Contents

HP E6198 Switch/Load Unit User's Manual

Edition 1

Legal and Safety Information

HEWLETT-PACKARD WARRANTY STATEMENT

HP PRODUCT: HP TS-5400 Functional Test System Series II **DURATION OF WARRANTY:** 1 year

1. This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year, with on-sit e service, from date of shipment. Duration and conditions of warranty for this product may be superseded when the product is integrated into (becomes a part of) other HP products. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

2. For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard (HP). Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country

3. HP warrants that HP software will not fail to execute its programming instructions, for the period specified above, due to defects in material and workmanship when properly installed and used. If HP receives notice of such defects during the warranty period, HP will replace software media which does not execute its programming instructions due to such defects.

4. HP does not warrant that the operation of HP products will be interrupted or error free. If HP is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

5. HP products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

6. The warranty period begins on the date of delivery or on the date of installation if installed by HP. If customer schedules or delays HP installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

7. Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by HP, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

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9. HP will be liable for damage to tangible property per incident up to the greater of $300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective HP product.

10. TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES IN THIS WARRANTY STATEMENT ARE CUSTOMER'S SOLE AND EXLUSIVE REMEDIES. EXCEPT AS INDICATED ABOVE, IN NO EVENT WILL HP OR ITS SUPPLIERS BE LIABLE FOR LOSS OF DATA OR FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFIT OR DATA), OR OTHER DAMAGE, WHETHER BASED IN CONTRACT, TORT, OR OTHERWISE.

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HP E6198A Switch/Load Unit User's Manual
Edition 1

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 (E6198-90000) . . . . .September 1999

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.

or 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.

Operating Location: Sheltered location where air temperature and humidity are controlled within this product’s specifications and the product is protected against direct exposure to climatic conditions such as direct sunlight, wind, rain, snow, sleet, and icing, water spray or splash, hoarfrost or dew. (Typically, indoor.) Pollution environment for which this product may be operated is IEC 664 Pollution degree 2.

WARNINGS (Cont.)

The HP TS-5400 System can have modules that are capable of measuring voltages up to 450V maximum. Voltage levels above the levels specified for accessible connectors or cable ends could cause bodily injury or death to an operator. Special precautions must be adhered to (discussed below) when applying voltages in excess of 60 Vdc, 30 Vac rms or 42.4 Vac peak.

Module connectors and test signal cables connected to them cannot be operator accessible. Cables and connectors are considered inaccessible if a tool (e.g., screwdriver, wrench, socket, etc.) or a key (equipment in a locked cabinet) is required to gain access to them. Additionally, the operator cannot have access to a conductive surface connected to any cable conductor (High, Low or Guard).

Assure the equipment under test has adequate insulation between the cable connections and any operator-accessible parts (doors, covers, panels, shields, cases, cabinets, etc.). Verify there are multiple and sufficient protective means (rated for the voltages you are applying) to assure the operator will NOT come into contact with any energized conductor even if one of the protective means fails to work as intended. For example, the inner side of a case, cabinet, door, cover or panel can be covered with an insulating material as well as routing the test cables to the module's front panel connectors through non-conductive, flexible conduit such as that used in electrical power distribution.

CLEANING INFORMATION

The system should only be cleaned by wiping it with a soft damp cloth.

Environmental Requirements

Altitude: 2000 meters or less.

Operating Temperature: 5 °C to 40 °C (41 ° F to 104 °F).

Humidity: 5 percent to 80 percent relative humidity (non-condensing).

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: HP TS-5400 Functional Test System Series II
Model Number: HP E8770A/E8785A
Product Options: All

Conforms to the following Product Specifications:

Safety: IEC 61010-1 (1990)+A2:1995/EN61010-1:1993+A2:1995
CSA C22.2 #1010.1 (1992)
UL 3111

EMC: CISPR 11:1990/EN55011 1991: Group 1, Class A
EN50082-1:1992
IEC 61000-4-2:1995/: 4kV CD
IEC 61000-4-3:1995/: 3V/m
IEC 61000-4-4:1995/: 1 kV Power line

Supplementary Information: This product complies with the requirements of the Low Voltage Directive 73/23/EEC (inclusive 93/68/EEC). This product also wherewith complies with the protection requirements of: The EMC Directive 89/336/EEC and carries the "CE" marking accordingly. Attestation is provided according to article 10(2) of the Directive by a Technical Construction File.

Technical File Number: 95-0900-002-TCF Rev. C Dated: 28 June, 1999

A Technical Report/Certificate has been issued by the following appointed Competent Body, namely,
KEMA Registered Quality Nederland B.V.
Utrechtseweg 310, 6812 AR Arnhem
6800 ET Arnhem, The Netherlands
Certificate Number: 71301-KRQ/EMC 97-4165 **Dated:** February 18, 1997

June 28, 1999

Jim White

Jim White, QA Manager

For Compliance Information ONLY, contact:

Australian Contact: Product Regulations Manager, Hewlett-Packard Australia Ltd., 31-41 Joseph Street, Blackburn, Victoria 3130, Australia

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Standards Europe, Herrenberger Straße 130, D-71034 Böblingen (FAX: +49-7031-14-3143)

USA Contact: Product Regulations Manager, Hewlett-Packard Company, P.O. Box 301, Mail Stop BU212, Loveland, CO 80537

Chapter 1
Switch/Load Unit and Plug-In Cards Overview

This chapter gives an overview of the Switch/Load Unit, Load Cards, and other associated equipment. The chapter contains the following information.

Switch/Load Unit Description

The HP E6198A Switch/Load Unit, Figure 1-1, consists of a standard VME type enclosure, a custom high current backplane, and slots for up to 21 optional HP plug-in cards. The following plug-in cards are available:

- HP E6175 8-Channel load card,
- HP E6176A 16-Channel load card,
- HP E6177A 24-Channel load card,
- HP E6178B 8-Channel, High Power Load Card,
- HP E8792A 32-Pin Matrix Card with instrumentation support,
- HP E8793A 32-Pin Matrix Card.
- HP E8794A Custom Card.

The above plug-in cards are described in detail in Chapters 3, 4 and Appendices B and C of this manual.

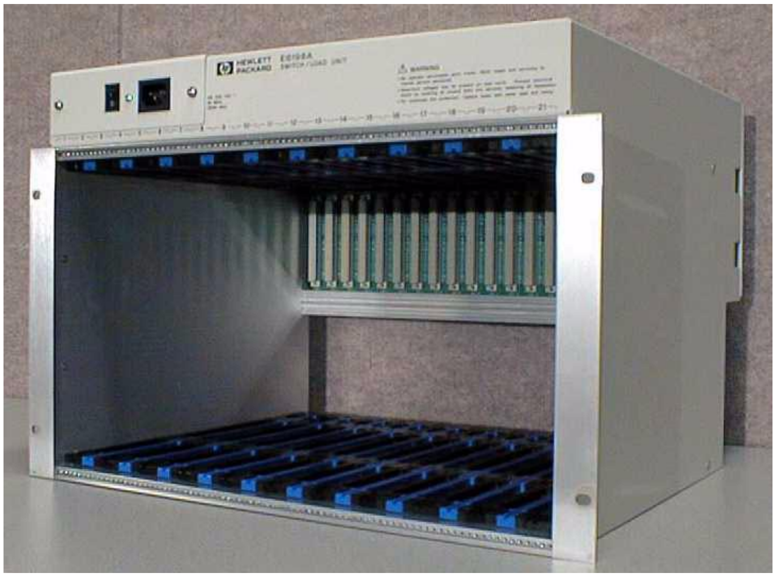


Figure 1-1. HP E6198A Switch/Load Unit

In addition to holding load cards, pin matrix cards and custom cards the Switch/Load Unit(s) provides the following capabilities:

- Built-in parallel interface,
- Digital I/O,
- Current Sense,
- Power Bus Sense,
- Two DAC Channels
- +12V, -12V, and Spare Power.

Each of the above features is described in detail in the following paragraphs.

Parallel Interface

The Switch/Load Unit switching and data transfer is controlled through a built-in parallel interface. Figure 2-11 on page 35 shows the location of the parallel interface.

Digital I/O

The Switch/Load Unit provides 8-bits of digital input, 8-bits of digital output (Open Drain Out), and 8-bits of TTL-level digital output (Spare Digital Out). Typical uses for the digital I/O include:

- Automation control,
- Digital control of circuitry on the HP E8794A Custom Card,
- Digital switches (for example, to indicate door open/closed),
- Actuator control,
- Fixture ID.

There is no handshaking capability.

Digital Input

The digital input bits have TTL thresholds (0.55 vdc for low, 3.0 Vdc for high) and are protected to ±24 Vdc. These includes the Fixture ID that also use standard TTL inputs, but are not protected to ±24 Vdc. Figure 1-2 is a typical example showing the usage of a digital input bit.

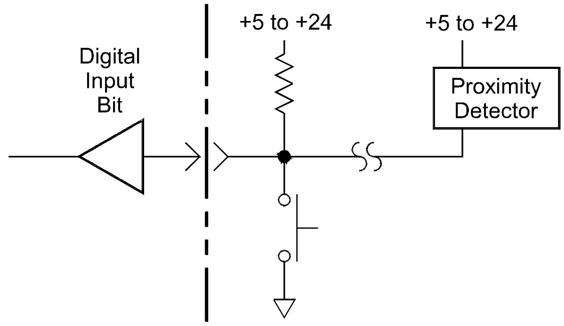


Figure 1-2. Digital Input Example

Open Drain Digital Output

The digital output bits use open drain drive circuitry designed for pull-ups up to +24 Vdc. The output port FET can sink up to 250mA. Figure 1-3 is an example showing one digital output bit controlling a relay.

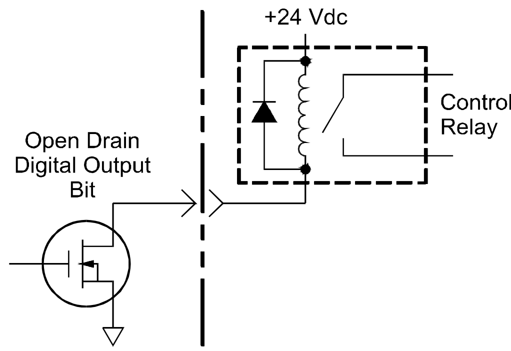


Figure 1-3. Digital Output Example

DAC Channels

The two 14-bit channels of DAC provide ±16 volts at 10 mA each. In order to provide this voltage swing, a charge pump is used to step-up the ±12 volt supply. The DAC channels are typically used for controlling differential input, voltage-controlled power supplies.

+12Vdc, -12Vdc, Spare Power

+12V and -12V from the Switch/Load Unit Power Supply. The +12V supply can deliver 1A, the -12V supply can deliver 800mA. You can also connect an additional (spare) power supply to the Switch/Load Unit backplane, see "Connecting an Additional (Spare) Power Supply" on page 30 for details.

Note These power supplies have resettable fuses located on the Switch/Load Unit. Should an overload occur, the fuse(s) will open. To reset the fuse(s), remove power from the Switch/Load Unit for approximately 20 seconds. The fuse(s) will reset when power is re-applied.

Current Sense

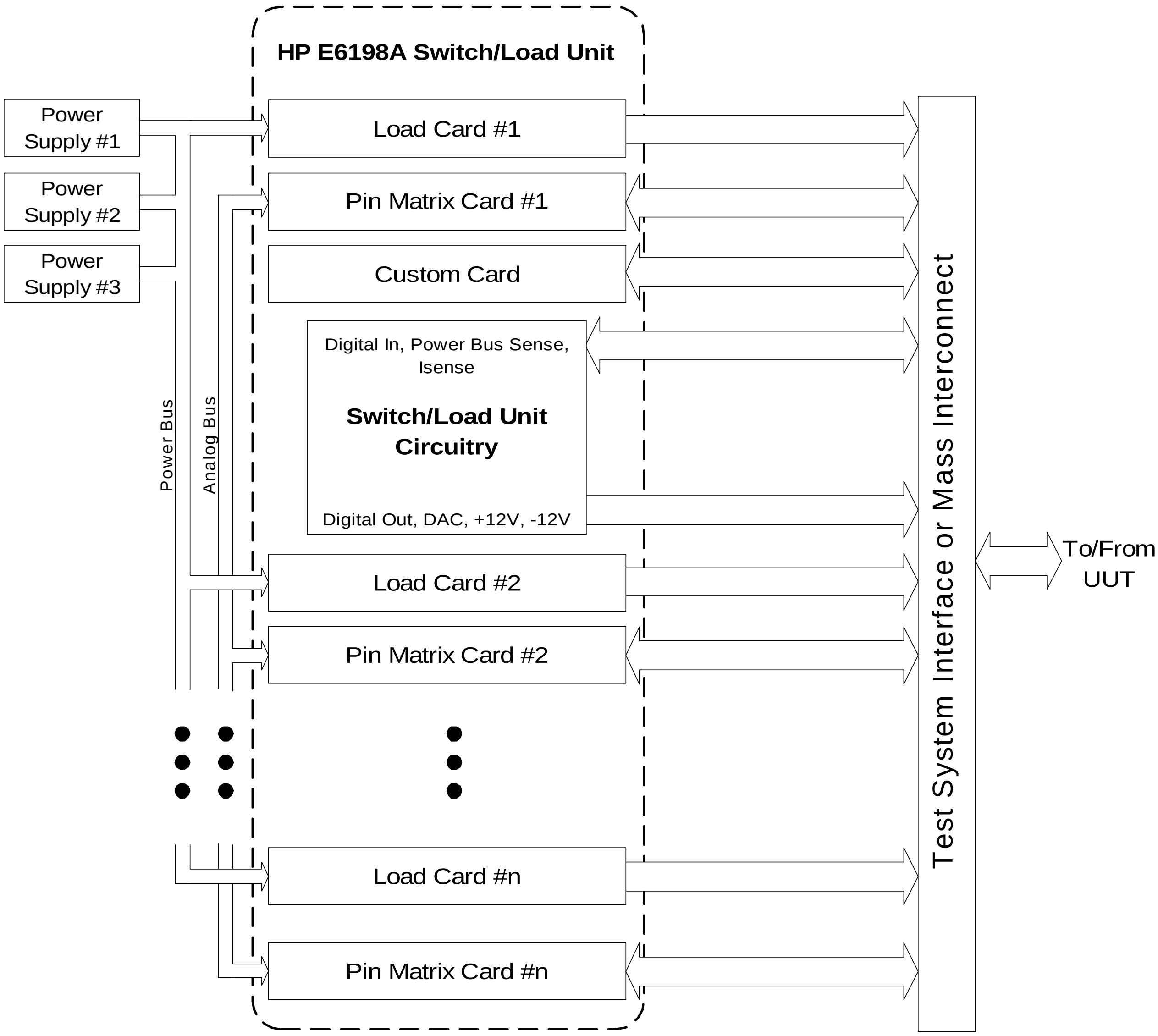
The Isense+ and Isense- lines connect to the current sense bus on the Switch/Load Unit backplane. These lines are used for sensing current on a selected load card channel. The 8-Channel and 16-Channel High Current Load Cards are designed to connect to the current sense bus. Each channel's current sense lines are multiplexed so that on each card only one channel at a time can be connected to the current sense bus.

Power Bus Sense

Power Bus Sense 1 - 4 are the remote sense lines for the power supplies connected to power buses 1 - 4. Remote sensing compensates for losses in the system wiring and ensures that the voltage value set will be applied at the sense point.

Switch/Load Unit Block Diagram

Figure 1-4 shows a conceptual block diagram of the HP E6198A Switch/Load Unit. All plug-in cards are optional so your system will have a different mix of cards from that shown here. Each type of plug-in card is described on the following pages. The Test System Interface or Mass Interconnect are also optional--you can also interface directly to the Switch/Load Unit. See Chapter 2 for details.



Note: All plug-in cards are optional--the mix and numbers of cards in your system will be different than shown here.

Figure 1-4. Switch/Load Unit Block Diagram

HP E6175A 8-Channel High-Current Load Card

The HP E6175A 8-Channel High-Current load card, with current sensing, is intended to be used with loads mounted inside the Switch/Load Unit. This card provides great flexibility, low series resistance, and high current carrying capability. A nine-inch by four-inch area of sheet metal is left open on the front of the card for mounting loads. You provide the load mounting hardware, drilling holes in the sheet metal as needed. The card is two slots wide, 4 cm (1.6-inches), to allow mounting of larger loads. Due to its high current capability, it is recommended that it be mounted in the left side (slots 1-4) of the HP E6198A Switch/Load Unit enclosure, closest to the incoming power buses. Each channel is capable of up to 7.5 amperes continuous carry current or up to 15 amperes with a two percent duty cycle. The HP E6175A is supplied with a slow blow fuse on each channel to protect the card traces against extended high current operation. The card type is 01_h. Figure 1-5 shows a block diagram of the HP E6175A Load Card.

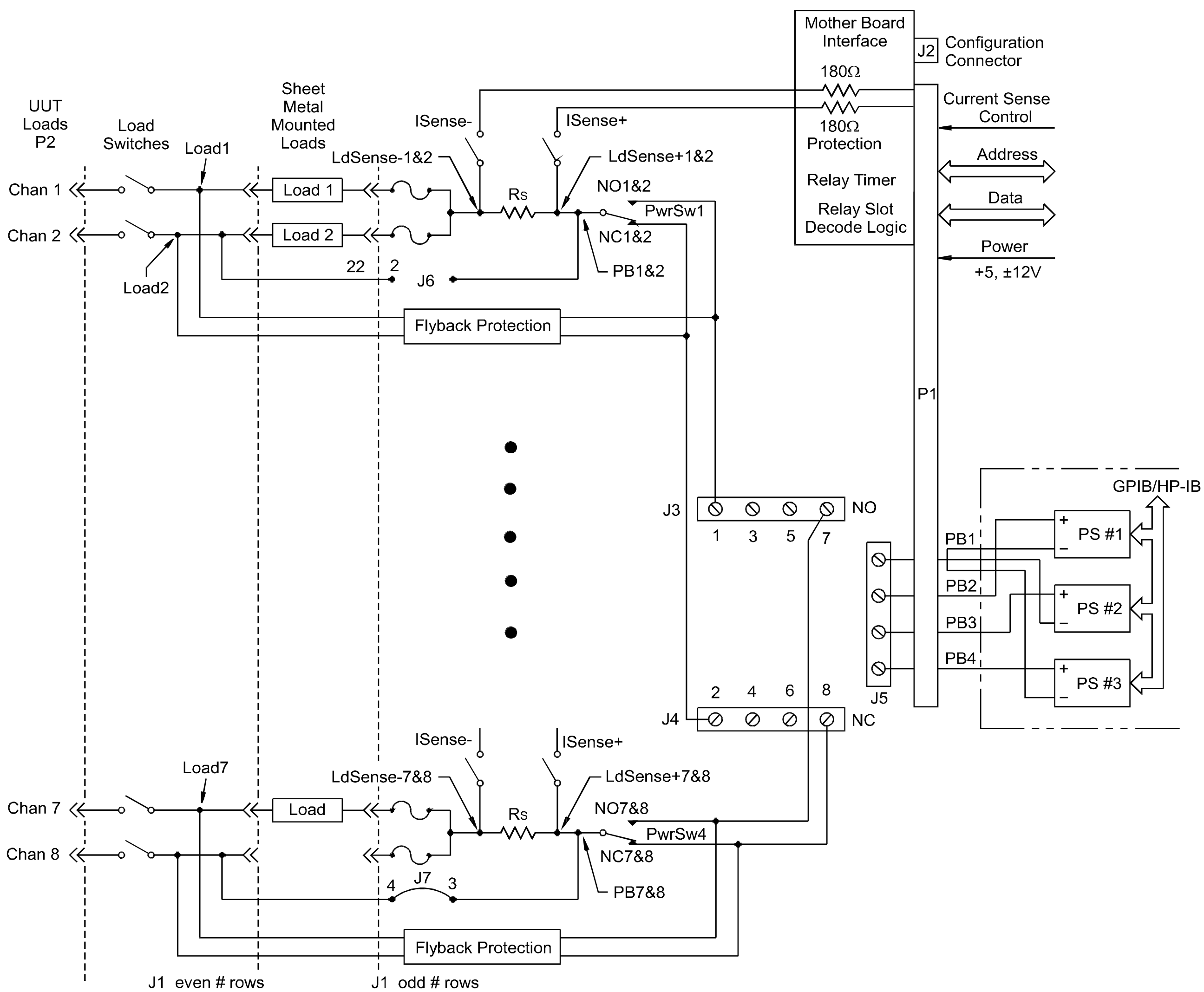


Figure 1-5. HP E6175A 8-Channel High Current Load Card Block Diagram

HP E6176A 16-Channel High-Current Load Card

The HP E6176A 16-Channel High Current Load card, shown in Figure 1-6, requires externally mounting the loads. The single-slot design offers high load density for high-current loads where current transducers and bridge drive configurations are not required.

You determine where and how the loads are mounted externally. Two load connectors, J1 and J2, are used with loads 1 through 8 on J1 and loads 9 through 16 on J2. The flyback protection is connected from both the normally open (NO) and normally closed (NC) power switch connections. The card type is 02_h.

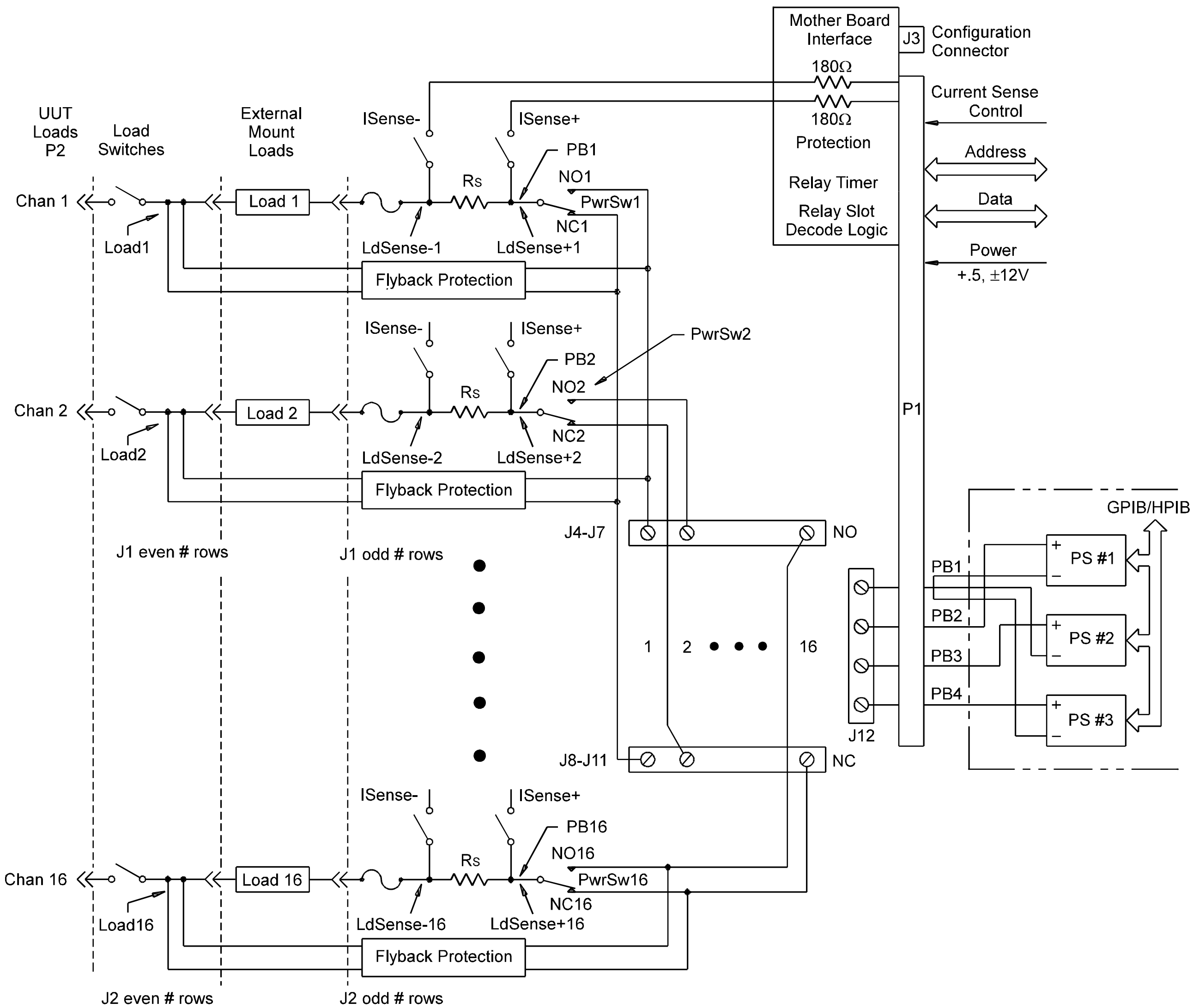


Figure 1-6. HP E6176A 16-Channel High Current Load Card Block Diagram

HP E6177A 24-Channel Medium-Current Card

The HP E6177A 24-Channel Medium-Current Load Card, Figure 1-7, is intended to be used with loads mounted inside the Switch/Load Unit. A nine-inch by four-inch area of sheet metal is left open on the front of the card to allow room for mounting small loads. The card is one slot wide. Each channel is capable of up to 2A continuous carry current. The card type is 03_h.

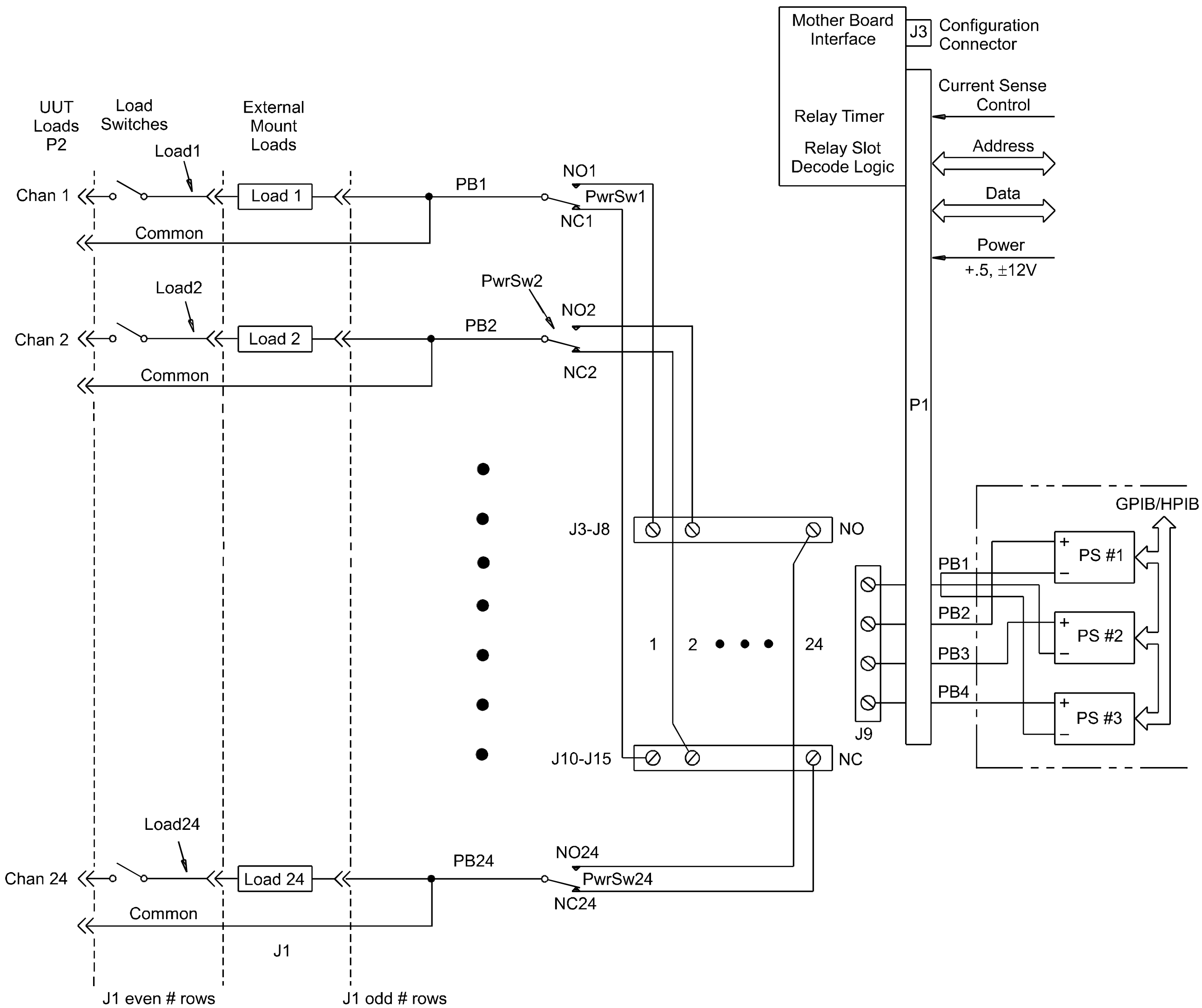


Figure 1-7. HP E6177A 24-Channel Medium Current Load Card Block Diagram

HP E6178B 8-Channel Heavy Duty Load Card

The HP E6178B 8-Channel Heavy Duty Load Card, Figure 1-8, with current sensing, is intended to be used with high power loads mounted outside the Switch/Load Unit. The card occupies two slots in the Switch/Load Unit. Power supply connections are made directly from the external power supplies to the Load Card - not through the HP E6198A Switch/Load Unit Power Supply Buses. Each channel is capable of up to 30 Amps continuous carry into a resistive load. The card type is 04_h.

Caution **It is possible to close more than one channel at a time. The power supply connections to the load card and individual channels are rated for 30 amps maximum continuous. Do not exceed these specifications.**

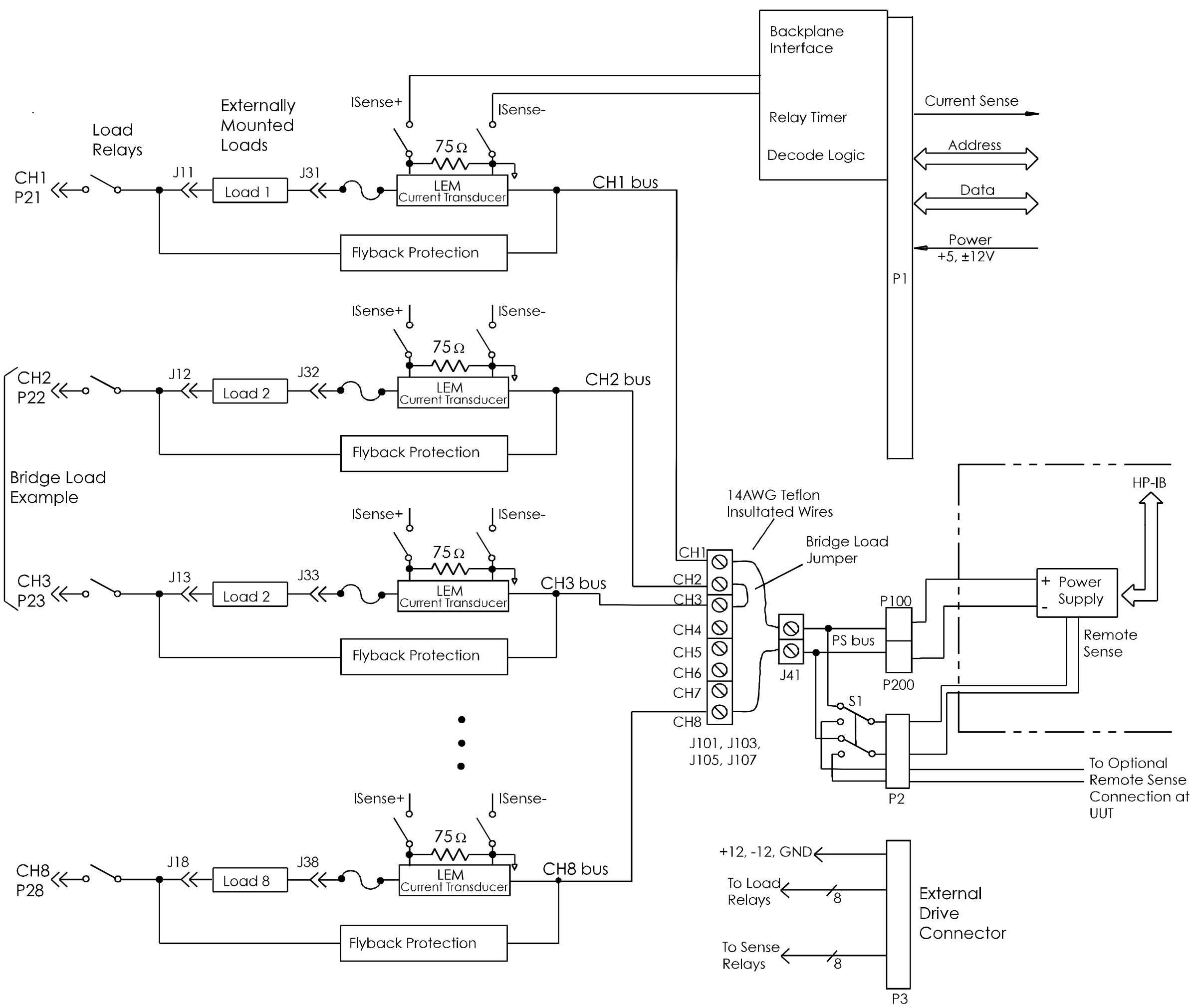


Figure 1-8. HP E6178B 8-Channel Heavy Duty Load Card Block Diagram

HP E8792A and E8793A 32-Pin Matrix Cards

Both the HP E8792A and E8793A 32-Pin Matrix Cards contain a 32 x 4 Measurement Matrix for switching signals to and from the Analog Bus. The HP E8792A also contains a 16 x 5 Instrument Matrix that connects external measuring instruments to the Analog Bus. Figure 1-9 is a simplified block diagram showing how the HP E8792A and E8793A are typically used together in a system. As shown in Figure 1-9, if you need more UUT connections, simply add more HP E8793A 32-Pin Matrix Cards to the bus.

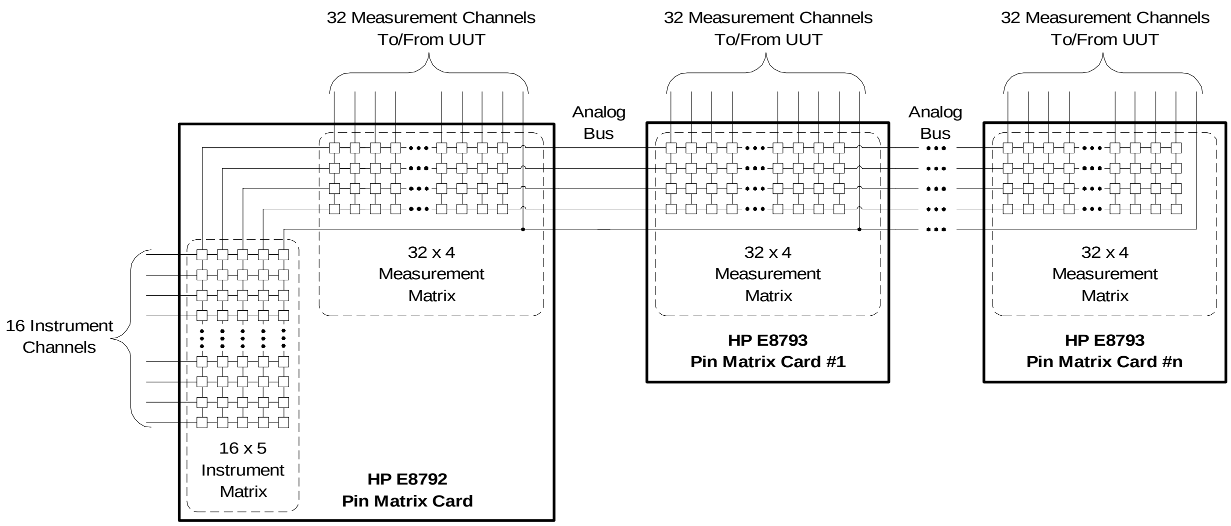


Figure 1-9. Pin Matrix Cards Conceptual Overview

Note The AUX channels are not shown in Figure 1-9. Refer to Chapter 4 for detailed schematics of the 32-pin matrix cards.

HP E8794A Custom Card

The HP E8794A Custom Card is used as a general-purpose breadboard card for system integrators to add custom circuitry. The Custom Card contains a breadboard area of through-holes on 0.1" centers for soldering custom circuitry (see Figure 1-10). The Custom Card can also be used to emulate the HP TS-5430 Series I, refer to Chapter 5 for details.

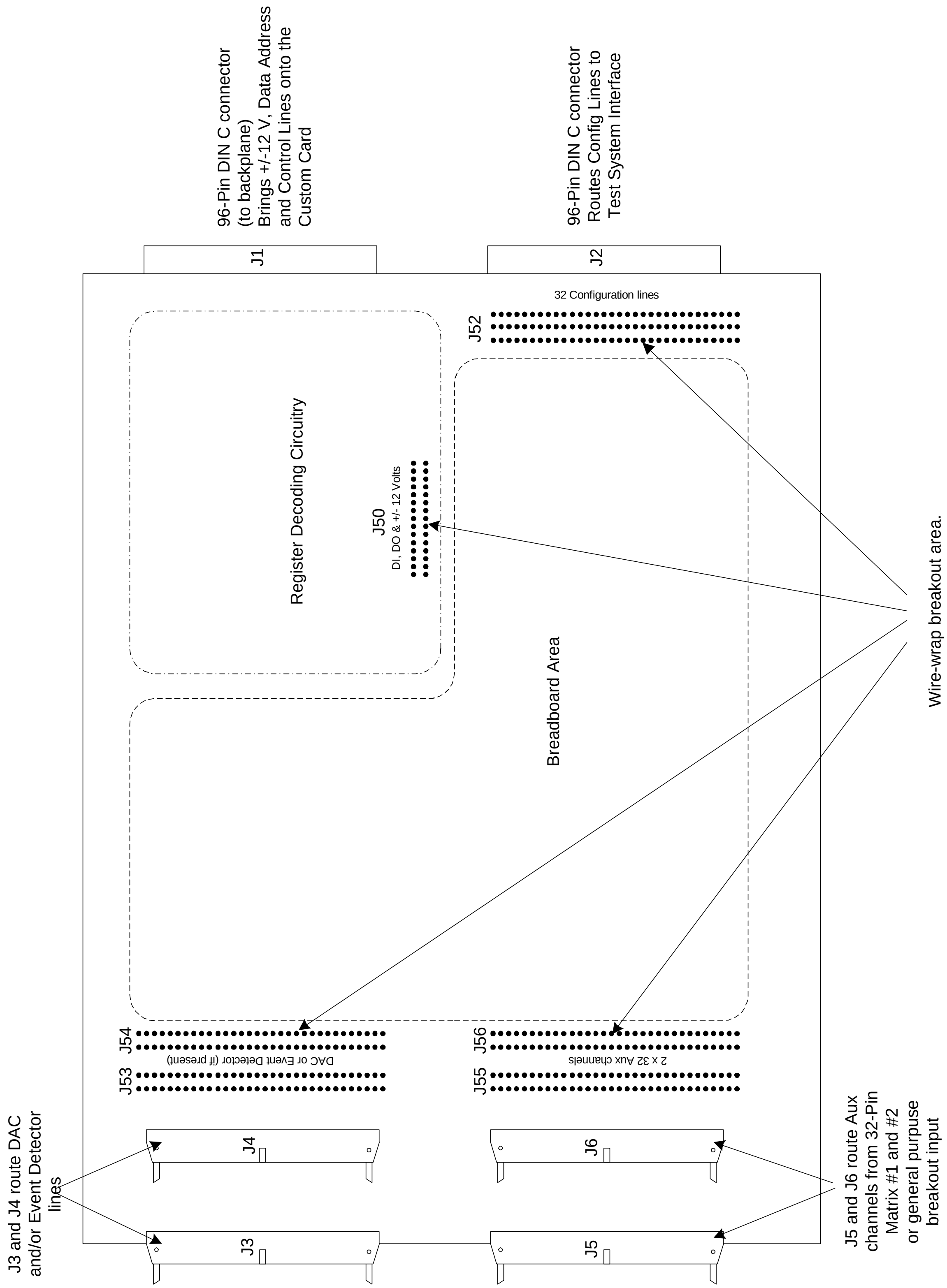


Figure 1-10. Custom Card Features

Chapter 2
Configuring the Switch/Load Unit

This chapter shows how to configure the Switch/Load Unit. Chapter contents are:

WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the Switch/Load Unit or plug-in cards. Before you remove any installed card, disconnect AC power from the mainframe and from other cards that may be connected to the cards.**

Caution **STATIC ELECTRICITY. Static electricity is a major cause of component failure. To prevent damage to electrical components, observe anti-static techniques whenever removing a card from the Switch/Load Unit or whenever working on a card.**

Card Location Recommendations

This section describes the factory default card installation locations. By adopting these installation defaults, consistency from system to system is maintained. As well, locations are reserved for future expansion if required.

For a single HP E6198A Switch/Load Unit installed in the system

- · Install matrix cards first. Slots 15 through 21 are reserved for the matrix and custom modules. Starting from slot 21 and working down, install matrix modules and custom modules in the following order:

  a. HP E8792A 32-Pin Matrix and Instrument Multiplexer Card
  b. HP E8793A 32-Pin Matrix Card(s)
  c. HP E8794A Custom Card(s)

- · Install the load cards using the following rules:

  HP E6177A 24-Channel Load Cards
  The HP E6177A 24 channel cards are installed first starting at slot #1. To allow for future expansion, leave an open slot after the last E6177A card.

  HP E6176A 16-Channel Load Cards
  The HP E6176A 16 channel cards are installed next. These cards are installed in the slots following the last 24 channel card (keeping in mind that a slot following the last 24 channel card is left open for future use). To allow for future expansion, leave an open slot after the last E6176A card.

  HP E6178B 8-Channel Heavy Duty Load Cards
  HP E6178B 8 channel Heavy Duty cards require 2 slots each. These cards are installed in even slot locations only. Install E6178B cards starting with the first available even slot following the 16 channel cards (allowing one slot open for future expansion).

  HP E6175A 8-Channel Load Cards
  HP E6175A 8 channel cards require 2 slots each. These cards are installed in even slot locations only. Install E6175A cards in first available even slot following the E6178B 8 channel Heavy Duty cards.

For example, Figure 2-1 shows the standard locations for matrix and load cards for a system which contains three matrix cards, a custom card, two 24 channel, four 16 channel, one 8 channel, and one 8 channel heavy duty load card. If using this configuration, be sure to leave the slots open between the cards, as shown in the figure.

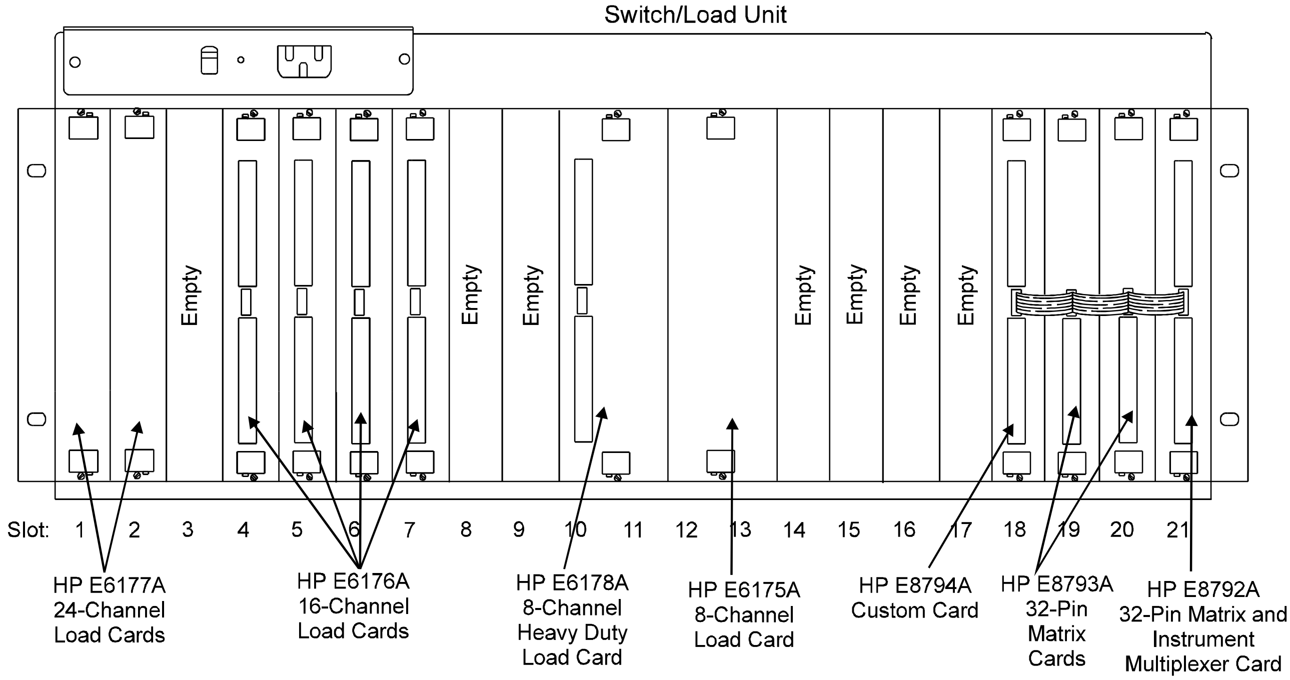


Figure 2-1. Example of Load/Matrix/CXustom Cards Loading Order

Load Card Types and Configuration ID

The available Load Cards and their associated Load Card types are:

- HP E6175A 8-Channel cards—Card type is 1
- HP E6176A 16-Channel cards—Card type is 2
- HP E6177A 24-Channel cards—Card type is 3
- HP E6178B 8-Channel Heavy Duty cards—Card type is 1

Each card is equipped with a 10 pin connector to allow assignment of a unique binary code ID number to each card. This is useful for verifying a particular configuration of Switch/Load Unit cards in the Switch/Load Unit.

