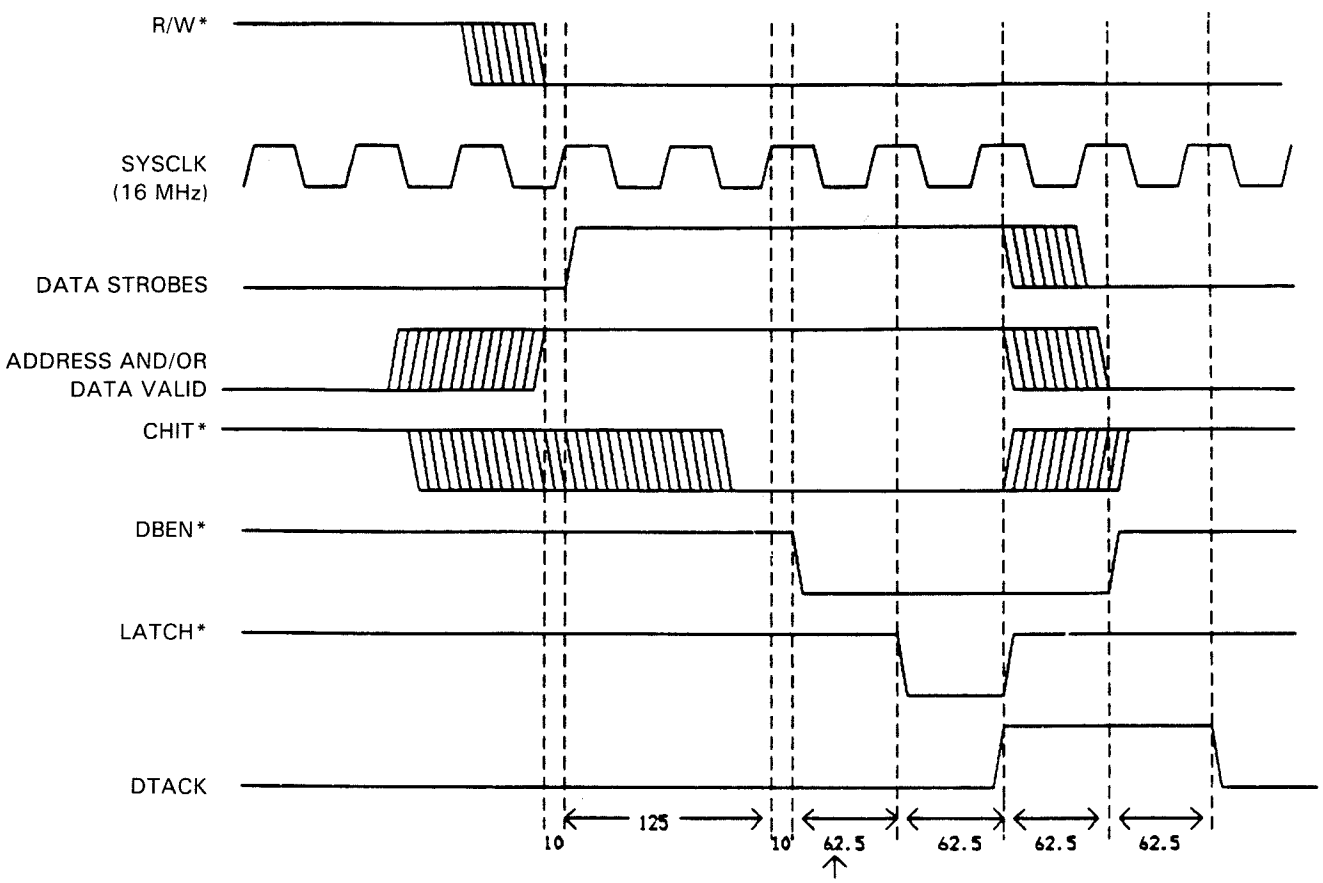
1. Address the module correctly by placing the data shown in Table 3-4 on the backplane address lines:

