Contents

HP E6172A 32-Pin Matrix Module

Edition 3

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Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

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HP E6172A 32-Pin Matrix Module User's Manual
Edition 3

Documentation History

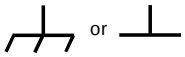
All Editions and Updates of this manual and their creation date are listed below. The first Edition of the manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct or add additional information to the current Edition of the manual. Whenever a new Edition is created, it will contain all of the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this documentation history page.

Edition 1 (E3751-90000) preliminary . . . . . July 1994
Edition 2 (E3751-90000) preliminary . . . . . July 1994
Edition 3 (E6172-90001) . . . . . February 1996

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.

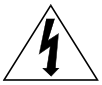
Indicates the field wiring terminal that must be connected to earth ground before operating the equipment—protects against electrical shock in case of fault.



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.

WARNINGS

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

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 fuse holders.

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.

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT service or adjust alone: Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

Declaration of Conformity

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Company
Loveland Manufacturing Center

Manufacturer's Address: 815 14th Street S.W.
Loveland, Colorado 80537

declares, that the product:

Product Name: 32-Pin Matrix Module

Model Number: HP E6172A

Product Options: All

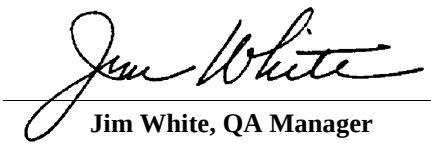
conforms to the following Product Specifications:

Safety: IEC 1010-1 (1990) Incl. Amend 1 (1992)/EN61010-1 (1993)
CSA C22.2 #1010.1 (1992)
UL 3111-1 (1994)

EMC: CISPR 11:1990/EN55011 (1991): Group1 Class A
IEC 801-2:1991/EN50082-1 (1992): 4kVCD, 8kVAD
IEC 801-3:1984/EN50082-1 (1992): 3 V/m
IEC 801-4:1988/EN50082-1 (1992): 1kV Power Line
.5kV Signal Lines

Supplementary Information: The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (inclusive 93/68/EEC) and carries the "CE" mark accordingly.

Tested in a typical configuration in an HP C-Size VXI mainframe.



February, 1996

Jim White, QA Manager

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Notes:

Chapter 1
Getting Started

This chapter describes the HP E6172A 32-Pin Matrix Module and contains the following sections:

Description

The HP E6172A 32-Pin Matrix Module is specifically designed for automotive electronic test applications. Implemented as a single C-sized VXIbus module, it is a simple, register-based A16/D16 module. The HP E6172A is intended for use with a HP E6171A Measurement Control Module, to make typical functional test measurements in an automotive electronics manufacturing environment.

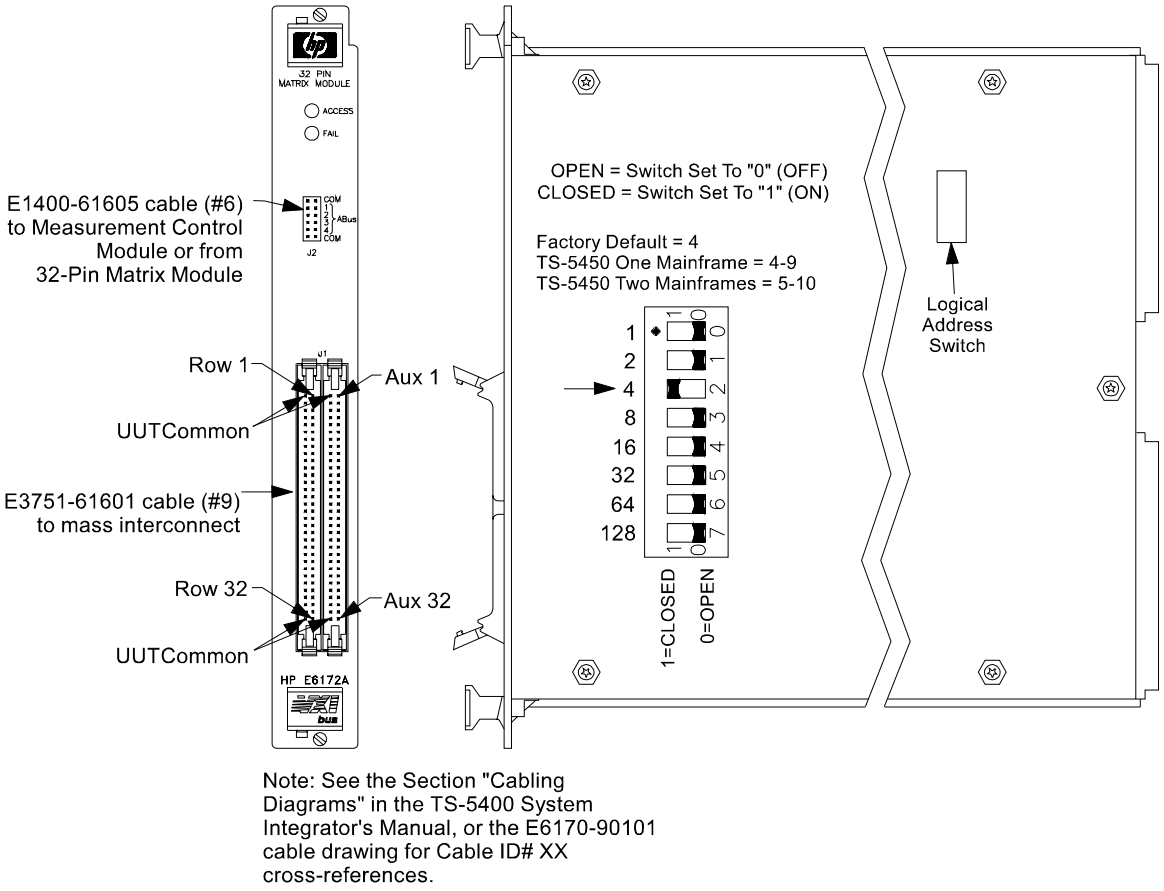
Key features of the module include:

- A 32 X 4 reed relay matrix for high-speed switching.
- An integrated relay timer.
- Automatic disconnecting of column relays for minimal loading of measurement bus.
- A single control bit can open all relays (OAR).
- Auxiliary or direct row access relays for digital I/O on each row.
- Independently switchable series resistance protection on each column.

Note that the HP E6172A 32-Pin Matrix Module has two LEDs on its front panel. They are:

- Failed — When lit, this LED indicates the module failed to power-up correctly. This LED remains lit until the VXIbus backplane is reset through a power-up sequence when power is applied or a VXI System Reset is asserted.

- Accessed — When lit, this LED indicates the module is in use.



Note: See the Section "Cabling Diagrams" in the TS-5400 System Integrator's Manual, or the E6170-90101 cable drawing for Cable ID# XX cross-references.

Figure 1-1. The HP 6172A 32-Pin Matrix Module

Warnings and Cautions

WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the switch module. Before you remove any installed module, disconnect AC power from the mainframe and from other modules that may be connected to the modules.**

Caution **STATIC ELECTRICITY. Static electricity is a major cause of component failure. To prevent damage to the electrical components in the switch module, observe anti-static techniques whenever removing a module from the mainframe or whenever working on a module.**

Setting the Address Switch

The logical address switch (LADDR) factory setting is 4. You may have to change the setting during module installation. Valid address values are from 1 to 254.Figure 1-1 shows the switch location.

Installing in a VXI Mainframe

The HP E6172A 32-Pin Matrix Module can be installed in any available mainframe slot except slot 0. The jumper cables require the first 32-Pin Matrix Module must be located to the left and adjacent to the Measurement Control Card, and the second 32-Pin Matrix Module must be adjacent to the first 32-Pin Matrix Module, as shown in
Figure 1-2.

We recommend that you use the following scheme when installing one or more HP E6172A 32-Pin Matrix Modules in an HP 5450 Automotive Electronic Test System. This places the HP E6172A modules adjacent to the Measurement Control Module for interconnection with it.