The configuration pins are normally high, so the configuration value is by default FF_h. Grounding selected pins creates a binary code which can be read back through the registers on the backplane. Refer to Appendix B for register definitions.

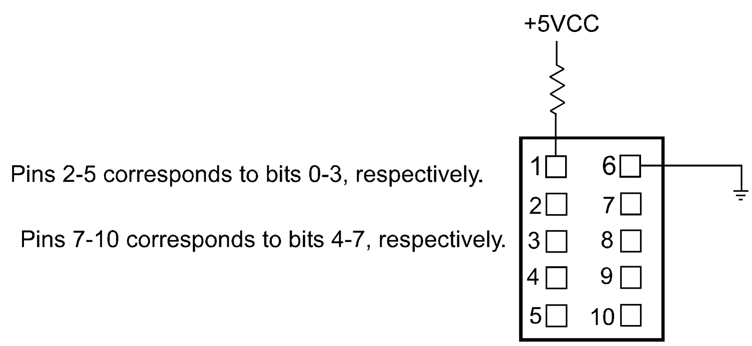


Figure 2-2. Pin Assignments on Configuration Jack

Backplane Jumpers, Connectors, and LEDs

Figure 2-3 shows the locations of the various backplane jumpers, connectors and LEDs. These components are described on the following pages.

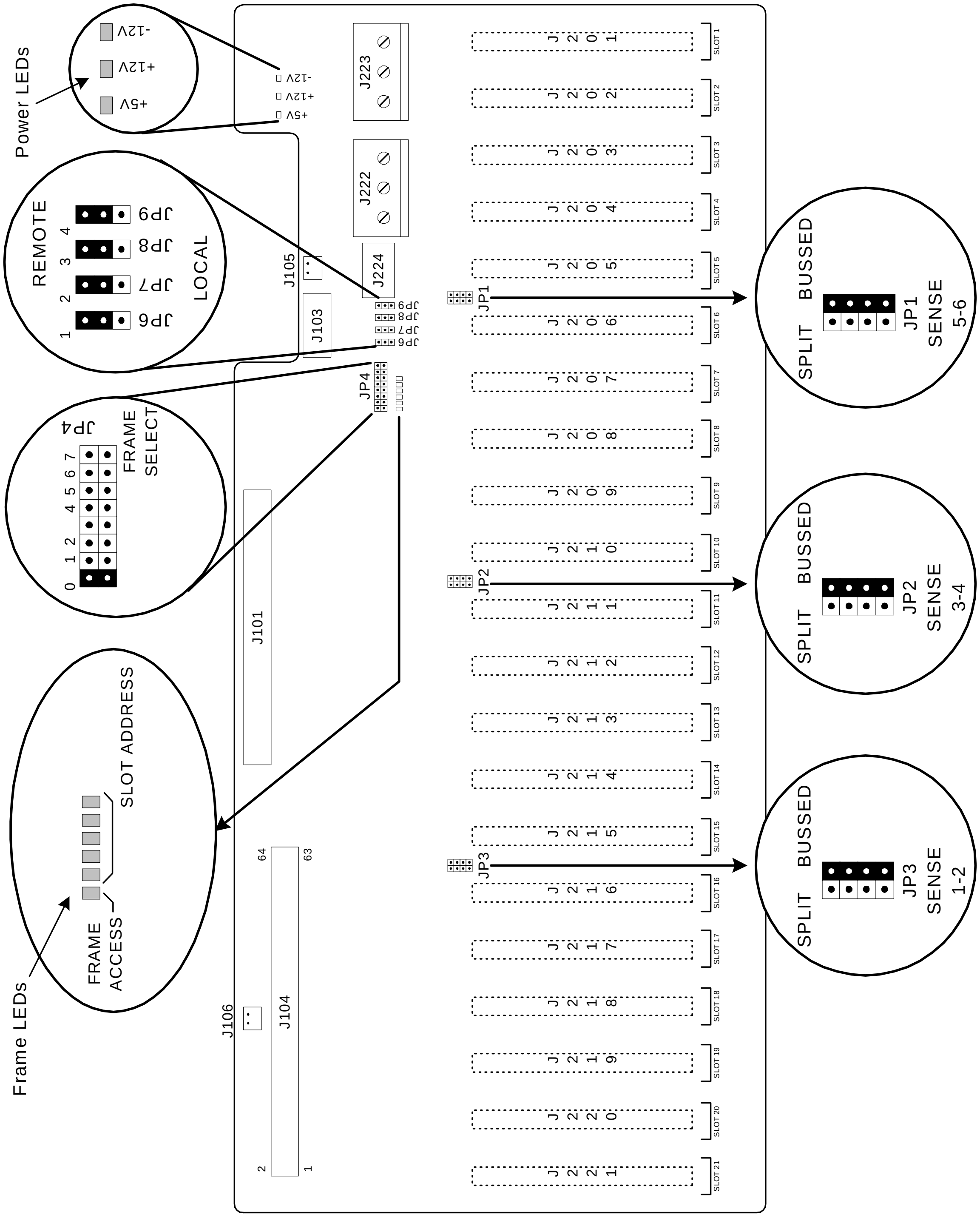


Figure 2-3. Switch/Load Unit Backplane Jumpers and Connectors (Parallel Interface Not Shown)

Backplane Jumpers

Table 2-1 shows the factory default configuration for each of the backplane jumpers.

Table 2-1. Backplane Factory Default Jumper Settings

Jumper	Default Setting	Description
JP1	Bussed	Switch/Load Unit Current-Sense Bus Jumper, Slots 1 through 5
JP2	Bussed	Switch/Load Unit Current-Sense Bus Jumper, Slots 6 through 10
JP3	Bussed	Switch/Load Unit Current-Sense Bus Jumper, Slots 11 through 15
JP4	0 (Zero)	Frame Select address 0-7. When using multiple Switch/Load Units in your test system, Jumper JP4 provides a unique address for each Switch/Load Unit. Factory default (one Switch/Load Unit) is 0.
JP6	Local	Switch/Load Unit Power Bus Sense select: Local/Remote
JP7	Local	Switch/Load Unit Power Bus Sense select: Local/Remote
JP8	Local	Switch/Load Unit Power Bus Sense select: Local/Remote
JP9	Local	Switch/Load Unit Power Bus Sense select: Local/Remote

Backplane Connectors

The following connector descriptions are referenced to Figure 2-3.

- **J103** is the Switch/Load Unit logic power supply connector. The logic supply provides the required +5 volts and ±12 volts for powering the backplane and Load Cards. Resettable fuses on the backplane protect each of the power supply lines.

- **J104** connects the signals that are cabled between the Switch/Load Unit and the mass interconnect. These signals include:

  -- **eight-bit fixture ID pins** allow the user to configure a unique ID for each mass interconnect fixture and read it back. Address 0 of the backplane is used for the fixture ID and to read back the status of reset and busy state of the backplane.
  -- **Digital In/Digital Out** eight bits each (TTL level).
  -- **Open Drain Outputs** eight bits each.
  -- **Four pairs of current sense busses** correspond to the current sense pairs from slots 1-5, 6-10, 11-15, and 16-21. These busses may be jumpered together to form a single bus, or split into independent current sense busses using jumpers JP1-JP3. Jumpers JP1-JP3 are shown in their factory default state of being bussed together. See Chapter 3, "Switch/Load Unit Backplane" for additional information and details for when you should split the busses.
  -- **Four remote power bus sense pins** remotely sense the power busses at the UUT. Remote or local sensins is set by jumpers JP6-JP9 for power bus PB1-PB4 respectively. The factory default is to sense the power supplies as remote.

-- **DAC 1 and 2 outputs**

- **J201-J221** are the Load Card slot connectors for Load Card slots 1-21, respectively. The top half of each Load Card connector is used to provide slot power, address, data, and control lines. The bottom half of each connector is used to connect the power busses to the Load Cards.

- **J222 and J223** provide the high power connections to power busses PB1-PB4. Three supplies with a common connection to PB1 or two independent supplies can be configured on the four power busses. Bulk bypassing between power busses may be desirable in certain applications.

- **J224** provides the sense connections for the four power busses.

Backplane LEDs

Two sets of LEDs are provided on the backplane for a visual indication that the Switch/Load Unit is functioning:

- **Power LEDs.** The +5V, +12V, and -12V LEDs indicate the status of the corresponding voltage lines from the Switch/Load Unit power supply. If one or more LEDs is NOT illuminated, the most likely problem was an overcurrent situation that opened the resettable fuse(s). To reset the fuse(s), remove power from the Switch/Load Unit for approximately 20 seconds. The fuse(s) will reset when power is re-applied.

- **Frame LEDs.** The Frame Access LED flashes to indicate a data access has occurred to that Switch/Load Unit. The five Slot Address LEDs indicate the slot currently being addressed.

J104 Pinouts

Switch/Load Unit backplane connector J104 carries such signals as the Digital I/O, DAC 1 and 2, and the ISense (current sense) lines. When configured as part of a standard HP system, J104 of the Switch/Load Unit is connected via cable to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make connections directly to J104 or to the exposed end of an HP E3750-61607 or HP E6170-61610 cable connected to J104. Figure 2-4 is a J104 connector pinout and Figure 2-5 shows the pinouts for the exposed cable connector end. Table 2-2 defines the signals available on J104.

Signal	Pin	Pin	Signal
DAC2	2	1	System Gnd
DAC1	4	3	System Gnd
No Connection	6	5	No Connection
System Gnd	8	7	System Gnd
System Gnd	10	9	System Gnd
Spare Supply	12	11	-12 Vdc Supply
+12 Vdc Supply	14	13	+12 Vdc Supply
+12 Vdc Supply	16	15	+12 Vdc Supply
Open Drain Out (7)	18	17	Open Drain Out (6)
Open Drain Out (5)	20	19	Open Drain Out (4)
Open Drain Out (3)	22	21	Open Drain Out (2)
Open Drain Out (1)	24	23	Open Drain Out (0)
Power Bus Sense 4	26	25	Power Bus Sense 3
Power Bus Sense 2	28	27	Power Bus Sense 1
ISense+ (4)	30	29	ISense- (4)
ISense+ (3)	32	31	ISense- (3)
ISense+ (2)	34	33	ISense- (2)
ISense+ (1)	36	35	ISense- (1)
Spare_DigOut (7)	38	37	Spare_DigOut (6)
Spare_DigOut (5)	40	39	Spare_DigOut (4)
Spare_DigOut (3)	42	41	Spare_DigOut (2)
Spare_DigOut (1)	44	43	Spare_DigOut (0)
Digital In (7)	46	45	Digital In (6)
Digital In (5)	48	47	Digital In (4)
Digital In (3)	50	49	Digital In (2)
Digital In (1)	52	51	Digital In (0)
System Gnd	54	53	System Gnd
Fixture ID (7)	56	55	Fixture ID (6)
Fixture ID (5)	58	57	Fixture ID (4)
Fixture ID (3)	60	59	Fixture ID (2)
Fixture ID (1)	62	61	Fixture ID (0)
System Gnd	64	63	System Gnd

Figure 2-4. Switch/Load Unit J104 Connector Pinouts

Cable Connector Endand Front View
(Center Column Not Used)

		A	B	C	
Row 1	System Gnd	3		1	System Gnd
Row 2	Fixture ID (0)	6		4	Fixture ID (1)
Row 3	Fixture ID (2)	9		7	Fixture ID (3)
Row 4	Fixture ID (4)	12		10	Fixture ID (5)
Row 5	Fixture ID (6)	15		13	Fixture ID (7)
Row 6	System Gnd	18		16	System Gnd
Row 7	Digital In (0)	21		19	Digital In (1)
Row 8	Digital In (2)	24		22	Digital In (3)
Row 9	Digital In (4)	27		25	Digital In (5)
Row 10	Digital In (6)	30		28	Digital In (7)
Row 11	Spare_DigOut (0)	33		31	Spare_DigOut (1)
Row 12	Spare_DigOut (2)	36		34	Spare_DigOut (3)
Row 13	Spare_DigOut (4)	39		37	Spare_DigOut (5)
Row 14	Spare_DigOut (6)	42		40	Spare_DigOut (7)
Row 15	ISense- (1)	45		43	ISense+ (1)
Row 16	ISense- (2)	48		46	ISense+ (2)
Row 17	ISense- (3)	51		49	ISense+ (3)
Row 18	ISense- (4)	53		52	ISense+ (4)
Row 19	Power Bus Sense 1	57		55	Power Bus Sense 2
Row 20	Power Bus Sense 3	60		58	Power Bus Sense 4
Row 21	Open Drain Out (0)	63		61	Open Drain Out (1)
Row 22	Open Drain Out (2)	66		64	Open Drain Out (3)
Row 23	Open Drain Out (4)	69		67	Open Drain Out (5)
Row 24	Open Drain Out (6)	72		70	Open Drain Out (7)
Row 25	+12 Vdc Supply	75		73	+12 Vdc Supply
Row 26	+12 Vdc Supply	78		76	+12 Vdc Supply
Row 27	-12 Vdc Supply	81		79	Spare Supply
Row 28	System Gnd	84		82	System Gnd
Row 29	System Gnd	87		85	System Gnd
Row 30	No Connection	90		88	No Connection
Row 31	System Gnd	93		91	DAC1
Row 32	System Gnd	96		94	DAC2

Figure 2-5. Cable Connector Pinouts

Table 2-2. J104 Signal Definitions

+12Vdc, -12Vdc Supply	+12V and -12V from the Switch/Load Unit Power Supply. The +12V supply can deliver 2.5A, the -12V supply can deliver 800mA.
Spare Supply	Connection for a user installed power supply not included in the standard system. Refer to *Connecting an Auxiliary Power Supply* in the *Switch/Load Unit User's Manual* for details.
DAC1 DAC2	The Switch/Load Unit provides two 14-bit channels of DAC which supply ±16 volts at 10 mA each.
Digital In 0 - 7 Open Drain Out 0 - 7 Spare_DigOut	The Switch/Load Unit provides 8-bits of digital input, 8-bits of open drain digital output, and 8-bits of TTL-level digital output (Spare_DigOut). There is no handshaking capability.
Fixture ID (0 - 7)	The Fixture ID allows you to configure a unique ID for each mass interconnect fixture and read it back. ID sent as TTL level bits.
Isense+ (1 - 4) Isense- (1 - 4)	These lines connect to the current sense bus on the Switch/Load Unit backplane. These lines are used for sensing current on a selected load card channel. The 8-Channel and 16-Channel High Current Load Cards are designed to connect to the current sense bus. Each load card channel's current sense lines are multiplexed so that on each card only one channel at a time can be connected to the current sense bus. The current sense lines and the slots they connect to are: Isense lines (1) connect to Switch/Load Unit slots 1 - 5. Isense lines (2) connect to Switch/Load Unit slots 6 - 10. Isense lines (3) connect to Switch/Load Unit slots 11 - 15. Isense lines (4) connect to Switch/Load Unit slots 16 - 21. Two or more sets of the above lines can be bussed together using jumpers JP1, JP2 and JP3. Refer to Figure 2-3 on page 24 for details.
Power Bus Sense 1 - 4	The remote sense lines for the power supplies connected to power buses 1 - 4.
Gnd	Chassis ground of the Switch/Load Unit.

Connecting an Additional (Spare) Power Supply

Backplane connector J106 allows you to add an additional power supply such as a +24 volt power supply for powering higher voltage relays. Figure 2-6 shows the placement and orientation on the backplane for the power supply components. Connector J106 is loaded at the factory. Capacitor C507 is not loaded at the factory and can be added to minimize high-frequency noise on the supply line. The auxiliary supply output (Spare Supply) appears on Switch/Load Unit connector J104 pin 12 and on the Test System Interface TC2 pin N4.

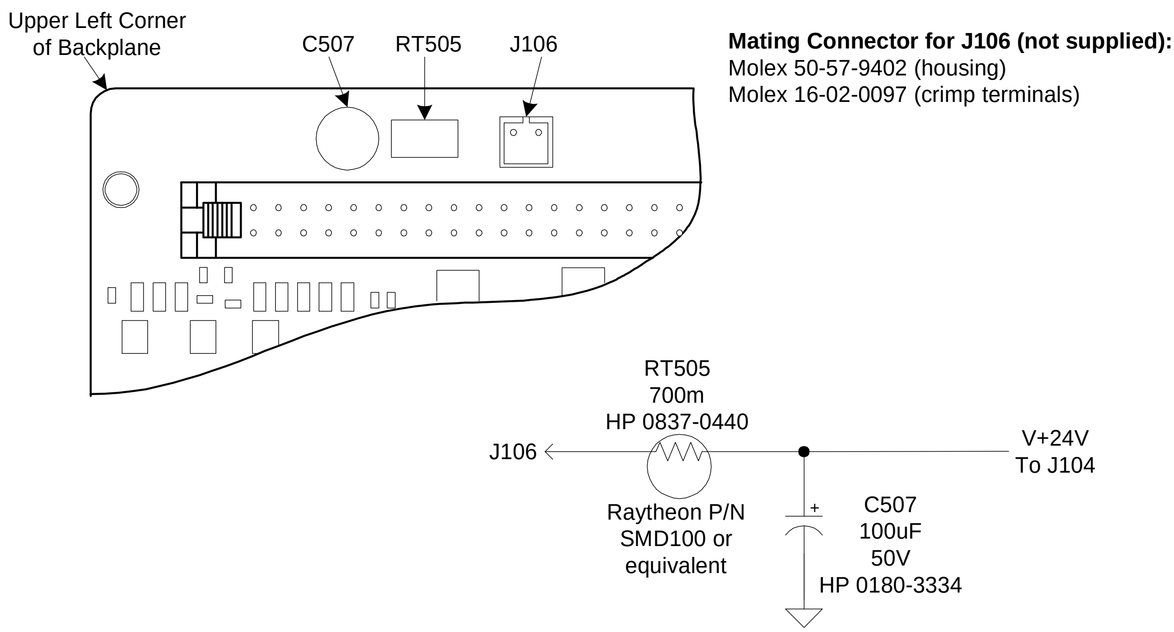


Figure 2-6. Component Location/Schematic for User-Installed External Power Supply

Configuring the Power Busses

The UUT power supplies attach to the power busses PB1-PB4. Figure 2-7 shows the power bus connectors J222 and J223 located on the Switch/Load Unit backplane PC board. These connectors use screw terminations for high current capability. The J222 connectors are bussed together on the PC board providing a common connection for up to three supplies.

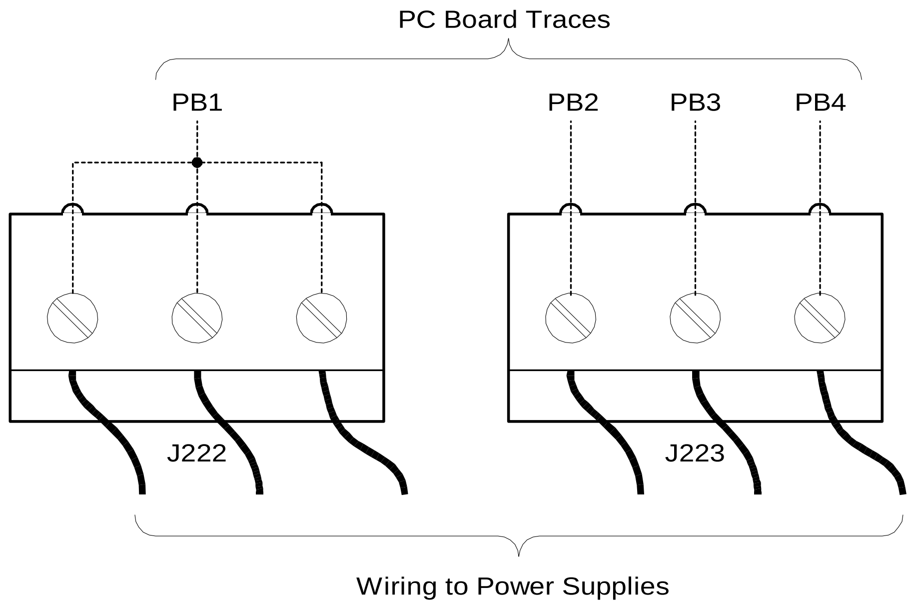


Figure 2-7. Power Bus Connectors J222 and J223

The following examples A and B show the two most common ways of configuring the power busses.

Example A shows three separate supplies attached to the busses, with all three sharing a common ground on Power Bus 1 (PB1). This is the factory default configuration. The grounds for all three supplies are connected together on connector J222.

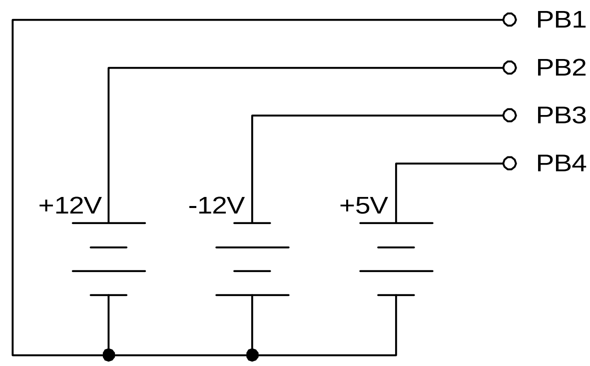


Figure 2-8. Example A: Three Separate Supplies on PB1 - PB4

Example B (available only as a special configuration) shows two isolated power supplies with separate grounds connected to the power bus. This configuration can be used if, for example, one supply requires local sensing, while the other requires remote sensing at the UUT.

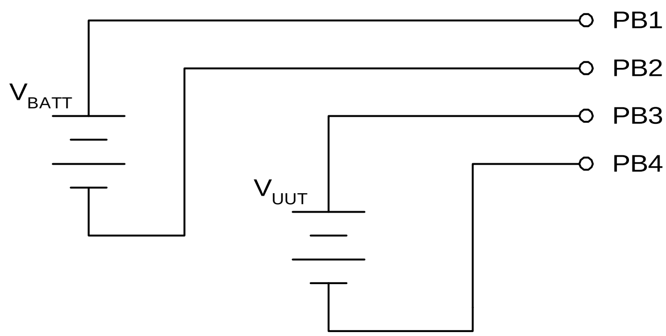


Figure 2-9. Example B: Isolated Power Supplies

Setting the UUT Power Supply Remote/Local Sense Jumpers

The UUT power supplies can be configured for either remote sense or local sense. In local sense, the voltage across the load equals the power supply voltage less the voltage drop across the cables between the load and power supply. In remote sense, the voltage across the load equals the selected power supply voltage. In this configuration, the power supply automatically increases the voltage output to compensate for the voltage drop across the cables. A conceptional view of both types of sensing is shown in Figure 2-10.

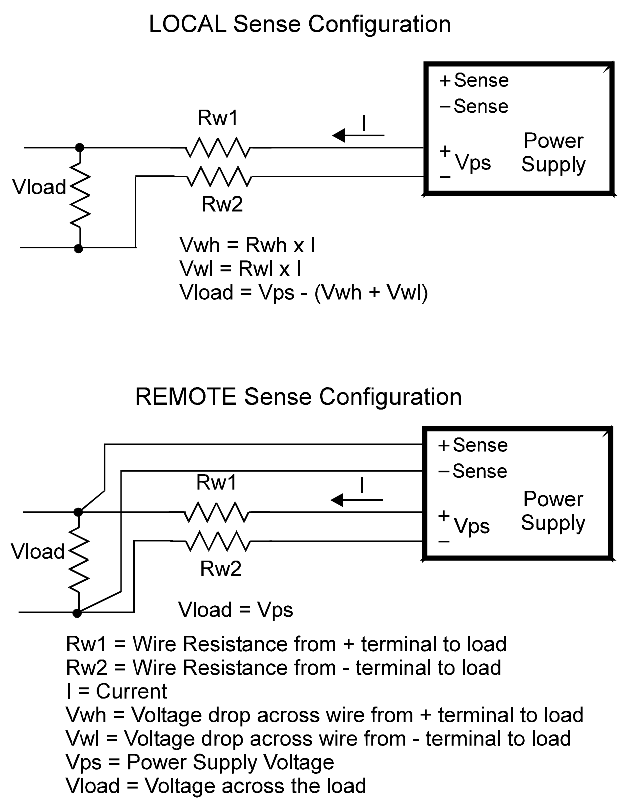


Figure 2-10. Conceptional View of Local/Remote Sensing

Set the power supply sense jumpers in the LOCAL position for sensing the power supply outputs at the PB1 - PB4 terminals. Figure 2-3 shows the jumpers to set the sensing.

Configuring the Current-Sense Jumpers

The Switch/Load Unit is shipped from the factory with the current-sense jumpers JP1, JP2, and JP3 installed in the BUSSED position forming one continuous current-sense bus along the Switch/Load Unit backplane. These three jumpers have been included so that, if necessary, the existing single current-sense bus can be split up into as many as four independent current-sense busses by changing the jumper location to SPLIT. Each independent current-sense bus provides one reading, so up to four simultaneous current-sense readings can be made at a time.

The jumpers are located between slots 5 and 6, 10 and 11, and 15 and 16. See Figure 2-3. Removing any jumper splits the current-sense bus at that point. Cards to the left of the removed jumper will now share a current-sense bus isolated from the one shared by the cards on the right side of the removed jumper.

The hardware allows each card to perform current-sense measurements on only one channel at a time. However, it is possible to command two cards sharing a common current-sense bus to attempt simultaneous current-sense readings. This can lead to a power bus to power bus short, causing confused and incorrect readings.

Note Be sure that Load Cards which will be accessed simultaneously for current-sense readings are located in slots that do not share a common current-sense bus.

Connecting the Switch/Load Unit to the Computer

The Switch/Load Unit's parallel interface connects to the computer's parallel port using a standard parallel cable (HP C2950A). Figure 2-11 shows the parallel cable connected to the Switch/Load Unit's parallel interface. Route the cable through the hole in the side of the Switch/Load Unit. Plastic inserts (provided with the Switch/Load Unit) secure the cable.

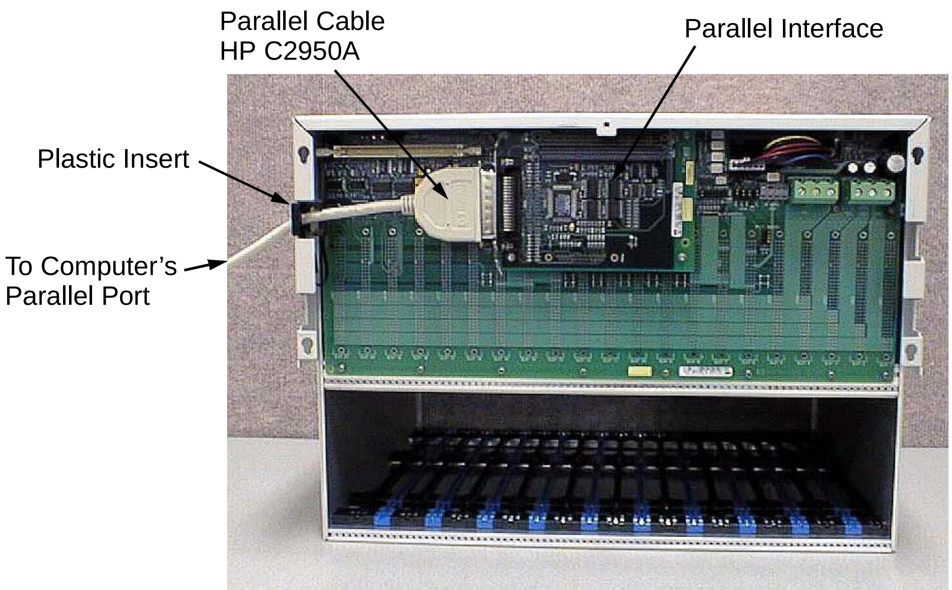


Figure 2-11. Parallel Cable Connections

Adding a Second Switch/Load Unit

You can add a second Switch/Load Unit to the system as the load requirements for the UUT exceed the capacity of a single Switch/Load Unit. The Frame Select, jumper JP4, sets the address of each Switch/Load Unit (see Figure 2-3 on page 24). The jumper can be set for any address from zero to seven. For each system, no two Switch/Load Units can have the same address. The factory default position is Address 0. As an example, you can leave the address of the first Switch/Load Unit set to 0 and set the address of the second Switch/Load Unit to 1. Figure 2-12 shows the cable connections to the second Switch/Load Unit. Route the cables through the holes in the sides of the Switch/Load Unit. Plastic inserts (provided with the Switch/Load Unit) secure the cables.

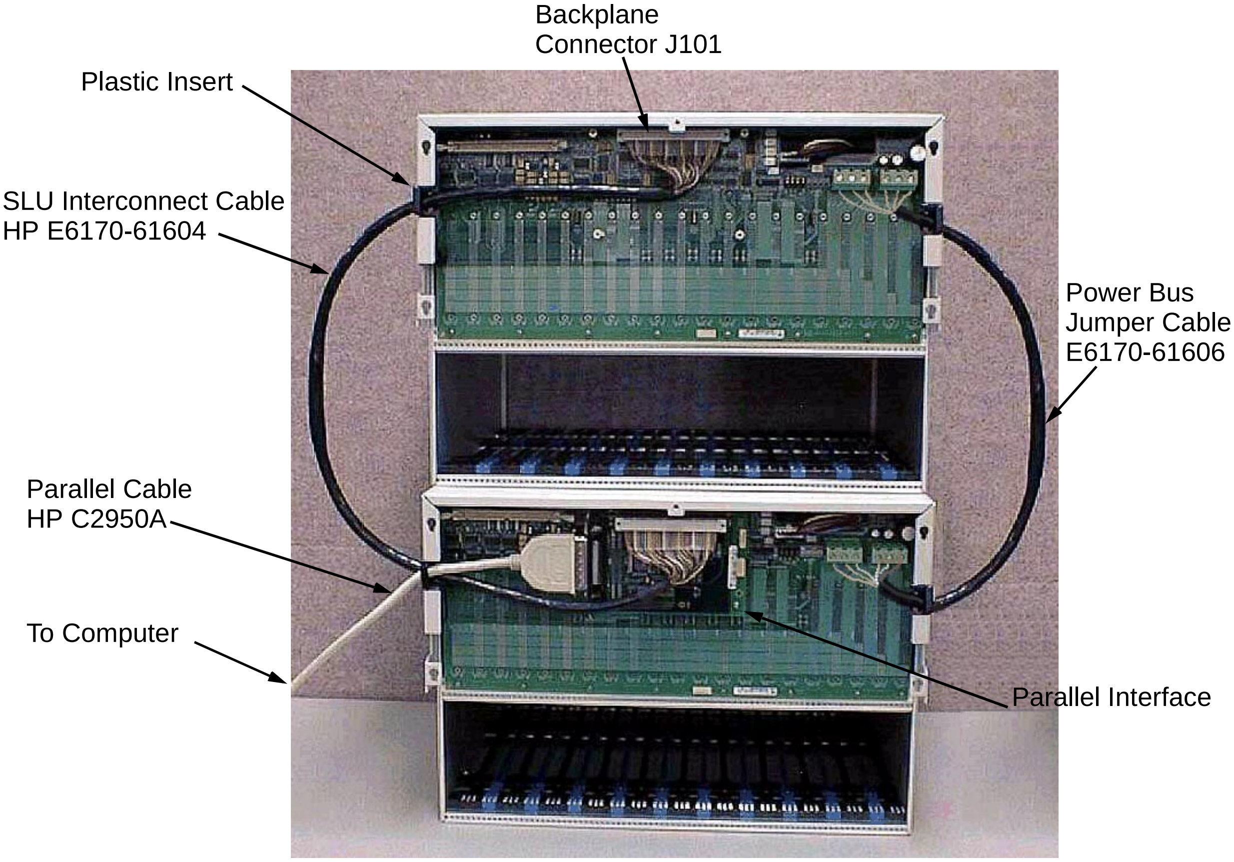


Figure 2-12. Connecting Multiple Switch/Load Units

Chapter 3

Using Load Cards and Loads

This chapter discusses how to configure load cards and how to use loads with the various load cards. Chapter contents are:

Load Card Capabilities

Table 3-1 summarizes the capabilities of each type of load card.

Table 3-1. Load Card Capabilities

Function	HP E6175A	HP E6176A	HP E6177A	HP E6178B
Number of Channels (Max.)	8	16	24	8
Number of Channels - Unshared relays	4	16	24	8
Maximum Current per Channel	7.5A (15A peak)	7.5A (15A peak)	>3 A	30A
Current Measuring with Sense Resistor	Yes	Yes	No	No
Current Measuring with Current Transducer	Yes	No	No	Yes
Flyback protection available (User Installed)	Yes	Yes	No	Yes

- The HP E6175A 8-Channel High Current Load Card, with integral current sensing, is intended to be used with loads mounted on the card. A 9-inch by 4-inch area of sheet metal is open on the front of the card for mounting loads. The card is two slots wide to allow mounting of larger loads.
- The HP E6176A 16-Channel High Current Load Card is a single-slot design, requiring externally mounted loads. This load card offers high load density for high current loads where current transducers and bridge drive configuration are not required.
- The HP E6177A 24-Channel Medium Current Load Card (for non-inductive loads) is intended to be used with loads mounted on the card. A 9-inch by 4-inch area of sheet metal is open on the front of the card for mounting small loads. This card is one slot wide and capable of up to 3A continuous carry current.
- The HP E6178B 8-Channel Heavy Duty Load Card is designed for very high current applications of up to 30A per channel.

Loads Overview

Figure 3-1 shows a conceptual block diagram of a typical load application having these four main areas:

- Power Supply,
- Load Card,
- Loads,
- Unit Under Test.

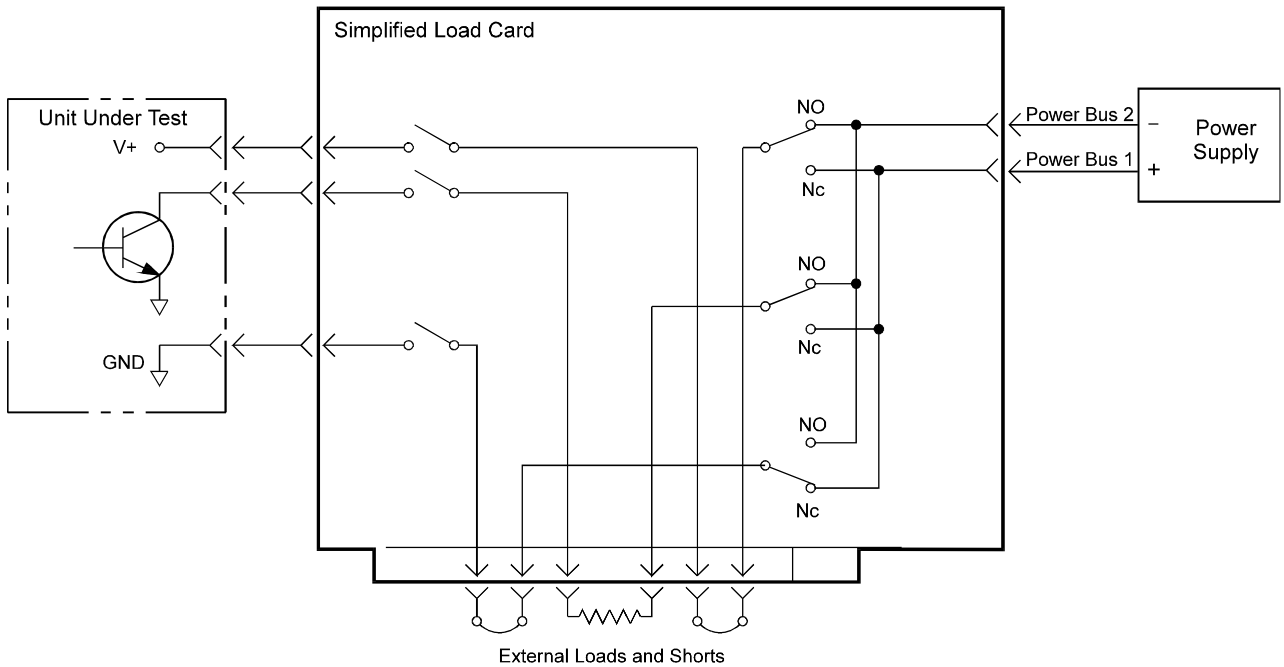


Figure 3-1. Loads/Sources Conceptual Overview

Using the Load Cards

This section describes how to configure and use the load cards.

Load Card Type and Configuration ID

Each load card type is assigned a card type number as follows:

HP E6175A 8-Channel: Card Type is 1
HP E6176A 16-Channel: Card Type is 2
HP E6177A 24-Channel: Card Type is 3
HP E6178B 8-Channel Heavy Duty: Card Type is 4

Each load card is equipped with a 10-pin connector to allow assignment of a unique binary code ID number to each card. This is useful for verifying a particular configuration of the cards in the Switch/Load Unit. Refer to Figure 3-2.

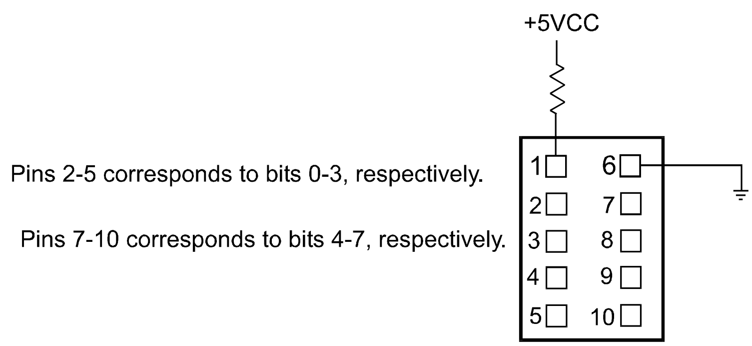


Figure 3-2. Pin Assignments on the Card Configuration Jack

The configuration pins are normally high producing a value of FF_h. Grounding selected pins creates binary codes which can be read back through the interface.

Using the HP E6175A 8-Channel Load Card

Figure 3-3 shows a block diagram of the HP E6175A 8-Channel Load Card. The card jumpers are shown in Figure 3-4. The factory default is to load a 0.05Ω, 0.1% Isense resistor in each channel. If a current transducer is preferred, the Isense resistor **must** be removed and the current transducer added as described in "Selecting a Current-Sense Method."

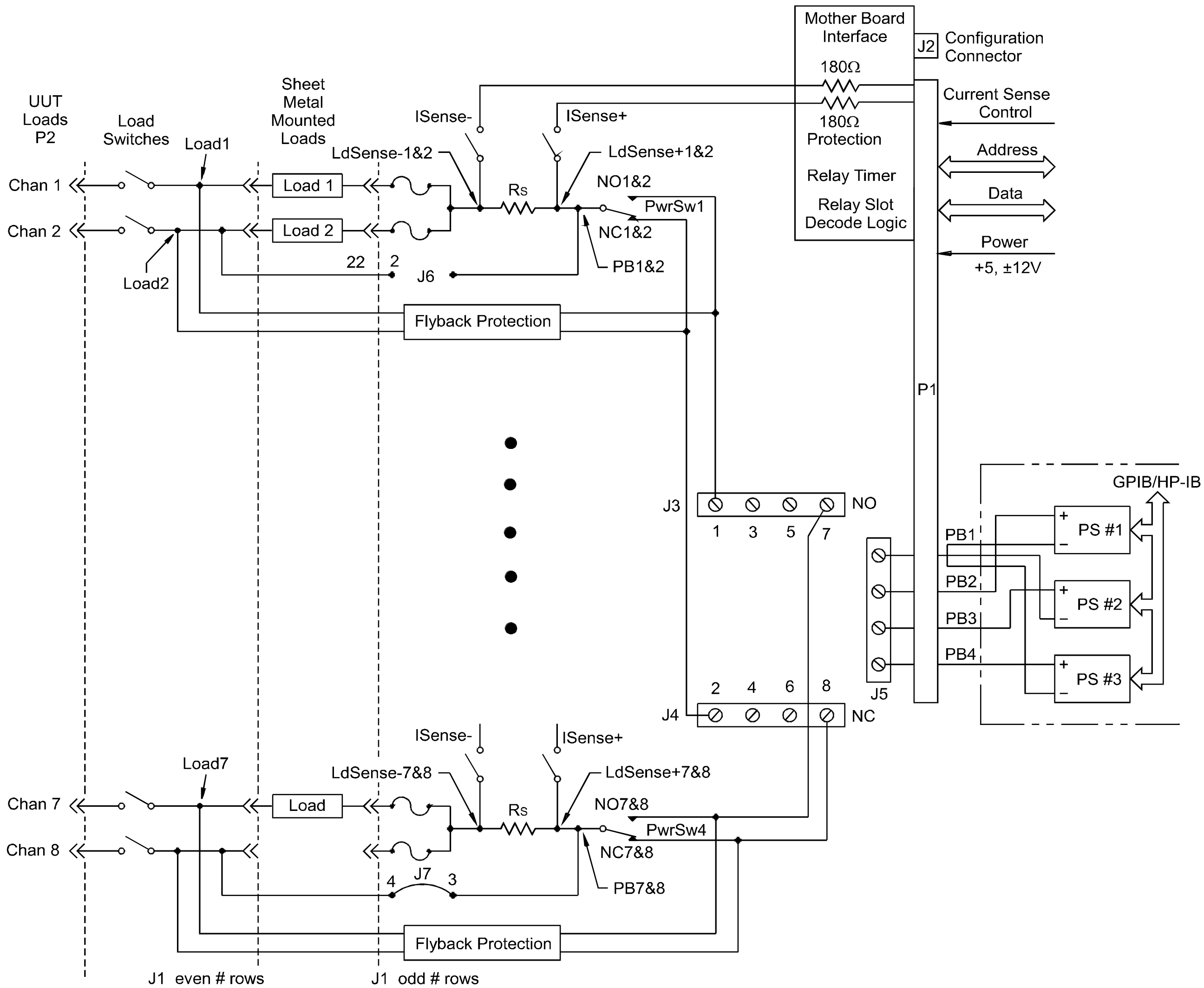


Figure 3-3. HP E6175A 8-Channel High-Current Load Card Block Diagram

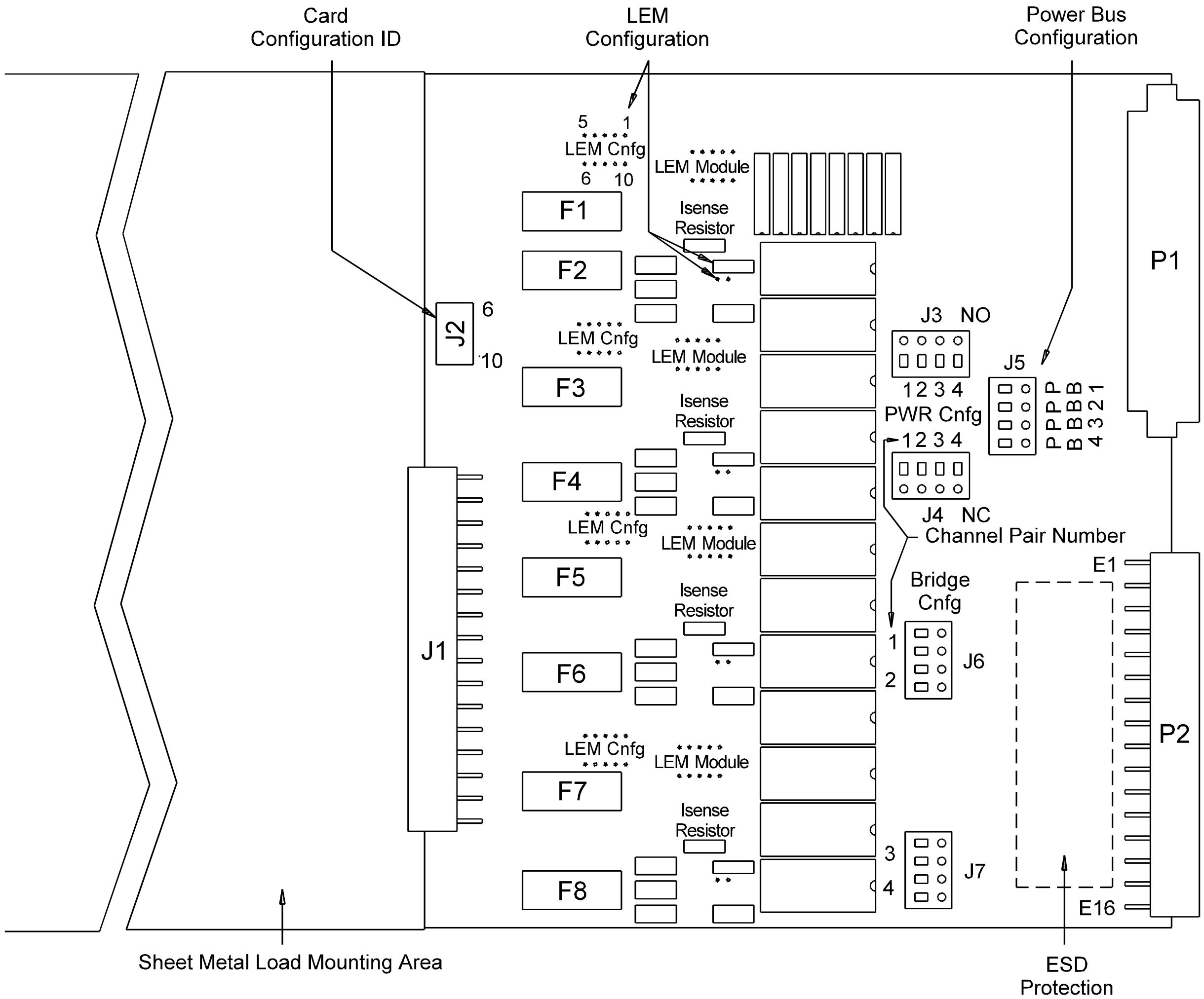


Figure 3-4. HP E6175A 8-Channel Load Card Jumpers

Selecting a Power Supply Configuration

Each channel pair connects to the power bus via a Form C SPDT (single-pole, double-throw) relay. This relay has an NO (normally-open) and an NC (normally-closed) terminal. Each NO terminal is connected to a pin on J3, and each NC terminal is connected to a pin on J4. Each pin on J3 or J4 can be connected to any of the four power bus lines on J5 via jumper wires. See Figure 3-3 and Figure 3-4. This arrangement allows convenient pull-up or pull-down of the various inputs. It also allows for terminating a UUT load at a different voltage than ground.