Table 3-4. Backplane Address Lines - Control Register

Lines	Data Required
Lines A1-A3	Must be set low/high/low (010) to select the BASE+ 4 enable line. BASE+ 4 set low provides an enable function at U2B for control register drivers U15/U16 to be clocked by the LATCH pulse (See Table 2-2).
Lines A4, A5	Must both be low (0) to enable the 3-to-8 line decoder U21.
Lines A6-A13	Must equal the logical address of the module as set on DIP switch SW1.
Lines A14, A15	Must always be set high (1) to access the upper 16K of address space.
Lines AM0-AM5	Must be set to either hexadecimal 29 (10 1001) or hexadecimal 2D (10 1101). Refer to the VMEbus Specification (Table 2-3) and the VXIbus Specificalion (Rule C.2.10).
Line LWORD*	Must always be set false (1) since this is a D16 device (short word transfer = 16 bits).

2. This is a *write* operation, so WRITE* must go true (0) to provide the LATCH signal from the DTACK state machine in U9. LATCH is a one clock-cycle negative-going pulse that is applied to the other input to U2B. With both inputs to U4A set low, the output is a positive-going pulse that clocks the control data from DB0-DB15 through U22/U23 to access points CTL2-CTL15.
3. Set IACK* false (1) to enable address equality detector U18.
4. Set data strobes DS0* and DS1* true (0) to indicate a 16 bit data transfer.

Figure 3-4 shows timing required for the PAL (U9) control and signal lines.



NOTE:
'Data Strobes' means DS0 x DS1
when going high and DS0 + DS1
when going low.

Figure 3-4. Timing for Writing to the Control Register

Using Interrupts

The breadboard module can be configured to generate an interrupt to the interrupt handler when service is required.

Configuring for Interrupts

To configure the module to generate interrupts, you must first assign an interrupt priority level to the module. Levels 1-7 are available, with level 7 being the highest level. Jumper J1 selects the Interrupt Request level (interrupt generated on the E1490B Breadboard) and Jumper J4 selects the interrupt Acknowledge level (interrupt passed through the VXI backplane to the E1490B). Both jumpers must be set to the same level.

Generating Interrupt Requests

To generate the interrupt request and accept the interrupt acknowledgement from the interrupt handler, you must implement the following actions:

- You must provide the interrupt request from your custom circuits by setting the IRQ access point low (0) when the interrupt is to occur. Interrupts are edge triggered.
- If more than one module in the mainframe has the same interrupter priority level, to ensure that *this* module reacts to its own interrupt acknowledge, position the breadboard module in the closest slot to the right of the interrupt handler.
- If you do *not* implement the interrupter capability, you must ensure that the daisy-chained IACKIN* signal is passed to IACKOUT* either on your module or by bypassing the slot entirely using jumpers.
- Your system controller and/or interrupt handler must react to the signal timing in the PAL (U9) for the IRQ and DTACK state machines as shown in Figure 3-5.
- The circuitry provided implements a read operation for only the lower eight bits of status/ID during the interrupt acknowledge cycle, using PIACK* to enable buffer U10. If you want to use the upper eight bits also, you must provide an additional buffer to the internal data bus that is enabled by PIACK* true and DS1* true.
- For testing purposes only, move Jumper J3 from the NORMAL position to the TEST position. In the TEST position, an interrupt can be generated by writing a "1" to Control Register bit 2. In the NORMAL Position, Control Register bit 2 can be used as a user signal, CTL2.