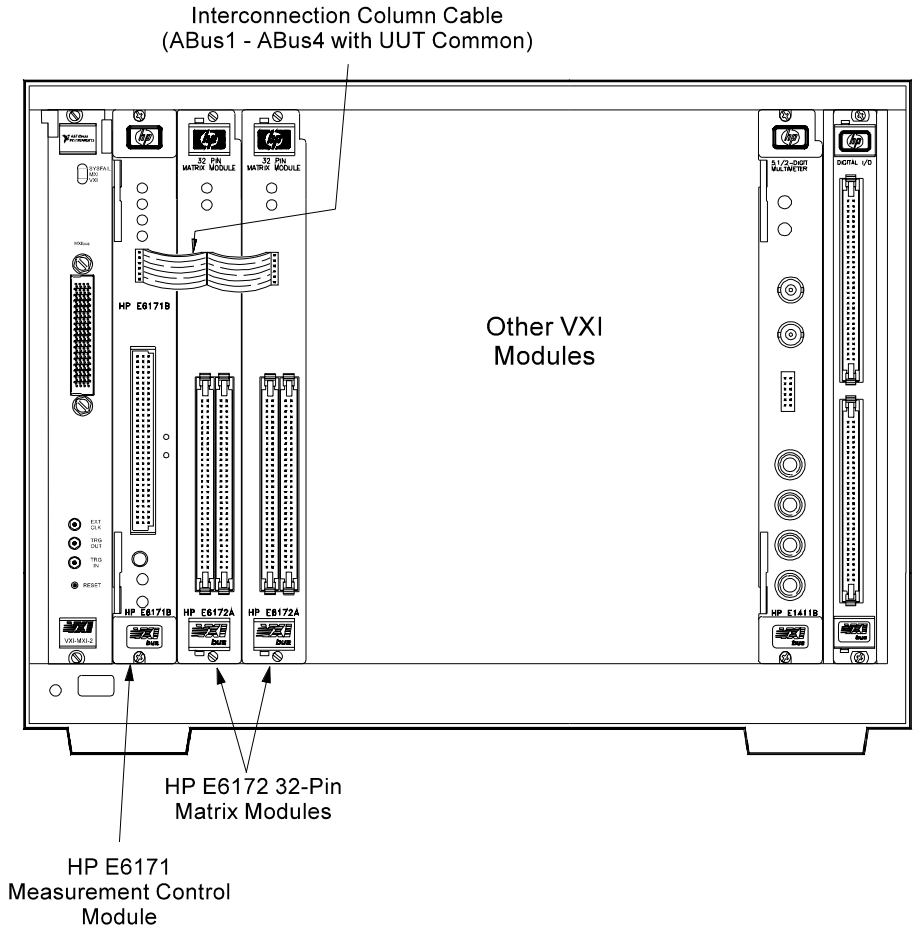


Figure 1-2. Using the HP 6172A 32-Pin Matrix Module in a Functional Test System

Notes:

Chapter 2
Understanding the HP E6172A 32-Pin Matrix Module

Using This Chapter

This chapter contains information about the operation of the HP E6172A 32-Pin Matrix Module. It contains the following sections:

Block Diagram

Figure 2-1 shows a block diagram of the HP E6172A 32-Pin Matrix Module.