The factory default is to provide two jumper combs, one that ties all the pins on J3 together and one that ties all the pins on J4 together. The NO pins are jumpered to power bus 2, and the NC pins are jumpered to power bus 1. The jumper combs for J3 and J4 can be easily cut to provide bus or pin isolation between the various input/power bus connections. For example, if you use one of the channel pairs in a bridge configuration, you would probably disconnect that channel from the J4 jumper comb to eliminate possible power bus interaction.

Selecting a Current-Sense Method

There are two ways to measure current on the HP E6175A 8-Channel Load Card; using a sense resistor, or using a LA 25-NP current transducer from LEM Inc.[1] Figure 3-5 shows the relationship between the sense resistor (Rs) and the LEM module current transducer (only one or the other is used, never both).

Sense Resistors

The card comes factory loaded with a 3-watt, 0.05Ω, 0.1% sense resistor already installed. This is the lowest value sense resistor that can safely be installed. If lower value currents are being measured, requiring a larger resistance value to make the sense voltage readable, then this sense resistor can be replaced by a four-wire resistor of higher value. The sense resistor should suffice for most measurements except those that require that the measurement be isolated from high common-mode voltage transients.

Current Transducers

The load card is designed to accept a LEM current transducer (LEM module) to be inserted in the circuit in place of the current-sense resistor.

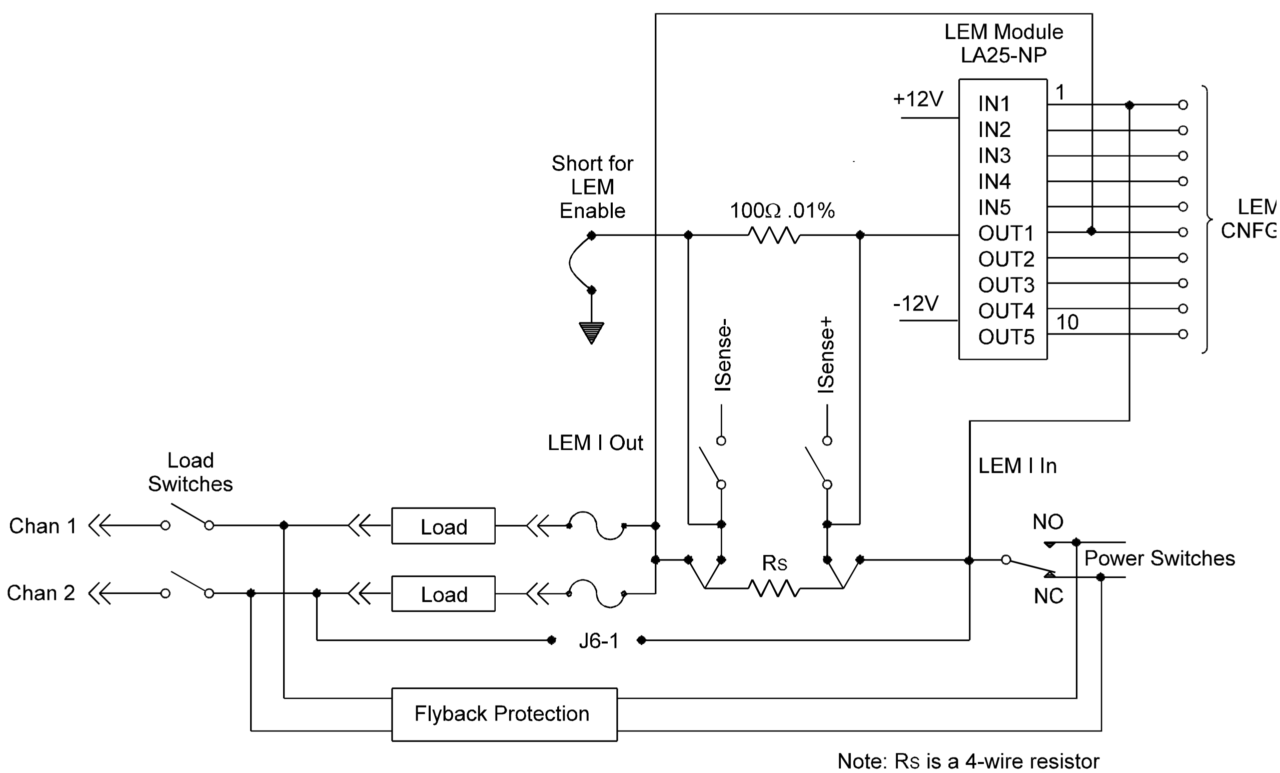


Figure 3-5. LEM Current Transducer

Installing a LEM Current Transducer

Figure 3-6 shows the component location of the current-sense section of the first two channels on the load card. The location of the components listed in Table 3-2 are silk-screened on the load card's printed circuit board. Installing

1. *This module was tested with a LEM Model LA25-NP Current Transducer from LEM USA, Inc. 6643 West Mill Road, Milwaukee, WI, 53218. (414) 353-0711*

a current transducer involves both elements of a channel pair. For example, if the LEM module were to be installed across channels 1-2:

1. Remove the 0.05Ω current-sense resistor (R1).

Caution **The current-sense resistor must be removed from the HP E6175A PC board.**

---

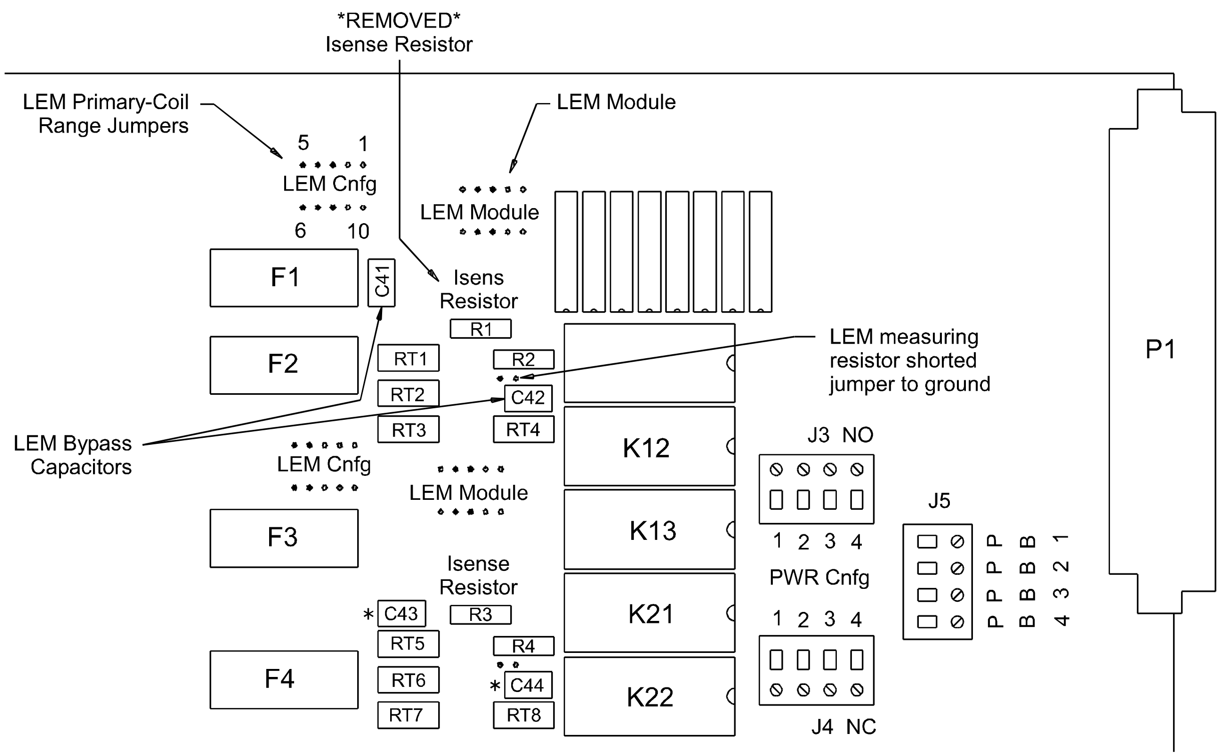
2. Install the LEM module.

3. Install the measuring resistor, R2 (preferably a 100Ω, 0.1% resistor).

4. Install the shorting jumper from R2 to ground, TP41 to TP42.

5. Install two bypass capacitors, C41 and C42, both 0.01 µF.

6. Install the appropriate primary-coil range jumpers. See Figure 3-7. Note: use a wire gauge appropriate for the current through the load.



* The LEM bypass capacitor location pattern for channels 2 & 3 is repeated for channel pairs 5-6 and 7-8.

Figure 3-6. Component Location for Installing LEM Current Transducer Module

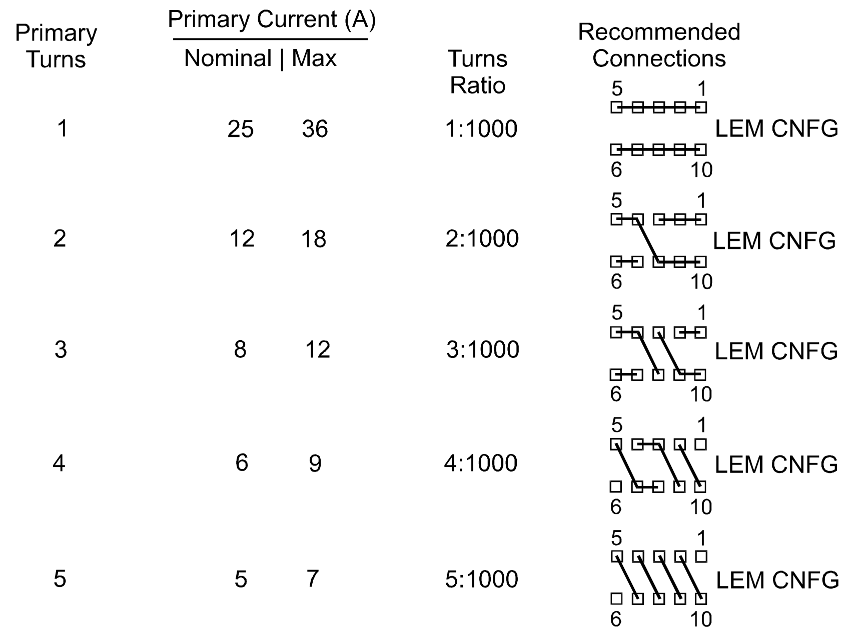


Figure 3-7. Wiring Options of LEM Model LA25-NP Primary for Various Current Ranges

Table 3-2 details the components that need to be installed/replaced for each of the two channel pairs of the HP E6175A 8-Channel Load Card.

Table 3-2. Components involved in LEM Module Installation

Channel(s)	Isense Resistor (Rmvd)	Measuring Resistor	Shorting Jumper	Bypass Capacitors (0.01 µ f)	LEM Module	LEM Tap Connection
1, 2	R1	R2	TP41 to TP42	C41 and C42	U1	See LEM module Spec. Sheet
3, 4	R3	R4	TP43 to TP44	C43 and C44	U2	See LEM module Spec. Sheet
5, 6	R5	R6	TP45 to TP46	C45 and C46	U3	See LEM module Spec. Sheet
7, 8	R7	R8	TP47 to TP48	C47 and C48	U4	See LEM module Spec. Sheet

The board was tested with a LEM Model LA25-NP[1]. Additional information about the use of this current transducer is available from the manufacturer.

Selecting and Loading Flyback Protection

Coils used as loads may have large flyback voltages which have the potential to damage other electronic components. Generally, the UUTs are equipped with flyback protection, so flyback protection on the load cards is redundant but provides additional back-up protection in case a defective UUT is tested. The system integrator is responsible for ensuring flyback protection devices are installed on the load cards.

1. *This load card was tested with a LEM Model LA25-NP Current Transducer from LEM USA, Inc. 6643 West Mill Road, Milwaukee, WI, 53218. (414) 353-0711*

Caution **The load cards are designed to handle a maximum of 500 V_{peak} flyback voltage. Operating the load cards without flyback protection installed on the appropriate channels, or with flyback voltages in excess of 500 V_{peak}, may results in damage to the load card or Switch/Load Unit.**

The HP E6175A 8-Channel Load Card comes with provisions for user-installed flyback voltage protection. Figure 3-9 is a detail of the first channel pair, channels 1 and 2, on the component locator diagram of the 8-Channel Load Card. It shows the location and polarity orientation for channel 1's (RT1 and RT2) and channel 2's (RT3 and RT4) flyback protection devices. This pattern is repeated for the other three channel pairs.

As an example, in Figure 3-8 Chan1 has two potential input lines connected to the input Form C switch K11. RT1 connects input line J4 and RT2 connects alternate input line J3, to the output of Load1. When a voltage spike occurs on the UUT that exceeds the rating on the flyback device, the device clamps the surge voltage to the device's predetermined value.

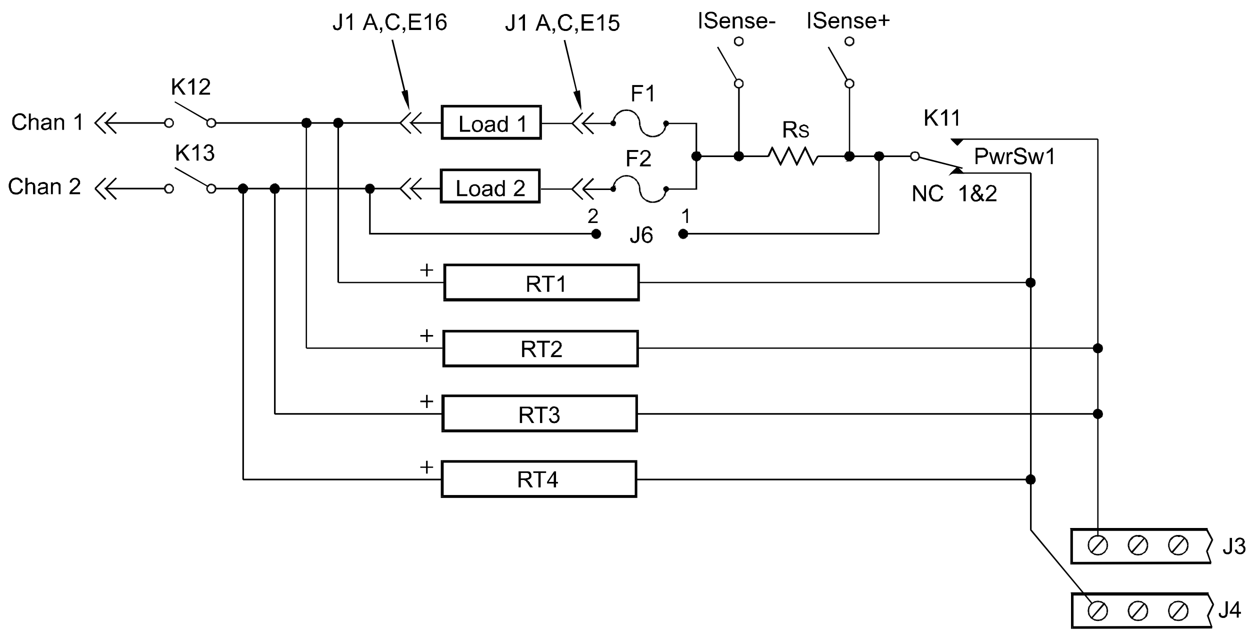


Figure 3-8. 8-Channel Load Card Detail - Flyback Protection Circuit

The flyback protection devices should be installed with the positive side towards the UUT. On each of the four channel pairs the high (+) side should be located as shown in the component locator diagram, Figure 3-9.

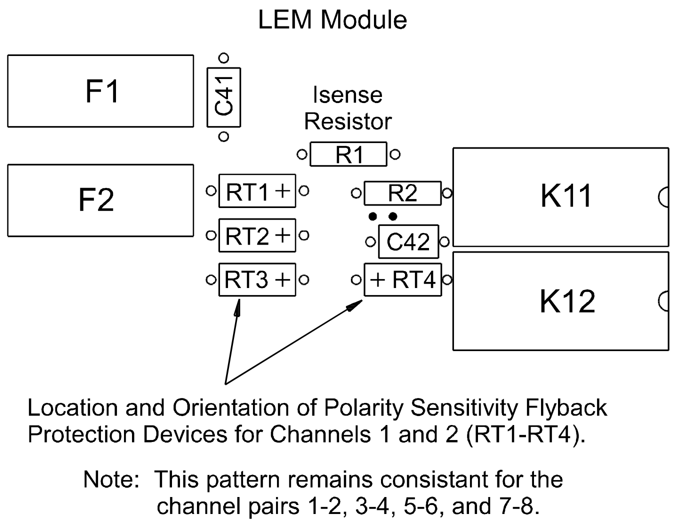


Figure 3-9. HP E6175A Flyback Protection Polarity

Protection Devices

MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.[1] Refer to Figure 3-10. Zener Diode, MOV (Metal-Oxide Varistor) or Transzorb® devices mounted at RTx or RTy (2 required per load - 1 at NC and 1 at NO) provide current path for the inductive load flyback. Select the protection device so that it conducts at a voltage higher than the UUT's internal protection. If the device's internal protection fails, then the added external protection conducts to protect the UUT and the load card.

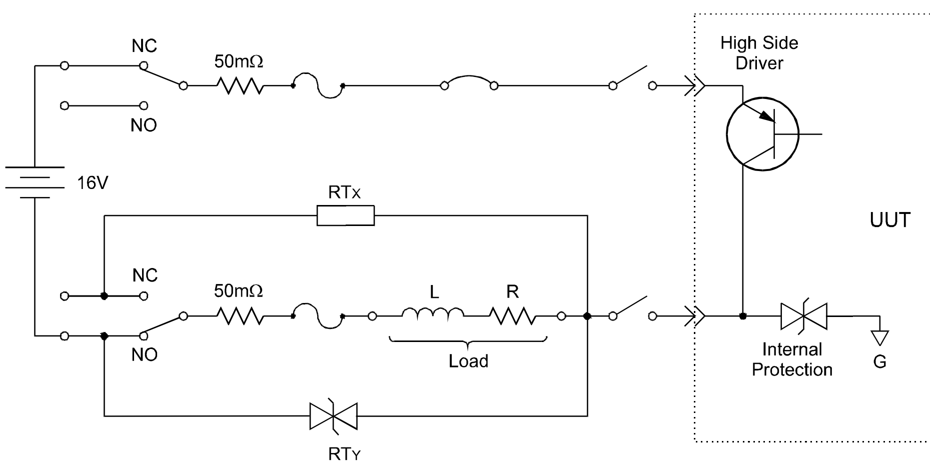


Figure 3-10. Typical HP E6175A Load Card Flyback Protection Circuit

Typical small MOV (3mm) axial lead mounted specifications are:
Continuous DC voltage: 220 V
Transient energy (10/1000mS)[2]: 0.90 Joules (watt-seconds)

1. *The card was tested using a General Electric GE MOV II, MA series MOV.*
2. *10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.*

Transient peak current (8/20mS)[1]: 100 Amperes
Varistor voltage @ 1.0mA DC: 300 Vdc Max
Maximum Clamping Voltage (8/20mS): 450 volts
Capacitance: 17 pF

Typical Transzorb® specifications are:
Breakdown voltage: 300V max at 1mA
Reverse Standoff voltage: 250 volts
Maximum reverse leakage: 5mA
Maximum peak pulse current: 5A
Maximum Clamping voltage: 400 volts
Maximum temperature coefficient: 0.110 %/°C

Selecting a Load Fuse

The load fuses used are IEC 5x20 mm, 5-ampere slow-blow. These fuses may be replaced by larger fuses if required by your equipment, but not to exceed 8 amperes. In any event, the maximum fuse rating must not exceed an I^2T value of 102-126.[2]

Sample Load Configurations

Four sets of tandem loads, each set sharing a current-sense resistor, may be mounted on the HP E6175A Load Card. You may need to drill holes in the sheet metal to attach the loads. On the eight-channel load card, the pairs are labeled 1 through 4 on the PC board silkscreen. For example, the load card could be configured to supply a power source and power ground to a module and measure the total current consumed by the module. Figure 3-3 shows four other examples of how loads could be configured.

In the NPN Pull-up example #1 (Figure 3-11-top), power switch one (PwrSw1), in its normally-closed state, supplies power to the first load. When the load switch connected to the NPN transistor output driver is closed, the current can be sensed at the external DMM when the corresponding Isense MUX relays are closed. The ground return in this example is assumed to be switched through another load card or connected directly to the UUT.

In the multiplex load example #2 (Figure 3-11-middle), a single load is shared by three load switches and may be configured as either a pull-up or pull-down through jumpers to J3 or J4 to J5. The solder-in jumpers are installed by the system integrator to allow the sharing of a load. The multiplexed load switches may be closed individually or in tandem as required to perform the test.

In the PNP pull-down example #3 (Figure 3-11-middle), power switch three (PwrSw3), in its normally closed state, supplies a switched ground to the PNP transistor. The positive source to the transistor is assumed to be switched through another load card to the UUT.

In the bridge load example #4 (Figure 3-11-bottom), both load switches and

1. *8/20mS refers to a standard pulse of 8mS rise and 20mS to 50% decay of peak value.*

2. *The I^2T figure is an industry standard term. If, for example, a fuse with a rating of I^2T = 100 experiences a current surge of 10A, it can maintain that current for 1 second before its capacity is exceeded. (10A * 10A * 1 Second = 100)*

power switch four (PwrSw4), through the bridge configuration jumper J7, are used to provide a sensed current path for pin-to-pin loads on the UUT. Each channel pair (1 through 4) is indicated by J6-1, J6-2, J7-3 and J7-4. In this example, both the power source and power return are assumed to be switched through another load card to the UUT.

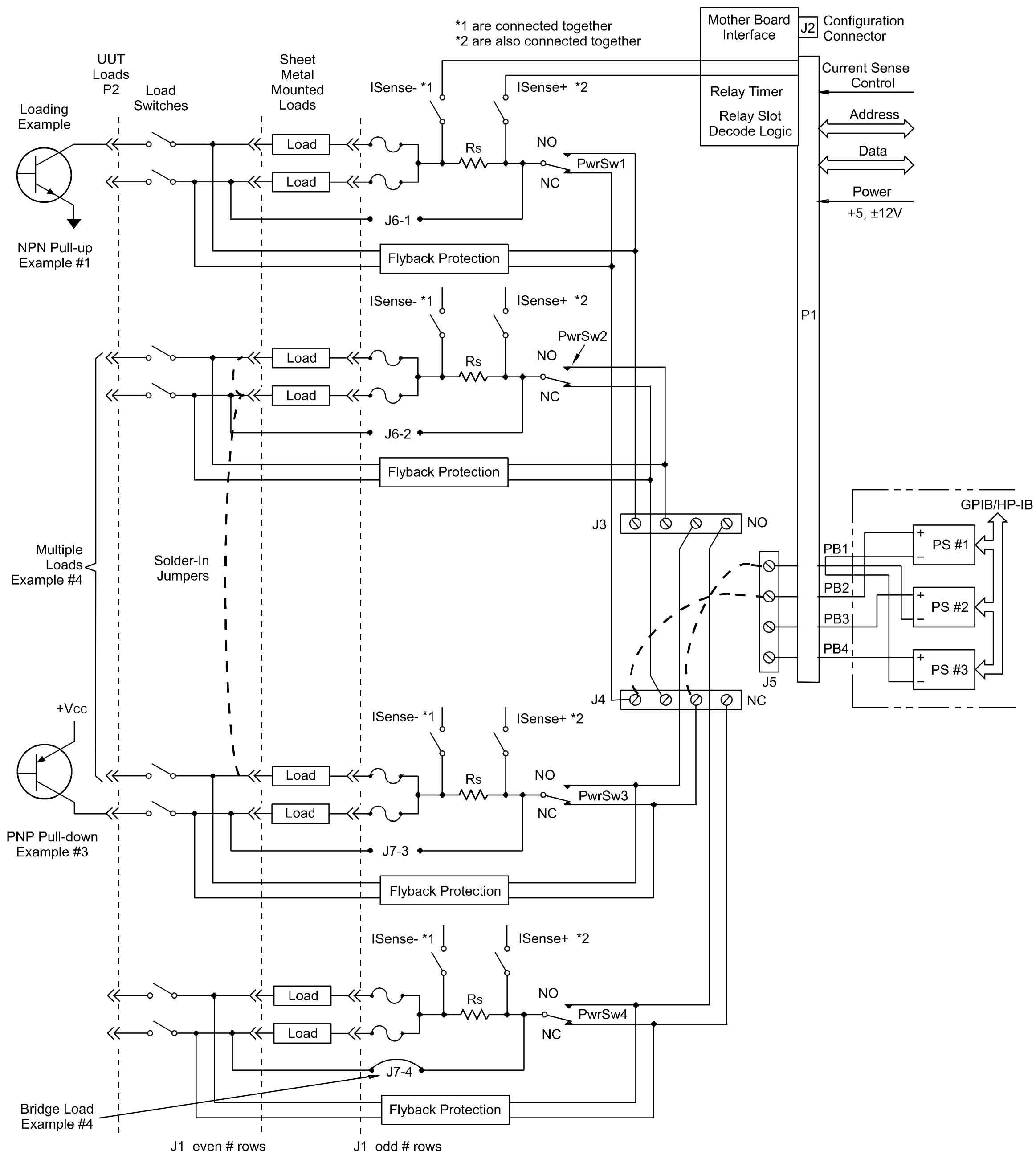


Figure 3-11. HP E6175A Load Examples

Setting up a Bridge Configuration

In the bridge configuration the power bus power supplies are not used. The power for the bridge is supplied by the module; the connection to the UUT power supply is effectively bypassed. See Figure 3-12.

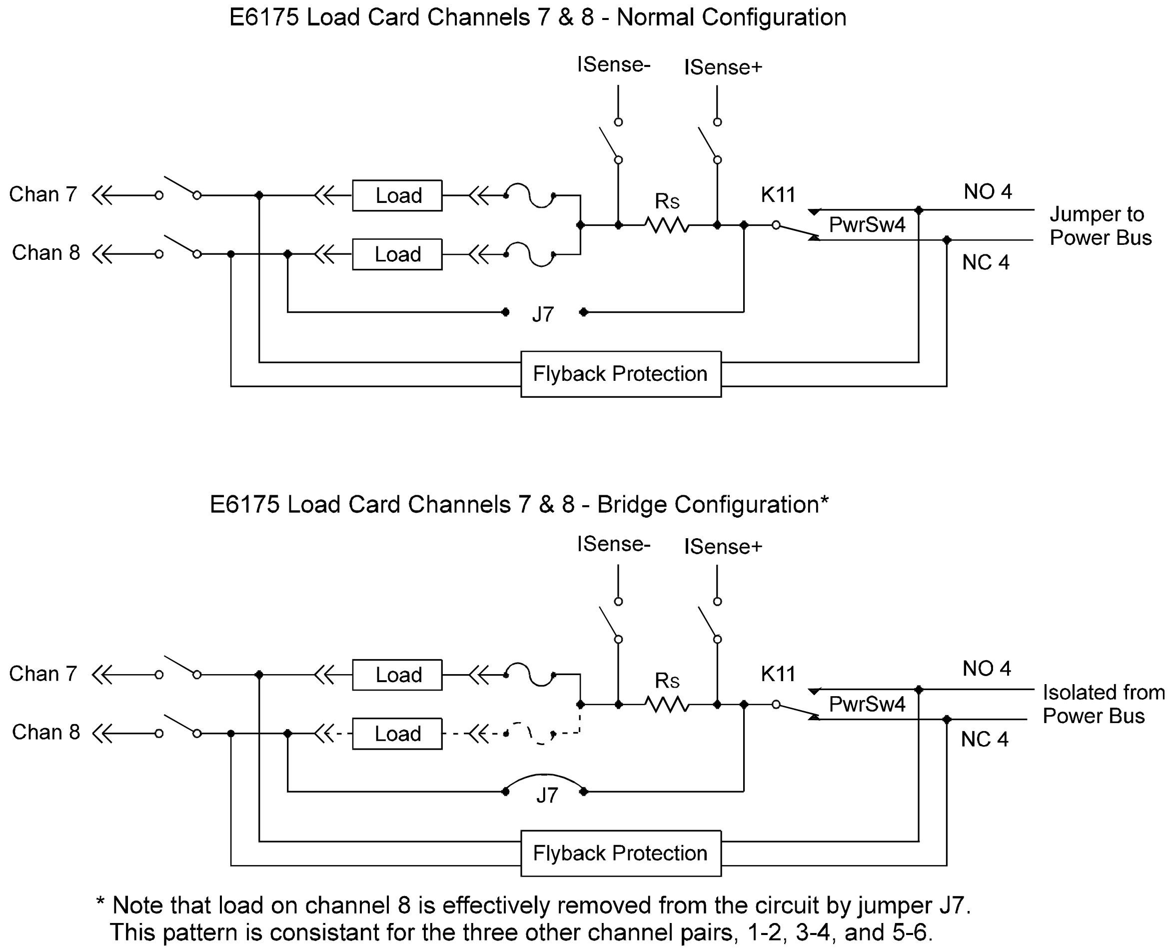


Figure 3-12. Bridge Configuration for Channels 7 and 8 on 8-Channel Load Card

Use the following table to determine the appropriate pins on J6 and J7 to jumper to create a bridge circuit on the indicated channels.

Bridge Circuit on:	Jumper Pins:
Channels 1 and 2	J6, 1 and 2
Channels 3 and 4	J6, 3 and 4
Channels 5 and 6	J7, 1 and 2
Channels 7 and 8	J7, 3 and 4

Bridge load flyback protection may be installed to power busses as a normal load if jumpered, or channel to channel by installing protection devices across the bridged channels.

Connecting Loads

Loads are mounted on the HP E6175A's sheet-metal mounting area. The loads are wired to connector P1 which mates to the HP E6175A's J1 connector. Figure 3-13 shows the HP E6175A's load mounting area and connectors J1 and P1.

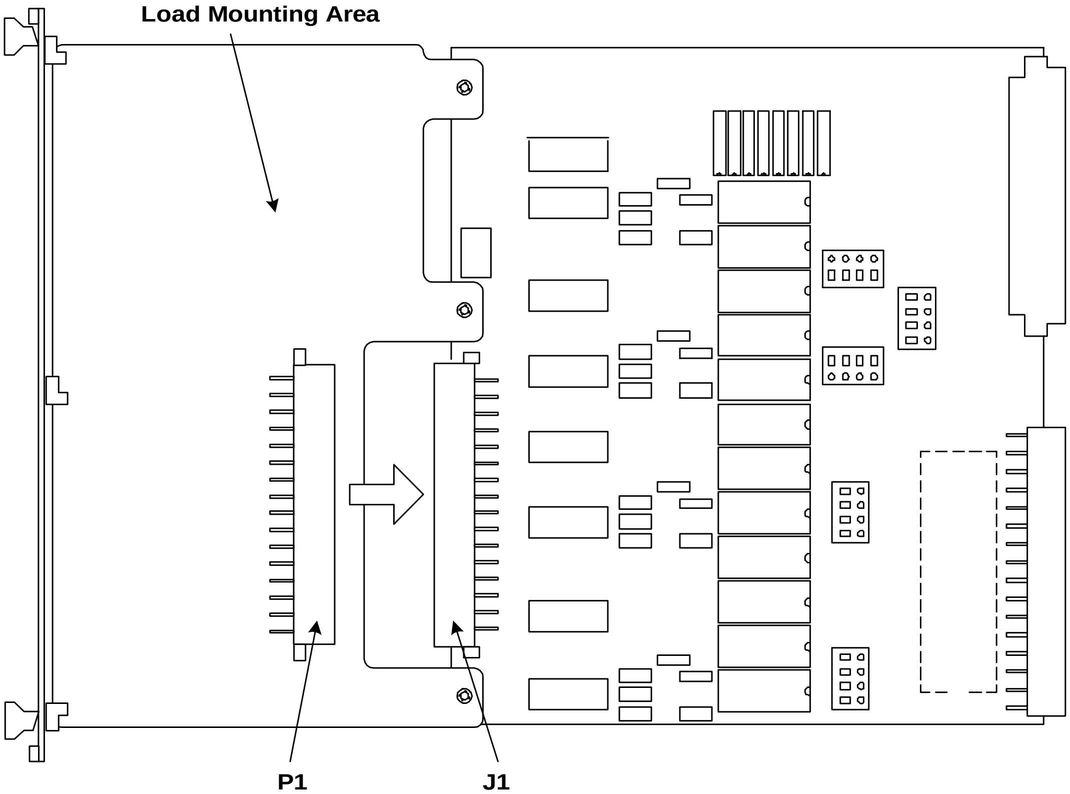


Figure 3-13. HP E6175A Load Mounting Area and P1/J1 Connectors

You can also use HP E3750-61619 cables (two cables per load) which connect directly to J1.

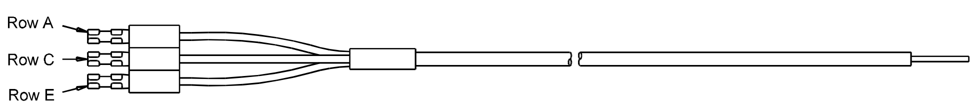


Figure 3-14. HP E3750-61619 Cable

Load Wiring

Figure 3-15 is a simplified schematic and P1 connector pinout showing how loads are connected to P1. Load 1 connects to Channel 1 (P1 row 16) and Power 1 (P1 row 15); Load 2 connects to Channel 2 (P1 row 14) and Power 2 (P1 row 13), and so on.

Caution **To prevent premature pin failure from excessive current flow, when connecting high-current (>3 amp) loads to P1, wire across all three pins in each row (see Figure 3-16 on page 52).**

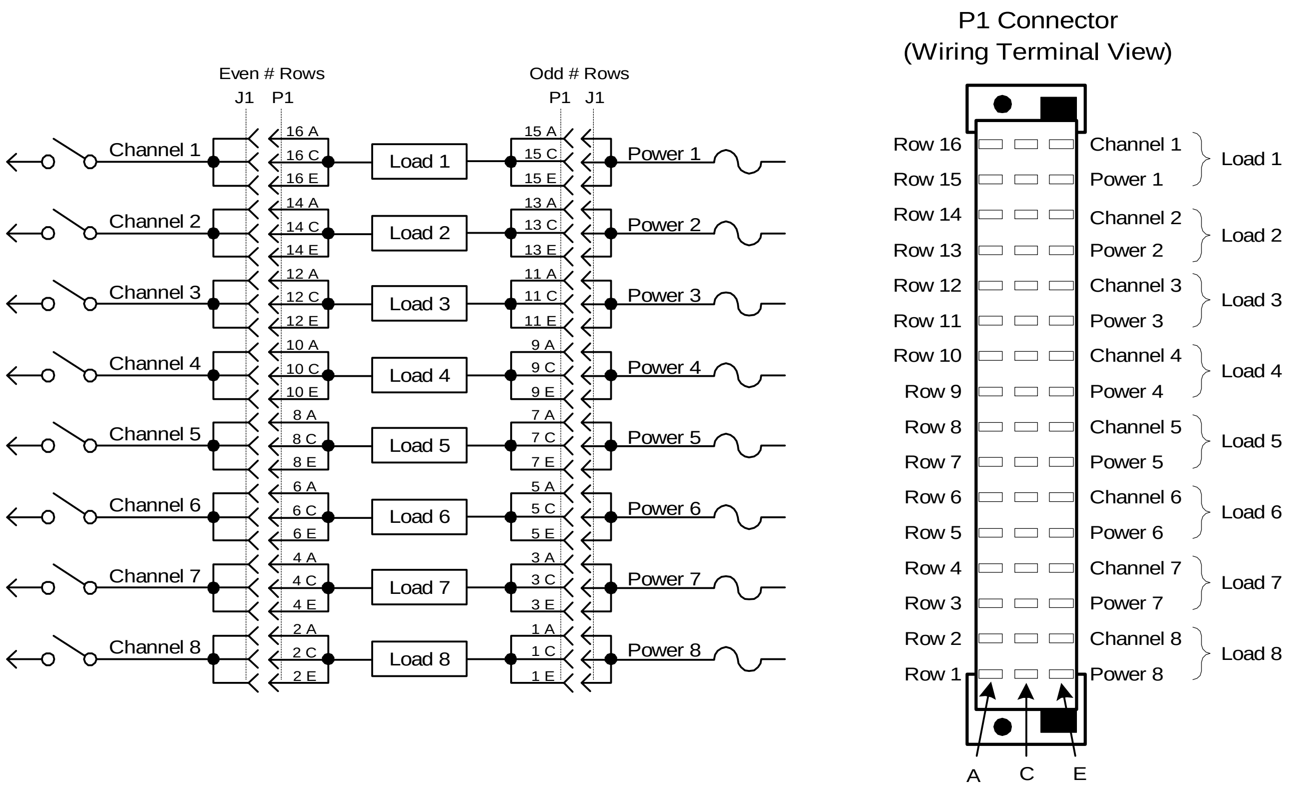


Figure 3-15. HP E6175A Load Wiring Schematic and P1 Pinouts

Current Sharing

Notice in the wiring schematic (Figure 3-15) that pins A, C and E in each row of J1 are connected together on the PC board. When connecting high-current (>3 amp) loads, wire across all three pins in each row of P1 (see Figure 3-16). This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

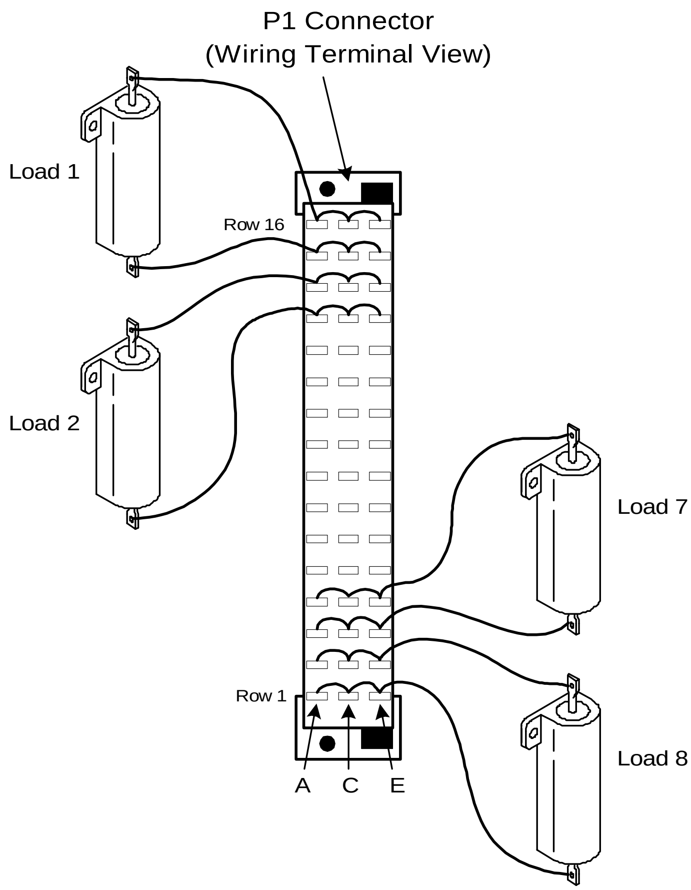
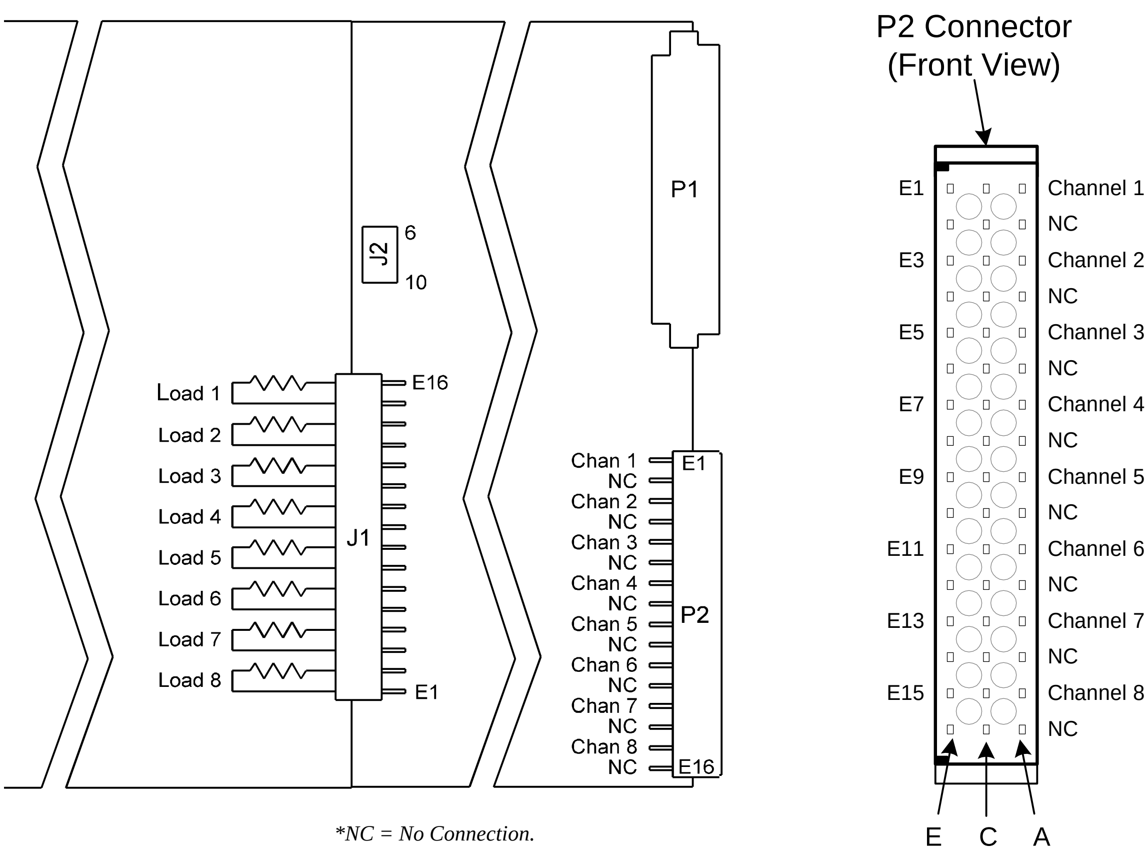


Figure 3-16. HP E6175A Current Sharing Example

UUT Connections

When configured as part of a standard HP system, P2 of the load card is typically connected via cables to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make connections directly to P2. Figure 3-17 is a P2 connector pinout showing the details. Each even-numbered row of P2 represents a single load card channel. The three pins in each row are connected together on the PC board for current sharing. When making UUT connections, wire across all three pins in each even-numbered row. This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.