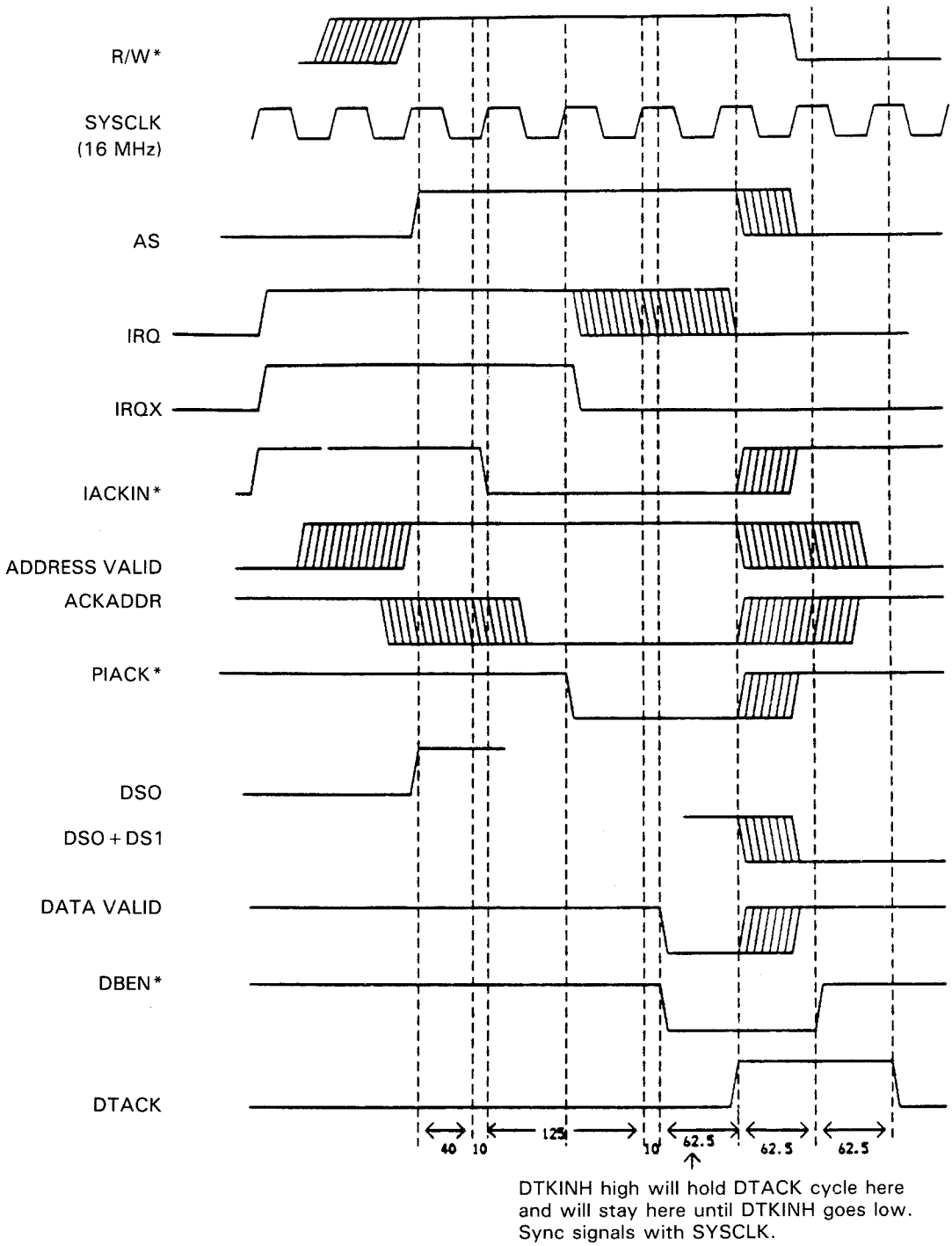


Figure 3-5. Interrupt Timing

Resetting the Module

A reset signal is provided to initialize the backplane interface circuit and your own custom-designed circuitry to a known state. Both hardware and software resets are implemented for your convenience.

Hardware Reset

The backplane SYSRESET* line drives both the hardware reset (HRESET*) and the software reset (CRESET*) user access points low (0) on the breadboard module. HRESET* goes to the clear inputs of U22 and U23, which drives all of the control register outputs (access points CTL2-CTL15) low (0).

Software Reset

Control register output bit CTL0 is used for the software reset. If you write a "1" to bit CTL0, the CRESET* access point on the module is driven low (0) by U4C. You can use CRESET* any way you choose in your custom circuitry.

CAUTION The VXI:RESET < logical_addr> command writes "1s" to all device dependent bits in the control register. Your custom designed circuitry should tolerate this and not malfunction during reset. This is defined in the VXIbus Specification Observation C.2.9.