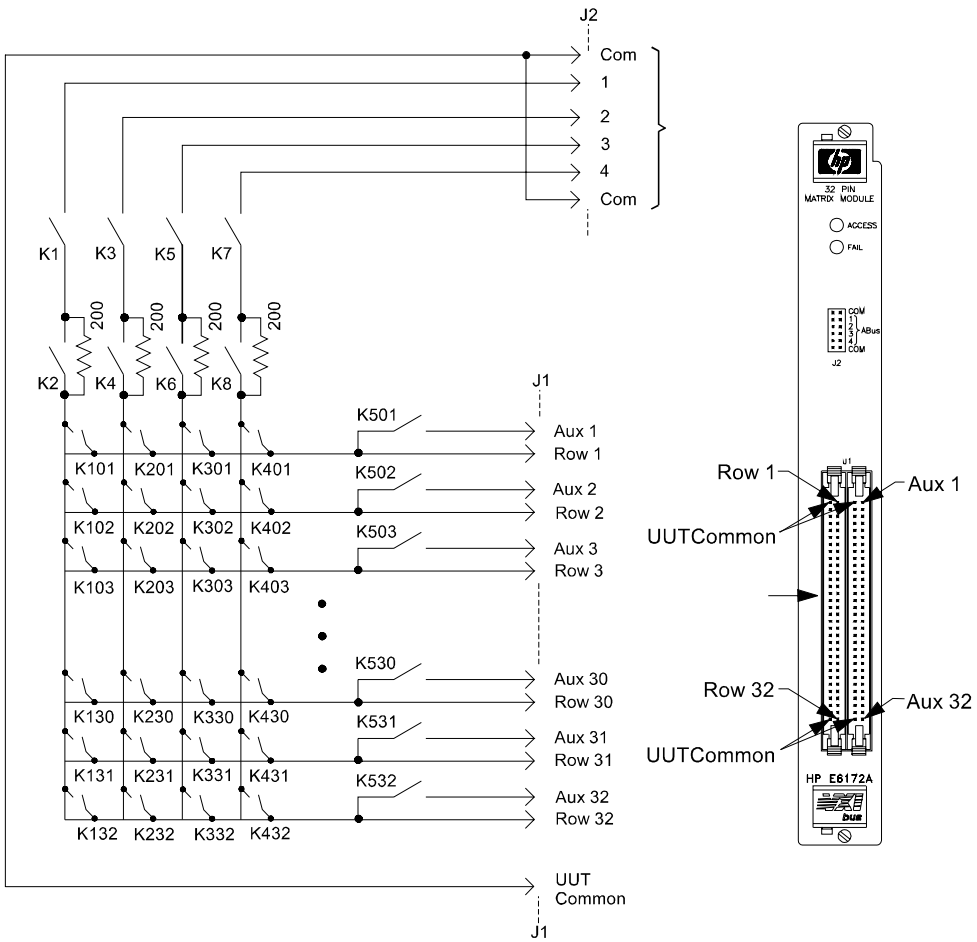


Figure 2-1. Block Diagram of the HP E6172A 32-Pin Matrix Module

One or more HP E6172A modules are used with a Measurement Control Module in a test environment. An overview of how the Measurement Control and HP E6172A modules are used is shown next

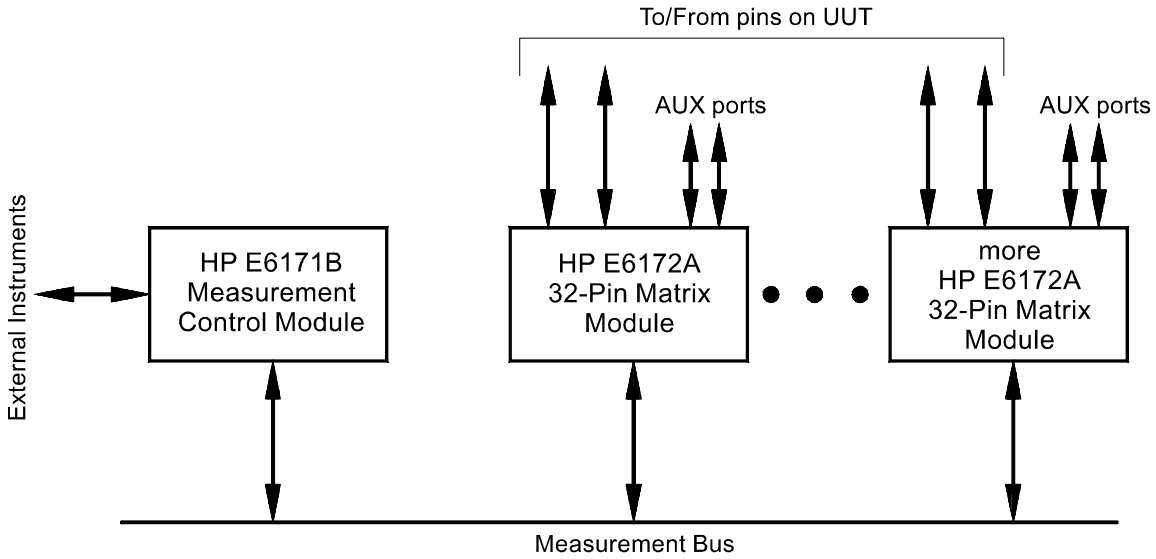


Figure 2-2. Conceptual Overview of HP E6172A with the Measurement Control Module

Used together, the Measurement Control and HP E6172A modules let you connect pins on the UUT to AUX ports, to resources on the Measurement Control Module, and to external instruments. If you need more UUT pins or AUX ports, simply add more HP E6172A 32-Pin Matrix Modules to the bus.

Description of Feature

The HP E6172A 32-Pin Matrix Module contains a 32 X 4 matrix of relays, additional relays to connect/disconnect signals on the buses, programmable registers to control the relays (described in Appendix B), and various other features. All relays are of the high-speed, dry reed type for fast switching.

As shown in Figure 2-1, the analog bus is arranged in 32 rows that can be connected to any of four columns on a common measurement bus. Closing a matrix relay connects a row on the analog bus to a column on the measurement bus, which carries a signal between the interface to the UUT (unit under test) and a Measurement Control Module.

This 32 X 4 structure lets you connect any system resource to any pin on the UUT. This matrix along with the unswitched UUT common return allows as many as four system resources to be connected simultaneously.[1] Also, disconnect relays automatically disconnect unused columns to minimize capacitive loading effects from the measurement bus. This makes it possible to expand the system without degrading the accuracy of measurements.

1. Multiplexing on the Measurement Control Module lets you multiplex up to sixteen resources onto these four lines.

Besides the 32 X 4 matrix of relays, there are auxiliary switched I/O (input/output) ports for each of the 32 rows. These ports are for digital I/O operations or other user-defined applications. For example, you can close any of these relays to connect a digital sensing source (or other low-impedance system resource), such an event detector or digital input card, to a pin on the UUT. Because these auxiliary inputs are available on any of the 32 rows, many inputs can be connected at once.