**NC = No Connection.*

Figure 3-17. HP E6175A 8-Channel High-Current Load Card UUT Connections

Using the HP E6176A 16-Channel Load Card

A block diagram of the HP E6176A 16-Channel High-Current Load Card is shown in Figure 3-18. The load card jumpers are shown in Figure 3-19. The factory default configuration is explained in "Selecting a Power Supply Configuration" on the next page. The factory default is to load a 0.05Ω, 0.1% Isense resistor in each channel.

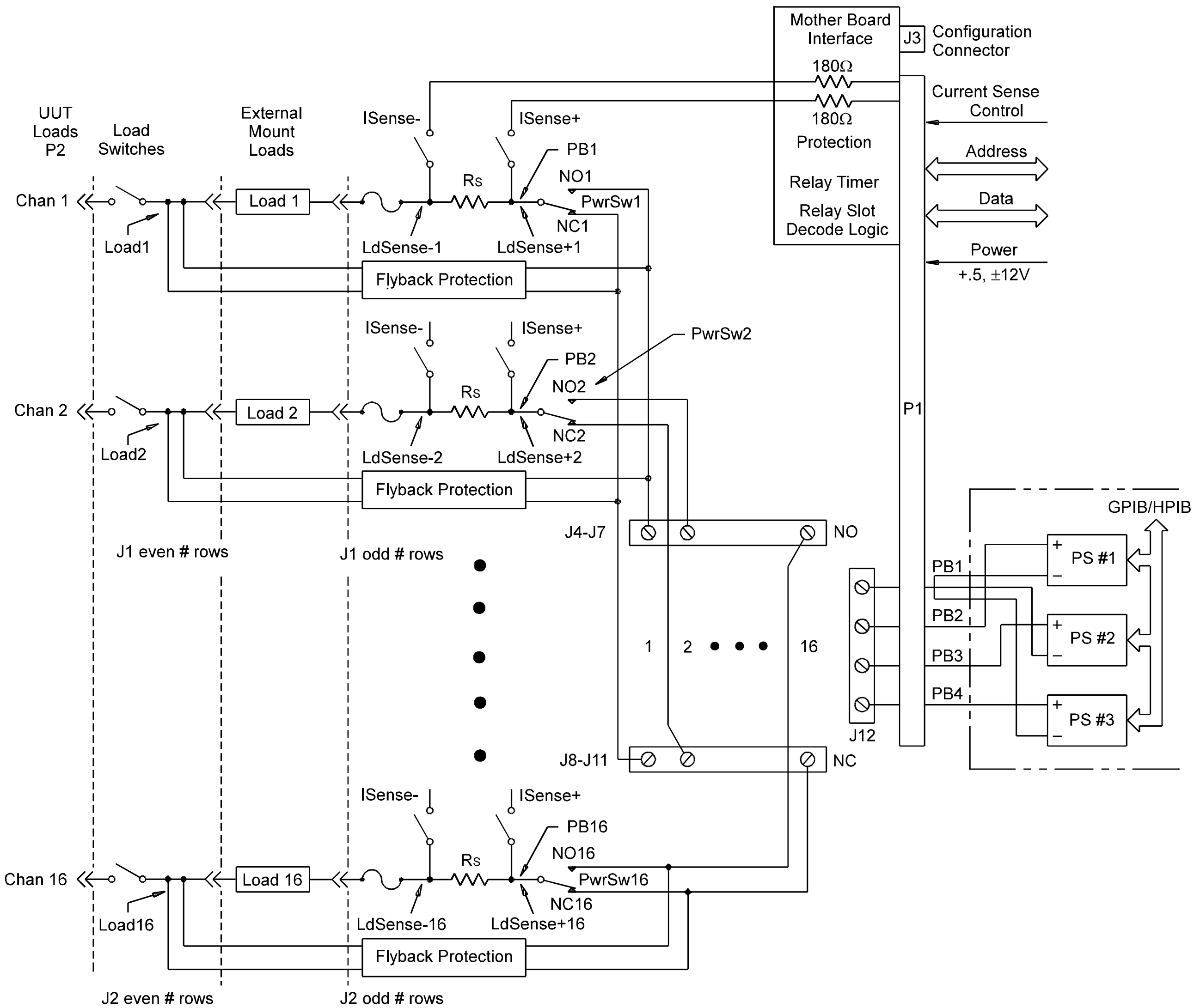


Figure 3-18. HP E6176A 16-Channel High-Current Load Card Block Diagram

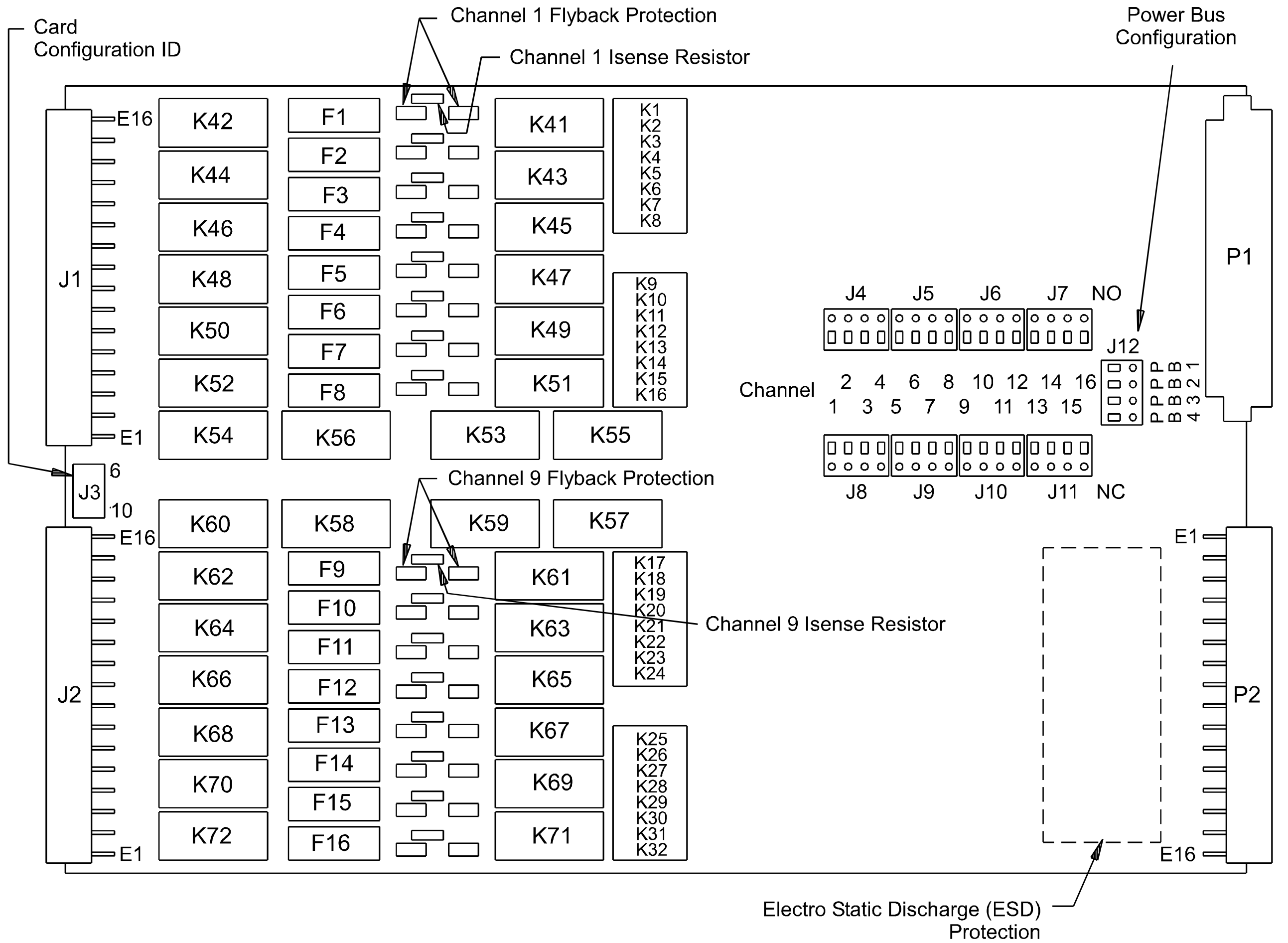


Figure 3-19. HP E6176A 16-Channel Load Card Jumper Configuration

Selecting a Power Supply Configuration

Each channel connects to the power bus via a Form C SPDT (single pole, double throw) relay. This relay has a NO (normally-open) and a NC (normally-closed) terminal. Each NO terminal is connected to a pin on J4-J7, and each NC terminal is connected to a pin on J8-J11. Each pin on J8-J11 can be connected to any of the four power bus lines on J12 via jumper wires. See Figure 3-18.

The terminal block jumper allows convenient connection of pull-up or pull-down voltages to the various inputs. It also allows for terminating a UUT load at a different voltage than ground. For example, the channel could be connected to +12 volts on one side, and +5 volts on the other.

The factory default is to provide two jumper combs, one that ties all the pins on J4-J7 (NO) together and one that ties all the pins on J8-J11 (NC) together. The NO pins are jumpered to power bus 2, and the NC pins are jumpered to power bus 1. The jumper combs for J4-Jll can be easily cut to provide bus or pin isolation between the various input/power bus connections.

Selecting a Current-Sense Resistor Value

The card comes factory loaded with a three watt, 0.05Ω, 0.1 % sense resistor already installed. This is the lowest value sense resistor that can be installed safely. If lower value currents are being measured, requiring a larger resistance value to make the sense voltage readable, then replace the sense resistor with a four wire resistor of higher value.

Selecting a Load Fuse

The load fuses used are IEC 5x20 millimeter, 5-amp slow-blow. These fuses may be replaced by fuses with a higher value, but not to exceed 8 amps.

Caution **The maximum fuse rating must not exceed an I^2T value of 102-126.[1]**

Selecting and Loading Flyback Protection

Coils used as loads may have large flyback voltages which have the potential to damage other electronic components. Generally the UUTs are equipped with flyback protection, so flyback protection on the load cards is redundant but provides backup protection in case a defective UUT is tested. The system integrator is responsible for ensuring the flyback protection devices are installed on the load cards.

Caution **The load cards are designed for a maximum of 500 V_{peak} flyback voltage. Operating the load cards without flyback protection installed on the appropriate channels, or with flyback voltages in excess of 500 V_{peak}, may results in damage to the load card or Switch/Load Unit.**

The HP E6176A Load Card comes with provisions for user-installed flyback voltage protection. Figure 3-20 is a detail of the first two channels on the component locator diagram of the load card. It shows the location and polarity orientation for channel 1's (RT1 and RT2) and channel 2's (RT3 and RT4) flyback protection devices when they are installed. This pattern is repeated for the other fourteen channels.

1. *The I^2T figure is an industry standard term. For example, if a fuse with a rating of I^2T = 100 experiences a current surge of 10A, it can maintain that current for 1 second before its capacity is exceeded. (10A * 10A * 1 Second = 100)*

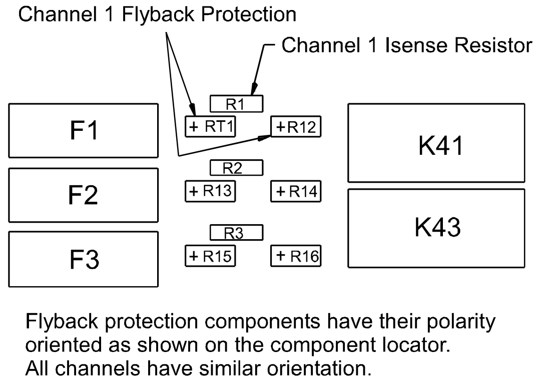


Figure 3-20. 16-Channel Load Card - Flyback Device Polarity Orientation

The flyback protection devices function exactly the same as for the 8-Channel Load Card; one flyback protection from the output to the normally open side of the power switch, and one flyback protection from the output to the normally closed side of the power switch.

In Figure 3-21, Channel 1 has two input lines connected to the input Form C switch. RT1 connects input line J4-J7, and RT2 connects alternate input line J8-J11, to the output of Load1. When a voltage spike occurs on the UUT that exceeds the rating on the flyback device, the device clamps the surge voltage to the devices predetermined value. The flyback protection is installed similarly on each input line.

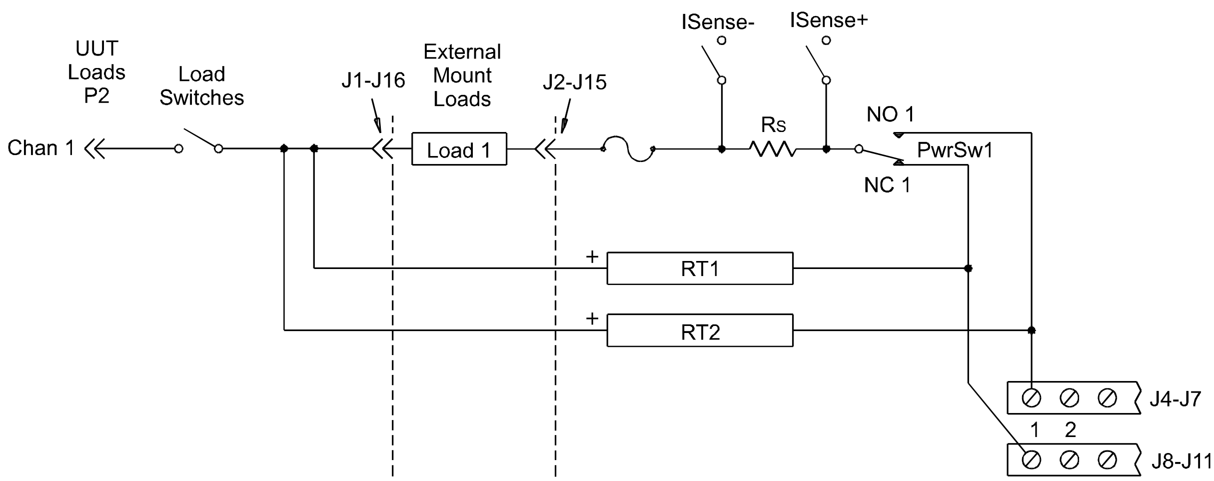


Figure 3-21. 16-Channel Load Card - Flyback Circuit Detail

The flyback protection devices should be installed with the positive side towards the UUT. On each of the 16 channels the high (+) side should be located as shown in the component locator diagram, Figure 3-20. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.[1]

1. *The card was tested using a General Electric GE MOV II, MA series MOV*

Protection Devices

Refer to Figure 3-22. Zener Diodes, MOVs (Metal-Oxide Varistor) or Transzorbs® devices mounted at RTx or RTy (2 required per load - 1 at NC and 1 at NO) provide current path for the inductive load flyback. Select the protection device so that it conducts at a voltage higher than the UUT's internal protection. If the device's internal protection fails, then the added external protection conducts to protect the UUT and the load card.

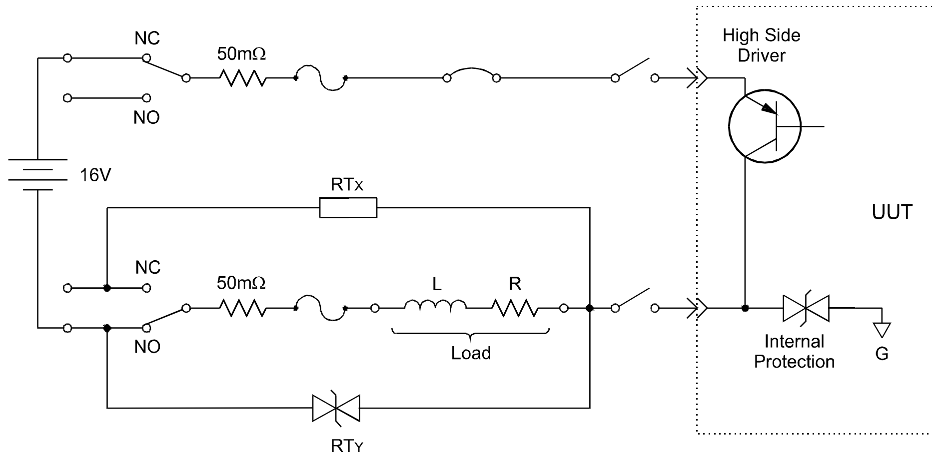


Figure 3-22. Typical HP E6176A Load Card Flyback Protection Circuit

Typical small MOV (3mm) axial lead mounted specifications are:
- Continuous DC voltage: 220 V
- Transient energy (10/1000mS[1]): 0.90 Joules (watt-seconds)
- Transient peak current (8/20mS[2]): 100 Amperes
- Varistor voltage @ 1.0mA DC: 300 Vdc Max
- Maximum Clamping Voltage (8/20mS): 450 volts
- Capacitance: 17 pF

Typical Transzorb® specifications are:
- Breakdown voltage: 300V max at 1mA
- Reverse Standoff voltage: 250 volts
- Maximum reverse leakage: 5mA
- Maximum peak pulse current: 5A
- Maximum Clamping voltage: 400 volts
- Maximum temperature coefficient: 0.110 %/°C

1. *10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.*
2. *8/20mS refers to a standard pulse of 8mS rise and 20mS to 50% decay of peak value.*

Connecting Loads

Loads are mounted externally and connected to the load card via wires or cables. The loads are wired to connectors P1 and P2 which mate to the HP E6176A's J1 and J2 connectors, respectively. Figure 3-13 shows these connectors.

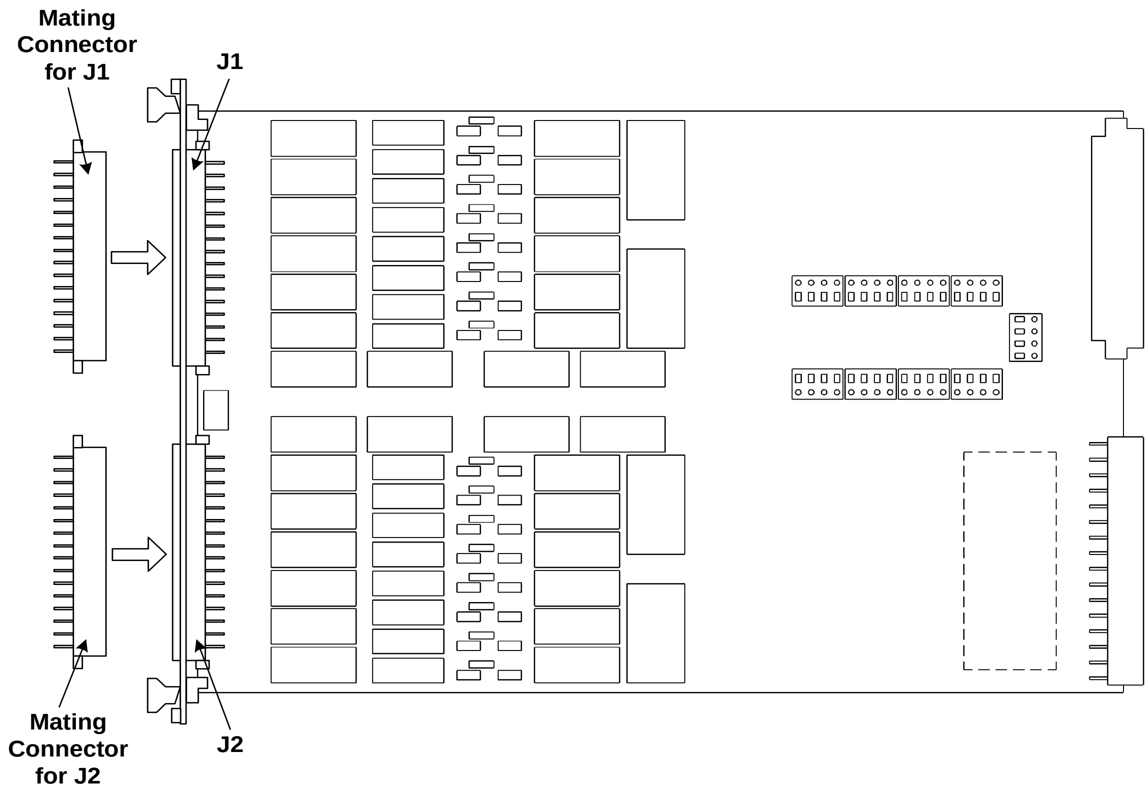


Figure 3-23. HP E6176A Connectors J1/J2 and Mating Connectors P1/P2

You can also use HP E3750-61619 cables (two cables per load) as shown in Figure 3-24.

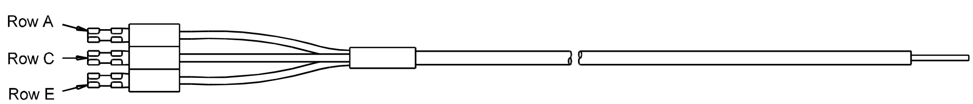


Figure 3-24. HP E3750-61619 Cable

Load Wiring

Figure 3-25 is a simplified schematic and connector pinouts showing how loads are connected to P1/P2. Loads 1 through 8 connect to P1 and loads 9 through 16 connect to P2.

Caution **To prevent premature pin failure from excessive current flow, when connecting high-current (>3 amp) loads to P1, wire across all three pins in each row (see Figure 3-26 on page 61).**

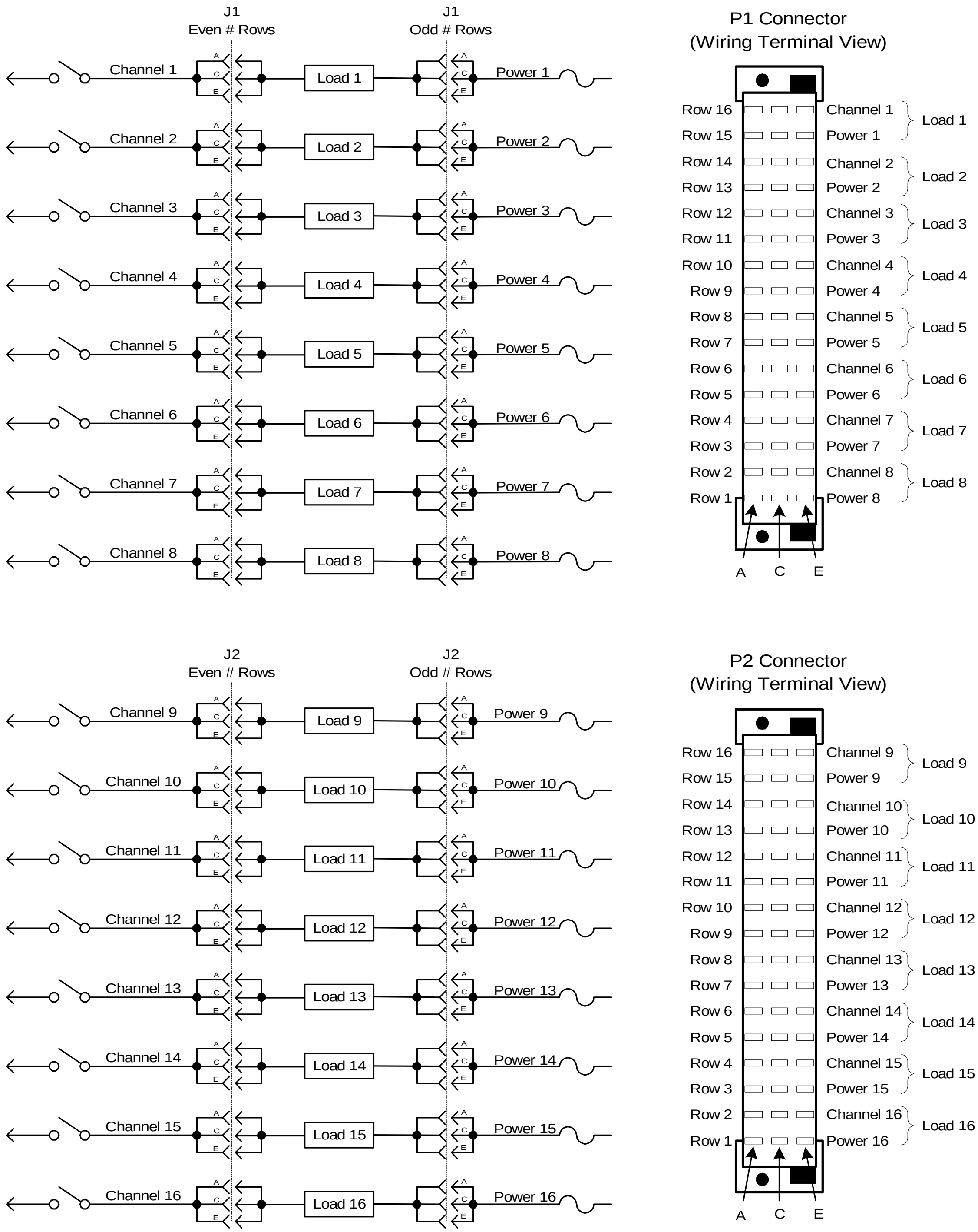


Figure 3-25. HP E6176A Load Wiring Schematic and P1/P2 Pinouts

Current Sharing

Notice in the wiring schematic (Figure 3-25) that pins A, C and E in each row of J1/J2 are connected together on the PC board. When connecting high-current (>3 amp) loads, wire across all three pins in each row of P1/P2 (see Figure 3-26). This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

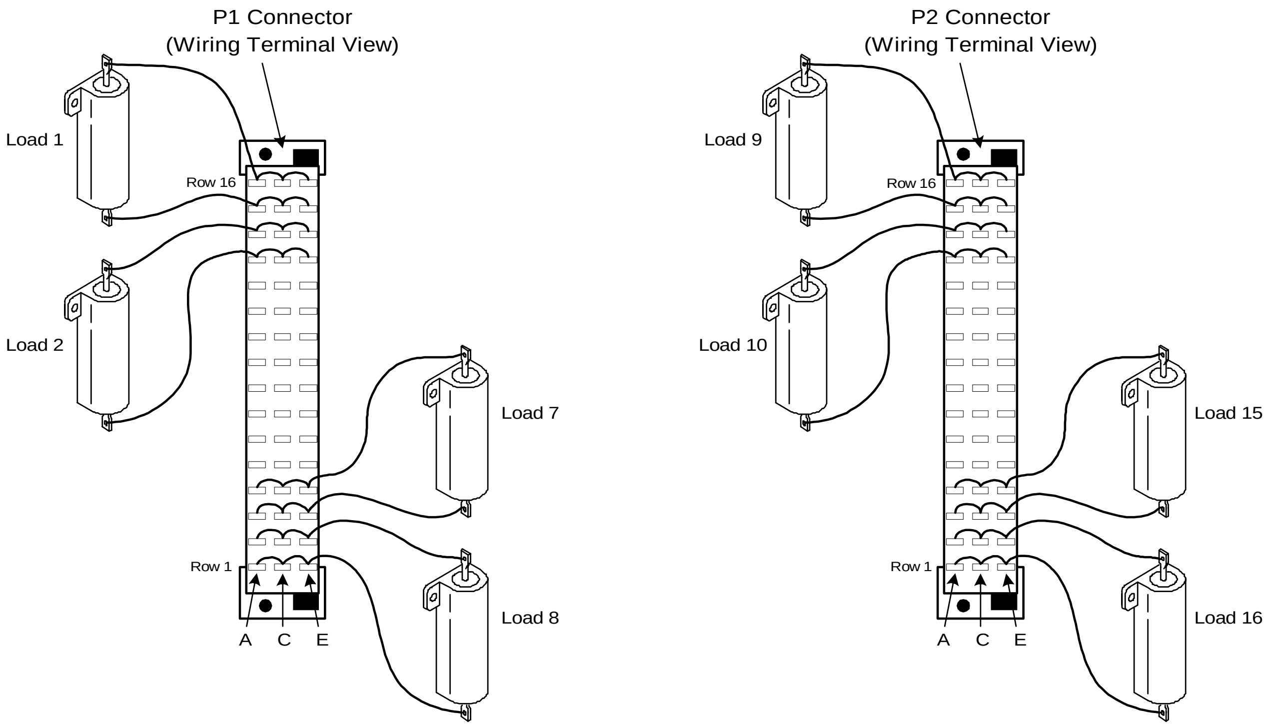


Figure 3-26. HP E6176A Current Sharing Example

External Load Mounting Options

- Loads mounted externally are typically “real” loads (injectors, actuators, etc.) making them awkward to mount internally. Mount them as close to the Switch/Load Unit as possible.
- Low form-factor loads and low value resistive loads for which cable resistance may be a significant factor can be mounted on a Load Plate (Figure 3-27) to be inserted into the Switch/Load Unit slot adjacent to the load card.
- The dimensions of the load plate for the 16-channel card are:
  Height- 23.32 cm (9.18 in.)
  Length (Max)- 34.00 cm (13.386 in.)
  Thickness- 1.59 mm (1/16 in.).
- Arrange the loads so that the lowest impedances have the shortest cable runs.Route the cable runs to the externally mounted loads in such a manner that the other cards can be removed without having to disconnect any wiring
- Cabling to externally mounted loads, including those on a load plate, should be clearly identified, either with labels, numbers, color coding, or some combination of these methods. Cabling to polarity sensitive devices should be labeled appropriately.

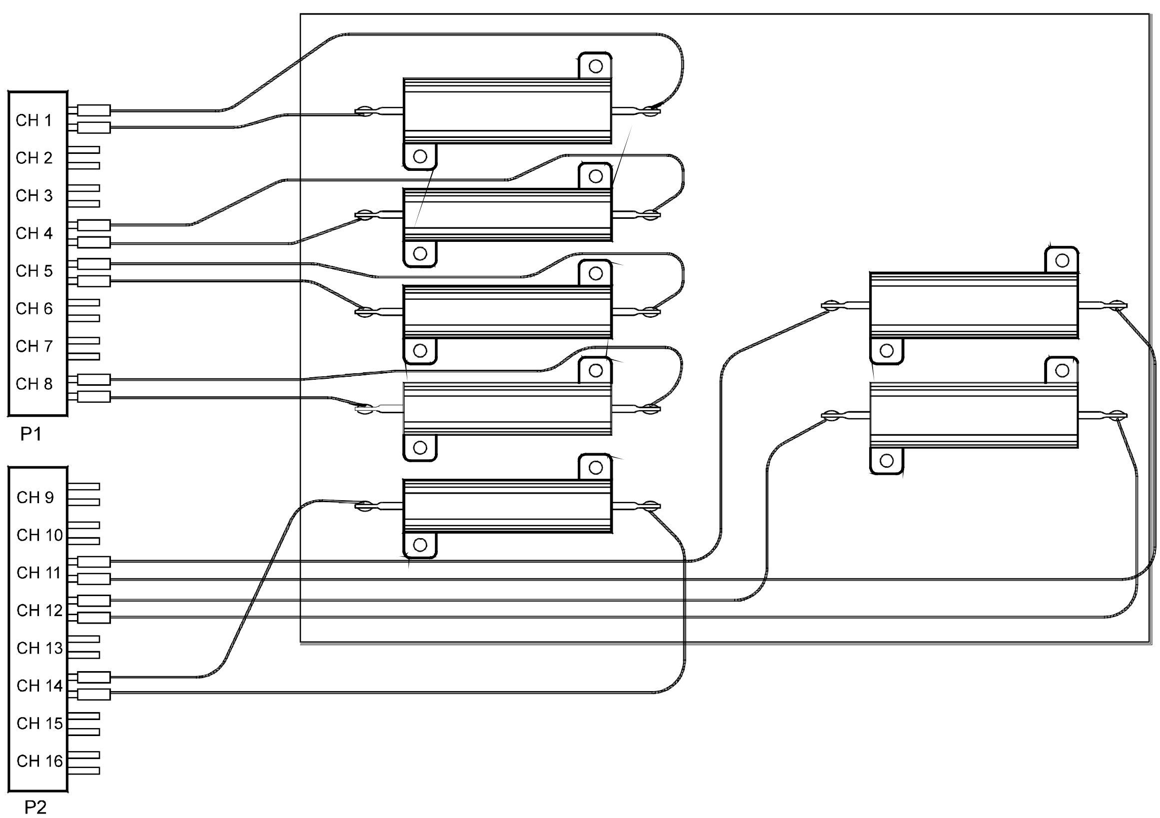


Figure 3-27. Example: Load Plate with Loads

UUT Connections

When configured as part of a standard HP system, P2 of the load card is typically connected via cables to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make connections directly to P2. Figure 3-28 is a simplified load card schematic and P2 connector pinout showing the details. Each row of P2 represents a single load card channel. The three pins in each row are connected together on the PC board for current sharing. When making UUT connections, wire across all three pins in each row. This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

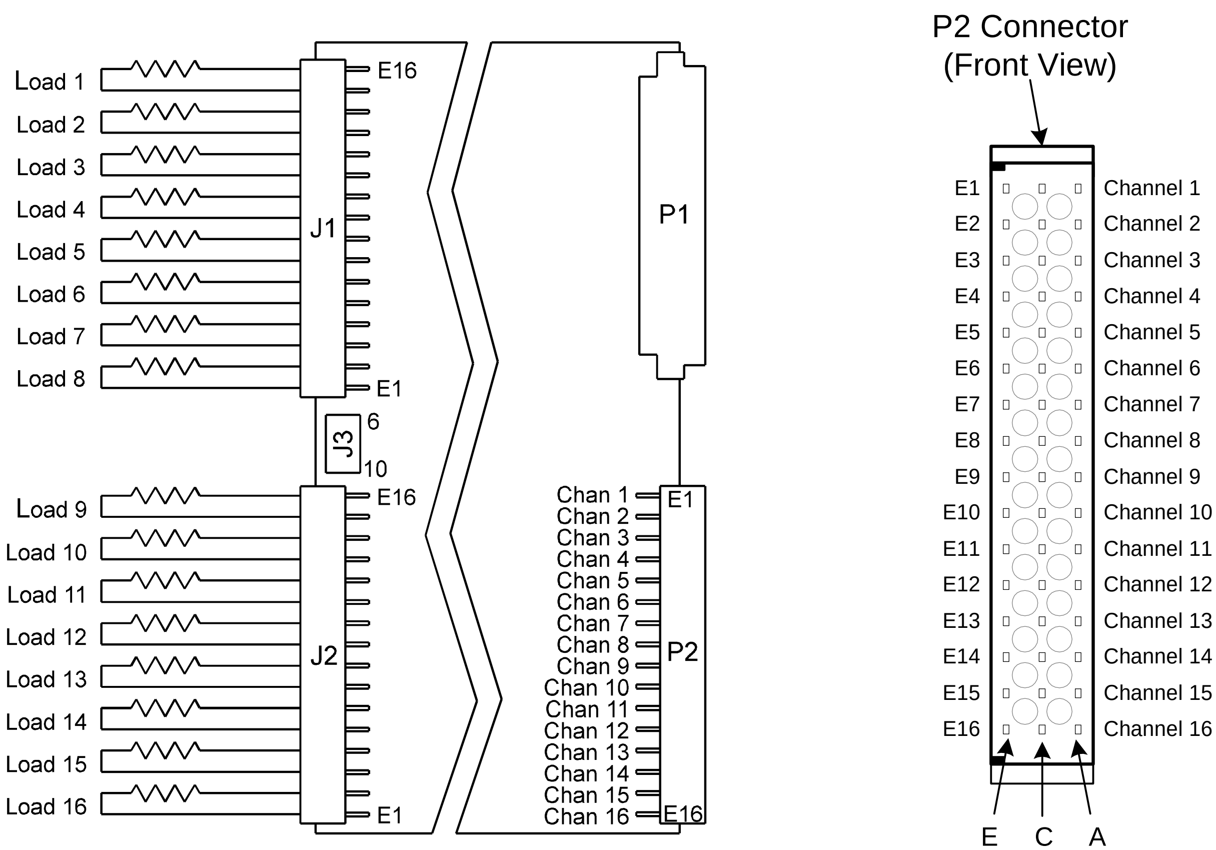


Figure 3-28. HP E6176A P2 Connector Pinouts

Using the HP E6177A 24-Channel Load Card

Figure 3-29 shows a block diagram of the HP E6177A 24-Channel Medium-Current Load Card. The 24-Channel Load Card differs from the 8-Channel and 16-Channel cards in three ways:

- It is not equipped for current sensing,
- It has no provisions for flyback voltage protection,
- It does provide an output relay in a general-purpose configuration.

The Common line (PwrX where X is the channel number) on the input is brought back out to the input, allowing each channel to operate in a general-purpose (GP) configuration. This would allow you, for example, to switch in a special external power supply while bypassing the power bus of the Switch/Load Unit. See Figure 3-29.

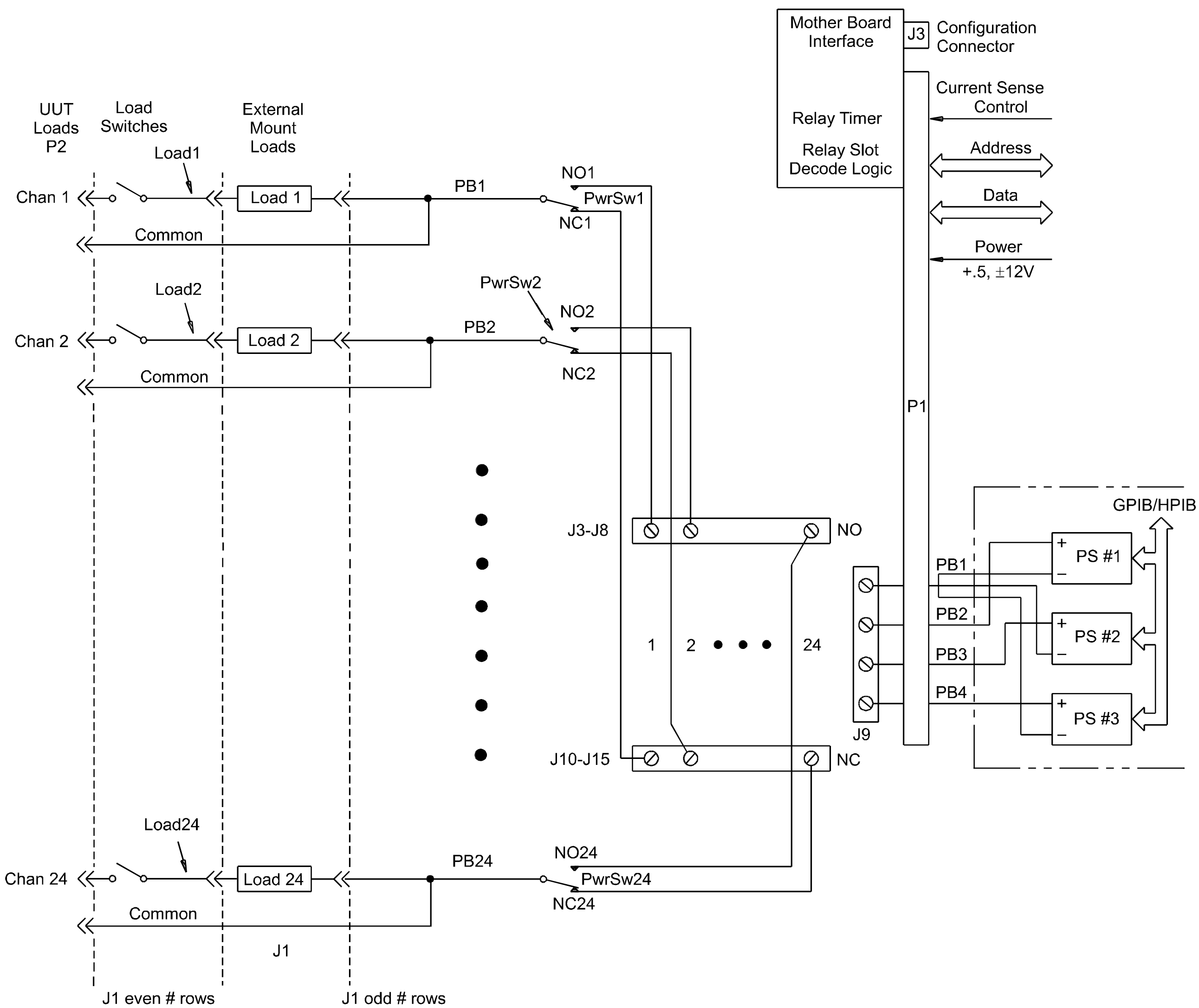


Figure 3-29. HP E6177A 24-Channel Medium-Current Load Card Block Diagram

Card Jumpers

Figure 3-30 shows the HP E6177A 24-Channel Load Card jumpers.

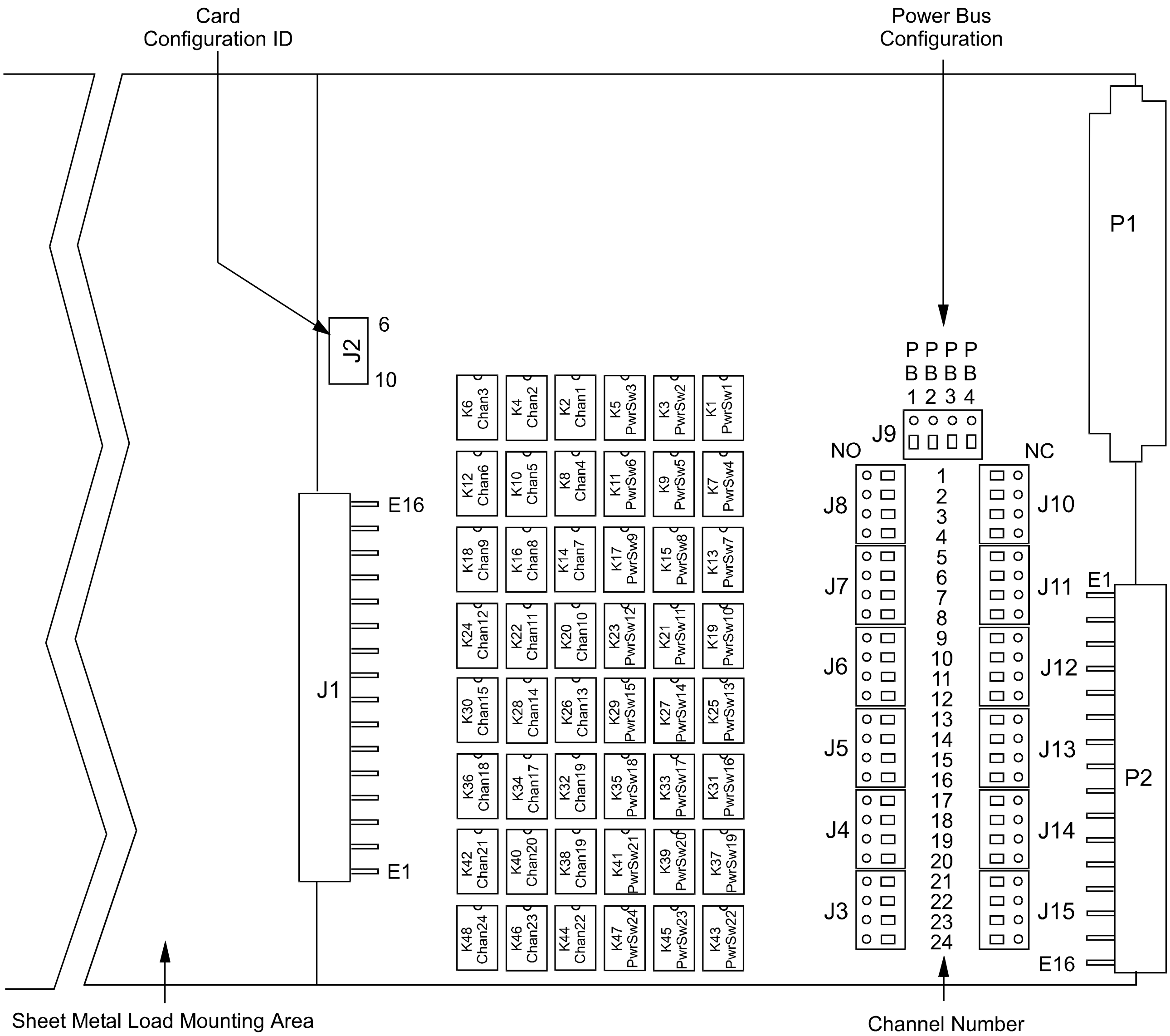


Figure 3-30. HP E6177A 24-Channel Load Card Jumpers

Selecting a Power Supply Configuration

Each channel connects to the power bus via a Form C SPDT (single-pole, double-throw) relay. This relay has a NO (normally-open) and a NC (normally-closed) terminal. Each NO terminal is connected to a pin on J3– J8, and each NC terminal is connected to a pin on J10–J15. Each pin on J3–J15 can be connected to any of the four power busses on J9 via jumper wires. See Figure 3-29. The terminal block jumpering allows convenient pull-up or pull-down of the various inputs. It also allows for terminating a UUT load at a different voltage than ground.