Detecting Errors

The breadboard module implements the following error/fail circuitry:

- The status register implements bit SR2 as a self-test "Passed/Failed" bit (see Table 2-4). If SR2 (PASSED access point) is set low (0), indicating your custom circuit self test either failed or is currently still executing *and* the SYSFAIL INHBT bit (CTL1 output of the control register) has been set low (0), then the module sets the backplane SYSFAIL* line true through U4B and U5D. If either SYSFAIL INHBT or the "PASSED" bit are set high, SYSFAIL* remains false.
- The ACFAIL* line has been stubbed onto the module from backplane connector P1 (pin B3) and is available as a user access point for your convenience.

Using Other Power Supplies

You can use any of the other power supply voltages from a standard VXIbus backplane as described in the VXIbus Specification. All of the available voltages have been stubbed onto the breadboard module as user access points. Just remember that you must provide your own fusing and filtering *on board the module* for each power supply you access from the backplane.

You must also provide adequate cooling for dissipation of the heat generated by the power requirements of your customs circuitry. See "Cooling Requirements" in Chapter 2 for more information on establishing cooling specifications for your module. Recommended power supply voltage applications are listed in Table 3-5.

Table 3-3. Power Supply Voltage Applications

Supply	Application
+ 5 VDC	Main power source for all systems. Used for supplying power to logic devices.
+ 12 VDC	General purpose power for switching power convertors, analog devices, and disc drives.
–12 VDC	General purpose power for analog devices and disc drives. Not recommended for power convertors.
+ 24 VDC	General purpose power for high level output drivers. Used to derive voltages for precision analog devices (such as + 15 VDC).
–24 VDC	General purpose power for high level output drivers. Used to derive voltages for precision analog devices (such as -15 VDC).
–5.2 VDC	Power for ECL devices.
–2 VDC	Power for ECL termination loads.

Embedded Controller Example Programs

This section shows example programs for the HP E1480A V/360 embedded Model 360-based VXI controller. These programs simply read the ID and Device Type Registers and write to the Control Register.

System Configuration

Mainframe: HP 75000 Series C

Controller: HP V/360 (HP E1480A) w/Resource Manager and Slot 0

Programming Language: HP BASIC/UX

Breadboard HP E1490B (Logical address = 48)

NOTE

The HP V/360 requires the HP E1481A software and the HP E1481L License to Use. Information on using C with the HP V/360 can be found in the *HP-UX Device I/O Library (VXI Interface)*, HP Part Number E1481-90601. For more information on HP BASIC/UX, refer to *HP BASIC/UX (VXI interface)*, HP Part Number E1481-90600.

Reading the Registers

The examples in this section show how to use the VXI:READ? command to read the ID and Device Type Registers. Reading the Status Register is similar.

Register Definitions

ID Register: Reading the ID register (register 00 h) returns $FFFF_h$ which indicates the manufacturer is Hewlett Packard and that the module is an A16 register based device.

Device Type Register: Reading the Device Type register (register 02_h) returns $FF60_h$ which indicates the device is the E1490B Breadboard.

Status Register: All 16 bits can be user defined. VXIbus specifications define bit 2 as self test (0 = failed/executing selftest, 1 = passed), bit 3 as extended selftest (if 0 and Status Register bit 2 is 1 the Extended Selftest is active), bit 14 as module selected by MODID (0 = module selected, 1 = not selected), and bit 15 as A24/A32 active (1 = A24/A32 Registers Accessible).

Reading the ID Register

The following example reads the ID register (register 0) at logical address 48. The program prints a decimal number representing the sum of the decimal values of the "set" bits.

```
OUTPUT 70900; "VXI:READ? 48, 0"
ENTER 70900; IDREG
PRINT IDREG
```

Reading the Device Type Register

The following example reads the Device Type register (register 2) at logical address 48. The program returns a decimal value representing the sum of the decimal values of the "set" bits.

```
OUTPUT 70900; "VXI:READ? 48, 2"
ENTER 70900; DEVREG
PRINT DEVREG
```

Writing to the Control Register

The example in this section shows how to use the VXI:WRITE command to write data to the Control Register. Fourteen of the 16 bits can be user defined; bits 1 and 2 provide SYSFAILIN and RESET, respectively.