Additional features include an integrated relay timer, the ability to open all relays with a single bit, and series protection resistors that can be bypassed programmatically. These features are individually described below.

Relay Timer

The HP E6172A module contains a timer whose status indicates whether or not the last modification to a relay's state— i.e., opening or closing the relay—is complete. The timer starts or restarts when a command to change a relay's state is received, and it stops when it times out after an interval sufficiently long for a relay to change state.

If the relay timer's status is “busy,” as reported by bit 7 of the Status Register (described in Appendix B), relays may not yet be in the desired state. If the status of the relay timer is “not busy,” then the relays can be considered to have reached their newly programmed state. The nominal time-out value of the relay counter is 500 µs.

Column Disconnect Relay Control

Each of the four columns has a disconnect relay interposed between it and the ABus that connects to the Measurement Control Module or another HP E6172A module. Depending on the state of bit 6 in the Control Register (described in Appendix B), the disconnect relays are either under manual or automatic control.

When in automatic mode, column disconnect relays close when a matrix element for the individual columns are closed; i.e., when you close a matrix relay, the disconnect relay associated with that column also closes. When in manual mode, the four column disconnect relays are controlled by bits 3-0 in the Column Control & Protection Bypass Register (described in Appendix B). Because manual mode is used only when doing diagnostic checks, control defaults to automatic mode.

OAR

Bit 5 in the Control Register controls the OAR (“open all relays”) feature, which immediately opens all relays in the module. Because the bit is self-clearing, it does not require resetting. OAR also clears bits 3-0 of the Column Control & Protection Bypass Register. When executed, OAR re-triggers the relay timer.

Reset

Bit 0 in the Control Register programmatically resets the HP E6172A module. Resetting the module clears all internal registers, which resets all board functionality to its default, power-up state. When the module is reset, all relay registers are cleared, column disconnect relay control is set to automatic mode, and the relay timer is started.

Protection Bypass

Each of the four columns has a 200 ohm protection resistor in series with it, which protects the relays by limiting the maximum current carried by the bus. However, some measurements (such as 2-wire resistance) may require bypassing—i.e., shorting across—the protection resistor to remove its effects. The default state is to have the protection bypass relays open, which means the series protection resistors are used.

Bits 7-4 in the ABus Control & Protection Bypass Register (described in Appendix B) control the relays used to bypass the series protection resistors. You can bypass the protection on a column-by-column basis.

Bypass the protection resistors only when absolutely necessary!

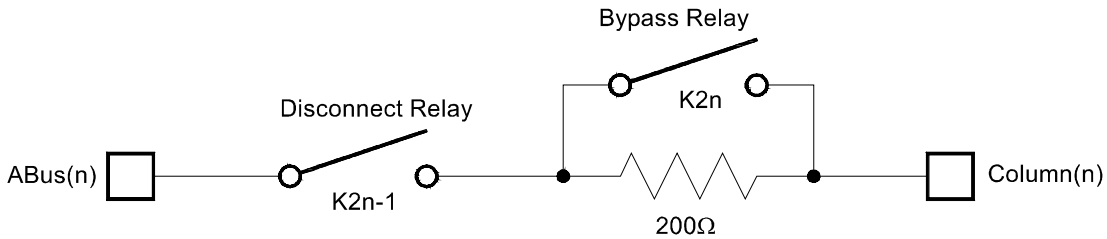


Figure 2-3. Configuration of Column Disconnect and Protection Bypass Relay

Chapter 3
HP E6172A 32-Pin Matrix Module

Using This Chapter

This chapter contains the following sections: Reset State, Programming

Reset State

The HP E6172A module resets to its default state whenever: Operating power is first applied. Operating power is removed and then reapplied. Bit 0 in the Control register (described in Appendix B) is asserted. System Reset on the VXI Backplane is asserted. When the module is reset, all relay registers are cleared, column disconnect relay control is set to automatic mode, and the relay timer is started.

Programming

Your programmatic interaction with this module is done via the test executive software provided with your test system. Refer to its documentation for more information.

Notes:

Appendix A
HP E6172A Specifications

General

Module Size/Device Type:
C-Size VXIbus, register based, A16/D16

Relay Life:
@ No load:10^8 operations
@ Full load:10^5 operations

Power Requirements:
Voltage:+5Vdc+12Vdc

Capacitance - DUT pin to UUT Common:
Open channel:100 pF
Closed channel:300 pF

Resistance:
DUT pin to auxiliary input:1 ohm (Max.)
DUT pin to analog bus connector:1 ohm* (Max.)
* with 100 ohm protection resistor bypassed.