The factory default is to provide two jumper combs, one that ties all the pins on J3–J8 together and one that ties all the pins on J10–J15 together. The NO pins are jumpered to power bus 2, and the NC pins are jumpered to power bus 1. The jumper combs for J3–J8 and J10–Jl5 can be easily cut to provide bus or pin isolation between the various input/power bus connections.

Using the Power Switches as General Purpose Relays

The 24-Channel Load Card has a special feature that is not available on the other load cards. It has both the high and low side of the load brought out to the front panel. This allows the load switching relay to be alternatively used as a general-purpose switching relay. For instance, to use channel 1 of the load card as a general-purpose switching relay, jumper across the LOAD 1 pins on the load card. See Figure 3-31.

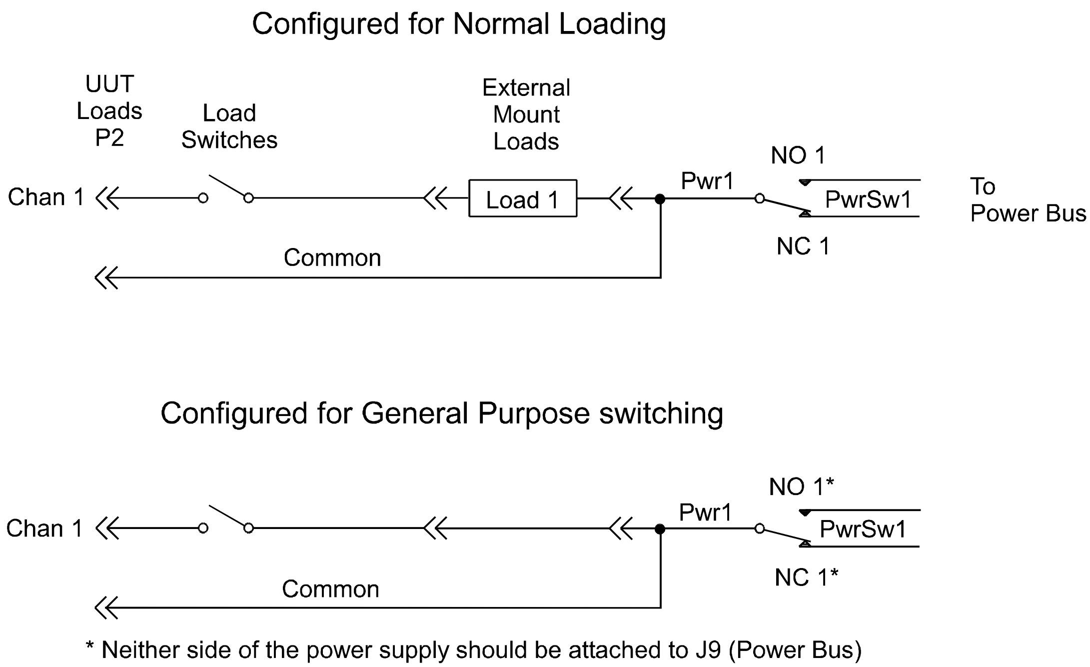


Figure 3-31. Using the 24-Channel Load Card Switches as GP Relays

Caution **When using a channel of the HP E6177A as a GP switch make sure that neither the NO nor NC connectors for that channel are jumpered to the load card power bus terminals on J9.**

Connecting Loads

Loads are mounted on the HP E6177A's sheet-metal mounting area. The loads are wired to connector P1 which mates to the HP E6177A's J1 connector. Figure 3-13 shows the HP E6177A's load mounting area and connectors J1 and P1.

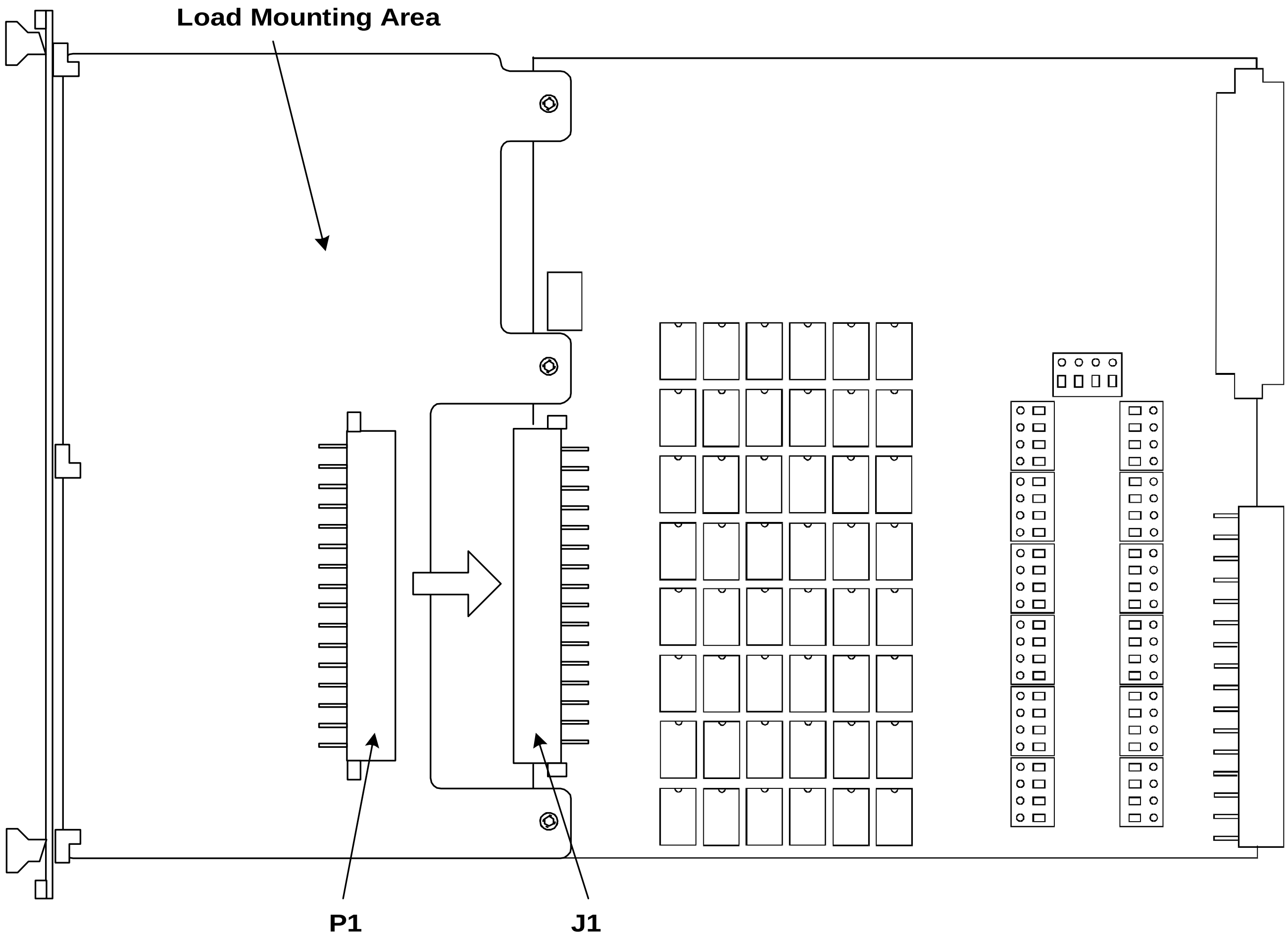


Figure 3-32. HP E6177A Load Mounting Area and P1/J1 Connectors

Load Wiring

Figure 3-33 is a simplified schematic and P1 connector pinout showing how loads are connected to P1.

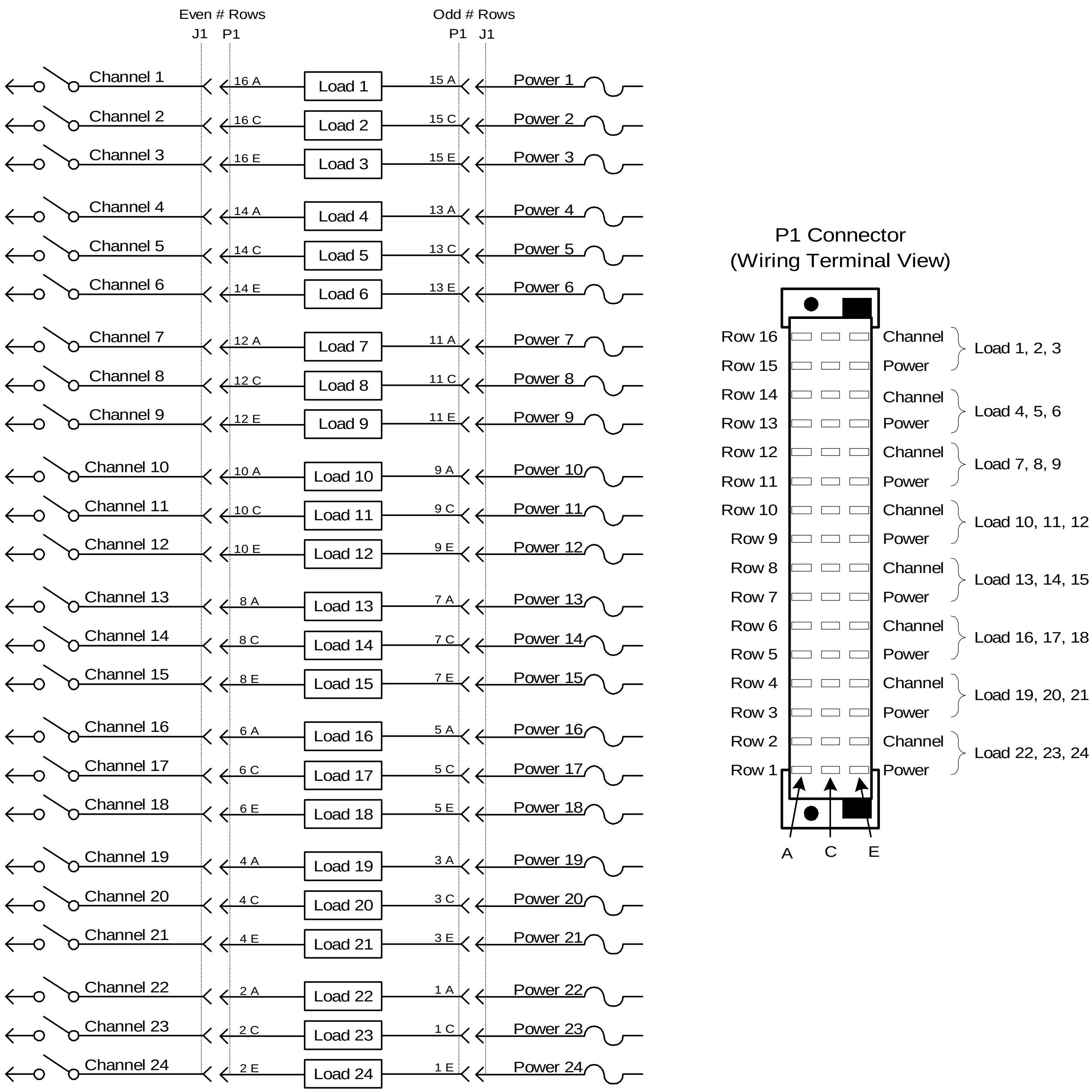


Figure 3-33. HP E6177A Load Wiring Schematic and P1 Pinouts

UUT Connections

When configured as part of a standard HP system, P2 of the load card is typically connected via cables to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make connections directly to P2. Figure 3-34 is a P2 connector pinout showing the details.

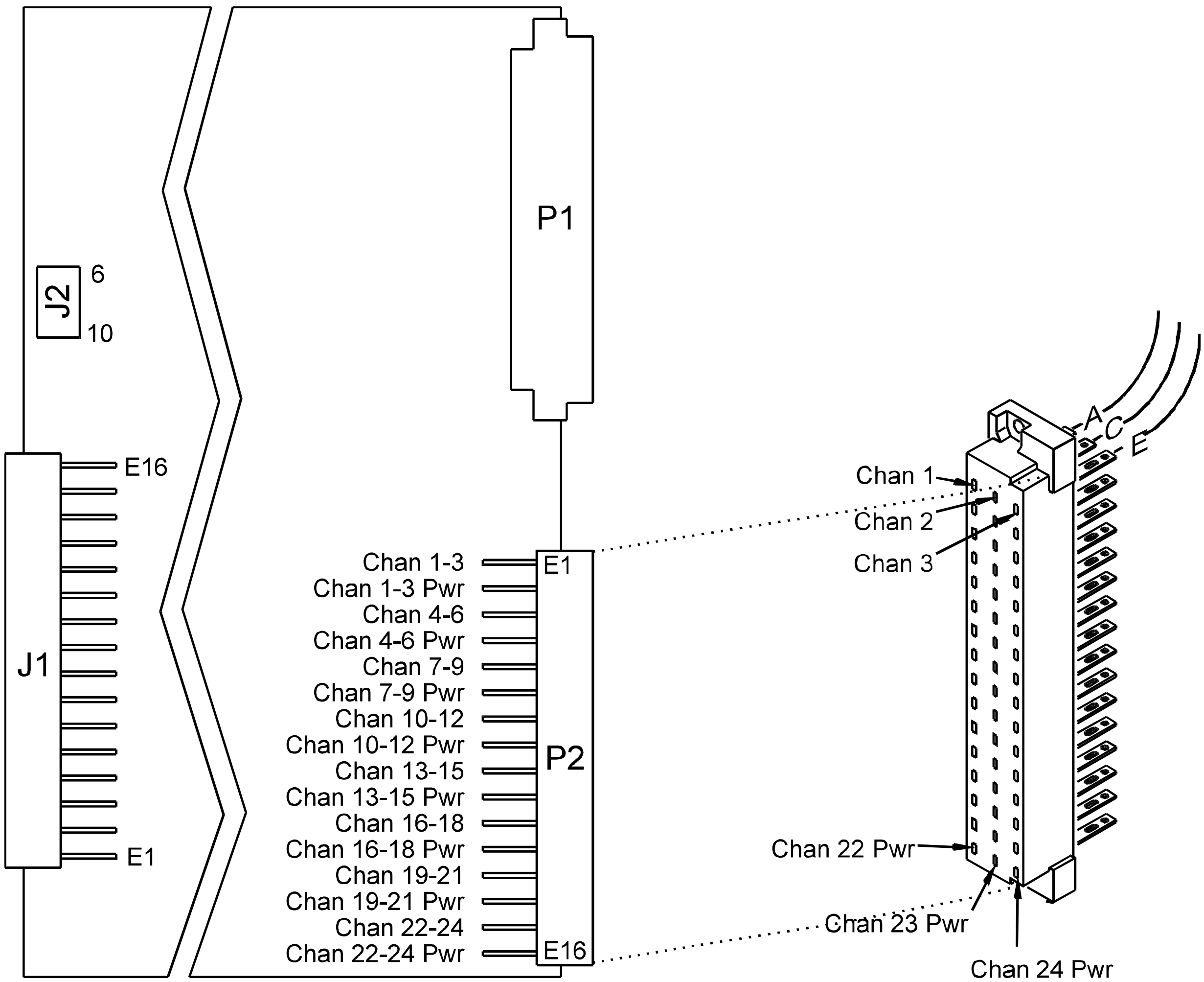


Figure 3-34. HP E6177A 24-Channel Medium-Current Load Card UUT Connections

Using the HP E6178B 8-Channel Load Card

Figure 3-35 shows a block diagram of the HP E6178B 8-Channel Heavy Duty Load Card typically configured with an external power supply. Figure 3-36 shows the component locator for the HP E6178B Load Card.

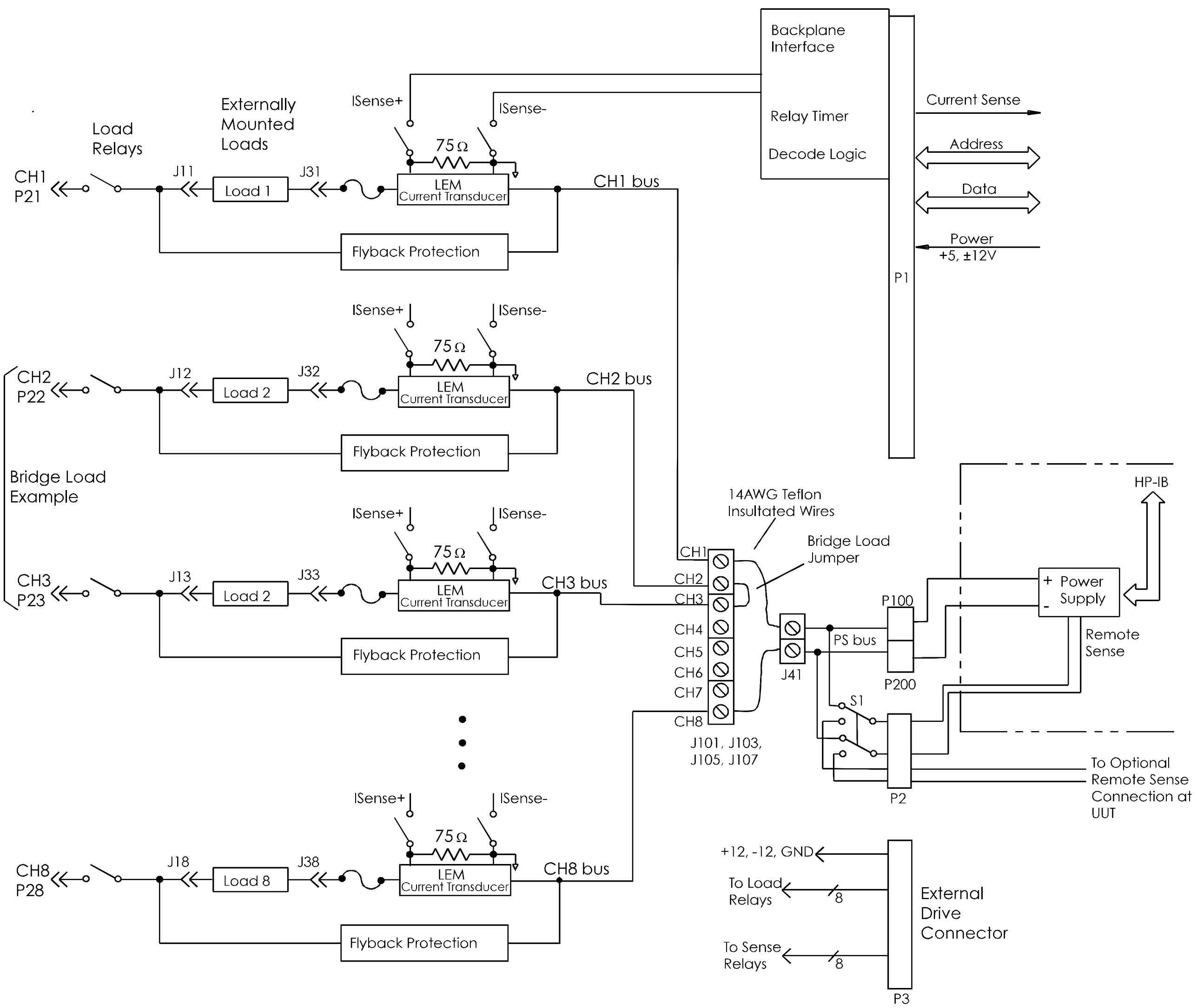


Figure 3-35. HP E6178B 8-Channel Heavy Duty Load Card Block Diagram

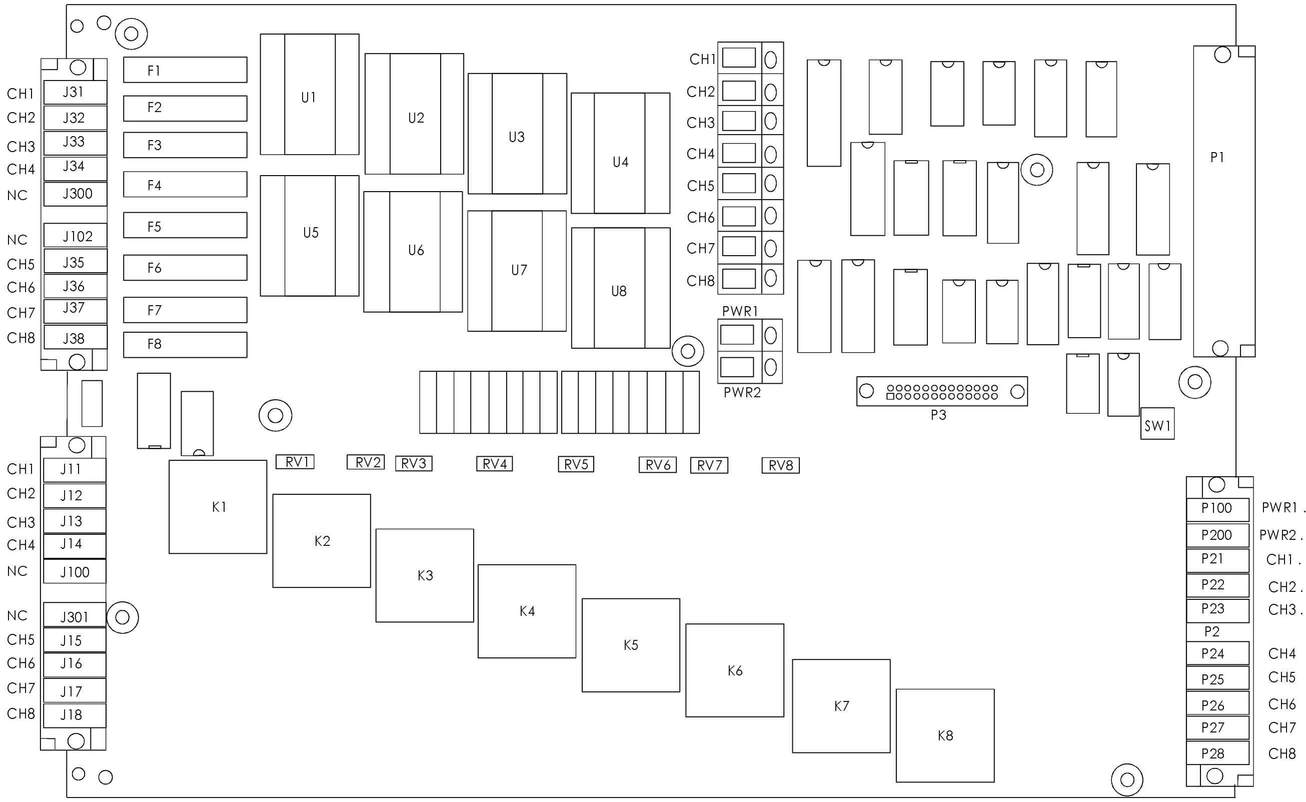


Figure 3-36. HP E6178B 8-Channel Heavy Duty Load Card Component Locator

Selecting a Power Supply Configuration

As shown in Figure 3-35, power supply connections for the loads are through P100 and P200 to PWR1 and PWR2 (J41) respectively. You must wire the power supply connectors to the individual channel connectors CH1 through CH8 (J101, J103, J105, and J107). Use at least a 14 AWG Teflon® insulated or 12 AWG vinyl insulated wire to carry 30 Amperes.

Figure 3-35 shows one possible power supply configuration. In this configuration, Channel 1 is configured for a single load connected to V+. Load 8 would be a short to provide a path return. Channels 2 and 3 are connected as a bridge load; a load that is “floating” with respect to the power system.

Other configurations are possible. For example, the negative terminals of two external power supplies could be connected together at the UUT and the positive terminals could be connected to P100 and P200 (respectively) and distributed to the individual channels. This would provide two simultaneous power supply connections to the UUT or multiple UUTs.

Note that the main power bus as well as each individual channel bus is rated for 30 Amps continuous. Thus you can run 30 Amps per channel for all 8 channels only if they are wired in a bridge configuration or the current through the power supply bus (PSbus) does not exceed 30Amps.

Caution **It is possible to close more than one channel at a time. The power supply connections to the load card are rated for 30 Amps maximum continuous and individual channels are rated at 30 Amps continuous. Do not exceed these specifications.**

Local / Remote Sensing

Switch S1 allows the external power supply remote sensing to be either local (P100/P200) or remote (through P2 to UUT). Refer to Figure 3-35.

Selecting a Load Fuse

The factory installed load fuses are ¼” x 1¼”, 30-amp slow-blow. These fuses may be replaced by fuses with a lower value depending on your load requirements. The HP E6178 was qualified with a Bussman™ MDL-30 fuse. This fuse is unique for its low power dissipation and very high I^2T rating which is required to meet the HP E6178 surge current specifications. Refer to the module specifications for more information.

Caution **To maintain HP E6178 safety and reliability, replace fuse with Bussman type MDL-30 fuse only.**

Current Monitor

Each channel on the HP E6178 uses a LEM[1] model LA 55-TP Current Transducers with a 75Ω 0.01%, 0.3W low TC (±2.5 ppm/°C) resistor for sensing the current through each channel. The sense relays are switched independently from the channel load relays.

The LEM current transducer module has a current gain of 1000:1 (primary to secondary, i.e., for a 1 amp primary current the secondary current is 1mA). The secondary of the LEM current transducer is connected across a precision 75Ω resistor, see Figure 3-35. The primary current is calculated by making a voltage measurement across this precision resistor and is determined by the equation:

$$I_{ch} = \frac{V_{Isense}}{0.075}$$

The current monitor specification is with respect to the channel primary current which is being measured:

Gain Error:±1.0% Maximum over the temperature range
Offset Error:±0.3 Amps Typical over the temperature range
±0.7 Amps Maximum over the temperature range

1. *LEM USA, Inc. 6643 West Mill Road, Milwaukee, WI, 53218. (414) 353-0711*

The error due to the offset component can be reduced by measuring the zero current offset voltage (channel relay open) after the test system has warmed up and using this offset to correct for all subsequent measurements. This should be done for each channel individually. Using this technique, the errors due to offset may be reduced to:

Offset Error:±0.1 Amps over the temperature range

Selecting and Loading Flyback Protection

Coils used as loads may have large flyback voltages which have the potential to damage other electronic components. Generally the UUTs are equipped with flyback protection, so flyback protection on the load cards is redundant but provides backup protection in case a defective UUT is tested. The system integrator is responsible for ensuring the flyback protection devices are installed on the load cards.

Caution

The load cards are designed for a maximum of 500 V_{peak} flyback voltage. Operating the load cards without flyback protection installed on the appropriate channels, or with flyback voltages in excess of 500 V_{peak}, may results in damage to the load card or Switch/Load Unit.

The HP E6178 Load Card comes with provisions for user-installed flyback voltage protection. Figure 3-36 shows the location for the flyback protection devices RV1 to RV8.

The flyback protection devices should be installed with the positive side towards the UUT. On each of the 8 channels the high (+) side should be located as shown in the component locator diagram, Figure 3-36. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.

Protection Devices

Refer to Figure 3-37. Zener Diodes, MOVs (Metal-Oxide Varistor) or Transzorbs® devices mounted at RV1 to RV8 provide current path for the inductive load flyback. Select the protection device so that it conducts at a voltage higher than the UUT’s internal protection. If the device’s internal protection fails, then the added external protection conducts to protect the UUT and the load card.

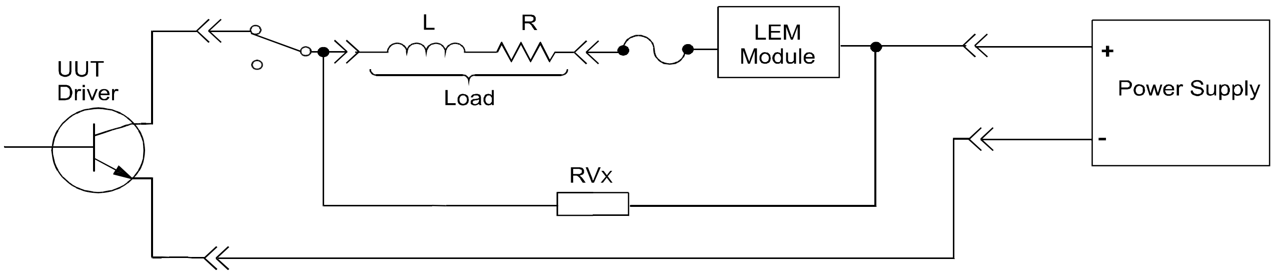


Figure 3-37. Typical HP E6178B Load Card Flyback Protection Circuit

Typical MOV (3mm) axial lead mounted specifications are:

Continuous DC voltage: 220 V
Transient energy[1] (10/1000mS): 0.90 Joules (watt-seconds)
Transient peak current[2] (8/20mS): 100 Amperes
Varistor voltage @ 1.0mA DC: 300 Vdc Max
Maximum Clamping Voltage (8/20mS): 450 volts
Capacitance: 17 pF

Typical Transzorb® specifications are:
Breakdown voltage: 300V max at 1mA
Reverse Standoff voltage: 250 volts
Maximum reverse leakage: 5mA
Maximum peak pulse current: 5A
Maximum Clamping voltage: 400 volts
Maximum temperature coefficient: 0.110 %/°C

Load and UUT Connections

Figure 3-38 shows how the HP E6178 Load Card is wired. Connect loads between J11-J18 and J31-J38. Loads are external to the load card and connected to the load card via cables. Connectors J11 and J31 connect to Channel 1, connectors J12 and J32 connect to Channel 2, etc.

When configured as part of a standard HP system, P2 of the load card is typically connected via cables to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make UUT and power supply connections directly to P2 as shown in Figure 3-38.

1. *10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.*
2. *8/20mS refers to a standard pulse of 8mS rise and 20mS to 50% decay of peak value.*

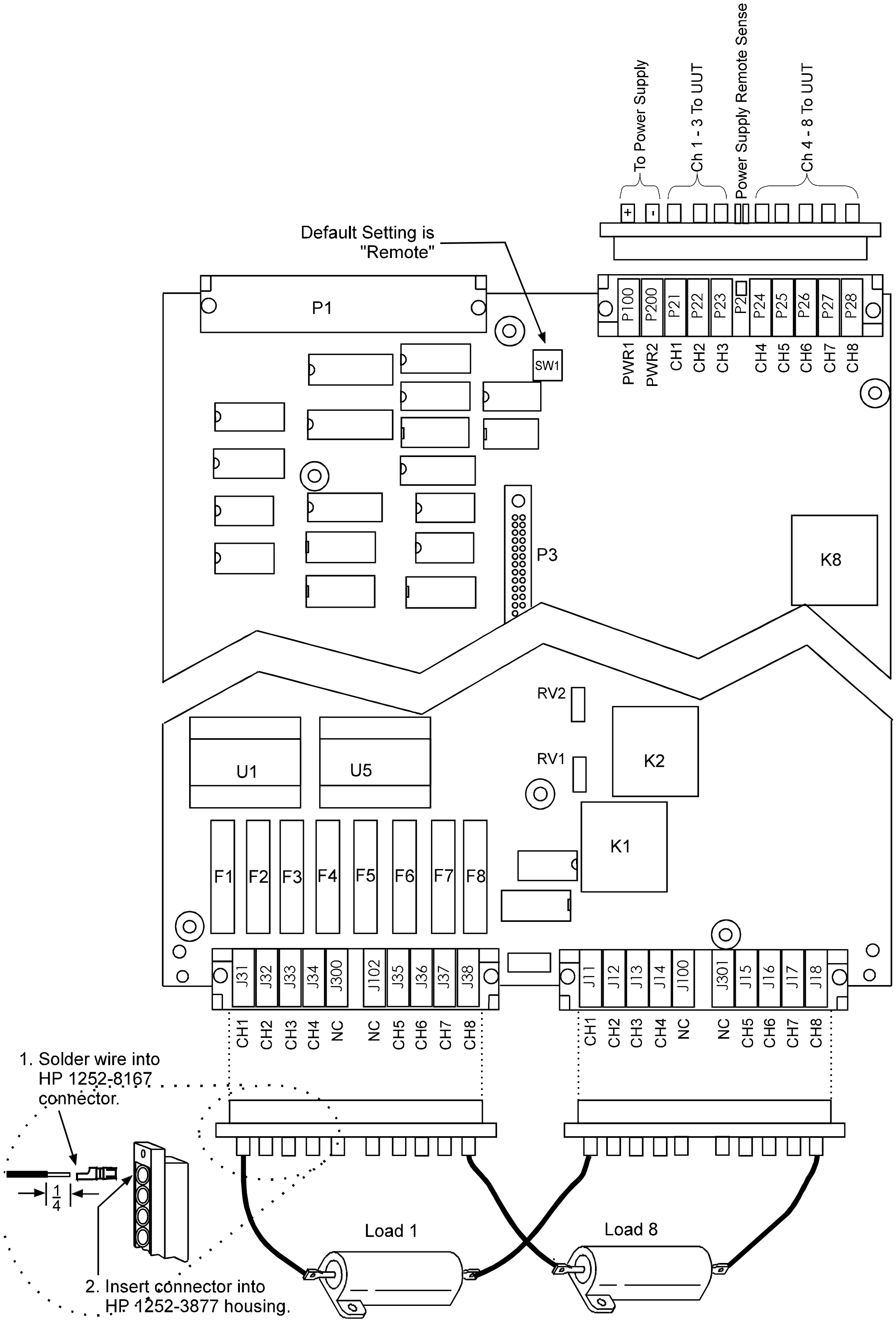


Figure 3-38. HP E6178 Load Card Wiring

Chapter 4

Using the 32-Pin Matrix Cards

This chapter describes how to configure and use the HP E8792A and E8793A 32-Pin Matrix Cards. This chapter the following sections:

Register descriptions for these cards are located in Appendix B of this manual.

Note This chapter describes using the HP 8792A 32-Pin Matrix Card as the Instrument Matrix. In some systems, the HP E6171A Measurement Control Module may be used as the Instrument Matrix. Refer to the HP E6171A User's Manuals for more information.

Conceptual Overview

Both the HP E8792A and E8793A 32-Pin Matrix Modules contain a 32 x 4 Measurement Matrix for switching signals to and from the Analog Bus. The HP E8792A also contains a 16 x 5 Instrument Matrix that connects external measuring instruments to the Analog Bus. Figure x is a simplified block diagram showing how the HP E8792A and E8793A are typically used together in a system. As shown in Figure 4-1, if you need more UUT connections, simply add more HP E8793A 32-Pin Matrix Cards to the bus.

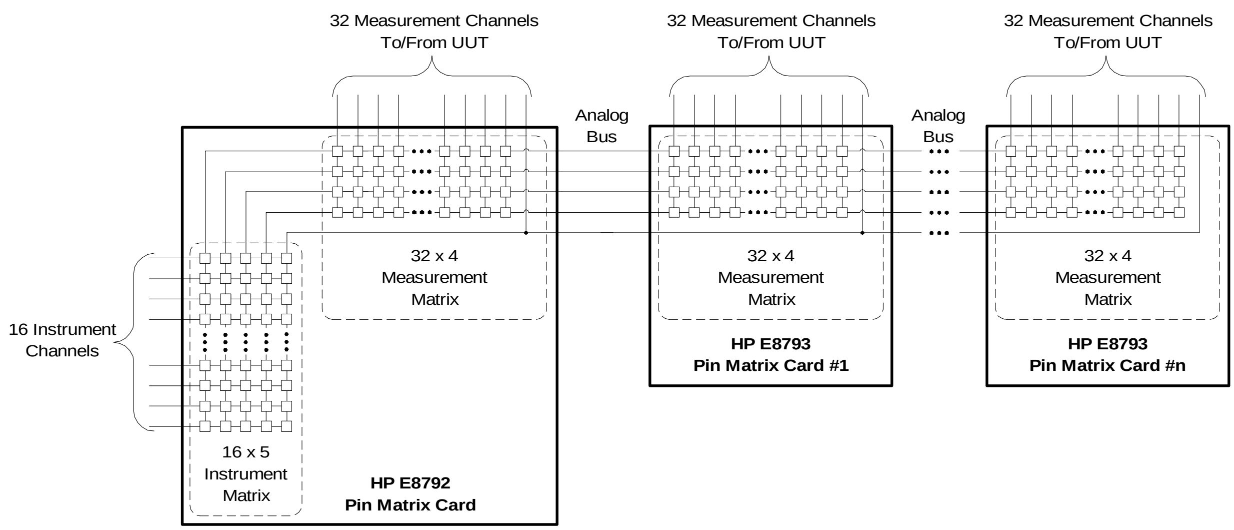


Figure 4-1. Pin Matrix Cards Conceptual Overview

Note The AUX channels are not shown in Figure 4-1. Refer to Figure 4-2 and Figure 4-3 for detailed schematics of the 32-pin matrix cards.

Features

Key features of the cards include:

- 16 x 5 high-speed reed relay Instrument Matrix (HP E8793A only),
- 32 x 4 high-speed reed relay Measurement Matrix,
- An integrated relay timer,
- Automatic disconnecting of column relays for minimal loading of the Analog Bus,
- A single control bit can open all relays (OAR),
- Auxiliary or direct row access relays on each row,
- Independently switchable series resistance protection on each column.

Detailed Block Diagram Descriptions

Figure 4-2 on page 80 is a detailed block diagram of the HP E8792A 32-Pin Matrix Card and Figure 4-3 on page 81 is a detailed block diagram of the HP E8793A 32-Pin Matrix Card.

Differences Between the Cards

The primary difference between the two cards is that the HP E8792A contains a 16 x 5 Instrument Matrix. The Instrument Matrix is used to connect measurement or source instruments to the Analog Bus. Also notice in Figure 4-2 the DAC1 or DAC2 inputs to the Instrument Matrix. These lines come from the Switch/Load Units DACs and can be switched into the Instrument Matrix. The HP E8793A also contains two additional sets of Analog Bus access on connector J1. Other than these differences, the two cards are electrically and functionally identical. The following discusssion applies to both cards.

Features Common to Both Cards

The 32-Pin Matrix Modules contain 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 4-2 and Figure 4-3, the Measurement Matrix is arranged in 32 rows that can be connected to any of four columns on the common Analog Bus. Closing a matrix relay connects a row to a column on the card. The columns are connected to the Analog Bus which carries the signal between the UUT (unit under test) and instruments connected to the Analog Bus through the HP E8792A. 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 allows as many as four system resources to be connected simultaneously.

Disconnect Relays automatically disconnect unused columns to minimize capacitive loading effects from the Analog Bus. This makes it possible to expand the system without degrading the accuracy of measurements.

Besides the 32 x 4 matrix of relays, there are switched auxiliary I/O lines (AUX1 through AUX32) connected to 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 auxiliary 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, and on 32-Pin Matrix Card connectors J2 and P2, 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 the following paragraphs starting on page 82.

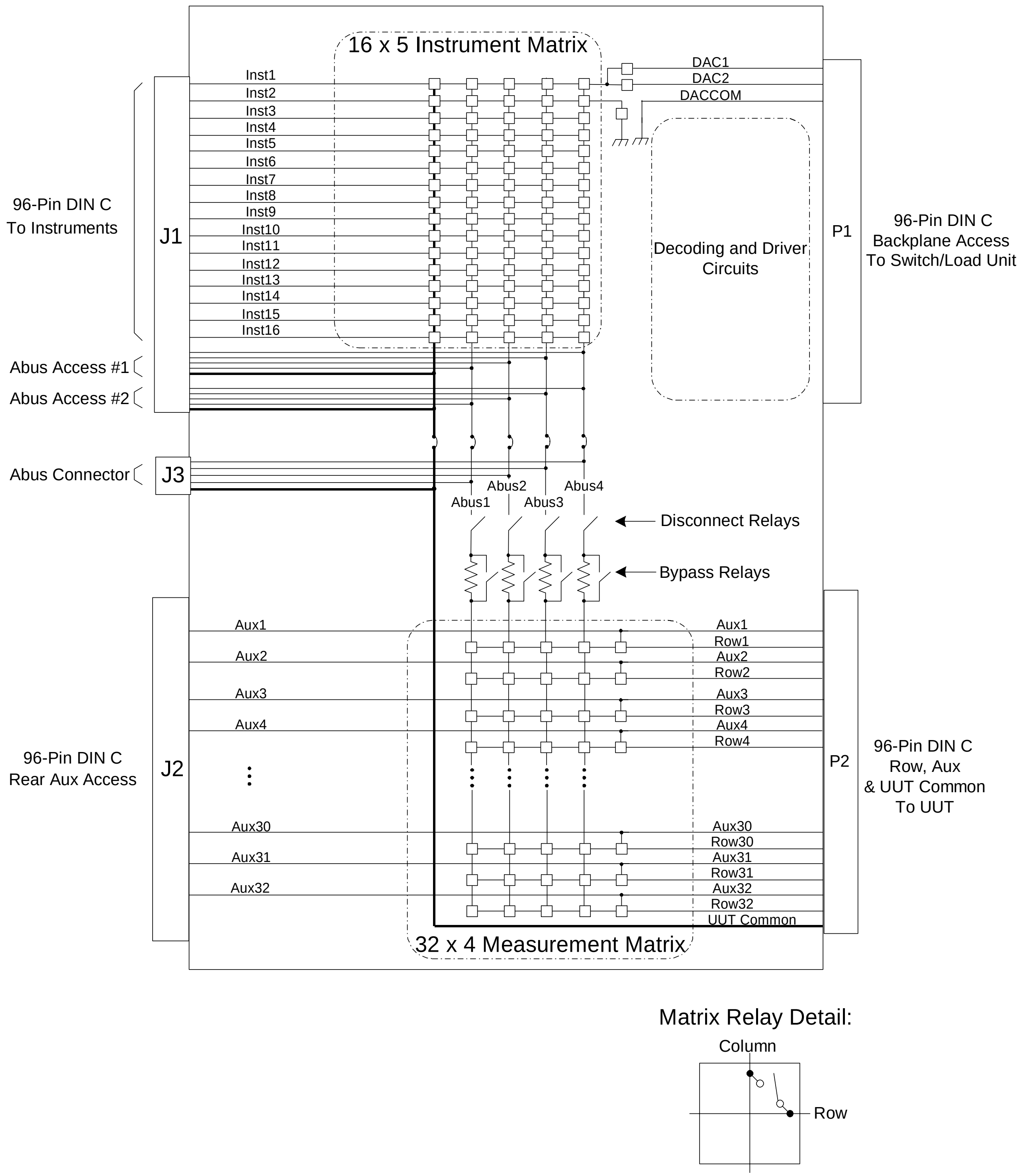


Figure 4-2. HP E8792A Detailed Block Diagram

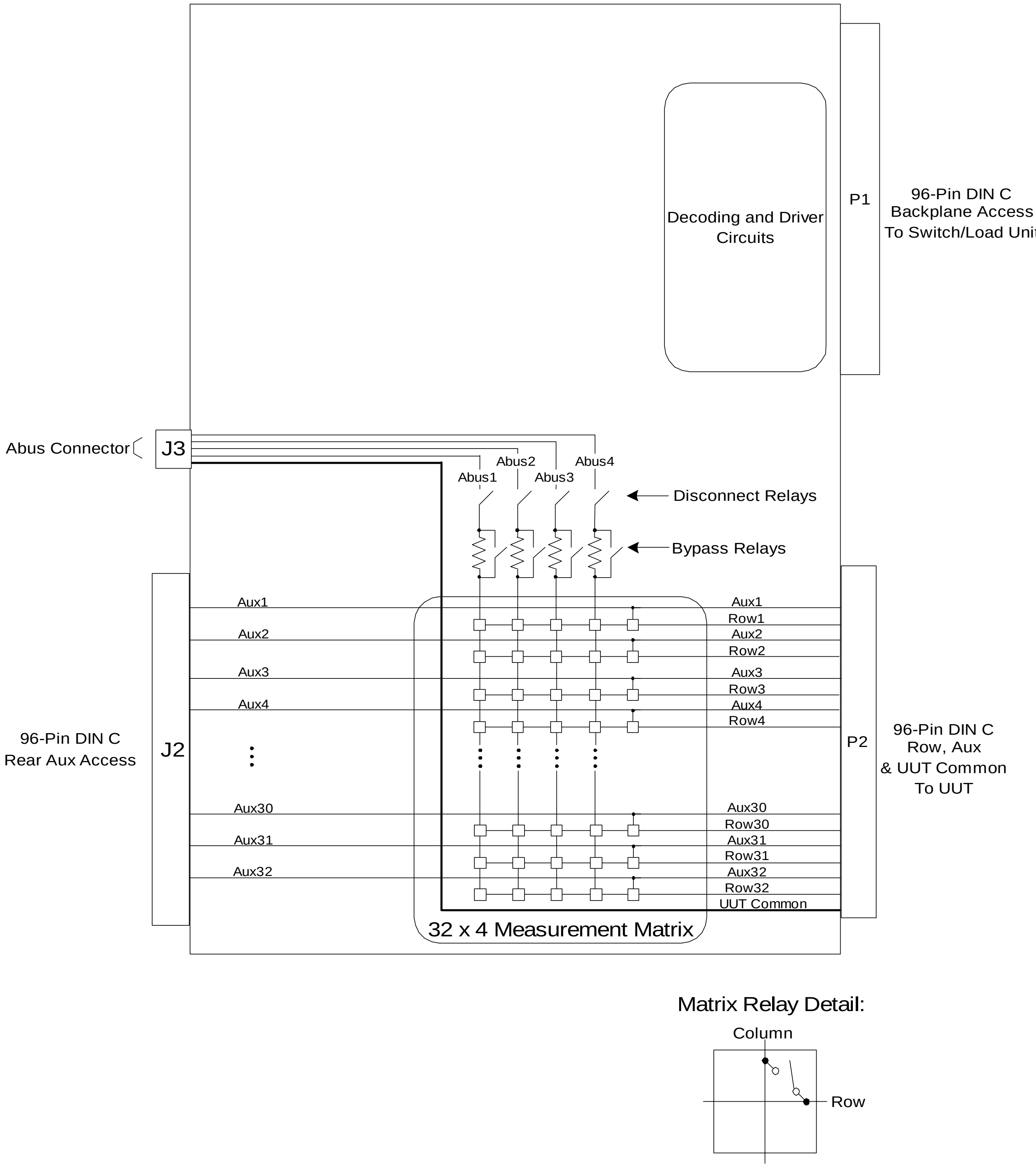


Figure 4-3. HP E8793A Detailed Block Diagram

Relay Timer

The Relay Timer indicates whether or not the last change to a relay's state (opening or closing the relay) is complete. The timer starts or restarts when a command to change a relay's state is received. The timer 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 between it and the Analog Bus. 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, 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, the default control mode is automatic.