The following example writes data ($FFFF_h$) to the Control Register (register 4) at logical address 48.

```
OUTPUT 70900; "VXI:WRITE 48, 4, # HFFFF"
```

Reading/Writing to Custom Registers

As you add your own custom registers to the Breadboard, use the REG0* through REG4* enable lines. These lines address registers 6, 8, A, C, E, respectively. You can read or write to your registers using the same procedures shown by substituting the correct register address.

A

E1490B Breadboard Specifications

Specifications Table

HP E1490B Breadboard module specifications follow.

Item	Specification
User Component Area	490 cm^2 (76 in^2)
Grid Hole Spacing	2.54 mm (0.1 in.)
Grid Hole Inside Diameter	1.17 mm (0.046 in.)
Maximum Component Height	18.0 mm (0.71 in.) above board
Maximum Lead Length	3.2 mm (0.125 in.) below board
Maximum Power Dissipation (per module)	Determined by mainframe cooling. Cannot exceed the number of watts per slot total cooling capacity available. (Backplane interface circuitry consumes 1.75 watts).
Power Supplies	+ 5 VDC @ 350 milliampheres is required for full backplane interface circuitry. Other backplane voltages available as stubs on the module are: + 5, + 5VSTDBY, —5.2V, + 12V —12V, + 24V, —24V, and —2V.
Terminal Card Connector	Maximum current 1.0 Amp. Derate to 100mA when using PC board traces.

HP E1490B Parts List/Schematic/Component Locator

Table B-1 lists the HP E1490B backplane interface circuitry components. See Figure B-1 for the schematic. To order a part, contact the vendor listed under Mfg. Code (see Table B-2 for a list of manufacturer's) and quote the mfr. part number, desired quantity, and the description.

Table B-1. HP E1490B Breadboard Parts List

Reference Designator	HP Part Number	Total Qty.	Description	Mfr. Code	Mfr. Part Number
C1 – C12	0160-4832	12	Fixed Capacitor, 0.01 µF, 100V	04222	SA101C103KAAH
C13 – C14	0160-4822	2	Fixed Capacitor, 1000 pF, 100V	04222	SA201A102JAAH
C15 – C18	0180-1746	4	Fixed Capacitor, 15µF + /-10%, 20V	56289	150D156X902082-DYS
CR1 – CR4	1900-0233	4	Diode, Schottky	50088	1N5711
F1	2110-0712	1	Subminiature Fuse, 4A	75915	R251004T1
J1, J4	1251-4927	2	Connector-Post Type 16-Contact	18873	67997-616
J3	1251-4682	1	Connector-Post Type 3-Contact	26742	1102-1-103-02
L1	9140-1354	1	Fixed Inductor, 47 µH + -15%	28480	9140-1354
P1, J2	1252-1596	2	Connector-Post Type 96-Contact	06776	DIN-96CPC-SRI-TR
P2	1251-7892	1	Connector-Post Type 64-Contact	18873	75882-364
R1	0757-0417	1	Fixed Resistor, 562 Ω, 0.01%	28480	0757-0417
R2 – R3, R6	0757-0437	3	Fixed Resistor, 4.75kΩ, 0.01% 1/8W	28480	0757-0437
R4	0757-0453	1	Fixed Resistor, 30.1kΩ, 0.01%	28480	0757-0453
R5	0757-0421	1	Fixed Resistor, 825Ω, 1%, 1/8W	28480	0757-0421
RP1	1810-0411	1	Resistor Network,,50.0Ω x 9	11236	750-101
RP2 – RP10	1810-0279	9	Resistor Network, 4.7kΩ x 9	56289	256CK472X2PD
SP1 – SP5	3101-3066	5	Switch Pack, Rocker	81073	76YY22968S U1
U2	1820-4197	1	IC-Driver	04713	MC10H123P
U3	1820-3674	1	IC-Driver	27014	MM74HC125N
U4	1820-4643	1	IC-Gate CMOS	18324	74HCT02N
U5	1820-4057	1	IC-Buffer	18324	74F38N
U6	1820-3100	1	IC-Decoder	01295	SN74ALS138N
U7	1820-3079	1	IC-Decoder	04713	MC74HC138N
U8	1820-4147	1	IC-Latch	34371	CD74HCT573E
U9	1820-6731	1	IC-ASIC Gate Array	27014	SCX6B04ACE/N9