Pin channel voltage: 200 volts

No. of concurrent analog channels: 4

Operating temperature: 0 to 40 °C

Operating humidity: 80% Relative Humidity, 0 to 40 °C

RelayCharacteristics

Type: dry reed

Switching Speed: Close: 500 µs
Open: 100 µs

Switching Characteristics:
0.5 A carry
7.5 Volt-Amps instantaneous switching

Other:
300 VDC Standoff voltage
200 VDC Switching voltage

Notes:

Appendix B
Register Definitions

Using This Appendix

This appendix contains the following main sections: Addressing the Registers Register Descriptions

Addressing the Registers

To access a specific register for either read or write operations, you must use its register address. Register addresses for VXIbus plug-in modules reside in an address space called "A16" whose size is $FFFF_h$. The exact location of the A16 address space within a VXIbus master's memory map depends on the system resource manager.

VXIbus modules are addressed at locations above $C000_h$ within the A16 address space. Because each module requires one 64 byte (40_h) block of addresses, the A16 address space between $C000_h$ and $FFFF_h$ can accommodate as many as 255 VXIbus modules.

Given that the address space of each module is 64 bytes, the address of a module is determined by its logical address (set by the address switches on the module) multiplied by an offset of 64 (40_h). Suppose the A16 address space began at $1F0000_h$ and the Measurement Control Module's address was 120 (78_h). Then the addresses of the module's internal registers—i.e., the base address of the module—would start at $1FDE00_h$, like this:

$$1F0000_h + C000_h + (78_h * 40_h) = 1FDE00_h$$

A16 Address Space Outside the System Controller

When the A16 address space is outside the system controller, the base address of the HP E6172A module is computed as:

$$A16_{base} + C000_h + (LADDR_h * 40_h)$$

or (decimal)

$$A16_{base} + 49{,}152 + (LADDR * 64)$$

where $C000_h$ (49,152) is the starting location of the register addresses, LADDR is the module's logical address, and 64 is the number of address bytes per VXIbus device. For example, if the HP E6172A's logical address (LADDR) was set to 4 (4_h), it would have a base address of:

$A16_{base}+C000_h+(4_h * 40_h) = A16_{base}+C000_h+ 00_h = C100_h$

or (decimal)