OAR

Bit 5 in the Control Register controls the OAR ("open all relays") feature, which immediately opens all relays on the card. 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 card. Resetting the card clears all internal registers, which resets all board functionality to its default, power-up state. When the card 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 connected in series which protects the relays by limiting the maximum current through the column. Some measurements (such as 2-wire resistance) may require bypassing (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 in circuit.

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.

Caution **To prevent damage to card, bypass the protection resistors only when absolutely necessary.**

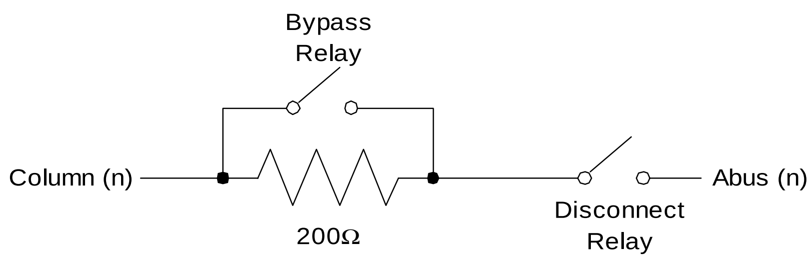


Figure 4-4. Column Disconnect and Protection Bypass Relays

Reset State

The card 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.

When the card is reset, all relay registers are cleared, column disconnect relay control is set to automatic mode, and the relay timer is started.

User Connectors and Pinouts

The figures and tables on the following pages show the pinouts for the HP E8792A and E8793A user connectors.

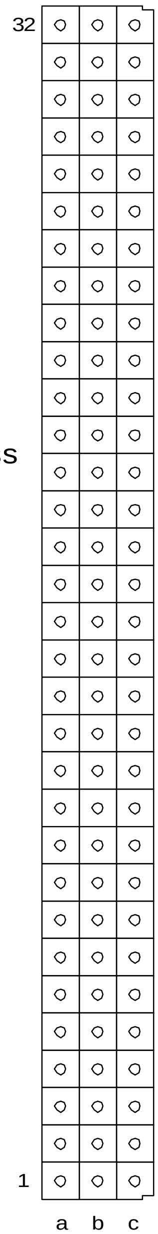
WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the Switch/Load Unit or plug-in cards. Before you remove any installed card, disconnect AC power from the mainframe and from other cards that may be connected to the cards.**

Caution **STATIC ELECTRICITY. Static electricity is a major cause of component failure. To prevent damage to electrical components, observe anti-static techniques whenever removing a card from the Switch/Load Unit or whenever working on a card.**

J1 Connector Pinouts

Figure 4-5 shows the pinouts for connector J1 which provides instrument and Abus access. J1 is available only on the HP E8792A 32-Pin Matrix Card.

J1
96 Pin DIN C
Instrument and Abus Access



Row	a	b	c
32	Gnd	INST1	INST2
31	Gnd	INST2	INST3
30	Gnd	INST3	INST4
29	Gnd	INST4	INST5
28	Gnd	INST5	INST6
27	Gnd	INST6	INST7
26	Gnd	INST7	INST8
25	Gnd	INST8	INST9
24	Gnd	INST9	INST10
23	Gnd	INST10	INST11
22	Gnd	INST11	INST12
21	Gnd	INST12	INST13
20	Gnd	INST13	INST14
19	Gnd	INST14	INST15
18	Gnd	INST15	INST16
17	Gnd	INST16	N/C
16	N/C	N/C	N/C
15	N/C	N/C	N/C
14	N/C	N/C	N/C
13	Gnd	Abus1	UUT Common
12	Gnd	Abus2	UUT Common
11	Gnd	Abus3	UUT Common
10	Gnd	Abus4	UUT Common
9	Gnd	N/C	N/C
8	Gnd	N/C	N/C
7	Gnd	N/C	N/C
6	Gnd	N/C	N/C
5	Gnd	N/C	N/C
4	Gnd	Abus1	UUT Common
3	Gnd	Abus2	UUT Common
2	Gnd	Abus3	UUT Common
1	Gnd	Abus4	UUT Common

Figure 4-5. J1 Pinouts--Instrument and Abus Access

J1 Instrument Connections

Figure 4-6 shows where instrument connections can be made on the J1 Connector. Notice, for example, that the INST2 connection is located in Row 32, Column C and is also connected to Row 31, Column B. This arrangement allows you to make either floating or earth-referenced connections as shown in Figure 4-6.

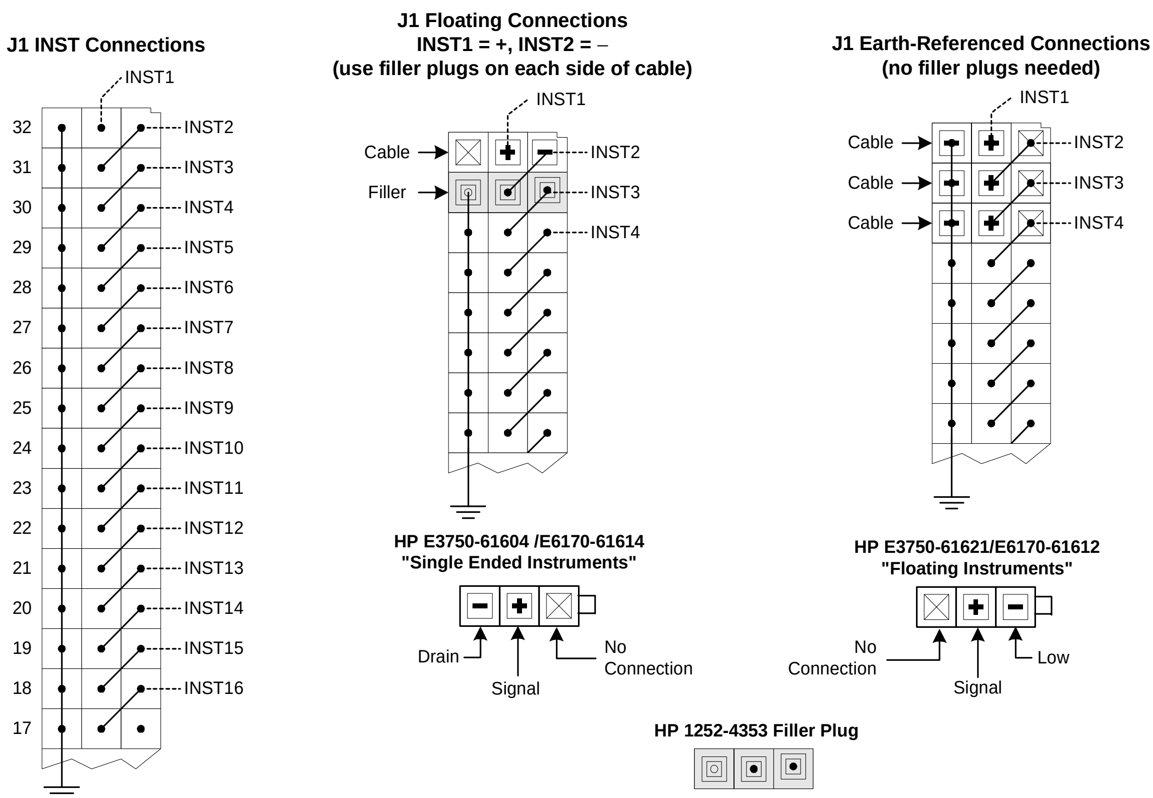


Figure 4-6. J1 Example Instrument Connections

Figure 4-7 shows two typical BNC cables used for instrument connections to J1.

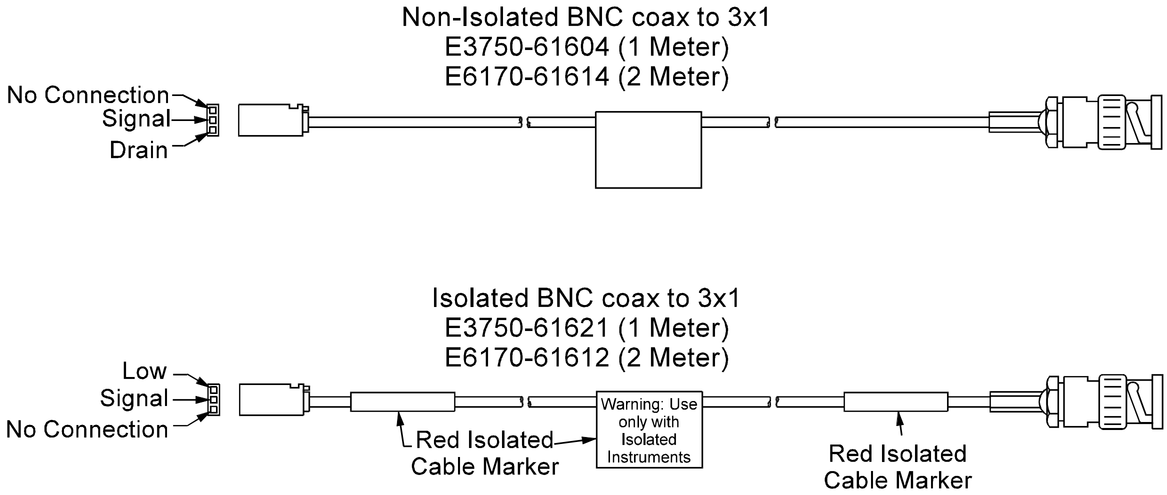
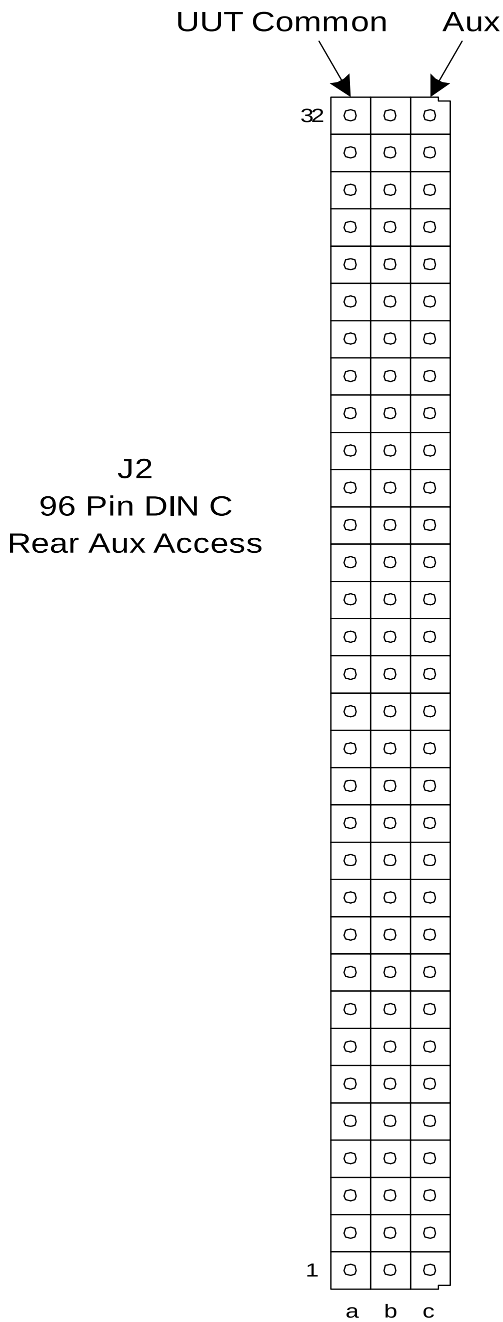


Figure 4-7. Instrument BNC Cables

J2 Connector Pinouts

Figure 4-8 shows the pinouts for connector J2 which provides rear Aux line access.

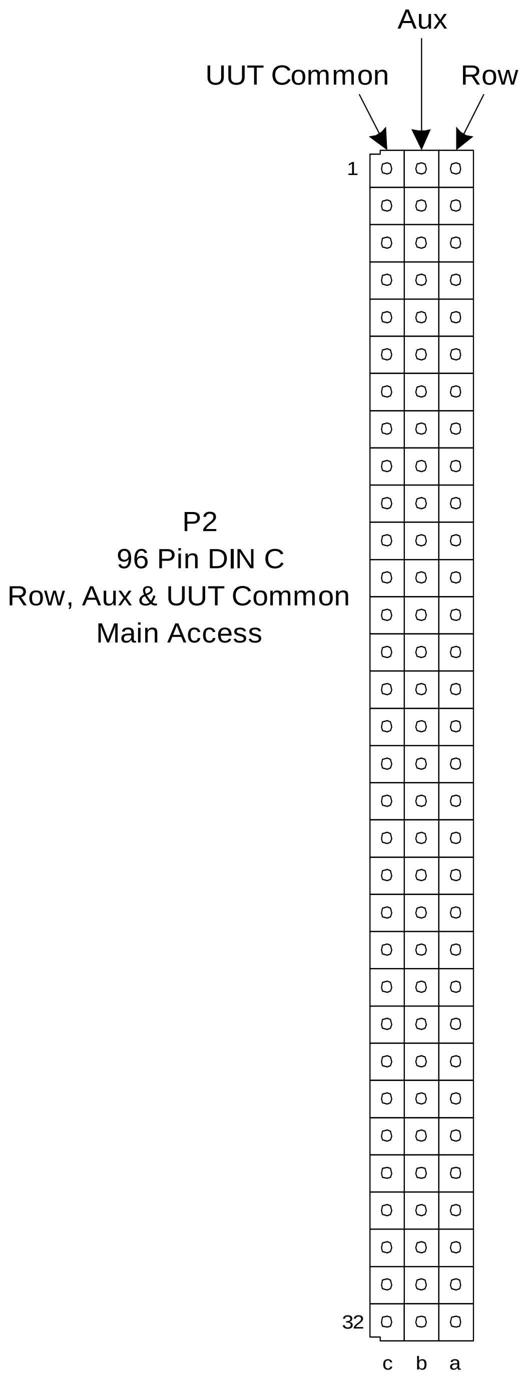


Row	a	b	c
32	UUT Common	System Ground	Aux32
31	UUT Common	System Ground	Aux31
30	UUT Common	System Ground	Aux30
29	UUT Common	System Ground	Aux29
28	UUT Common	System Ground	Aux28
27	UUT Common	System Ground	Aux27
26	UUT Common	System Ground	Aux26
25	UUT Common	System Ground	Aux25
24	UUT Common	System Ground	Aux24
23	UUT Common	System Ground	Aux23
22	UUT Common	System Ground	Aux22
21	UUT Common	System Ground	Aux21
20	UUT Common	System Ground	Aux20
19	UUT Common	System Ground	Aux19
18	UUT Common	System Ground	Aux18
17	UUT Common	System Ground	Aux17
16	UUT Common	System Ground	Aux16
15	UUT Common	System Ground	Aux15
14	UUT Common	System Ground	Aux14
13	UUT Common	System Ground	Aux13
12	UUT Common	System Ground	Aux12
11	UUT Common	System Ground	Aux11
10	UUT Common	System Ground	Aux10
9	UUT Common	System Ground	Aux9
8	UUT Common	System Ground	Aux8
7	UUT Common	System Ground	Aux7
6	UUT Common	System Ground	Aux6
5	UUT Common	System Ground	Aux5
4	UUT Common	System Ground	Aux4
3	UUT Common	System Ground	Aux3
2	UUT Common	System Ground	Aux2
1	UUT Common	System Ground	Aux1

Figure 4-8. J2 Pinouts--Rear Aux Access

P2 Connector Pinouts

Figure 4-9 shows the pinouts for connector P2 which provides Row, Aux and UUT Common access.



Row	c	b	a
1	UUT Common	Aux1	Row1
2	UUT Common	Aux2	Row2
3	UUT Common	Aux3	Row3
4	UUT Common	Aux4	Row4
5	UUT Common	Aux5	Row5
6	UUT Common	Aux6	Row6
7	UUT Common	Aux7	Row7
8	UUT Common	Aux8	Row8
9	UUT Common	Aux9	Row9
10	UUT Common	Aux10	Row10
11	UUT Common	Aux11	Row11
12	UUT Common	Aux12	Row12
13	UUT Common	Aux13	Row13
14	UUT Common	Aux14	Row14
15	UUT Common	Aux15	Row15
16	UUT Common	Aux16	Row16
17	UUT Common	Aux17	Row17
18	UUT Common	Aux18	Row18
19	UUT Common	Aux19	Row19
20	UUT Common	Aux20	Row20
21	UUT Common	Aux21	Row21
22	UUT Common	Aux22	Row22
23	UUT Common	Aux23	Row23
24	UUT Common	Aux24	Row24
25	UUT Common	Aux25	Row25
26	UUT Common	Aux26	Row26
27	UUT Common	Aux27	Row27
28	UUT Common	Aux28	Row28
29	UUT Common	Aux29	Row29
30	UUT Common	Aux30	Row30
31	UUT Common	Aux31	Row31
32	UUT Common	Aux32	Row32

Figure 4-9. P2 Pinouts--Row, Aux, and UUT Common Main Access

Installing in the Switch/Load Unit

The HP E8792A/E8793A 32-Pin Matrix Card can be installed in any available Switch/Load Unit slot. The Analog Bus connection cables require that all 32-Pin Matrix Cards be in adjacent slots (so the cables will reach). Figure 4-10 shows a typical installation.

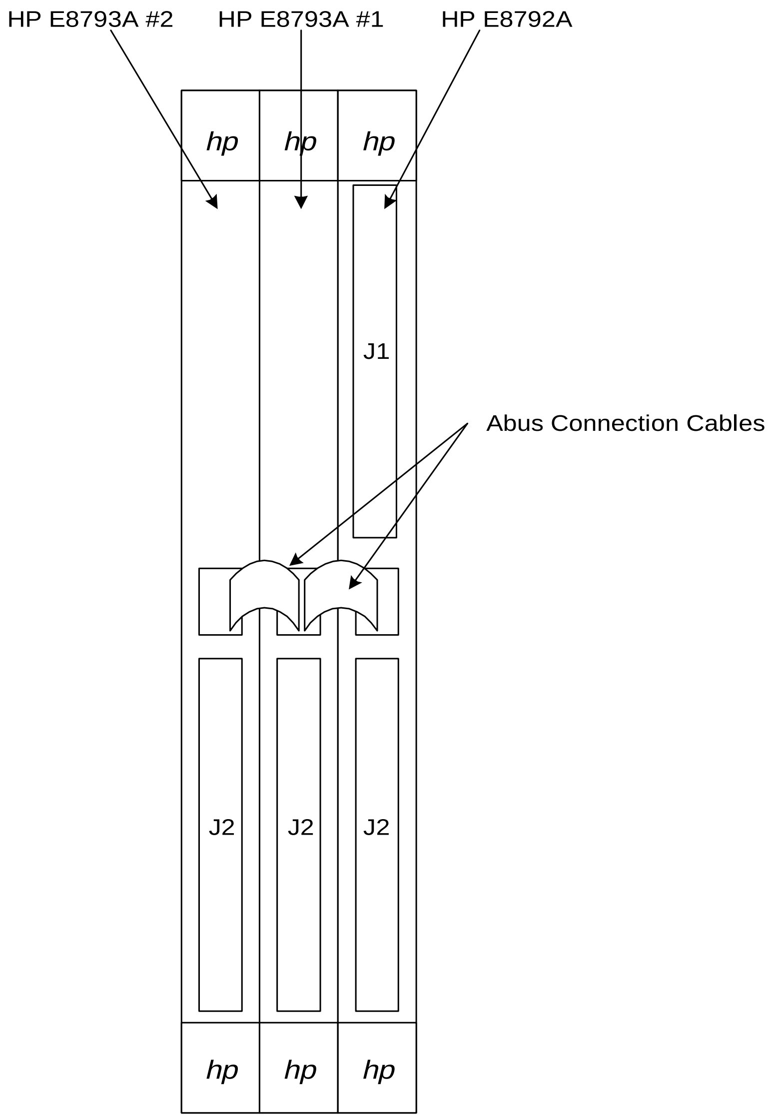


Figure 4-10. Installed 32-Pin Matrix Cards

Chapter 5
Using the Custom Card

This chapter describes how to configure and use the HP E8794A Custom Card. This chapter the following sections:

Register descriptions for the Custom Card are located in Appendix B of this manual.

The HP E8794A Custom Card is intended to be used for one of these purposes:

- A general-purpose breadboard card for system integrators to add custom circuitry,
- Emulation of the HP TS-5430 Series I.

General-Purpose Breadboard

The Custom Card contains a breadboard area of through-holes on 0.1" centers for soldering custom circuitry (see Figure 5-1).

TS-5430 Series I Emulation

The HP E8794A Custom Card may be used to provide routing and breadboard support similar to that found on the HP TS-5430 “Personality Board”. Digital I/O, matrix, Aux channels, routing area and ICA interface connections that were found on the TS-5430 “Personality Board” are also found on the E8794A Custom Card.

- 64 Aux Channels (from up to two 32-Pin Matrix Cards),
- 8 system DAC channels,
- 32 event detector channels.

In addition, 32 configuration lines are brought from the Custom Card to the TC connectors on the Test System Interface. Figure 5-1 shows the J2 - J6 connectors used to route channels and signals to/from the Custom Card. Each of these connectors is routed to a breakout area on the Custom Card. You can make connections from these breakout areas to your custom circuitry.

Digital I/O

A full 16 bits of digital I/O is required to emulate the TS-5430 Series I. The Switch/Load Unit provides 8 channels of digital I/O and the Custom Card provides 8 channels of digital I/O. The Custom Card digital I/O is the same type of 8-bit digital input and 8-bit digital output (Open Drain) provided by the Switch/Load Unit (refer to “Digital I/O” on page 10 for details). The Custom Card digital I/O is available in breakout area J50 (see Figure 5-1).

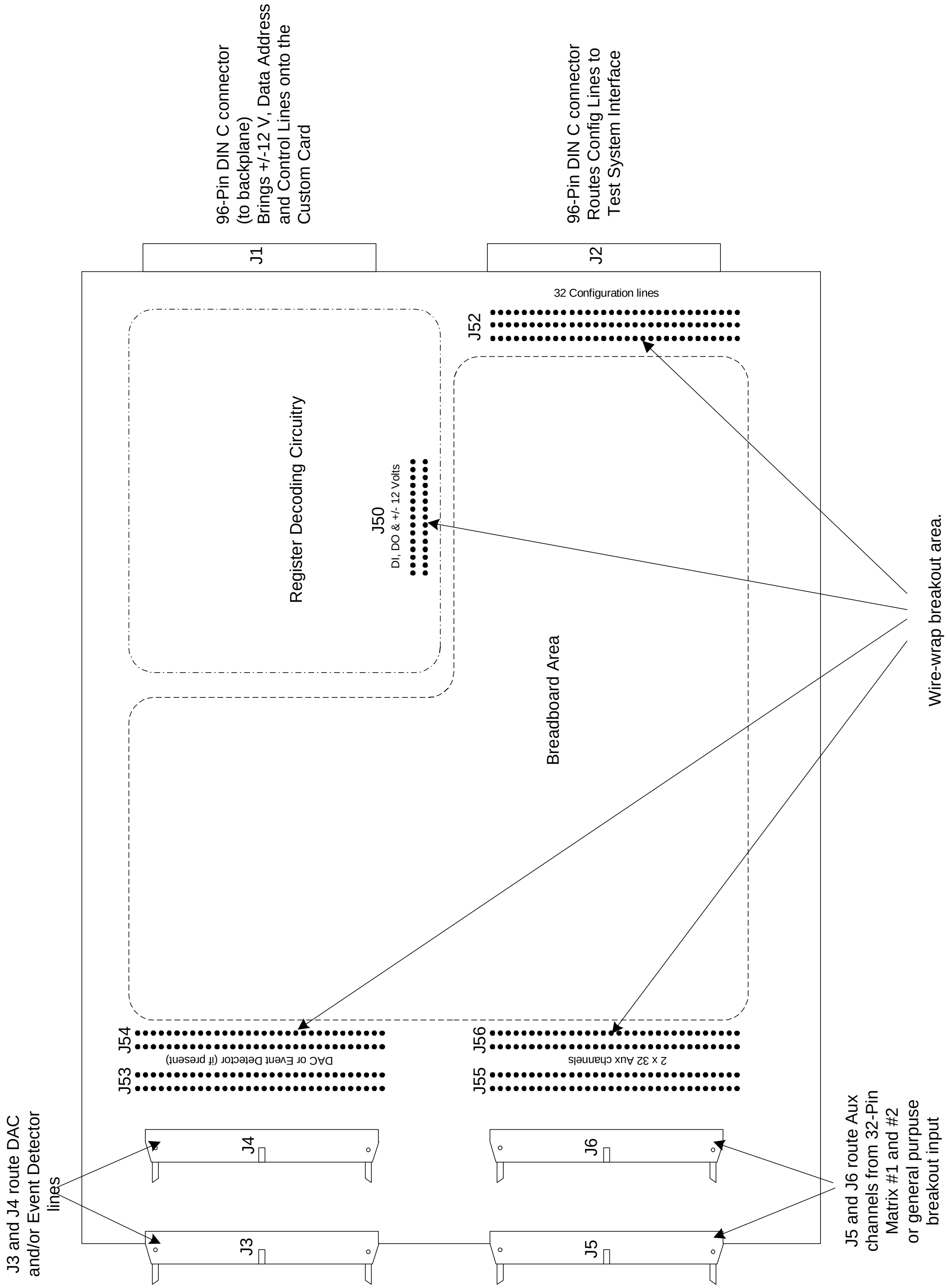


Figure 5-1. Custom Card Features

Connector Breakouts

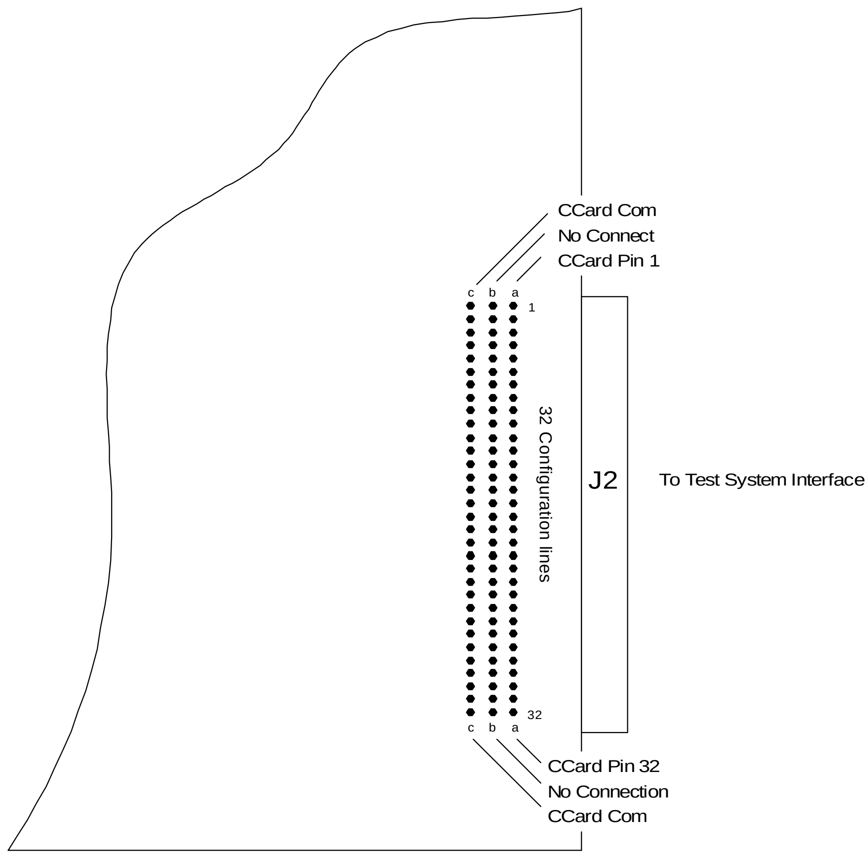
The figures and tables on the following pages show the breakouts for connectors J2 through J6. Refer to the schematic on page X for details on the J50 (Digital I/O) breakouts.

WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the Switch/Load Unit or plug-in cards. Before you remove any installed card, disconnect AC power from the mainframe and from other cards that may be connected to the cards.**

Caution **STATIC ELECTRICITY. Static electricity is a major cause of component failure. To prevent damage to electrical components, observe anti-static techniques whenever removing a card from the Switch/Load Unit or whenever working on a card.**

J2 Connector Breakouts

Figure 5-2 shows the J2 connector breakouts when cable part number E6170-61604 is used to connect J2 to the Test System Interface.



Note: Pinout shown is valid when using cable p/n E6170-61604

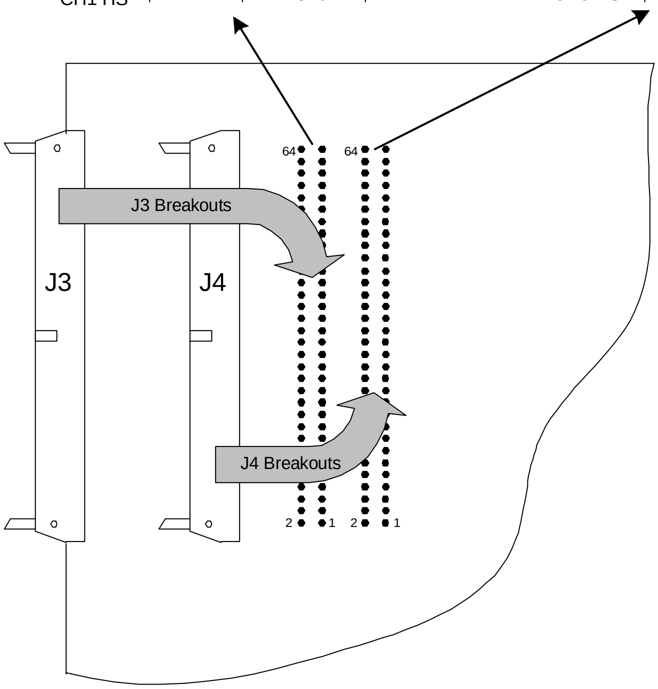
Figure 5-2. J2 Configuration Lines Pinouts

J3/J4 Connector Breakouts (DAC)

Figure 5-3 shows the J3/J4 connector breakouts when cable part number E6170-61615 is used to connect J3/J4 to the HP E1418 16-Channel DAC. The DAC's top connector is cabled to J3, the DAC's bottom connector is cabled to J4.

Signal	Pin Number	Signal	Pin Number
CH12 LS	64	Gnd	63
CH12 LO	62	Gnd	61
CH12 HI	60	Gnd	59
CH12 HS	58	Gnd	57
CH11 LS	56	Gnd	55
CH11 LO	54	Gnd	53
CH11 HI	52	Gnd	51
CH11 HS	50	Gnd	49
CH10 LS	48	Gnd	47
CH10 LO	46	Gnd	45
CH10 HI	44	Gnd	43
CH10 HS	42	Gnd	41
CH9 LS	40	Gnd	39
CH9 LO	38	Gnd	37
CH9 HI	36	Gnd	35
CH9 HS	34	Gnd	33
CH4 LS	32	Gnd	31
CH4 LO	30	Gnd	29
CH4 HI	28	Gnd	27
CH4 HS	26	Gnd	25
CH3 LS	24	Gnd	23
CH3 LO	22	Gnd	21
CH3 HI	20	Gnd	19
CH3 HS	18	Gnd	17
CH2 LS	16	Gnd	15
CH2 LO	14	Gnd	13
CH2 HI	12	Gnd	11
CH2 HS	10	Gnd	9
CH1 LS	8	Gnd	7
CH1 LO	6	Gnd	5
CH1 HI	4	Gnd	3
CH1 HS	2	Gnd	1

Signal	Pin Number	Signal	Pin Number
CH16 LS	64	Gnd	63
CH16 LO	62	Gnd	61
CH16 HI	60	Gnd	59
CH16 HS	58	Gnd	57
CH15 LS	56	Gnd	55
CH15 LO	54	Gnd	53
CH15 HI	52	Gnd	51
CH15 HS	50	Gnd	49
CH14 LS	48	Gnd	47
CH14 LO	46	Gnd	45
CH14 HI	44	Gnd	43
CH14 HS	42	Gnd	41
CH13 LS	40	Gnd	39
CH13 LO	38	Gnd	37
CH13 HI	36	Gnd	35
CH13 HS	34	Gnd	33
CH8 LS	32	Gnd	31
CH8 LO	30	Gnd	29
CH8 HI	28	Gnd	27
CH8 HS	26	Gnd	25
CH7 LS	24	Gnd	23
CH7 LO	22	Gnd	21
CH7 HI	20	Gnd	19
CH7 HS	18	Gnd	17
CH6 LS	16	Gnd	15
CH6 LO	14	Gnd	13
CH6 HI	12	Gnd	11
CH6 HS	10	Gnd	9
CH5 LS	8	Gnd	7
CH5 LO	6	Gnd	5
CH5 HI	4	Gnd	3
CH5 HS	2	Gnd	1

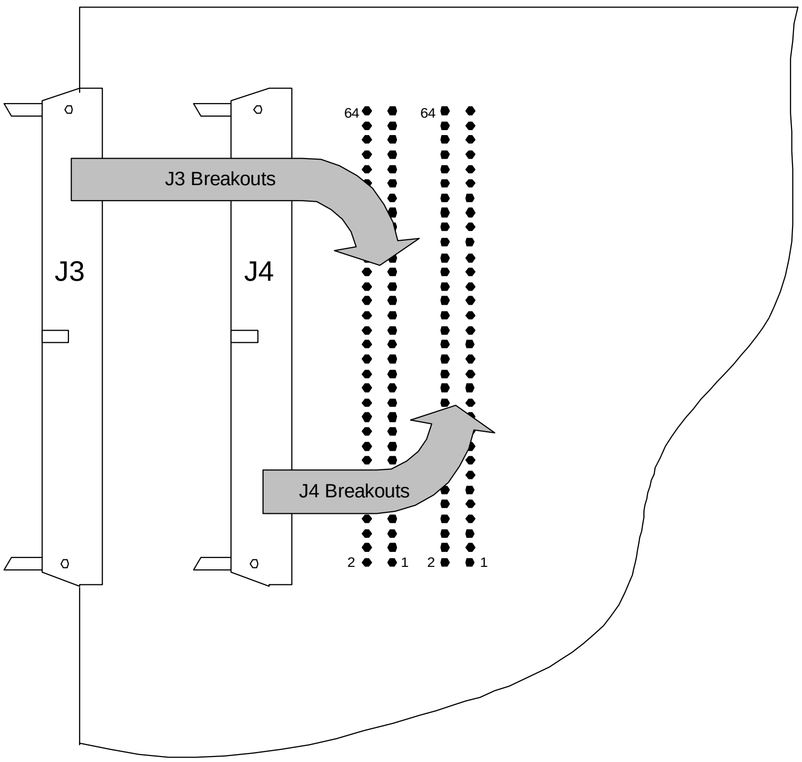


Note: DAC channel break-out is valid when using cable part number E6170-61615 (DAC top connector to J3, bottom connector to J4).

Figure 5-3. J3/J4 Breakouts for HP E1418 DAC

J3 or J4 Connector Breakouts (Event Detector)

The Event Detector can be cabled to either J3 or J4. Figure 5-4 shows the J3 or J4 connector breakouts. Connections are made to either J3 or J4 to the HP E6174 Event Detector.



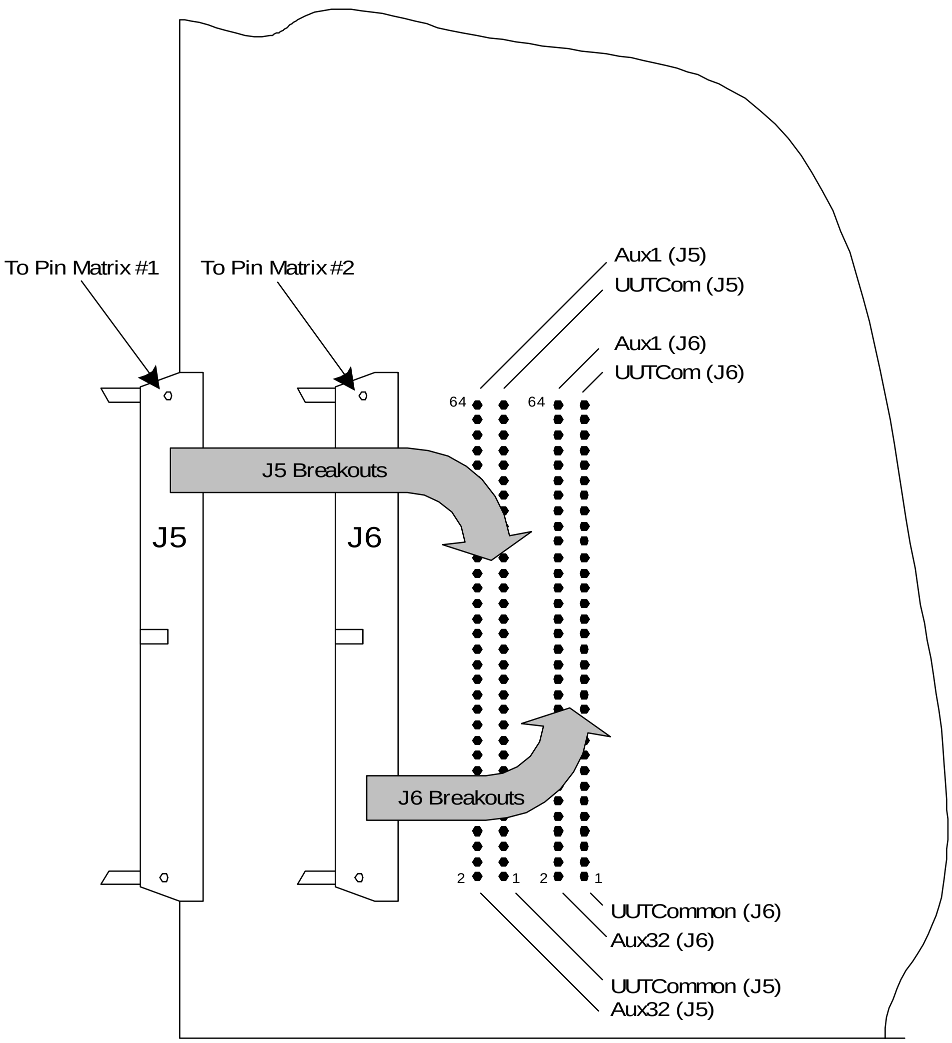
Signal	Pin Number	Signal	Pin Number
Gnd	64	CH31	63
Gnd	62	CH30	61
Gnd	60	CH29	59
Gnd	58	CH28	57
Gnd	56	CH27	55
Gnd	54	CH26	53
Gnd	52	CH25	51
Gnd	50	CH24	49
Gnd	48	CH23	47
Gnd	46	CH22	45
Gnd	44	CH21	43
Gnd	42	CH20	41
Gnd	40	CH19	39
Gnd	38	CH18	37
Gnd	36	CH17	35
Gnd	34	CH16	33
Gnd	32	CH15	31
Gnd	30	CH14	29
Gnd	28	CH13	27
Gnd	26	CH12	25
Gnd	24	CH11	23
Gnd	22	CH10	21
Gnd	20	CH9	19
Gnd	18	CH8	17
Gnd	16	CH7	15
Gnd	14	CH6	13
Gnd	12	CH5	11
Gnd	10	CH4	9
Gnd	8	CH3	7
Gnd	6	CH2	5
Gnd	4	CH1	3
Gnd	2	CH0	1

Note: Event Detector can be connected to J3 (left breakout connections) or J4 (right breakout connections.

Figure 5-4. J3 or J4 Connector Breakouts for HP E6174 Event Detector

J5 and J6 Connector Breakouts (32-Pin Matrix Cards)

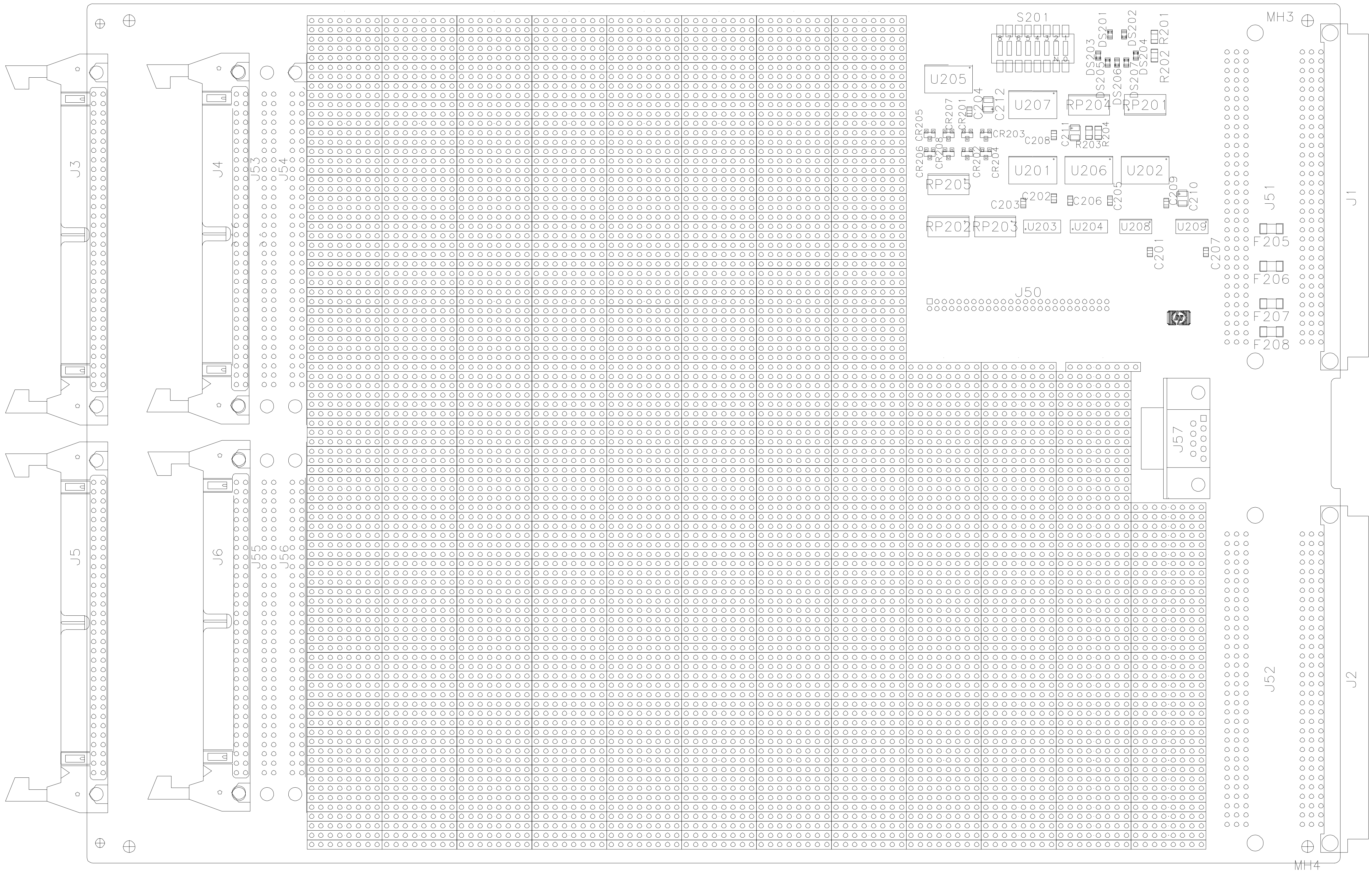
32-Pin Matrix Card #1 can be cabled to J5 and 32-Pin Matrix Card #2 can be cabled to J6. Figure 5-4 shows the J5 and J6 connector breakouts when cable part number E3751-61601 is used to connect the 32-Pin Matrix Card(s) to J5 and J6.



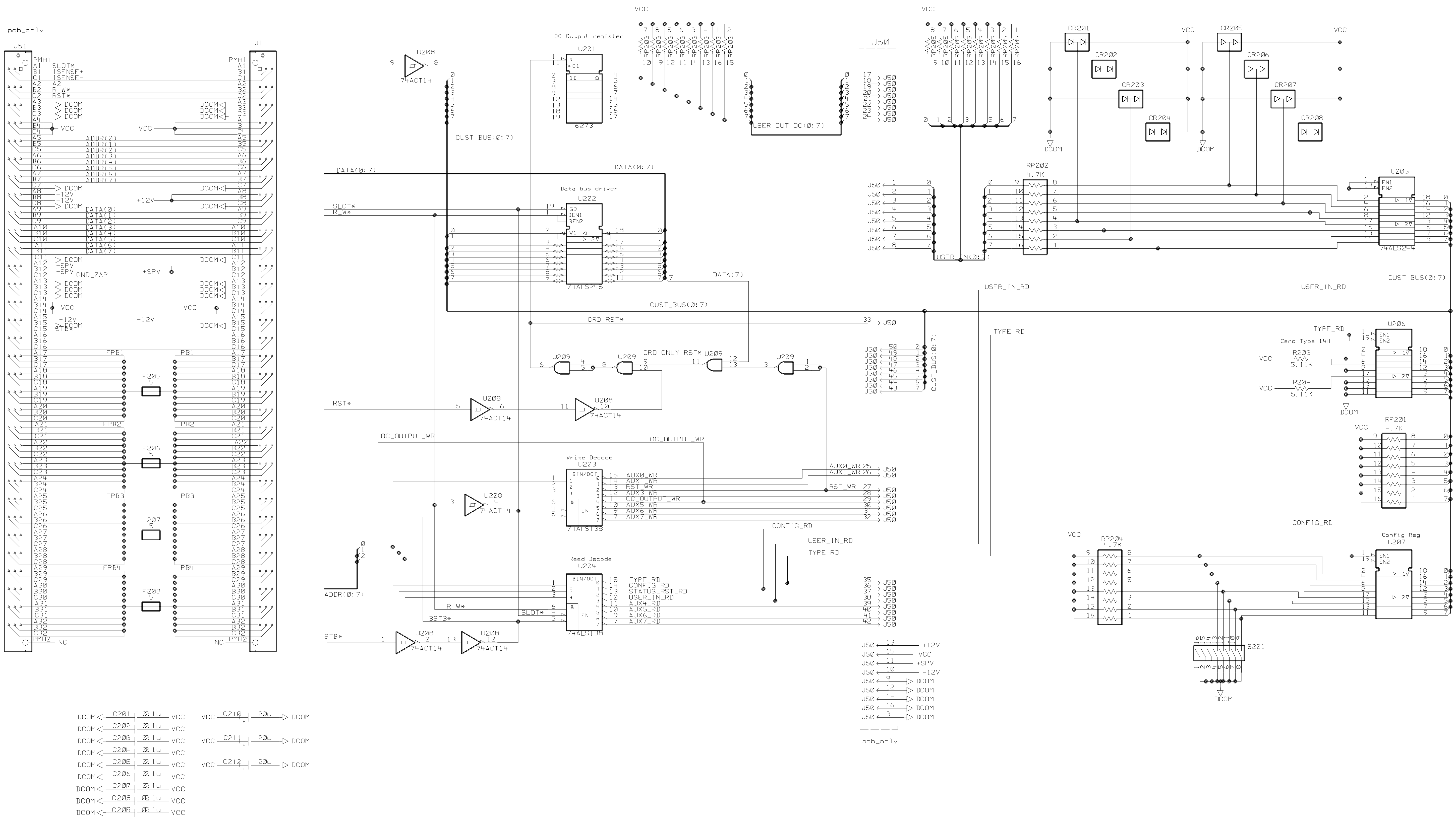
Note: Pinout for Aux and UUT Common connections is valid when cable p/n E3751-61601 is used to connect to pin matrix cards.

Figure 5-5. J5 and J6 Breakouts (32-Pin Matrix Cards)

HP E8794A Component Locator



HP E8794A Schematic



Chapter 6
Repair Information

Support Strategy

Rebuilt exchange assemblies are available for many HP VXI modules. However, there are no exchange assemblies available for the load cards. If a load card fails, you have two choices: purchase a new load card or troubleshoot the problem and repair it. If the problem is a relay and you can determine which relay is defective, you can repair the module. The relays are through-hole technology and easy to replace.

Load Card Component Locators

HP E6175A 8-Channel High-Current Card

The HP E6175A 8-Channel High-Current Load Card relays and fuses are shown in Figure 6-1. The 8-Channel High-Current Load Card uses the HP 0490-1517 Form C relay, as shown in Figure 6-2. Two HP 0490-1839 relays, switched in parallel, are used to connect the Isense+ and Isense- signals. The component locator diagram, Figure 6-2, is shown looking at the non-component side, back of the HP E3750-66503 through-hole PC board.

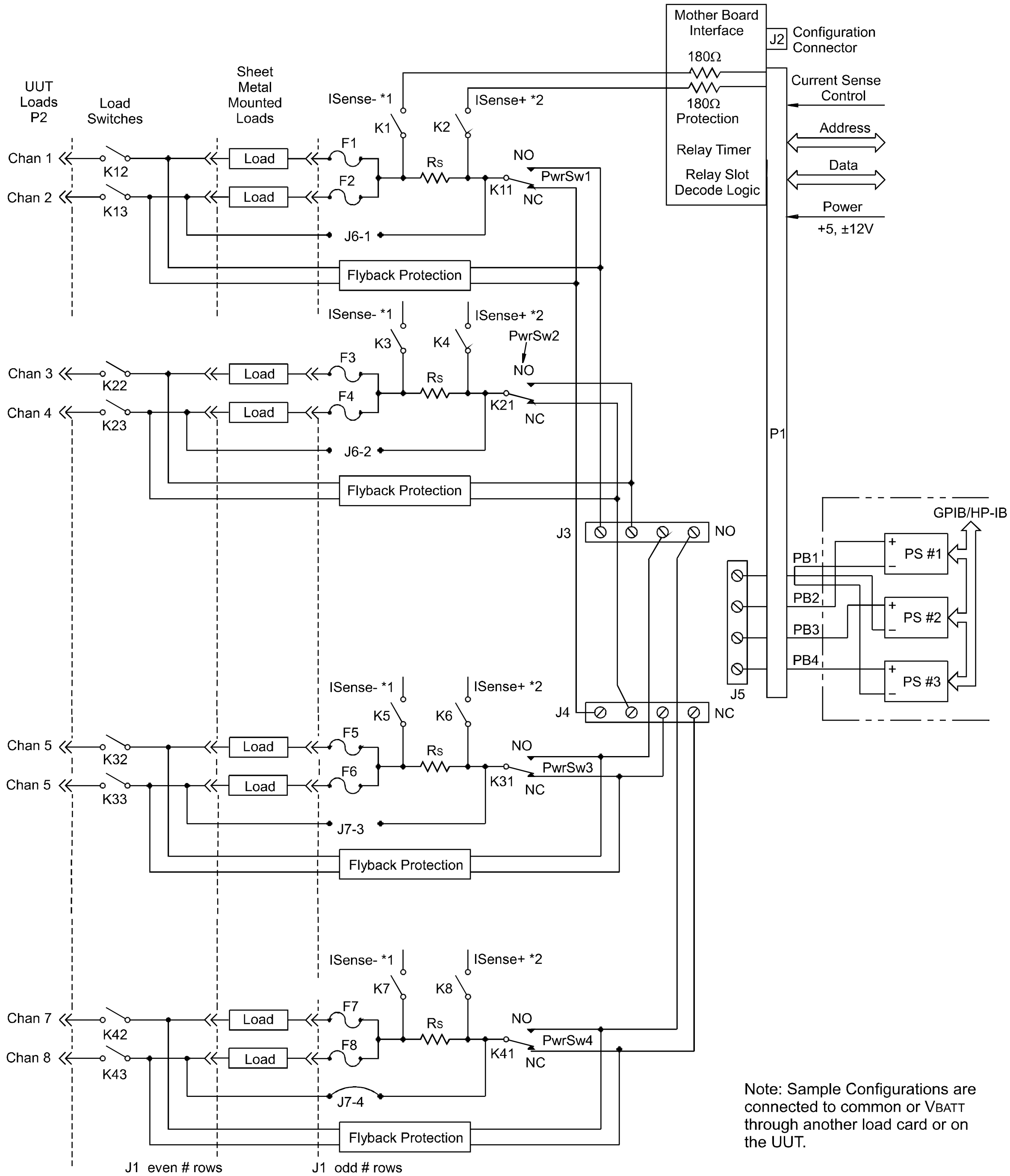


Figure 6-1. HP E6175A 8-Channel Load Card Relays and Fuses

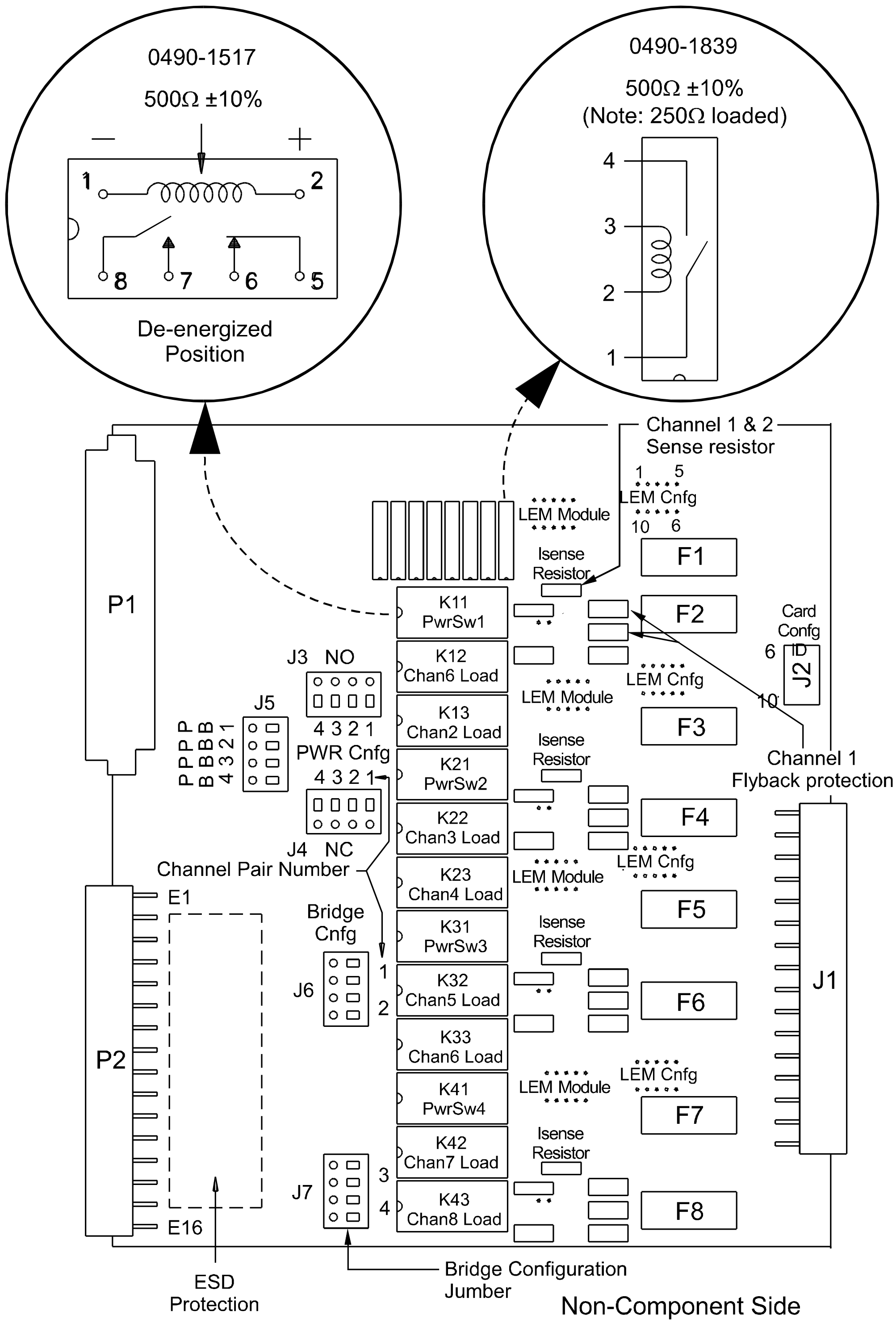


Figure 6-2. HP E6175A 8-Channel Load Card Component Locator (Rear View)

HP E6176A 16-Channel High-Current Card

The HP E6176A 16-Channel High-Current Load Card relays and fuses are shown in Figure 6-3. The 16-Channel High-Current Load Card uses the HP 0490-1517 Form C relay, as shown in Figure 6-4. Two HP 0490-1839 relays, switched in parallel, are used to connect the Isense+ and Isense- signals. The component locator diagram, Figure 6-4, is shown looking at the solder-side, back of the HP E3750-66504 through-hole PC board.

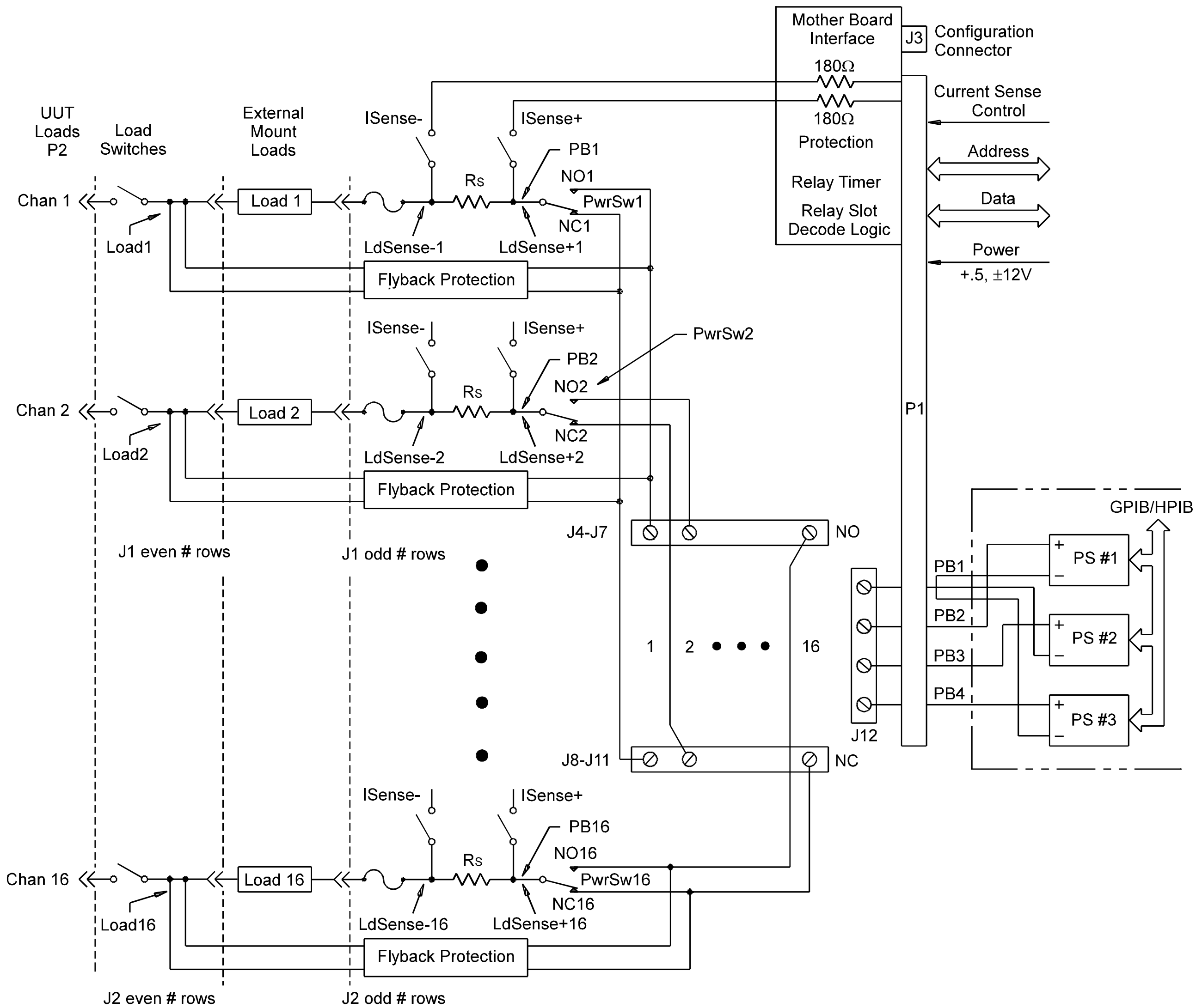


Figure 6-3. HP E6176A 16-Channel Load Card relays and Fuses

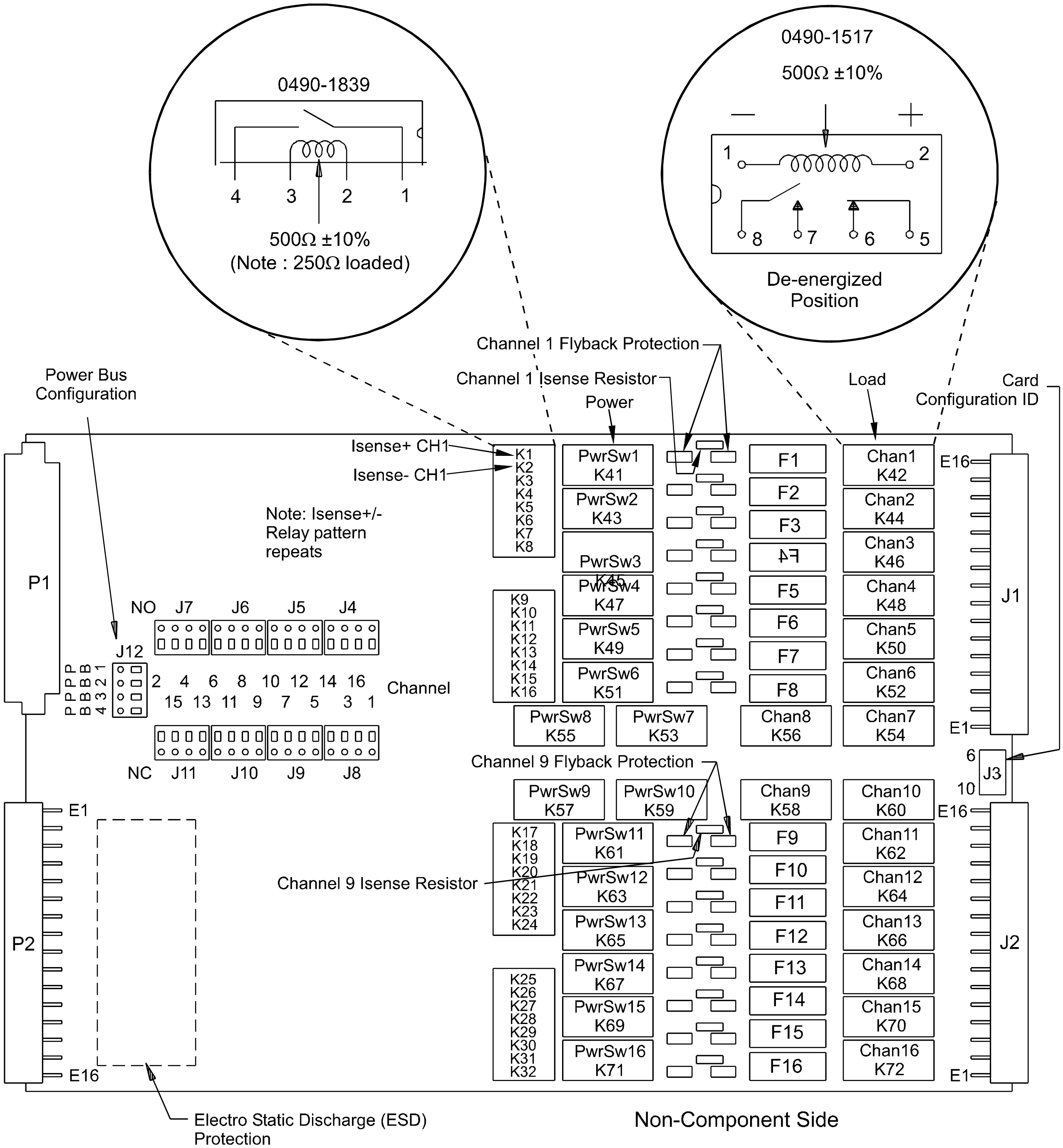


Figure 6-4. HP E6176A 16-Channel Load Card Component Locator (Rear View)

HP E6177A 24-Channel Medium-Current Card

The HP E6177A 24-Channel Medium-Current Load Card relays and fuses are shown in Figure 6-5. The HP E6177A 24-Channel Medium-Current Load Card uses the HP 0490-1774 Form C relay, as shown in Figure 6-6. The component locator diagram, Figure 6-6, is shown looking at the solder-side, back of the HP E3750-66505 through-hole PC board.

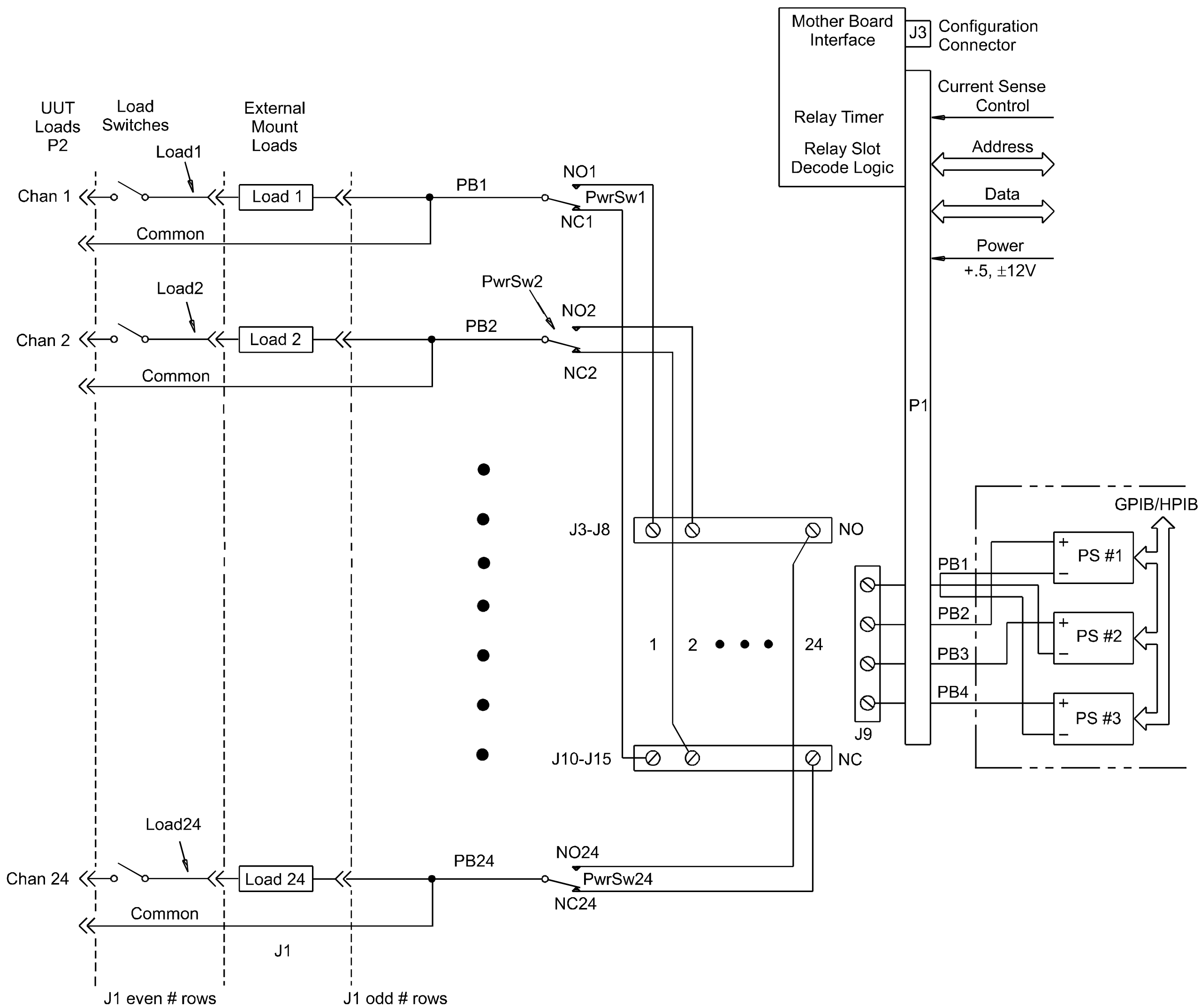


Figure 6-5. HP E6177A 24-Channel Medium-Current Load Card Block Diagram

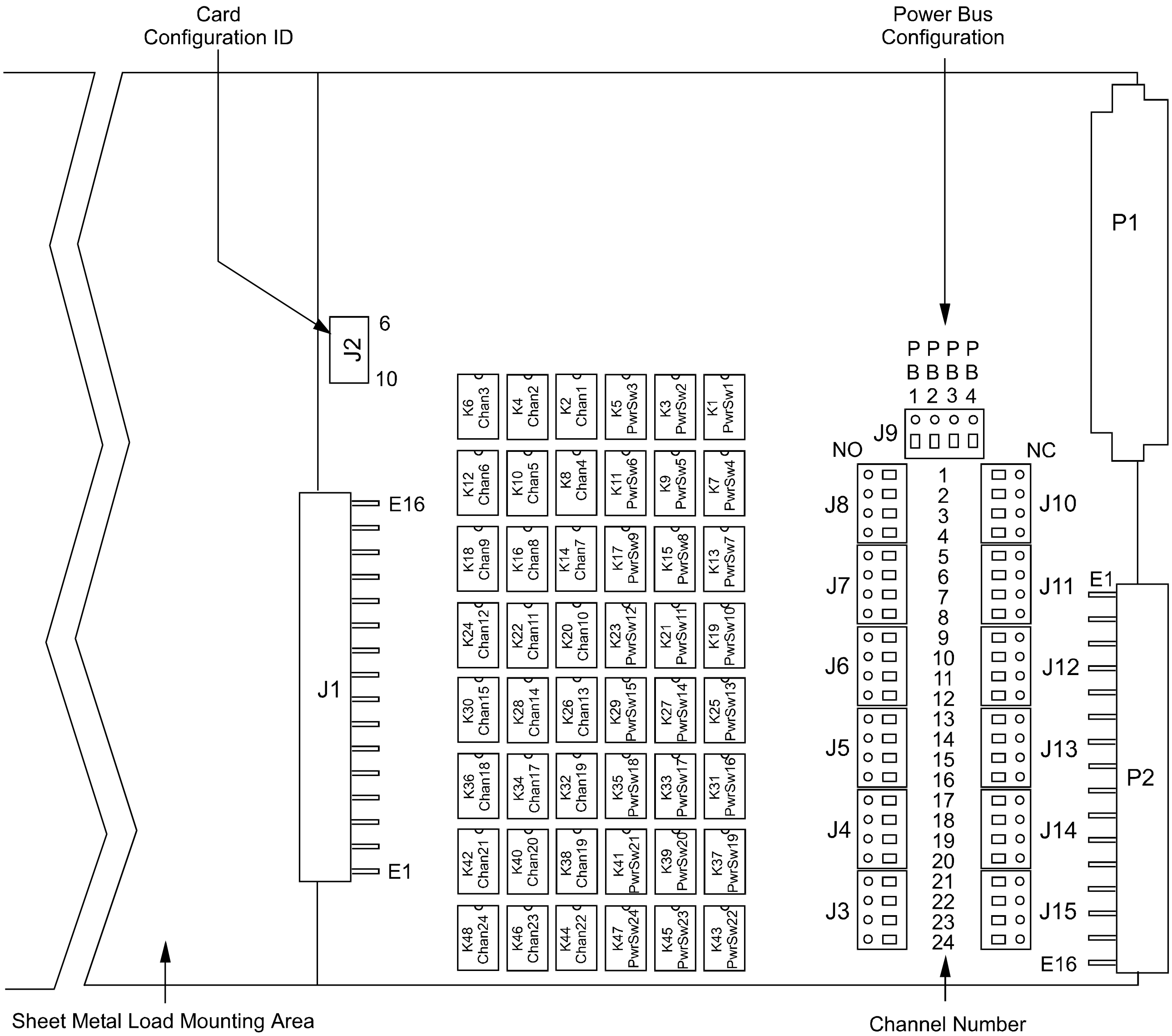


Figure 6-6. HP E6177A 24-Channel Load Card Component Locator (Rear View)

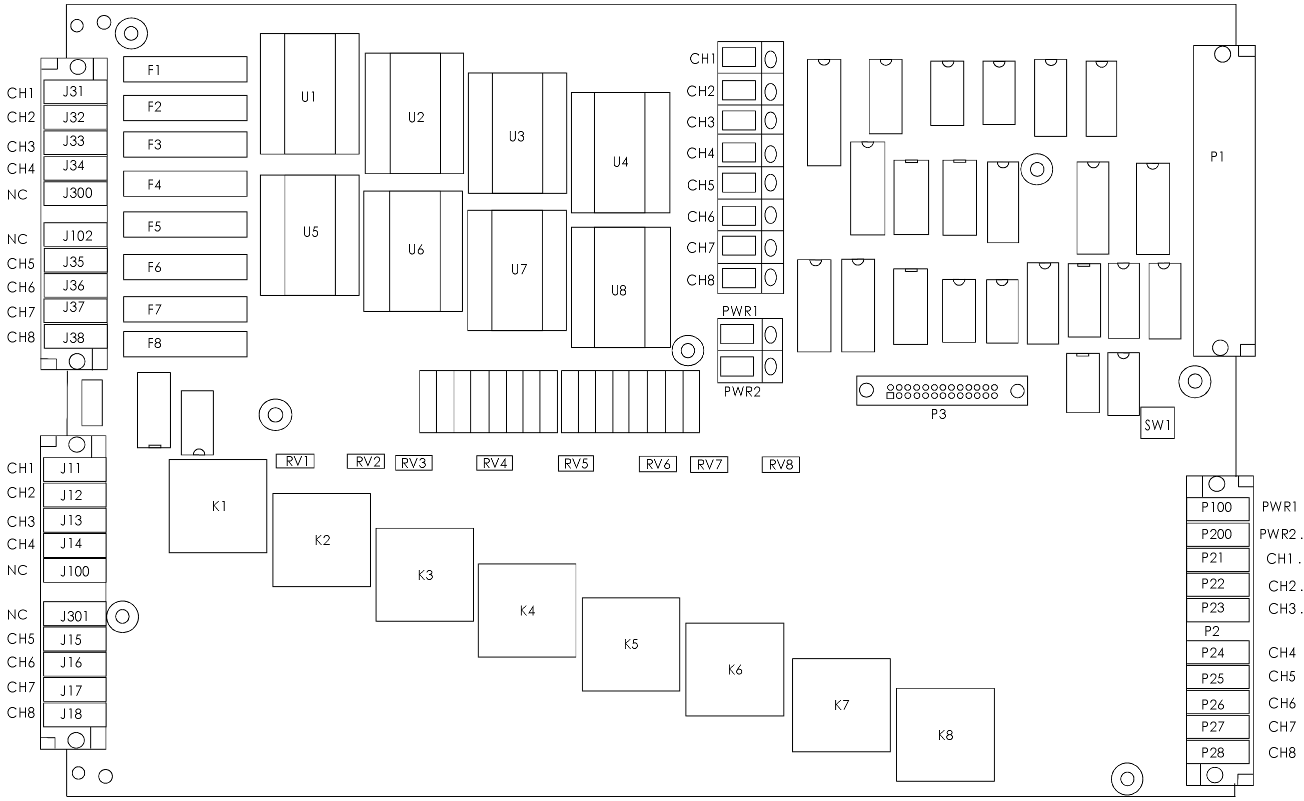


Figure 6-7. HP E6178B Component Locator

32-Pin Matrix Modules

Individual relays can be replaced on the HP E8792A and E8793A 32-Pin Matrix Modules. All relays are 5V, 1A reed relays. The HP part number for an 8-pack of relays is 0490-1838. Figure 6-8 shows the relay groupings for the HP E8792A (the HP E8793A is identical but does not have the instrumentation relays). The tables on the following pages list the component number for each possible relay. The tables for the Measurement and Instrument Matrices are listed in a row/column format. For example, in Table 6-1 the relay that connects Measurement Matrix Row5 to Column3 (Abus3) is K305. Relay component numbers are silk-screened on the back of the PC board.

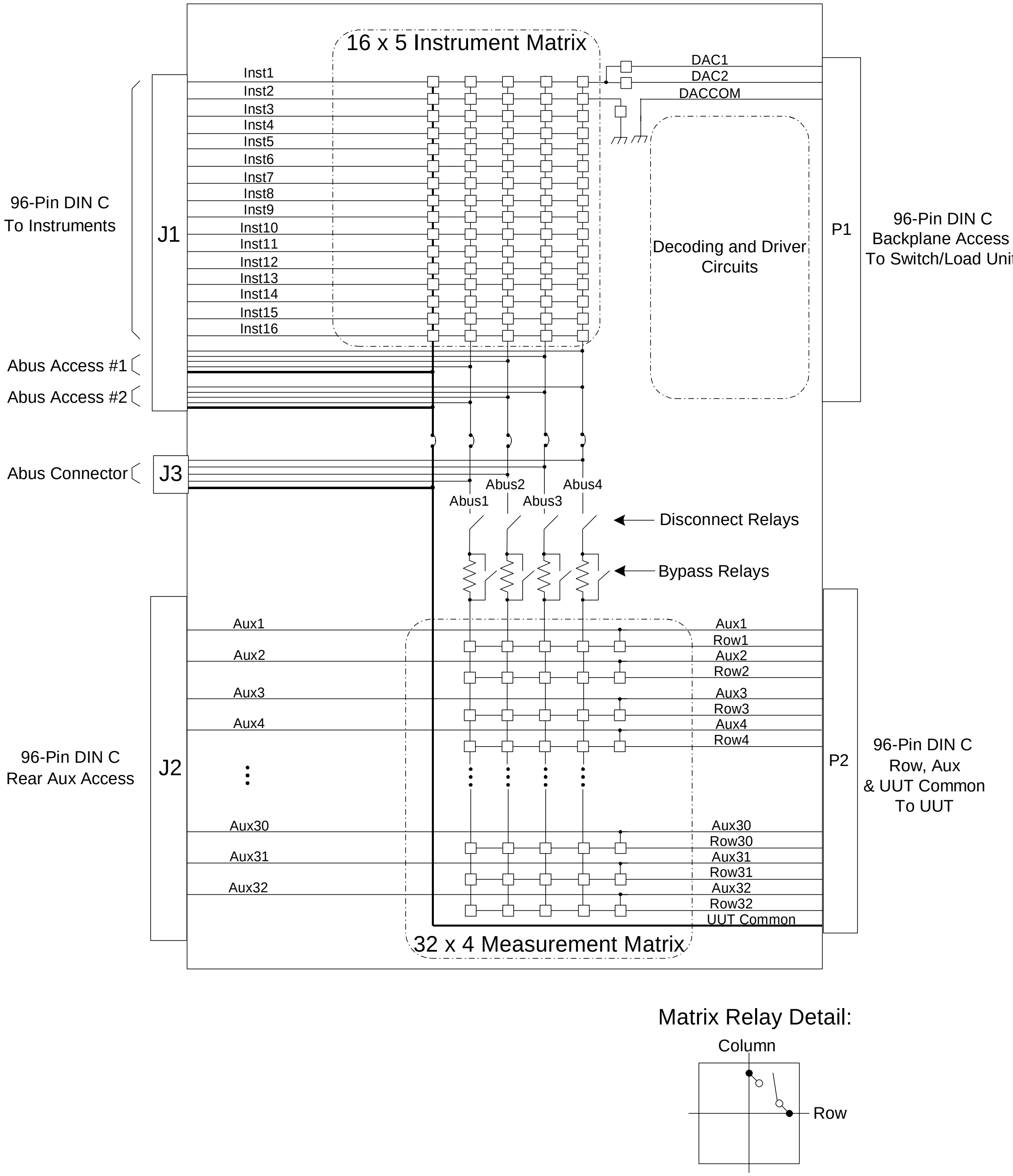


Figure 6-8. HP E8792A Block Diagram

Table 6-1. Measurement Matrix Relays

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Row1	K101	K201	K301	K401	K501
Row2	K102	K202	K302	K402	K502
Row3	K103	K203	K303	K403	K503
Row4	K104	K204	K304	K404	K504
Row5	K105	K205	K305	K405	K505
Row6	K106	K206	K306	K406	K506
Row7	K107	K207	K307	K407	K507
Row8	K108	K208	K308	K408	K508
Row9	K109	K209	K309	K409	K509
Row10	K110	K210	K310	K410	K510
Row11	K111	K211	K311	K411	K511
Row12	K112	K212	K312	K412	K512
Row13	K113	K213	K313	K413	K513
Row14	K114	K214	K314	K414	K514
Row15	K115	K215	K315	K415	K515
Row16	K116	K216	K316	K416	K516
Row17	K117	K217	K317	K417	K517
Row18	K118	K218	K318	K418	K518
Row19	K119	K219	K319	K419	K519
Row20	K120	K220	K320	K420	K520
Row21	K121	K221	K321	K421	K521
Row22	K122	K222	K322	K422	K522
Row23	K123	K223	K323	K423	K523
Row24	K124	K224	K324	K424	K524
Row25	K125	K225	K325	K425	K525
Row26	K126	K226	K326	K426	K526
Row27	K127	K227	K327	K427	K527
Row28	K128	K228	K328	K428	K528
Row29	K129	K229	K329	K429	K529
Row30	K130	K230	K330	K430	K530
Row31	K131	K231	K331	K431	K531
Row32	K132	K232	K332	K432	K532

Table 6-2. Instrument Matrix Relays

	Abus1	Abus2	Abus3	Abus4	UUT Common
Inst1	K1101	K1201	K1301	K1401	K1001
Inst2	K1102	K1202	K1302	K1402	K1002
Inst3	K1103	K1203	K1303	K1403	K1003
Inst4	K1104	K1204	K1304	K1404	K1004
Inst5	K1105	K1205	K1305	K1405	K1005
Inst6	K1106	K1206	K1306	K1406	K1006
Inst7	K1107	K1207	K1307	K1407	K1007
Inst8	K1108	K1208	K1308	K1408	K1008
Inst9	K1109	K1209	K1309	K1409	K1009
Inst10	K1110	K1210	K1310	K1410	K1010
Inst11	K1111	K1211	K1311	K1411	K1011
Inst12	K1112	K1212	K1312	K1412	K1012
Inst13	K1113	K1213	K1313	K1413	K1013
Inst14	K1114	K1214	K1314	K1414	K1014
Inst15	K1115	K1215	K1315	K1415	K1015
Inst16	K1116	K1216	K1316	K1416	K1016

Table 6-3. Bypass and Disconnect Relays

	Abus1	Abus2	Abus3	Abus4
Bypass Relays	K2	K4	K6	K8
Disconnect Relays	K1	K3	K5	K7

Table 6-4. Miscellaneous Relays

Inst2 to System Ground Relay	K1502
DAC1 to Inst1	K1503
DAC2 to Inst1	K1504

Appendix A

Specifications: Switch/Load Unit, Load Card, Pin Matrix Card, and Custom Card

HP E6198A Switch/Load Unit Specifications

Power Bus Resistance:

0.02Ω maximum

Power Bus Current:

20 A maximum continuous

Peak Power Bus Current:

30 A maximum (<0.1 second, duty cycle <10%)

Peak Power Bus Voltage:

60 V maximum

Combined Power Bus Current (all buses):

45 A maximum continuous

Switch/Load Unit to Power Supply Cable Resistance (per bus):

0.03Ω (standard supplied HP cable with connectors included)

Switch/Load Unit to Load Card Connection Resistance:

0.03Ω maximum

Average Load Power for all loads mounted in Switch/Load Unit:

250 Watte average
500 Watts maximum

DAC Channels:

Vout: 916V to +16V
Iout: 10 mA
Resolution: 14 bit
Gain Error: .3% typical
Offset Error: 20 mV typical

HP E6175A 8-Channel High-Current Load Card Specifications

Path resistance from power bus to load card connect:

0.25Ω maximum[1]

Load path relay operate/release time:

10/8 msec typical, 16/10 msec maximum, 30 cps maximum

Peak voltage to Earth:

60 V continuous
500 V maximum transient, non-switching (devays to <60V in 200mS)

Load carry/switching current:

7.5 A maximum non-switching, continuous

Load carry peak current:

15 A maximum, non-switching (<100 msec, <2% duty cycle)

Load switching power:

150 Watts maximum, resistive load

Load switching voltage:

60 V maximum

Average power for loads mounted on load card:

40 Watts maximum total, per card

Minimum permissible load:

1mA, 1V

Basic current sense accuracy with standard 0.05Ω sense resistor:

0.1 % maximum

1. Exclusive of load, with standard 0.05Ω sense resistor and 10A slo-blo fuse installed. (5Ω for load currents <1A).

HP E6176A 16-Channel High-Current Load Card Specifications

Path resistance from power bus to load card connect:

0.4Ω maximum[1]

Load path relay operate/release time:

10/8 msec typical, 16/10 msec maximum, 30 cps max

Peak voltage to Earth:

60 V continuous
500 V maximum transient, non-switching (devays to <60V in 200mS)

Load carry/switching current:

7.5 A maximum non-switching, continuous

Load carry peak current:

15 A max., non-switching (<100 msec, <2% duty cycle)

Load switching power:

150 Watts maximum, resistive load

Load switching voltage:

60 V maximum

Minimum permissible load:

1mA, 1V

Basic current sense accuracy with standard 0.05Ω sense resistor:

0.1 % maximum

1. Exclusive of load, with standard 0.05Ω sense resistor and 10A slo-blo fuse installed. (5Ω for load currents <1A).

HP E6177A 24-Channel Medium-Current Load Card Specifications

Path resistance from power bus to load card connect:

0.5Ω maximum[1]

Load path relay operate/release time:

3.3/2.4 msec typical, 8/8 msec max, 10 cps maximum

Peak voltage to Earth:

60 V continuous
500 V maximum transient, non-switching (devays to <60V in 200mS)

Load carry/switching current:

3 A maximum

Relay switching voltage:

60 Vdc maximum

Minimum permissible load:

10µA, 10mV DC

1.Exclusive of load 5Ω for load currents <0.1A.

HP E6178B 8-Channel Heavy Duty Load Card Specifications

Path resistance from power bus to load card connect:
0.030 Ω typical, 0.075 Ω maximum[1]

Load path relay operate/release time:
15/10 msec typical, 20CPS max w/o load, 6CPM max w/rated load

Peak Voltage to Earth:
60V continuous
500 V maximum transient, non-switching (devays to <60V in 200mS)

Load Carry Current (continuous):
30 A maximum

Load Transient Peak Current (non-switched):
200 A maximum, <100mS, <2% duty cycle[1]

Load Transient Peak Current (switched):
120 A maximum, <10mS, 14Vdc (resistive)

Power Bus Carry Current (continuous):
30 A maximum

Load Switching Power:
500 W max @ 25Vdc max. resistive load;
100 W max @ 40Vdc max. resistive load

Load Switching Voltage:
40 V max, V*I not to exceed Load Switching Power[1]

Current Sense Accuracy:
Gain + Linearity accuracy: 1.2% maximum
Zero Current Offset:
0.1A typical, when zero offset is adjusted per user manual.
0.3A typical, no zero offset adjustment.
Cycle Lifetime (Relay) Mechanical: 10^7 Cycles minimum
Cycle Lifetime (Relay) at rated power: 10^5 Cycles minimum Switched @ 40A, 14Vdc resistive load
Auxiliary Relay Drive Requirements (via P3):
Channel Relays: 150mA max. Requires low side driver @ +12Vdc
Current Monitor Relays: 15mA max. Requires low side driver @ +12Vdc

Factory Installed Fuse:

Bussman MDL-30, DO NOT SUBSTITUTE

1.Factory Installed Fuse

HP E8792A and E8793A Specifications

Instrument Multiplexer (HP E8792A Only)

Number of Analog Instrument Channels: 16

Analog Channel:
Voltage (Max.): 200 volts
Resistance: <1Ω
Unbalanced Bandwidth: 10 MHz (Minimum)
Balanced Pair Bandwidth: 5 MHz (Minimum)

Relay Type: dry reed

Relay Life:
@ No load: $1x10^8$ operations
@ Full load: $1x10^5$ operations

Relay Switching Speed:
Close: 500 µS
Open: 400 µS

Relay Switching Characteristics:
1.0 A carry
0.5 A while switching
7.5 Volt-Amps max. instantaneous switching

Other Relay Parameters:
300 VDC Standoff voltage
200 VDC Switching voltage

General Specifications (HP E8792A and E8793A)

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

Power Requirements:
Voltage:+5Vdc

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

Relay Characteristics (HP E8792A and E8793A)

Type: dry reed

Switching Speed:
Close: 500 µs
Open: 400 µs

Switching Characteristics:
1.0 A carry
0.5 A while switching
7.5 Volt-Amps max. instantaneous switching

Other:
300 VDC Standoff voltage
200 VDC Switching voltage

Relay Life

Electromechanical relays are subject to normal wear-out. Relay life depends on several factors including loading and switching frequency.

Relay Load. In general, higher power switching reduces relay life. In addition, capacitive/inductive loads and high inrush currents (e.g. turning on a lamp or starting a motor) reduces relay life. Exceeding specified maximum inputs can cause catastrophic failures.

Switching Frequency. Relay contacts heat when switched. As the switching frequency increases, the contacts have less time to dissipate heat. The resulting increase in contact temperature reduces relay life.

End-of-Life Detection

A preventative maintenance routine can prevent problems caused by unexpected relay failure. The end-of-life of a relay can be determined by using one or more of the three methods described below. The best method (or combination of methods), as well as the failure criteria, depends on the application in which the relay is used.

Contact Resistance. As the relay begins to wear out, its contact resistance increases. For the HP E8792A 32-Pin Matrix Card, the total resistance measured through and external instrument connector to an analog bus connector is less than 1Ω. Since most of this resistance is trace resistance, an increase of 1 or 2Ωs indicates relay deterioration.

Stability of Contact Resistance. The stability of contact resistance decreases with age. Using this method, the contact resistance is measured several (5 - 10) times, and the variance of the measurement is determined. An increase in the variance indicates deteriorating performance.

Number of Operations. Relays can be replaced after a predetermined number of contact closures. However, this method requires knowledge of the applied load and life specifications for the applied load. The expected life of the relays range from $1x10^5$ operations at full load to $1x10^8$ operations for mechanical end-of-life (no load).

Replacement Strategy

The replacement strategy depends on the application. If some relays are used more often, or at a higher load, than the others, the relays can be individually replaced as needed. If all the relays see similar loads and switching frequencies, the entire circuit board can be replaced when the end of relay life approaches. The sensitivity of the application should be weighed against the cost of replacing relays with some useful life remaining.

Note Relays that wear out normally or fail due to misuse should not be considered defective and are not covered by the product's warranty.

Appendix B

Switch/Load Unit, Load Cards, Pin Cards, and Custom Card Register Definitions

Introduction

This appendix provides register-based programming information for the HP E6198A Switch/Load Unit backplane and the individual load cards. This can be useful for component level troubleshooting of the load cards or Switch/Load Unit.

We strongly recommend that addressing the registers and relays be done through drivers that track the state of all the Switch/Load Unit relays from the moment of start-up. Failure of the software to maintain state awareness could result in shorting the power bus across one or more relays, thereby damaging or destroying them.

Address Space

The Switch/Load Unit address space is divided as follows:

$FFFSSSSSRRRRRRRR_2$

where:

F = Frame select 0-7
S = Slot number 0-21
R = Register offset 0-255

Use slot number 0 for Switch/Load Unit backplane access. For Switch/Load Unit Pin Matrix, Load or Custom cards, slot numbers are 1-21.

For ease of configuration and for software auto detection, all of the Switch/Load Unit cards (and backplane) conform to an address map structure that begins with the three registers as show in Table 6-5.

Table 6-5. Standard Registers

Register Offset	Register Name	Description
00_h	Card type	See Table 6-6.
01_h	Card configuration	Defaults to FF_h unless changed by user.
02_h	Status/Control	Card specific controls.

Table 6-6 shows the values returned from each card's Card Type register.

Table 6-6. Card Type Values

Model Number	Card Type Value	Description
HP E6175A	01_{10} (01_h)	8-Channel Load Card
HP E6176A	02_{10} (02_h)	16-Channel Load Card
HP E6177A	03_{10} (03_h)	24-Channel Load Card
HP E6178B	04_{10} (04_h)	8-Channel Heavy Duty Load Card (30 Amp)
HP E8792A	10_{10} ($0A_h$)	Fully loaded pin card (includes instrumentation multiplexer)
HP E8793A	11_{10} ($0B_h$)	Partially loaded pin card (w/out instrumentation multiplexer).
HP E8794A	20_{10} (14_h)	Custom Card
HP E6198A	30_{10} ($1E_h$)	Backplane Rev. A

Base Address

All register address definitions are with respect to a base address as follows:

- The Switch/Load Unit base address is defined as the slot base address for slot 0: Base = FFF00000 00000000_2

- The Base address for the cards within the Switch/Load Unit is defined as: Base = FFFSSSSS 00000000_2

  Where SSSSS is any binary value from (slot) 1 to 21.

For example: The base address for a load card inserted in slot 20 of the first Switch/Load Unit would be:

Frame 1: 001_2
Slot 20: 10100_2
Register 0: 00000000_2
Base Address: 0011010000000000_2 or 3400_h

Switch/Load Unit Register Definitions

The Switch/Load Unit registers are defined in the following tables. Each register has a (W) or (R) following the section title. This indicates whether the register is a: (R) read only, or (W) write only register. The following registers are with respect to a Switch/Load Unit base address corresponding to $FFF0000000000000_2$ on the Switch/Load Unit selected. Table 6-7 summarizes the Switch/Load Unit registers.

Table 6-7. Switch/Load Unit Registers

Register Offset	Definitions	Type
Base + 0_h	Card Type	Read Only
Base + 1_h	Card Configuration	Read Only
Base + 2_h	Status Register	Read Only
Base + 3_h	Fixture ID	Read Only
Base + 4_h	Digital Input	Read Only
Base + 5_h - 7_h	Not Used	
Base + 8_h	DAC1 Output MSB	Write Only
Base + 9_h	DAC1 Output LSB	Write Only
Base + A_h	Control Register	Write Only
Base + B_h	Open Drain Output	Write Only
Base + C_h	Digital Output	Write Only
Base + D_h	DAC2 Output MSB	Write Only
Base + E_h	DAC2 Output LSB	Write Only
Base + F_h	Not Used	

Card Type (R) Base + 0_h

This register reads back $1E_h$ (30_{10}) for the Switch/Load Unit.

Bits	7-0
Read	Card Type
Setting	$1E_h$

- Read Only
- Power On/Reset State = $1E_h$ (30_{10}).

Card Configuration (R) Base + 1_h

For the Switch/Load Unit, this register always returns FF_h (255_{10}).

Bits	7-0
Read	**Card Configuration**
Setting	**FF_h**

Status Register (R) Base + 2_h

The status register provides readback of the current Reset and Busy status of the backplane. Busy~ is an open collector line that any slot can drive to indicate its status, typically a relay timer. The state of Busy~ upon reset may be transient.

Bits	7-2	1	0
Read	Undefined	Reset~	Busy~
Setting	All 1s	state	state

- Read Only
- Undefined bits readback as all 1s
- Busy~: 0 = Busy, 1 = Ready.
- Reset~: 0 = reset active (Switch/Load Unit is currently being reset), 1 = reset inactive

Fixture ID (R)
Base + 3_h

The Fixture ID register contains the frame address setting of the Frame Select Jumper (JP4). When using multiple Switch/Load Units in your test system, Jumper JP4 provides a unique address (0-7) for each Switch/Load Unit. Factory default (one Switch/Load Unit) is 0.

Bits	7-0
Read	Fixture ID

- Default State = 255_h
- Read Only

Digital Input (R)
Base + 4_h

Digital Input is a direct read-back of the logic state present on lines Spare_DigIn[0]- Spare_DigIn[7] of the system resource access connector J104.

Bits	7	6	5	4	3	2	1	0
Read	Din_7	Din_6	Din_5	Din_4	Din_3	Din_2	Din_1	Din_0

DAC1 Output MSB (W)
Base + 8_h

Writing to the DAC1 Output register sets the Most Significant Bit (MSB) of the DAC1 digital input.

Note To set the value of the DAC output, always write the MSB first, followed by the LSB (register offset 9_h). The output of the DAC will not update until the LSB is written. See “DAC Scaling” on page 129.

Bits	7	6	5	4	3	2	1	0
Write	x	x	$DAC1_{13}$	$DAC1_{12}$	$DAC1_{11}$	$DAC1_{10}$	$DAC1_9$	DAC_8

DAC1 Output LSB (W)
Base + 9_h

Writing to the DAC1 Output register sets the Least Significant Bit (LSB) of the DAC1 digital input.

Note To set the value of the DAC output, always write the MSB first, followed by the LSB (register offset 9_h). The output of the DAC will not update until the LSB is written. See “DAC Scaling” on page 129.

Bits	7	6	5	4	3	2	1	0
Write	$DAC1_7$	$DAC1_6$	$DAC1_5$	$DAC1_4$	$DAC1_3$	$DAC1_2$	$DAC1_1$	$DAC1_0$

DAC Scaling

The DAC output voltage is determined by the following:

$V_{out} = (N/16{,}384 \bullet 32) - 16$

where N = Decimal value of DAC code programmed; MSB, LSB.

Table 6-8 shows some example values of N, and the corresponding MSBs, LSBs, and DAC voltage outputs.

Table 6-8. DAC Scaling Examples

N	Hex	MSB	LSB	DAC V_{out}
16383_{10}	$3FFF_h$	11111111	11111111	+16V
12288_{10}	3000_h	00110000	00000000	+8V
8192_{10}	2000_h	00100000	00000000	0V
4096_{10}	1000_h	00010000	00000000	-8V
0_{10}	0000_h	00000000	00000000	-16V

Control Register (W) Base + A_h

To reset the Switch/Load Unit including DACs, Open Drain outputs and all Load and Pin Cards, write a 1 to this register, wait 5 mS and then write a 0 to this register.   DACs will reset to 0Vout.

Bits	7	6	5	4	3	2	1	0
Write	x	x	x	x	x	x	x	Reset

Open Collector Output (W) Base + B_h

The Open Drain Output register controls the state of the Switch/Load Unit backplane mounted open drain drivers. The open drain drivers can sink up to 200 mA individual, 150 mA with all drivers on at once. The drivershave a light pull-up to Vcc (100 k ohm).

Bits	7	6	5	4	3	2	1	0
Write	$OCout_7$	$OCout_6$	$OCout_5$	$OCout_4$	$OCout_3$	$Ocout_2$	$OCout_1$	$OCout_0$

:

Table 6-9. $OCout_x$ States

Register State	Driver State	Nominal Output value
0	off	Float to +5 V
1	on	Pulled to ground.

Digital Output (W)
Base + C_h

Writing to the Digital Output register sets the output value of the Spare_DigOut[0]-Spare_DigOut[7] signals present on back plane connector J104. Spare_DigOut[0]- Spare_DigOut[7] outputs will directly reflect the contents of this register (1 = hi, 0 = low).

Bits	7	6	5	4	3	2	1	0
Write	$Dout_7$	$Dout_6$	$Dout_5$	$Dout_4$	$Dout_3$	$Dout_2$	$Dout_1$	$Dout_0$

DAC2 Output MSB(W)
Base + D_h

Writing to the DAC2 Output register sets the Most Significant Bit (MSB) of the DAC2 digital input.

Note To set the value of the DAC output, always write the MSB first, followed by the LSB (register offset E_h). The output of the DAC will not update until the LSB is written. See “DAC Scaling” on page 129.

Bits	7	6	5	4	3	2	1	0
Write	x	x	$DAC2_{13}$	$DAC2_{12}$	$DAC2_{11}$	$DAC2_{10}$	$DAC2_9$	$DAC2_8$

DAC2 Output LSB (W)
Base + E_h

Writing to the DAC2 Output register sets the Least Significant Bit (LSB) of the DAC2 digital input.

Note To set the value of the DAC output, always write the MSB first, followed by the LSB. The output of the DAC will not update until the LSB is written. See “DAC Scaling” on page 129.

Bits	7	6	5	4	3	2	1	0
Write	$DAC2_7$	$DAC2_6$	$DAC2_5$	$DAC2_4$	$DAC2_3$	$DAC2_2$	$DAC2_1$	$DAC2_0$

Load Card Register Definitions

Registers for the various load cards are defined in the following tables. Each register has a (W) or (R) following the section title. This indicates whether the register is a: (R) read only, or (W) Write only register.

Table B-1 summarizes the register mapping for all load cards.

Table B-1. Summary of Load Card Register Definitions

Register Offset	HP E6175A 8-Ch. Load Card Register	HP E6176A 16-Ch. Load Card Register	HP E6177A 24-Ch. Load Card Register	HP E6178B 8-Ch. Load Card Register
Base+0_h	Card Type	Card Type	Card Type	Card Type
Base+1_h	Card Configuration	Card Configuration	Card Configuration	Card Configuration
Base+2_h	Status	Status	Status	Status
Base+3_h	Current Select	Current Select	Load Select 1-8	Current Select
Base+4_h	Load Select 1-8	Load Select 1-8	Load Select 9-16	Load Select
Base+5_h	Power Select 1-8	Load Select 9-16	Load Select 17-24	N/A
Base+6_h	N/A	Power Select 1-8	Power Select 1-8	N/A
Base+7_h	N/A	Power Select 9-16	Power Select 9-16	N/A
Base+8_h	N/A	N/A	Power Select 17-24	N/A

Note: N/A indicates the card does not have a register at that offset address.

HP E6175A 8-Channel High-Current Load Card

The HP E6175A Load Card is a highly flexible load card for high-current loads mounted directly on a sheet metal panel attached to the load card. The card provides current sense (both resistive and transducer type), pull-up/down, flyback protection, and bridge load capabilities. The card also provides Card Type, Card Configuration, and Status readback of the built in relay timers. Registers definitions for the card follow:

Card Type (R) Base + 0_h

This register reads back the Card Type (01_h) of the card.

Bits	7-0
Purpose	**Card Type**
Setting	**01_h**

- Read Only
- Power On/Reset State = 01_h

Card Configuration (R) Base + 1_h

This register reads back the Card Configuration. The Card Configuration is determined by the user to distinguish different load configurations of the same load card Card Type.

Bits	7-0
Purpose	Card Configuration
Setting	state

- Read Only
- Undefined bits readback as all 1s

Status (R) Base + 2_h

This register reads back the card's status. Currently the status is defined as the state of the relay timer. The relay timer has two timers wire-OR'd together. One timer is designed for the slower armature relays (>16 ms) and the second designed for the faster reed relays (>500 µs). The timers restart whenever the registers controlling the respective relays are written to or the card is reset. The card remains in the busy state until both timers have timed out.

Bit	7-1	0
Purpose	Undefined	BUSY~
Setting	all 1s	state

- Read Only
- Undefined bits readback as all 1s
- BUSY~: 0 = Busy, 1 = Ready

Current Sense Select (W) Base + 3_h

This register controls the current sense relays of the card. Since only one current sense channel at a time per slot is allowed, these channel selects are encoded. This allows for either none or one current sense relay to be selected. Writing to this register starts the reed relay timer.

Bit	7-3	2-0
Purpose	Undefined	I Sense Select
Setting	X	Channel #'s

- Write Only
- Undefined bits are not used.
- Select: 001_2 - 100_2 valid selects, 000_2 or 101_2 - 111_2 unselected
  001_2 - corresponds to current sense select on channels 1 and 2.
  010_2 - corresponds to current sense select on channels 3 and 4.
  011_2 - corresponds to current sense select on channels 5 and 6.
  100_2 - corresponds to current sense select on channels 7 and 8.
  000_2 or $nnn_2>100_2$ - means no current sense relay selected

  (Example: Setting the current sense register to 1002 selects the fourth pair of channels, channels 7 and 8. Therefore relays K7 and K8 would be closed.)

- Power On/Reset State = 0

Select Value	0,5-7	1 (001)	2 (010)	3 (011)	4 (100)
Relays	none	K1, K2	K3, K4	K5, K6	K7, K8
Channels	None	1, 2	3, 4	5, 6	7, 8

Load Select (W) Base + 4_h

This register controls the Load Select switch armature relays of the card, one per channel. The register uses positive logic: 1 = closed. Writing to this register starts the armature relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K43 CH 8	K42 CH 7	K33 CH 6	K32 CH 5	K23 CH 4	K22 CH 3	K13 CH 2	K12 CH 1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Power Select (W) Base + 5_h

This register controls the Pull Up/Down Power Select armature relays of the card, one per channel pair. These relays are Form C (double-pole, single-throw) and the register uses positive logic: 1 = Normally open (NO) shorted to COM, normally closed (NC) is open; 0 = NC shorted to COM, NO is open. The power buses selected depend on how the card is configured by the user. Writing to this register starts the armature relay timer.

Bit	7-4	3 (011)	2 (010)	1 (001)	0 (000)
Purpose	Undefined	K41 CH 8/7	K31 CH 6/5	K21 CH 4/3	K11 CH 2/1
Setting	X	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open
- Power On/Reset State = 0

HP E6176A 16-Channel High-Current Load Card

The HP E6176A Load Card is designed for high-current loads mounted outside the load card. The card provides current sense, pull-up/down, and flyback protection. The card also provides Card Type, Card Configuration, and Status readback of the built in relay timers. Register definitions for the card follow:

Card Type (R) Base + 0_h

This register reads back the Card Type (02_h) of the card.

Bit	**7-0**
Purpose	Card Type
Setting	02_h

- Read Only
- Power On/Reset State = 02_h

Card Configuration (R) Base + 1_h

This register reads back the Card Configuration. The Card Configuration is determined by the user to distinguish different load configurations of the same load card type.

Bit	**7-0**
Purpose	Card Configuration
Setting	state

- Read Only
- Undefined bits readback as all 1s

Status (R) Base + 2_h

This register reads back the card's status. Currently the status is defined as the state of the relay timer. The relay timer has two timers wire-OR'd together. One timer is designed for the slower armature relays (>16 ms) and the second designed for the faster reed relays (>500 µs). The timers restart whenever the registers controlling the respective relays are written to or the card is reset. The card remains in the busy state until both timers have timed out.

Bit	**7-1**	**0**
Purpose	Undefined	BUSY~
Setting	all 1s	state

- Read Only
- Undefined bits readback as all 1s
- BUSY~: 0 = Busy, 1 = Ready

Current Sense Select (W) Base + 3_h

This register controls the current sense relays of the card. Since only one current sense channel at a time per slot is allowed, these channel selects are encoded. This allows for none or one current sense relay to be selected. Writing to this register starts the reed relay timer.

Bit	7-5	4-0
Purpose	Undefined	I Sense Select
Setting	X	Select No.

- Write Only
- Undefined bits are not used
- Valid current sense selection values are: 00001_2 - 10000_2. Selecting values 00000_2 or 10001_2 - 11111_2 will NOT select current sensing for any channel.
  00001_2 - corresponds to current sense select on channel 1.
  00010_2 - corresponds to current sense select on channel 2.
  01101_2 - corresponds to current sense select on channel 13.
  10000_2 - corresponds to current sense select on channel 16.
  00000_2 or $nnnnn_2 > 10000_2$ - no current sense relays selected.
  (Example: Setting the current sense register to 00110_2 selects channel six. Therefore relays K11 and K12 would be closed.)
- Power On/Reset State = 0

Select	0,17-31	1	2	3	4	5	6	7	8
Relays	none	K1, K2	K3, K4	K5, K6	K7, K8	K9, K10	K11, K12	K13, K14	K15, K16

Select	9	10	11	12	13	14	15	16
Relays	K17, K18	K19, K20	K21, K22	K23, K24	K25, K26	K27, K28	K29, K30	K31, K32

Load Select 1-8 (W) Base + 4_h

This register controls the Load Select switch armature relays for channels 1-8. The register uses positive logic: 1 = closed. Writing to this register starts the armature relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K56 CH 8	K54 CH 7	K52 CH 6	K50 CH 5	K48 CH 4	K46 CH 3	K44 CH 2	K42 CH 1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Load Select 9-16 (W) Base + 5_h

This register controls the Load Select switch armature relays for channels 9-16. The register uses positive logic: 1 = closed. Writing to this register starts the armature relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K72 CH 16	K70 CH 15	K68 CH 14	K66 CH 13	K64 CH 12	K62 CH 11	K60 CH 10	K58 CH 9
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Power Select 1-8 (W) Base + 6_h

This register controls the Pull Up/Down Power Select armature relays for channels 1-8. These relays are Form C and the register uses positive logic: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open. The power buses selected depend upon how the card is configured by the user. Writing to this register starts the armature relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K55 CH 8	K53 CH 7	K51 CH 6	K49 CH 5	K47 CH 4	K45 CH 3	K43 CH 2	K41 CH 1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC open; 0 = NC shorted to COM, NO open
- Power On/Reset State = 0

Power Select 9-16 (W) Base + 7_h

This register controls the Pull Up/Down Power Select armature relays for channels 9-16. These relays are Form C and the register uses positive logic: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open. The power buses selected depend upon how the card is configured by the user. Writing to this register starts the armature relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K71 CH 16	K69 CH 15	K67 CH 14	K65 CH 13	K63 CH 12	K61 CH 11	K59 CH 10	K57 CH 9
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC open; 0 = NC shorted to COM, NO open
- Power On/Reset State = 0

HP E6177A 24-Channel Medium-Current Load Card

The HP E6177A Load Card is a load card for moderate current loads mounted on a sheet-metal panel attached to the load card. The card provides pull-up/down selection, Card Type, Card Configuration, and Status readback of the built-in relay timers. Register definitions for the card follow:

Card Type (R) Base + 0_h

This register reads back the Card Type (03_h) of the card.

Bit	7-0
Purpose	Card Type
Setting	03_h

- Read Only
- Power On/Reset State = 03_h

Card Configuration (R) Base + 1_h

This register reads back the Card Configuration. The Card Configuration is determined by the user to distinguish different load configurations of the same load card Card Type.

Bit	7-0
Purpose	Card Configuration
Setting	state

- Read Only
- Undefined bits readback as all 1s

Status (R) Base + 2_h

This register reads back the card's status. Currently the status is defined as the state of the relay timer. The relay timer is designed for the armature relays (>4ms). The timer restarts whenever the registers controlling the respective relays are written to or the card is reset. The card remains in the busy state until the timer has timed out.

Bit	7-1	0
Purpose	Undefined	BUSY~
Setting	all 1s	state

- Read Only
- Undefined bits readback as all 1s
- BUSY~: 0 = Busy, 1 = Ready

Load Select 1-8 (W) Base + 3_h

This register controls the Load Select switch armature relays for channels 1-8. The register uses positive logic: 1 = closed. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K16 CH 8	K14 CH 7	K12 CH 6	K10 CH 5	K8 CH 4	K6 CH 3	K4 CH 2	K2 CH 1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Load Select 9-16 (W) Base + 4_h

This register controls the Load Select switch armature relays for channels 9-16. The register uses positive logic: 1 = closed. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K32 CH 16	K30 CH 15	K28 CH 14	K26 CH 13	K24 CH 12	K22 CH 11	K20 CH 10	K18 CH 9
Setting	state	state	stat	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Load Select 17-24 (W) Base + 5_h

This register controls the Load Select switch armature relays for channels 17-24. The register uses positive logic: 1 = closed. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K48 CH 24	K46 CH 23	K44 CH 22	K42 CH 21	K40 CH 20	K38 CH 19	K36 CH 18	K34 CH 17
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = closed, 0 = open
- Power On/Reset State = 0

Power Select 1-8 (W) Base + 6_h

This register controls the Pull Up/Down Power Select armature relays for channels 1-8. These relays are Form C and the register uses positive logic: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open. The power buses selected are determined by how the card is configured. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K15 CH 8	K13 CH 7	K11 CH 6	K9 CH 5	K7 CH 4	K5 CH 3	K3 CH 2	K1 CH 1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open
- Power On/Reset State = 0

Power Select 9-16 (W) Base + 7_h

This register controls the Pull Up/Down Power Select armature relays for channels 9-16. These relays are Form C and the register uses positive logic: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open. The power buses selected are determined by how the card is configured. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K31 CH 16	K29 CH 15	K27 CH 14	K25 CH 13	K23 CH 12	K21 CH 11	K19 CH 10	K17 CH 9
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open
- Power On/Reset State = 0

Power Select 17-24 (W) Base + 8_h

This register controls the Pull Up/Down Power Select armature relays for channels 17-24. These relays are Form C and the register uses positive logic: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open. The power buses selected are determined by how the card is configured. Writing to this register starts the relay timer.

Bit	7	6	5	4	3	2	1	0
Purpose	K47 CH 24	K45 CH 23	K43 CH 22	K41 CH 21	K39 CH 20	K37 CH 19	K35 CH 18	K33 CH 17
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO shorted to COM, NC is open; 0 = NC shorted to COM, NO is open
- Power On/Reset State = 0

HP E6178B 8-Channel 30 Amp Load Card Register Definitions

The HP E6178B following Features:

- Fuse protected at 30A (slow blow),
- 8 loads with individual current sensing,
- Flyback protection can be added for each load,
- 30 Amp continuous current on one channel at a time.

Card Type (R) (Base + 00_h)

This register reads back the Card Type (04_h) of the card.

Bit	7-0
Purpose	Card Type
Setting	04_h

Card Configuration (R) (Base + 01_h)

This register reads back the Card Configuration. The Card Configuration is determined by the user (using J2) to distinguish different load configurations of the same load board Card Type. When unused, a read of this register will be FF_h.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Card Configure (R)	J2-10	J2-9	J2-8	J2-7	J2-5	J2-4	J2-3	J2-2

Status Register (R) (Base + 02_h)

This register contains the BUSY~ bit (bit 0). The BUSY~ bit reflects the state of all relay timers. A zero means the card is busy setting a relay and a one means it is ready or done.

Bit	7-1	0
Purpose	Undefined	BUSY~
Setting	all 1s	state

Current Sense Select (W) (Base + 03_h)

This register controls the current sense relays of the card. Since only one current sense channel at a time per slot is allowed, these channel selects are encoded. This allows for a single channel to be selected. At reset no channel is selected.

SELECT	BITS 7-4	BITS 3-0
no channel	N/A	0000
Channel 1	N/A	0001
Channel 2	N/A	0010
Channel 3	N/A	0011
Channel 4	N/A	0100
Channel 5	N/A	0101
Channel 6	N/A	0110
Channel 7	N/A	0111
Channel 8	N/A	1000
no channel	N/A	1001-1111

Load Select (W) (Base + 04_h)

The register controls the Load Select switch armature relays (K1-K8) of the card, one bit per channel. The register uses positive logic, i.e. 1=closed. At reset no channel is selected.

BIT	7	6	5	4	3	2	1	0
DEF	CH 8	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1

Caution **It is possible to close more than one channel at a time. Since the trace from P2 to J41 can only carry 30 Amps, the total current of all the channel must be less than or equal to 30 Amps.**

HP E8792A and E8793A Pin Card Register Definitions

For relays, writing a 1 closes the relay, writing a 0 opens the relay. Register read back for the relay states is not provided. Thus, state tracking must be done in software.

Card Type (R)Base + 0_h

Returns the pin card type:

- HP E8792A returns a card type of 10_{10}: (dddd = 1010).
- HP E8793A returns card type of 11_{10}: (dddd = 1011).

Bits	7	6	5	4	3	2	1	0
Read	0	0	0	0	d	d	d	d

Card Configuration (R) Base + 1_h

Pin card configuration register and firmware revision (FWR) register. Initial firmware revision = 0_h.

Bits	7	6	5	4	3	2	1	0
Read	FWR_3	FWR_2	FWR_1	FWR_0	1	1	1	1

Status and Control (Read/Write) Base + 2_h

Status and Control Register provides applicable features from the HP E6172 VXI card; register offset 4_h:

Bits	7	6	5	4	3	2	1	0
Read	Busy~	Manual	OAR	IsensRly	DAC2Rly	DAC1Rly	GndRly	Reset
Write	x	Manual	OAR	IsensRly	DAC2Rly	DAC1Rly	GndRly	Reset

Read Only:

- **Busy~**: 0 indicates busy, 1 indicates not busy.

Write and Read Bits:

- **Manual:** 0 to set column relay control to automatic, 1 to set column relay control to manual.

NOTE: See description for Register offset 4_h.

- **Reset:** 0 causes no change, 1 causes board reset and triggers the relay timer. Clears itself afterward.

Note

Reset causes Inst16 to be connected to the Inst MUX and Isense relay is disconnected

Note Since the card level reset bit is "OR'd" with the back plane reset, the state of the Reset bit during read also indicates the state of the back plane reset line.

- **GndRly:** 0 opens relay from Inst2 (DMM Lo) to System Gnd (default), 1 closes relay from Inst2 (DMM Lo) to System Gnd
- **DAC1Rly:** 0 opens relay from Inst1 (DMM Hi) to DAC1 (default), 1 closes relay from Inst1 (DMM Hi) to DAC1
- **DAC2Rly:** 0 opens relay from Inst1 (DMM Hi) to DAC2 (default), 1 closes relay from Inst1 (DMM Hi) to DAC2

Note The above values are valid for the HP E8792A only.

When measuring DAC1 or DAC2, system ground must be connected to low side of DMM.

- **ISensRly:** 0 opens relay from Inst16 (Spare16) to ISense (default), 1 closes relay from Inst16 (Spare16) to Isense.

Note The above value is currently not implemented.

Writing a 1 to IsensRly disconnects INST16 from the instrument matrix. Writing a 0 to IsenseRly connects INST16 to the instrument matrix.

- **OAR:** 0 causes no change, 1 causes all relays to open.

Note The only difference between OAR and Reset is OAR leaves the state of "Manual" the same. "Reset" clears the "Manual" setting.

Not Used Base + 3_h

Note: Register offset 3_h used only for a placeholder to make software addressing simpler.

Abus control and protection bypass relay (W) Base + 4_h

Pin card Abus and protection bypass relay control register. All relay control registers are positive-true logic: writing 0 opens the relay and writing 1 closes the relay.

Bits	7	6	5	4	3	2	1	0
Write	PB_4	PB_3	PB_2	PB_1	AB_4	AB_3	AB_2	AB_1

- Writing to PB_4-PB_1 sets state of protection bypass relays.

- Writing to AB_4-AB_1, when the Status/Control register manual bit is set to 1, sets state of Abus disconnect relays.

- Writing to AB_4-AB_1, when Status/Control register manual bit is set to 0, does not change the state of the disconnect relays.

Note When the manual bit is set to 0, writing to this register puts new relay settings into a "on board" latch. These settings have no impact on the state of the disconnect relays as long as the "manual" bit is set to 0. However if the manual bit is set back to 1, the disconnect relay state written to this register will immediately be invoked, resulting in a immediate change in the state of the disconnect relays.

Not Used Base + 5_h

Note: Register offset 5_h used only for a placeholder to make software addressing simpler.

Aux Relays:

Auxiliary Relay 1-8 (W) Base + 6_h

Bits	7	6	5	4	3	2	1	0
Write	Aux_8	Aux_7	Aux_6	Aux_5	Aux_4	Aux_3	Aux_2	Aux_1

Auxiliary Relay 9-16 (W) Base + 7_h

Bits	7	6	5	4	3	2	1	0
Write	Aux_{16}	Aux_{15}	Aux_{14}	Aux_{13}	Aux_{12}	Aux_{11}	Aux_{10}	Aux_9

Auxiliary Relay 17-24 (W) Base + 8_h

Bits	7	6	5	4	3	2	1	0
Write	Aux_{24}	Aux_{23}	Aux_{22}	Aux_{21}	Aux_{20}	Aux_{19}	Aux_{18}	Aux_{17}

Auxiliary Relay 25-32 (W) Base + 9_h

Bits	7	6	5	4	3	2	1	0
Write	Aux_{32}	Aux_{31}	Aux_{30}	Aux_{29}	Aux_{28}	Aux_{27}	Aux_{26}	Aux_{25}

Abus1 to Row

Row Relay 1-8 (W)
Base + A_h (10_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_8	Row_7	Row_6	Row_5	Row_4	Row_3	Row_2	Row_1

Row Relay 9-16 (W)
Base + B_h (11_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{16}	Row_{15}	Row_{14}	Row_{13}	Row_{12}	Row_{11}	Row_{10}	Row_9

Row Relay 17-24 (W)
Base + C_h (12_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{24}	Row_{23}	Row_{22}	Row_{21}	Row_{20}	Row_{19}	Row_{18}	Row_{17}

Row Relay 25-32 (W)
Base + D_h (13_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{32}	Row_{31}	Row_{30}	Row_{29}	Row_{28}	Row_{27}	Row_{26}	Row_{25}

Abus2 to Row

Row Relay 1-8 (W)
Base + E_h (14_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_8	Row_7	Row_6	Row_5	Row_4	Row_3	Row_2	Row_1

Row Relay 9-16 (W)
Base + F_h (15_{10}):

Bits	7	6	5	4	3	2	1	0
Write	Row_{16}	Row_{15}	Row_{14}	Row_{13}	Row_{12}	Row_{11}	Row_{10}	Row_9

Row Relay 17-24 (W)
Base + 10_h (16_{10}):

Bits	7	6	5	4	3	2	1	0
Write	Row_{24}	Row_{23}	Row_{22}	Row_{21}	Row_{20}	Row_{19}	Row_{18}	Row_{17}

Row Relay 25-32 (W)
Base + 11$_h$ (17$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_{32}	Row_{31}	Row_{30}	Row_{29}	Row_{28}	Row_{27}	Row_{26}	Row_{25}

Abus3 to Row

Row Relay 1-8 (W)
Base + 12$_h$ (18$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_8	Row_7	Row_6	Row_5	Row_4	Row_3	Row_2	Row_1

Row Relay 9-16 (W)
Base + 13$_h$ (19$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_{16}	Row_{15}	Row_{14}	Row_{13}	Row_{12}	Row_{11}	Row_{10}	Row_9

Row Relay 17-24 (W)
Base + 14$_h$ (20$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_{24}	Row_{23}	Row_{22}	Row_{21}	Row_{20}	Row_{19}	Row_{18}	Row_{17}

Row Relay 25-32 (W)
Base + 15$_h$ (21$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_{32}	Row_{31}	Row_{30}	Row_{29}	Row_{28}	Row_{27}	Row_{26}	Row_{25}

Abus4 to Row

Row Relay 1-8 (W)
Base + 16$_h$ (22$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_8	Row_7	Row_6	Row_5	Row_4	Row_3	Row_2	Row_1

Row Relay 9-16 (W)
Base + 17$_h$ (23$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	Row_{16}	Row_{15}	Row_{14}	Row_{13}	Row_{12}	Row_{11}	Row_{10}	Row_9

Row Relay 17-24 (W)
Base + 18_h (24_{10}):

Bits	7	6	5	4	3	2	1	0
Write	Row_{24}	Row_{23}	Row_{22}	Row_{21}	Row_{20}	Row_{19}	Row_{18}	Row_{17}

Row Relay 25-32 (W)
Base + 19_h (25_{10}):

Bits	7	6	5	4	3	2	1	0
Write	Row_{32}	Row_{31}	Row_{30}	Row_{29}	Row_{28}	Row_{27}	Row_{26}	Row_{25}

UUT Common to Instrument Bus

The following values are valid for the HP E8792A only.

Instrument Relay 1-8 (W)
Base + $1A_h$ (26_{10}):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_8$	$Inst_7$	$Inst_6$	$Inst_5$	$Inst_4$	$Inst_3$	$Inst_2$	$Inst_1$

Instrument Relay 9-16 (W)
Base + $1B_h$ (27_{10}):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_9$

Abus1 to Instrument Bus

Instrument Relay 1-8 (W)
Base + $1C_h$ (28_{10}):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_8$	$Inst_7$	$Inst_6$	$Inst_5$	$Inst_4$	$Inst_3$	$Inst_2$	$Inst_1$

Instrument Relay 9-16 (W)
Base + $1D_h$ (29_{10}):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_9$

Abus2 to Instrument Bus

Instrument Relay 1-8 (W)
Base + $1E_h$ (30_{10}):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_8$	$Inst_7$	$Inst_6$	$Inst_5$	$Inst_4$	$Inst_3$	$Inst_2$	$Inst_1$

Instrument Relay 9-16 (W)
Base + 1F$_h$ (31$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_9$

Abus3 to Instrument Bus

Instrument Relay 1-8 (W)
Base + 20$_h$ (32$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_8$	$Inst_7$	$Inst_6$	$Inst_5$	$Inst_4$	$Inst_3$	$Inst_2$	$Inst_1$

Instrument Relay 9-16 (W)
Base + 21$_h$ (33$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_9$

Abus4 to Instrument Bus

Instrument Relay 1-8 (W)
Base + 22$_h$ (34$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_8$	$Inst_7$	$Inst_6$	$Inst_5$	$Inst_4$	$Inst_3$	$Inst_2$	$Inst_1$

Instrument Relay 9-16 (W)
Base + 23$_h$ (35$_{10}$):

Bits	7	6	5	4	3	2	1	0
Write	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_9$

HP E8794A Custom Card Register Definitions

Card Type (R)
Base + 0_h

The Custom Card always returns a card type of 20_{10} (14_h).

Bits	7	6	5	4	3	2	1	0
Read	0	0	0	1	0	1	0	0

Configuration (R)
Base + 1_h

Configuration registers are programmable by the user and may be used to identify what version of custom card is installed. Default is pull high (return FF_h). Use switch S201 to set value configuration.

Bits	7	6	5	4	3	2	1	0
Read	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0

Control register (W)
Base + 2_h

Writing a 1 to bit seven generates a reset pulse (duration ~ 250 nS) which you can use to reset on-board circuitry. The reset pulse is self-clearing.

Bits	7	6	5	4	3	2	1	0
Write	Reset	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Digital Input (R)
Base + 3_h

Digital Input is a direct read-back of the logic state present on custom card input lines ccSpare_DigIn[0]- ccSpare_DigIn[7].

Bits	7	6	5	4	3	2	1	0
Read	Din_7	Din_6	Din_5	Din_4	Din_3	Din_2	Din_1	Din_0

Digital Output (W)
Base + 4_h

Writing to the Digital Output register sets the output value of the custom card ccSpare_DigOut[0]- ccSpare_DigOut[7] signals. The outputs of ccSpare_DigOut[x] are open drain with a light pull-up (100 k ohm).

Bits	7	6	5	4	3	2	1	0
Write	$Dout_7$	$Dout_6$	$Dout_5$	$Dout_4$	$Dout_3$	$Dout_2$	$Dout_1$	$Dout_0$

Writing a 1 sets the output of a open collector driver on (meaning that the output voltage is pulled low):

ccSpare_DigOut[x]	Driver state	Nominal output value
1	on	0 volts
0	off	+5 Volts or pull up value

The reset state of this register is 0_h (all outputs off). This output can be used for general-purpose relay, lamp and solenoid drive requirements.

Glossary Of Terms

Adjustment An adjustment is an action performed in the field to modify an instrument's response to some input. It can usually be performed by the user on-site.

Calibration A standardized maintenance procedure designed to ensure system accuracy. In this manual it refers to removing those items that require calibration - the DVM and the Frequency Counter - and shipping them to an HP bench site for calibration.

Card Plug-in devices that are installed into either the Switch/Load Unit or a VXI mainframe.

Common Line This refers to the power bus side of a load on the 24-Channel Load Card. A line is run back up to the UUT load side of the card, and jumpering a channel's internal load terminals allows the user to utilize the load switch as a GP relay.

Current Sensing Determining the current through a fixed, known-value resistor, using the four-wire measurement method and deriving~ the current in amperes via the equation: I=E/R.

Duty Cycle That portion of a cycle when components are actually being used. For example: A component that can carry 10A with a 10% duty cycle, and with a cycle equal to 1 second, could carry 10A for 100ms, then 0A for 900ms.

Flyback Protection Device Any device that controls the magnitude of positive or negative-going voltage spikes on a channel.

Flyback Voltage The voltage surge experienced when current flow through a coil is abruptly stopped or started.

Form C Relay Standard terminology for Single-Pole, Double Throw (SPDT) relay contacts.

glitch An unexpected or unplanned event or occurrence. Abrupt termination of tests is usually due to a software glitch.

GP Acronym for General Purpose. The relays on the E6177A 24-Channel Medium Current Load card can be configured as GP relays.

Hardware Configuration The physical and functional arrangement of the system components with respect to each other. Refers to the relative placement of modules load cards in the E6185A Switch/Load Unit.

Isense + and Isense - The Switch/Load Unit has a two-line current sense bus along the

Switch/Load Unit backplane. This Current sense bus can be broken into as many as four discrete buses by removing jumper plugs on JP1, JP2, and JP3. Current sensing is performed on any load card channel across a four-terminal current sense resistor. Two load cards are designed to connect to the current sense bus in the Switch/Load Unit: The 8-Channel, and 16-Channel High Current Load Cards. Each channel’s current sense lines are multiplexed so that on each card only one channel at a time can be connected to the Switch/Load Unit current sense bus.

Isolated Inputs Inputs that have the common connected to system ground.

ISrcHi and ISrcLo The signal between the E1411B DMM “Current Source” Channel and J3 row 3 of the Measurement Control module.

LADDR Logical Address - The address set on a VXIbus module that is unique to that system. This usually corresponds to its slot number.

LEM Module A current transducer with multiple primary coil taps that allows it to be set for five different current levels.

Load Card A C-sized card designed to fit in the Switch/Load Unit that provides switching for the various loads, and provisions for either internal load mounting, or connections for external load mounting. Load cards provide a two level card ID; card type, and load configuration ID.

Load Switching A load that can be switched in or out of a power supply circuit on command.

Module As used in this manual, specifically refers to a VXIbus-compatible module instrument.

MOV Metal Oxide Varistor - An electronic component whose characteristic resistance changes dramatically at a certain predetermined voltage.

NC Normally Closed switch contacts. A Form C (Single-Pole, Double-Throw) switch has two possible states. The default or un-powered, state is its “normal” state. The two terminals on the switch are therefore called “normally open,” or “normally closed.”

NO Normally Open switch contacts. See NC.

Open All Relays (OAR) A command that immediately opens all the relays, both columns and rows, on a module.

Optical Isolator A digital device that electronically isolates a signal from its source by converting the input signal to a light source, usually laser or LED, and reconverts the signal to an electronic signal using a photoelectric device.

Remote Sensing Monitoring the voltage output of a power supply can be done either at the inputs of the Switch/Load Unit (locally) or at the inputs of the UUT (remotely). Remote sensing guarantees the voltage value set will be applied at the sense point, and losses in the system will be compensated for.

For example: If the UUT requires precisely 12 Vdc applied to it, and there is a 0.5 Vdc drop between the power supply and the UUT due to system and cable losses, setting the voltage sense to remote and thereby monitoring the power supply output at the UUT will compensate for the voltage drops between the power supply and the UUT.

Rs Source resistance.

Safety Shroud A cover for the Switch/Load Unit that protects personnel from possible contact with dangerous voltages on the exposed PC board.

Self-test A test executed by an instrument or system on itself to verify the functionality of the instrument or system.

Sense See: Current sensing.

Slot Decode Logic The circuitry that interprets the data that represents the physical slot a load card occupies in a Switch/Load Unit.

Stand Off Voltage The maximum voltage differential an open relay can tolerate without arcing across the contacts.

Switching Voltage The nominal voltage differential across a relay’s contacts at which it can be switched. The switching voltage is typically much less than the standoff voltage.

Unit Under Test (UUT) The automotive module or printed circuit board being tested.

VME Computer backplane architecture standard.

VXI Computer backplane architecture standard that incorporates both the VMEbus and HP-IB communications features.

A

B

C

D

E

F

G

H

I

J

L

Z