Table B-1. HP E1490B Breadboard Parts List (cont'd)

Reference Designator	HP Part Number	Total Qty.	Description	Mfr. Code	Mfr. Part Number
U10 – U14 U24 – U25	1820-4586	7	IC-Driver/Receiver	01295	SN74HCT541N
U15 – U16	1820-4242	2	IC-Schmitt-Trig	18324	74HCT14N
U17 – U18	1820-3631	2	IC-Comparator	27014	MM74HCT688N
U19 – U20	1820-3714	2	IC-Transceiver	01295	SN74ALS245A-1N
U21	1820-3081	1	IC-FF CMOS	04713	MC74HC74N
U22 – U23	1820-3399	2	IC-FF CMOS	04713	MC74HC273N

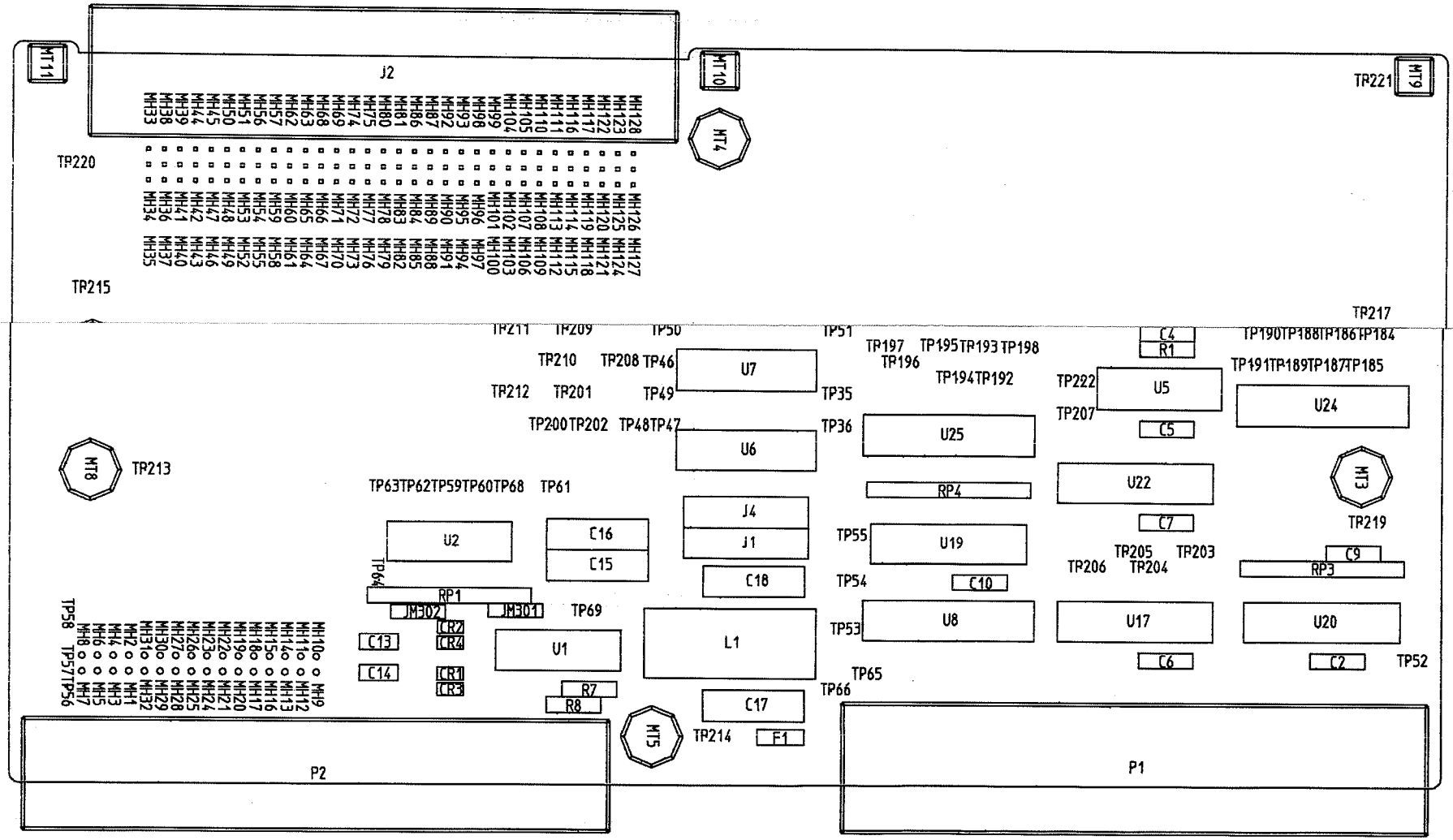
Table B-2 lists the vendors to contact if a replacement part is needed.

Table B-2. HP E1490B Code List of Manufacturer's

Mfr. Code	Manufacturer's Name	Manufacturer's Address	Zip Code
01295	Texas Instruments Inc	Dallas, TX USA	75265
04222	AVX Corp	Great Neck, NY USA	11021
04713	Motorola Inc	Roselle, IL USA	60195
06776	Robinson Nugent Inc	New Albany, IN USA	47150
11236	CTS Corp	Elkhart, IN USA	46514
18324	Signetics Corp	Sunnyvale, CA USA	94086
18873	DuPont E I De Nemours & Co.	Wilmington, DE USA	19801
26742	Methode Electronics Inc	Chicago, IL USA	60656
27014	National Semiconductor Corp	Santa Clara, CA USA	95052
28480	Hewlett-Packard Company - Corporate	Palo Alto, CA USA	94304
34371	Harris Corp	Melbourne, FL USA	32901
50088	SGS-Thomson Microelectronics Inc	Phoenix, AZ USA	85022
56289	Sprague Electric Co.	Lexington, MA USA	02173
75915	Littelfuse Inc	Des Plaines, IL USA	60016
81073	Grayhill Inc.	La Grange, IL USA	60525

Backplane Interface Component Locator

The E1490-66511 component locator is included as a fold-out. See Chapter 2, "Configuring the HP E1490B" for information on individual interface groups.



Backplane Interface Schematic

Complete schematics are enclosed as "C" size fold-out drawings. See Chapter 2, "Configuring the HP E1490B" for information on individual interface groups.

Index

S

U

W

SALES & SUPPORT OFFICES
Arranged alphabetically by country

HEADQUARTERS OFFICES
If there is no sales office listed for your area, contact one of these headquarters offices.

NORTH/CENTRAL AFRICA
Hewlett-Packard S.A.
7, rue du Bois-du-Lan
CH-1217 **MEYRIN** 1, Switzerland
Tel: (022) 83 12 12
Telex: 27835 hmea
Cable: HEWPACKSA Geneve

ASIA
Hewlett-Packard Asia Ltd.
47/F, 26 Harbour Rd.,
Wanchai, **HONG KONG**
G.P.O. Box 863, Hong Kong
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HPASIAL TD

EASTERN EUROPE
Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O.Box 72
A-1222 **VIENNA,** Austria
Tel: (222) 2500-0
Telex: 1 3 4425 HEPA A

NORTHERN EUROPE
Hewlett-Packard S.A.
V. D. Hooplaan 241
P.O.Box 999
NL-1183 AG **AMSTELVEEN**
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Tel: 20 547999
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ROCKVILLE, MD 20850
Tel: (301) 948-6370

MIDWESTERN USA
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