$A16_{base}+ 9,152+ 4 * 64) = A16_{base}+49,152+256 = 49,408$

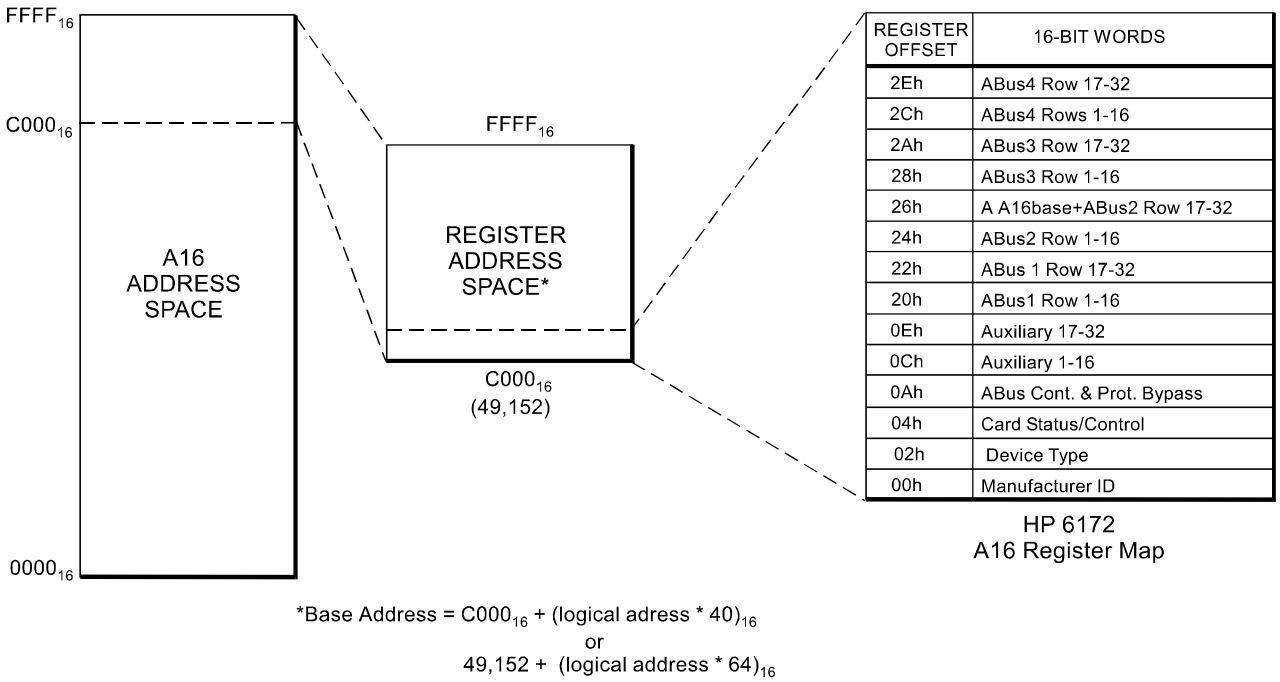


Figure B-1. Register Locations Within the A16 Address Space

Register Offset

The offset for a specific register is that register's location in the block of 64 address bytes that belongs to the module. For example, the module's Status/Control Register has an offset of 04h. Continuing with the previous example, whose base address was 1FDE00h, when accessing this register, you would add the offset to the base address to form the register address, like this:

$1FDE00_h + 04_h = 1FDE04_h$

or (decimal)

2,088,448 + 4 = 2,088,452

Register Descriptions

The HP E6172A 32-Pin Matrix Module has the following registers: Manufacturer ID Register (base + 00_h) Device Type Register (base + 02_h) Status/Control Register (base + 04_h) Relay registers, which are: ABus Control & Protection Bypass (base + A_h) Auxiliary Relay 1-16 (base + C_h) Auxiliary Relay 17-32 (base + E_h) ABus1 Row 1-16 Relay (base + 20_h) ABus1 Row 17-32 Relay (base + 22_h) ABus2-4 Row 1-16 & 17-32 Relay (base + 24-$2E_h$)

Manufacturer Identification Register

The Manufacturer ID Register is a 16-bit read-only register at address 00_h with the most significant byte (MSB) at 00_h and the least significant byte at 01_h. Reading this register returns $FFFF_h$, which identifies this module as register-based, A16-only, and made by Hewlett-Packard.

Device Type Register

The Device Type Register is a 16-bit read-only register at address 02_h with the most significant byte (MSB) at address 02_h and the least significant byte (LSB) at address 03_h. Reading this register returns 0223_h, which uniquely identifies this module as an HP E6172A.

Status/Control Register

The Status/Control Register is actually two independent registers at a single address. The readable or “status” portion of the register returns information about the current state of the module. The writable or “control” portion of the register controls various functions of the module. The bit fields of both registers are described below, along with the definitions of terms unique to them.

Status Register (base + 04_h)

Bit	15	14	13-8	7	6	5-4	3	2	1-0
Purpose	A24/A32	MODID\	undefined	BUSY\	MANUAL	undefined	READY	PASSED	undefined
Value	0	1	$3F_h$	state	state	3_h	1	1	3_h

* After an initial transition at power-on, the default state of this register is $7FBF_h$.

A24/A32: Address size; either 16-bit addressed based or 24/32-bit address based. “0” indicates A16 mode.

MODID: “0” indicates the module is present. Used only during configuration.

undefined: All undefined bits appear as “1” when read.

BUSY: “1” indicates NOT busy, “0” implies the relay state is undefined. After an initial transition at power-on, defaults to “1”.

MANUAL: Manual control of column relays when “1”, automatic control of column relays when “0”. Defaults to automatic.

READY: "1" indicates the module powered up successfully.

PASSED: "1" indicates the module powered up successfully.

state: The value reflects the state of the board. Unless it has been modified, the value is the default from power-on or reset.

Control Register (base + 04_h)

Bit	15-7	6	5	4-2	1	0
Purpose	undefined	MANUAL	OAR	undefined	SYSFAIL inhibit	RESET
Value	X	state	state	X	1	state

undefined: Writing to an undefined bit has no effect.

MANUAL: Manual control of column relays when "1", automatic control of column relays when "0". This bit simultaneously controls all four column disconnect relays. In manual mode, the control of ABus disconnect relays reverts to the individual control bits (see Column Control and Protection Bypass Register). In automatic mode, the ABus disconnect relays close when a matrix element for the individual bus is closed.

OAR: (Open All Relays) A "1" opens all relays and retriggers the relay timer, a "0" causes no change. OAR clears itself upon execution.

SYSFAIL inhibit: A "1" means inhibit, a "0" enables SYSFAIL. Because this module does not drive SYSFAIL, this bit does nothing.

RESET: A "1" causes reset and retriggers the relay timer, a "0" causes no change. RESET clears itself upon execution. The reset state of this module is all relays open and automatic control of ABus disconnected, and the relay timer running. Note that the protection series resistors are active in the reset state.

state: The value reflects the state of the board. Unless it has been modified, the value is the default from power-on or reset.

Relay Registers

Relay registers directly control or return the status of relays in this module. All relay control signals use positive-true logic: i.e., "0" is open and "1" is closed. Writing to any of these registers retriggers the relay time to begin counting, which sets BUSY\ to "0". Reading the status of these registers returns to status of the relay drive voltage. Issuing an OAR command or resetting the module opens all relays and clears all control registers.

ABus Control & Protection Bypass Register

This register controls the ABus disconnect and protection bypass relays. The column control bits control the ABus disconnect relays only when the board is in manual mode (see the Control Register). Otherwise, the ABus disconnect relays are automatically switched when a matrix element for that column is closed. The four protection bypass bits control the four bypass relays for shorting across the series protection resistors in each column. Reading the status returns the values of the eight bits plus the state of the eight relays.

ABus Control & Protection Bypass Register (base + $0A_h$)

Bit	15	14	13	12	11	10	9	8
Purpose	read status of Protection Bypass Relay				read status of ABus Disconnect Relay			
ABus	4	3	2	1	4	3	2	1
Value	actual state of relay							

Bit	7	6	5	4	3	2	1	0
Purpose	Protection Bypass				ABus Disconnect Relays			
ABus	4	3	3	1	4	3	2	1
Value	programmed state				programmed state			

* The default state of this register at power-on is 0000_h.
* Bits 15-8 are read-only and return the actual relay states.
* Bits 7-0 are read/write.

Auxiliary Relay 1-16 Register

This register controls, in ascending bit order, the auxiliary relays for row 1-16.

Auxiliary Relay 1-16 Register (base + $0C_h$)

Bit	15-0
Purpose	Auxiliary relays 16-1
Value state	of relay

* The default state of this register at power-on is 0000_h.
* Reading the status of this register returns the actual relay state.
* Bit 0 is AUX relay 1, bit 1 is AUX relay 2, etc. Relay numbers correspond to the row numbering shown in Figure B-1.

Auxiliary Relay 17-32 Register

This register controls, in ascending bit order, the auxiliary relays for rows 17-32.

Auxiliary Relay 17-32 Register (base + $0E_h$)

Bit	15-0
Purpose	Auxiliary relays 32-17
Value	state of relay

* The default state of this register at power-on is 0000_h.
* Reading the status of this register returns the actual relay state.
* Bit 0 controls AUX relay 17, bit 1 controls AUX relay 18, etc. Relay numbers correspond to the row numbering shown in Figure B-1.

ABus1 Row 1-16 Relay Register

This register controls, in ascending bit order, the matrix relays in ABus1 for rows 1-16.

ABus1 Row 1-16 Relay Register (base + 20_h)

Bit	15-0
Purpose	ABus1 Row 16-1 relays
Value	state of relay

* * The default state of this register at power-on is 0000_h.
  * Reading the status of this register returns the actual relay state.
  * Bit 0 controls relay for ABus1 row 1 relay, bit 1 controls relay for ABus1 row 2, etc. Relay numbers correspond to the ABus numbering shown in Figure B-1.

ABus1 Row 17-32 Relay Register

This register controls, in ascending bit order, the matrix relays in column 1 for rows 17-32.

ABus1 Row 17-32 Relay Register (base + 22_h)

Bit	15-0
Purpose	Column 1 Row 32-17 relays
Value	state of relay

* The default state of this register at power-on is 0000_h.
* Reading the status of this register returns the actual relay state.
* Bit 0 controls relay for ABus1 row 17, bit 1 controls relay for column 1 row 18, etc. Relay numbers correspond to the ABus numbering shown in Figure B-1.

ABus2-4 Row 1-16, 17-32 Relay Registers

These registers control, in ascending bit and register order, the matrix relays in columns 2-4 for rows 1-16 and 17-32. The bit definitions and ordering are identical to those of the previous two registers.

ABus2-4 Row 1-16, 17-32 Relay Registers (base + 24_h thru $2E_h$)

Address	24_h	26_h	28_h	$2A_h$	$2C_h$	$2E_h$
ABus	2	2	3	3	4	4
Rows	1-16	17-32	1-16	17-32	1-16	17-32

* Address is base address + value shown; i.e., address of column 2 row 17-32 register is base + 26h.

Notes: