Agilent TS-5000 Functional Test System

E6198B Switch/Load Unit User Manual

Agilent Technologies

Notices

This manual covers the following Agilent equipment:

- E6198B Switch/Load Unit
- E6175A 8-Channel High Current Load Card
- E6176A 16-Channel High Current Load Card
- E6177A 24-Channel Medium Current Load Card
- U1777A 24-Channel Medium Current Load Card
- U7178A 8-Channel Heavy Duty Load Card
- U7179A 16-Channel High Current Load Card
- E6178B 8-Channel Heavy Duty Load Card
- N9377A 16-Channel Dual-Load Load Card
- N9378A 24-Channel Low Resistance Load Card
- N9379A 48-Channel High Density Load Card
- E8792A Pin Matrix Card
- E8793A Pin Matrix Card
- E8782A 24-Instrument, 40-Measurement Matrix Card
- E8783A 64-Pin Matrix Card
- E8794A Custom Card

Manual Part Number

E6198-90050

Edition

9th Edition, August 2012

Printed in Malaysia

Agilent Technologies Microwave Products (Malaysia) Sdn. Bhd.
Bayan Lepas Free Industrial Zone
11900 Penang, Malaysia

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as "Commercial computer software" as defined in DFAR 252.227-7014 (June 1995), or as a "commercial item" as defined in FAR 2.101(a) or as "Restricted computer software" as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies' standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

6 Using the Pin Matrix Cards

7 Using the Custom Card

THIS PAGE IS INTENTIONALLY LEFT BLANK.

List of Figures

List of Tables

C Repair Information

A Glossary Of Terms

1
Legal Information

Legal Information

Warranty

Technology Licenses

Restricted Rights Legend

Service and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center.

Agilent on the Web

You can find information about technical and professional services, product support, and equipment repair and service on the Web: http://www.agilent.com/

Double-click the link to **Test & Measurement**. Select your country from the drop-down menus. The Web page that appears next has contact information specific for your country.

Agilent By Phone

If you do not have access to the Internet, call one of the numbers in Table 1-1

Table 1-1 Agilent Sales And Support Contact Numbers

Americas	Canada	(877) 894-4414
	Latin America	305 269 7500
	United States	(800) 829-4444
Asia Pacific	Australia	1 800 629 485
	China	800 810 0189
	Hong Kong	800 938 693
	India	1 800 112 929
	Japan	0120 (421) 345
	Korea	080 769 0800
	Malaysia	1 800 888 848
	Singapore	1 800 375 8100
	Taiwan	0800 047 866
	Thailand	1 800 226 008

Table 1-1 Agilent Sales And Support Contact Numbers (continued)

Europe & Middle East	Austria	01 36027 71571
	Belgium	32 (0) 2 404 93 40
	Denmark	45 70 13 15 15
	Finland	358 (0) 10 855 2100
	France	0825 010 700* *0.125 €/minute
	Germany	07031 464 6333** **0.14 €/minute
	Ireland	1890 924 204
	Israel	972-3-9288-504/544
	Italy	39 02 92 60 8484
	Netherlands	31 (0) 20 547 2111
	Spain	34 (91) 631 3300
	Sweden	0200-88 22 55
	Switzerland	0800 80 53 53
	United Kingdom	44 (0) 118 9276201
	Other European Countries:	www.agilent.com/find/contactus

Manufacturing Address

Agilent Technologies Microwave Products (Malaysia) Sdn. Bhd.

Bayan Lepas Free Industrial Zone,

11900 Penang,

Malaysia.

2
Safety and Regulatory Information

Declaration of Conformity

The Declaration of Conformity (DoC) for this product is available on the Agilent Technologies website. You can search for the DoC by its product model or description at the following web address:

http://regulations.corporate.agilent.com/DoC/search.htm

NOTE If you are unable to locate the DoC, please contact your local Agilent representative.

Safety Information

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. 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 instrument. Agilent Technologies, Inc. assumes no liability for the customer's failure to comply with these requirements.

Safety Notice

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

General Safety Information

This product is provided with a protective earth terminal. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

WARNING

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE. Do not operate the product in the presence of flammable gases or flames.

WARNING

DO NOT REMOVE RACK PANELS OR INSTRUMENT COVERS. Operating personnel must not remove any rack panels or instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel. Products that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by a qualified service personnel.

WARNING

The protection provided by the Agilent TS-5000 system may be impaired if the system is used in a manner not specified by Agilent.

Environmental Conditions

The Automotive Electronics Functional Test System is designed for indoor use only. Table 2-1 shows general environmental requirements.

Table 2-1 Environment Requirements

Environment Conditions	Requirements
Maximum Altitude	2000 meters
Temperature (Operation)	5 °C to 40 °C
Maximum Relative Humidity	The test system is designed to operate in the range from 5% to 80% relative humidity (non-condensing).

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2, per IEC 61010-1.

Before Applying Power

Verify that the product is set to match the available line voltage and all safety precautions are taken. Note the external markings of the instruments described in “Safety Symbols and Regulatory Markings”.

Ground the System

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Fuses

Use only fuses with the required rated current, voltage, and specified type (normal blow, time delay). Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

For AC inlet fuse, use only 5A/250 Vac fuse with Time-Lag and Low Breaking capacity. For other fuse ratings, refer Table 3-11.

WARNING **In order to avoid electrical hazards, all system internal fuses must be replaced by trained and qualified personnel.**

Operator Safety Information

WARNING **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 a conductive surface connected to any cable conductor (High, Low or Guard).

WARNING **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 front panel connectors of the module through non-conductive, flexible conduit such as that used in electrical power distribution.

Safety Symbols and Regulatory Markings

Symbols and markings on the system, in manuals and on instruments alert you to potential risks, provide information about conditions, and comply with international regulations. Table 2-2 defines the symbols and markings you may find in a manual or on an instrument.

Table 2-2 Safety Symbols and Regulatory Markings

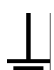
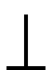
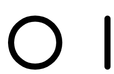
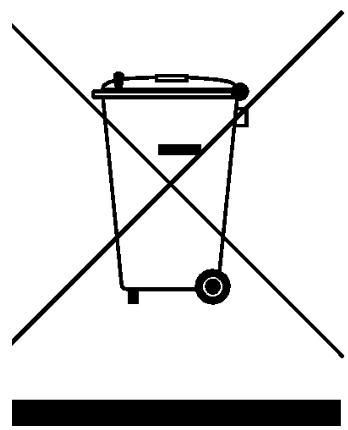
Symbols	Description
Safety symbols	
	Warning: risk of electric shock.
	Caution: refer to accompanying documents.
	Alternating current.
	Both direct and alternating current.
	Earth (ground) terminal
	Protective earth (ground) terminal
	Frame or chassis terminal
	Terminal is at earth potential. Used for measurement and control circuits designed to be operated with one terminal at earth potential.
	Switch setting indicator. O = Off, | = On.

Table 2-2 Safety Symbols and Regulatory Markings (continued)

Symbols	Description
	Standby (supply); units with this symbol are not completely disconnected from ac mains when this switch is off. To completely disconnect the unit from ac mains, either disconnect the power cord, or have a qualified electrician install an external switch.
Regulatory markings	
ICES/NMB-001	This text indicates that the ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.
C US	The CSA mark is a registered trademark of the Canadian Standards Association. A CSA mark with the indicators “C” and “US” means that the product is certified for both the U.S. and Canadian markets, to the applicable American and Canadian standards.
N10149	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
	This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.
CE ISM 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.

End of Life: Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This product complies with the WEEE Directive (2002/96/EC) marking requirement. The affixed product label (see below) indicates that you must not discard this electrical/electronic product in domestic household waste.



Product Category:

With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control Instrumentation” product.

Do not dispose in domestic household waste

To return unwanted products, contact your local Agilent office, or see:

http://www.agilent.com/environment/product

for more information.

3
Switch/Load Unit and Plug-In Cards

This chapter gives an overview of the Agilent E6198B (Standalone and Integrated) Switch/Load Unit (SLU), load cards, and other associated equipment.

E6198B Standalone/Integrated Switch/Load Unit Rating

Electrical

Table 3-1 Switch/Load Unit Rating (Electrical)

Parameter	Value
Input Voltage	100–240 VAC nominal
Frequency	50/60 Hz
Power	325 W maximum

Mechanical

Table 3-2 Switch/Load Unit Rating (Mechanical)

Parameter	Value
Width	484.64 mm
Height	373.61 mm
Depth	520.52 mm
Weight	15.0 kg

E6198B Standalone Switch/Load Unit Description

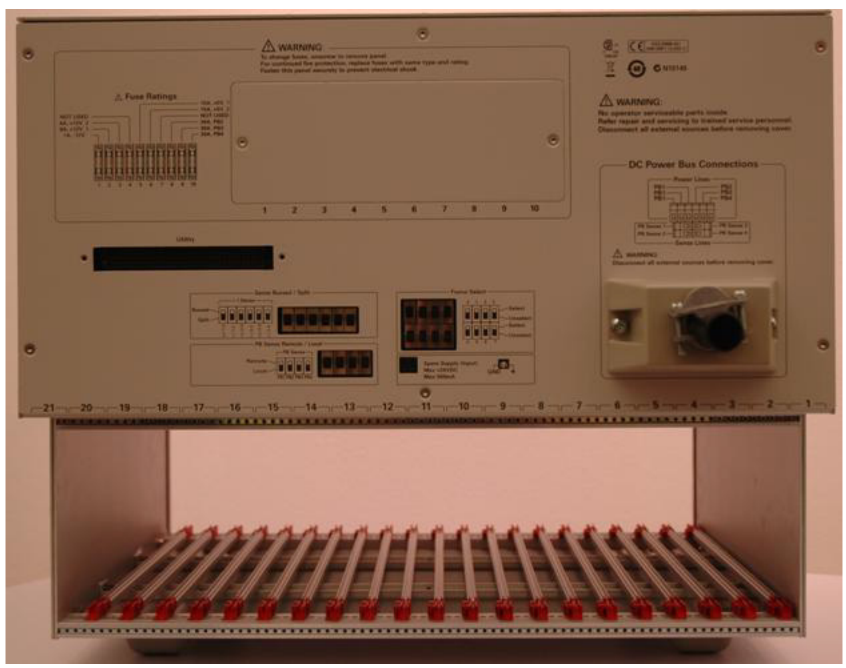
The Switch/Load Unit (Figure 3-1) consists of a standard VME type enclosure, a custom high current backplane, and slots for up to 21 optional Agilent plug-in cards. The following plug-in cards are available:

- Agilent E6175A 8-channel load card
- Agilent E6176A 16-channel load card
- Agilent E6177A 24-channel load card
- Agilent U7177A 24-channel load card with current sense
- Agilent E6178B 8-channel heavy duty load card
- Agilent N9377A 16-channel dual-load load card
- Agilent N9378A 24-channel low resistance load card
- Agilent N9379A 48-channel high-density load card
- Agilent E8792A 32-pin matrix card with instrumentation support
- Agilent E8793A 32-pin matrix card
- Agilent E8782A 40-pin matrix card with 24 instrumentation support
- Agilent E8783A 64-pin matrix card
- Agilent E8794A custom card
- Agilent U7178A 8-channel heavy duty load card
- Agilent U7179A 16-channel high current load card

Load cards are described in detail in Chapter 5 and Appendix A to Appendix C of this manual. The pin matrix cards are described in Chapter 6. The E8794A custom card is discussed in Chapter 7.

Figure 3-1 Agilent E6198B Standalone Switch/Load Unit Front View

Figure 3-2 Agilent E6198B Standalone Switch/Load Unit Back View



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

- Built-in USB interface
- Digital I/O
- Current Sense
- Power Bus Sense
- Two DAC Channels
- +5, +12V, –12V, and Spare Power

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

USB Interface

The Switch/Load Unit switching and data transfer is controlled by a built-in USB interface. Figure 4-13 shows the location of the USB interface.

Digital I/O

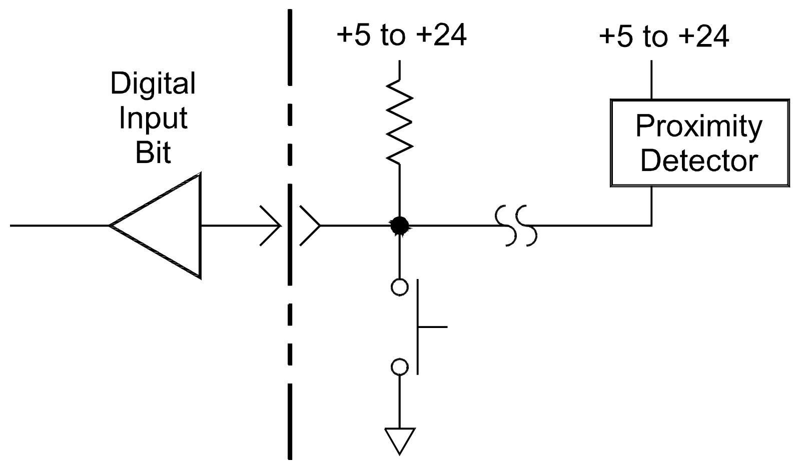
The Switch/Load Unit provides 8-bits of digital input, 8-bits of digital output (Open Drain Out), and 8-bits of TTL-level digital output (Spare Digital Out). There is no handshaking capability in the digital I/O. Typical usage of the digital I/O includes:

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

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 IDs that also use standard TTL inputs, but are not protected to ±24 Vdc. Figure 3-3 is a typical example showing the usage of a digital input bit.

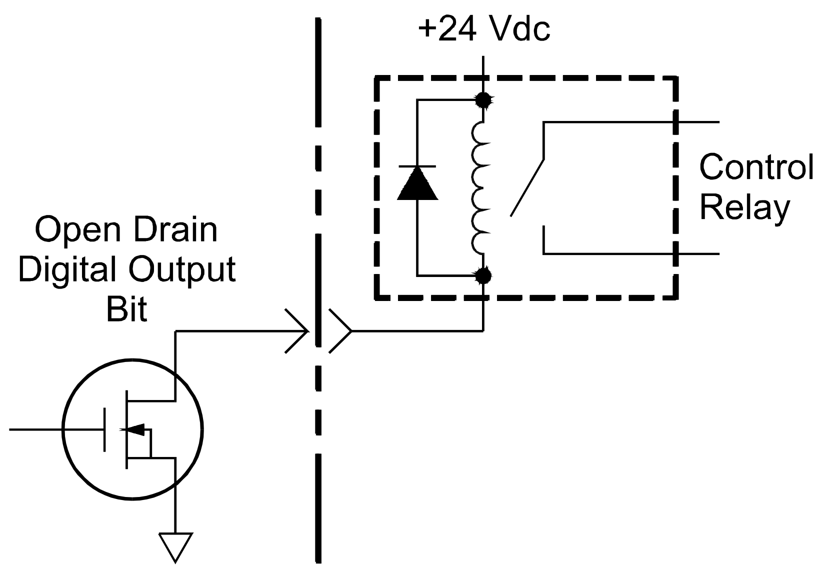
Figure 3-3 Digital Input Example



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 250 mA. Figure 3-4 shows one digital output bit controlling a relay.

Figure 3-4 Digital Output Example



DAC Channels

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

+5 Vdc, +12 Vdc, –12 Vdc, Spare Power

+5 V, +12 V, and –12V from the Switch/Load Unit Power Supply. The +5 V supply can deliver 7.5 A to 30 A, +12 V supply can deliver 2.5 A to 12.5 A, and the –12 V supply can deliver 700 mA to 1 A. You can also connect an additional (spare) power supply to the Switch/Load Unit backplane, see “Connecting an Additional (Spare) Power Supply for details.

NOTE

Power supplies +5 V, +12 V, and –12 V for E6198B have non-resettable fuses. (Non-resettable fuses need to be replaced, refer to Table 3-11 for fuse ratings.)

Spare supply has resettable fuse. If an overload occurs, the fuse(s) open. To reset the fuse(s), remove power from the Switch/Load Unit for approximately 20 seconds. The fuse(s) reset when power is re-applied.

Current Sense

The Isense+ and Isense– lines sense current on a selected load card channel. They connect to the current sense bus on the SLU backplane. Current sense lines of each channel are multiplexed. Only one channel can connect to the current sense bus at one time.

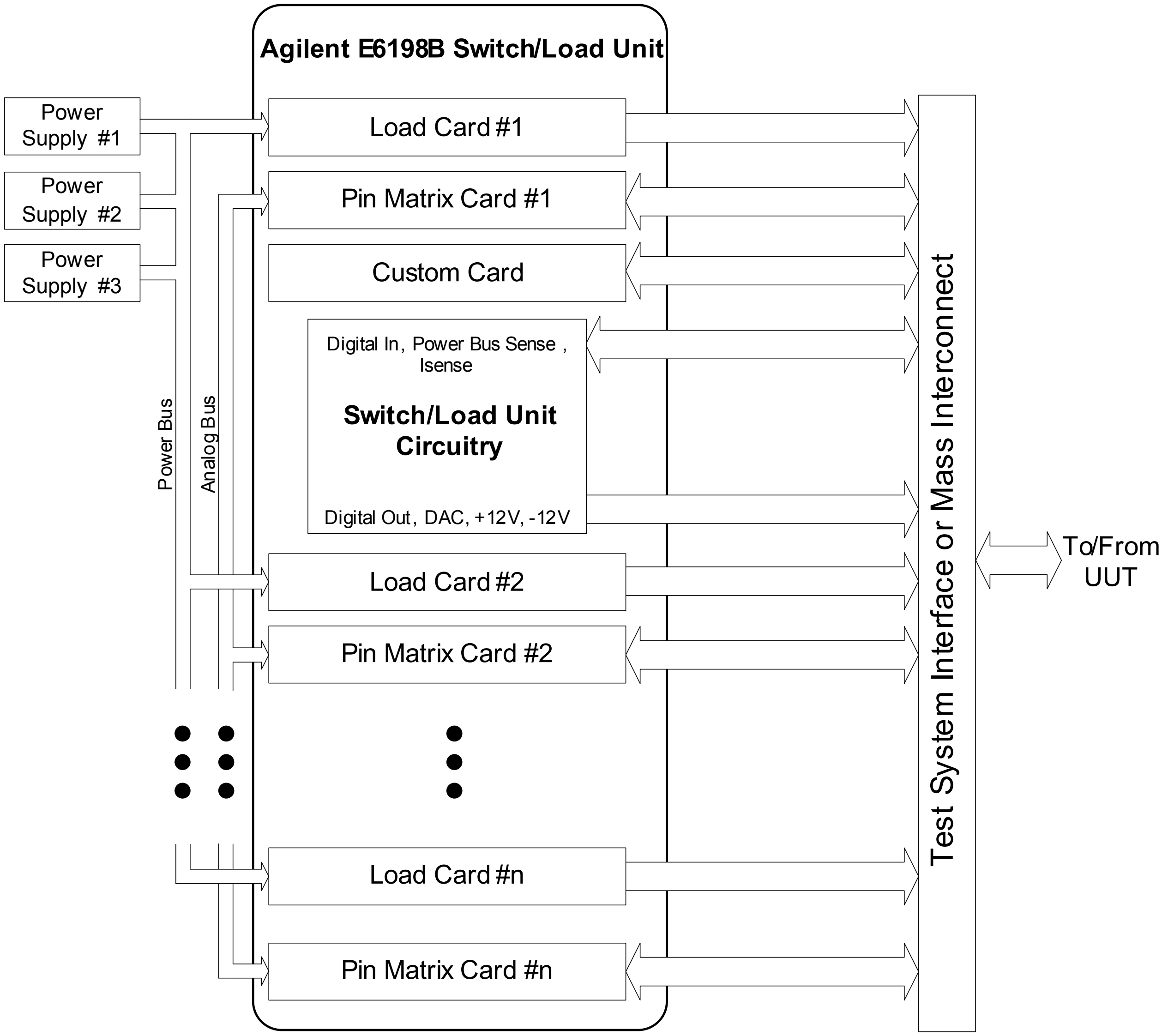
Power Bus Sense

Power Bus Sense lines 1-4 remotely sense power supplies connected to power buses 1-4. This sensing compensates the losses in the system wiring to ensure that the set voltage is applied to the sense point.

Switch/Load Unit Block Diagram

Figure 3-5 shows a block diagram of the SLU. All plug-in cards are optional so your system will have a different mix of cards from that shown here. The Test System Interface or Mass Interconnect are also optional — you can also interface directly to the Switch/Load Unit. See Chapter 4 for details.

Figure 3-5 Switch/Load Unit Block Diagram

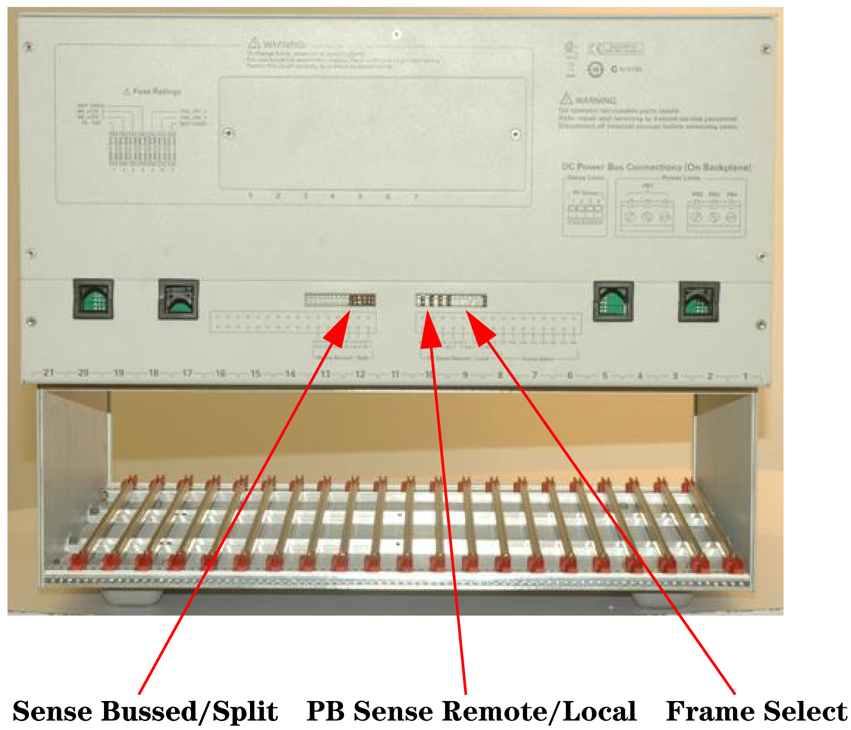


Note: All plug-in cards are optional --the mix and numbers of cards in your system will be different than shown here.

E6198B Integrated Switch/Load Unit Description

The Agilent E6198B now comes as a system integrated unit or as a standalone unit. The features and functionality remains the same as the previous E6198A. Differences between the two are in the cabling and function selection panel.

Figure 3-6 E6198B Integrated SLU Back View



Backplane And Breakout Board Connectors and LEDs

Figure 3-7 Switch/Load Unit Backplane Connectors (USB port adaptor board Not Shown)

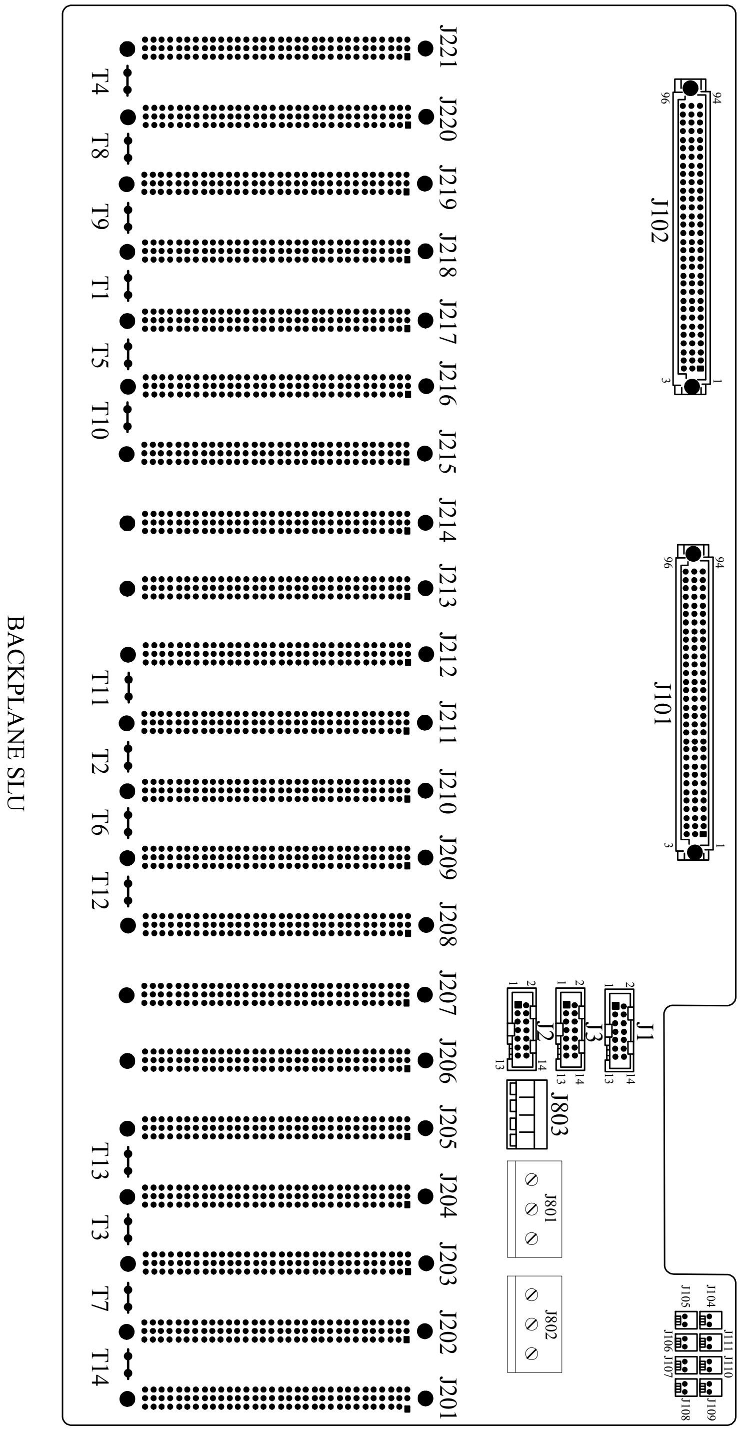


Figure 3-7 shows the locations of the various backplane connectors and LEDs. These components are described on the following pages. See Table 3-3 for more detail.

Figure 3-8 Switch/Load Unit Breakout Board Connectors (Standalone only)

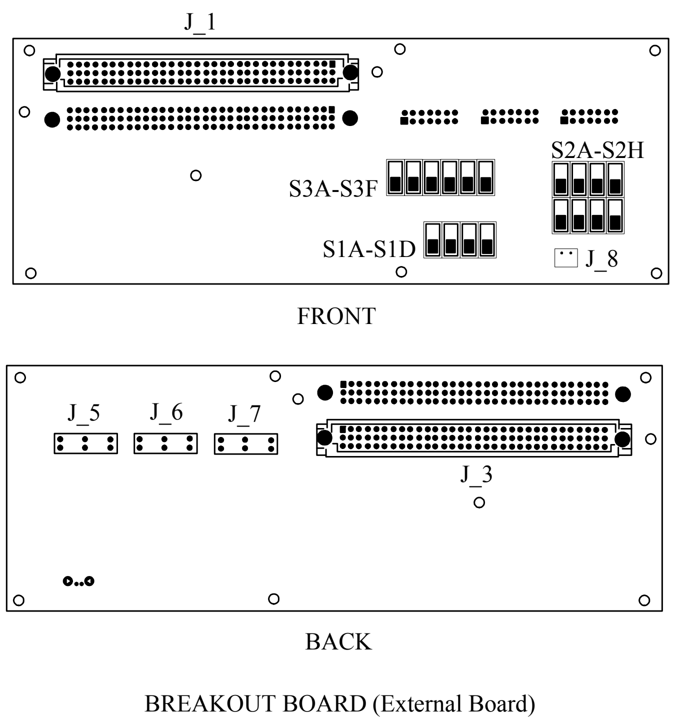


Figure 3-8 shows connector locations on the breakout board (external board). Refer Table 3-5 for the detailed descriptions.

The breakout panel is available with the E6198B Standalone option and is easily accessible from the SLU rear.

Backplane Connector Name

Table 3-3 lists the connectors on a E6198B backplane.

Table 3-3 Backplane Connectors for E6198B

E6198B Reference Designator	Description
J2	SLU Current Sense: Bussed/Split
J3	SLU Power Bus Sense Select: Local/Remote
J1	Frame Select
T1-T14	SLU Logic Power Supply Connector
J101	To USB Controller Connector
J102	Utility Connector
J104	External Reset (reserved)
J105	+5 V Indicator (+5 V Status)
J106	+12 V Indicator (+12 V Status)
J107	–12 V Indicator (–12 V Status)
J108	READY Indicator (Control Status)
J109	+12 V Output For Fan
J110	+12 V Output For Fan
J111	+12 V Output For Fan
J201-J221	Load Card Slots Connector
J801 & J802	Power Busses PB1-PB4
J803	Sense For PB1-PB4

Backplane J1, J2 and J3 Connectors

Table 3-4 shows the factory default configuration for the backplane connectors.

Table 3-4 Backplane Factory Default Connector Settings

Connector	Default Setting	Description
J1	0 (Zero)	Frame Select address 0-7. When using multiple Switch/Load Units in your test system, Connector J1 provides a unique address for each Switch/Load Unit. Factory default (one Switch/Load Unit) is 0.
J2	Bussed	Switch/Load Unit Current-Sense Bus
J3	Local	Switch/Load Unit Power Bus Sense select: Local/Remote

Breakout Board Connector Name (for E6198B Standalone option)

Breakout board extends the connection from backplane to SLU rear. Table 3-5 lists the description of each connector.

Table 3-5 Breakout Board Connectors

Connector	Description
J_1	Utility Connector (J102 extension connector)
J_3	Utility Connector (J102 internal connector)
J_5	Frame Select & Spare Supply (Connect to J1 of backplane internal connector)
J_6	Power Bus Sense Local/Remote (Connect to J3 of backplane internal connector)
J_7	Isense Bussed/Split (Connect to J2 of backplane internal connector)
J_8	Spare Supply Connector
S1A-S1D	Toggle switches for Local/Remote
S2A-S2H	Toggle switches for Frame Select
S3A-S3F	Toggle switches for Isense Bussed/Split

NOTE The breakout board is not available with E6198B System Integrated option. See Figure 3-6.

Backplane Connectors

The following connector descriptions are referenced to Figure 3-9.

T1-T14 are the Switch/Load Unit power supply connectors. The supply provides the required +5 V and ±12 V for powering the backplane and Load Cards. These power supply lines are protected by fuses.

J102 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 connected together to form a single bus, or split into independent current sense busses using jumpers on SLU backplane J2 connector (Integrated) or switches S3A-S3F on breakout board (Standalone). Factory default connects all sense busses to a single bus. Find more information on when should you split the busses and how in Chapter 3.

Four remote power bus sense pins remotely sense the power busses at the UUT. Remote or local sensing for power bus PB1-PB4 can be set using jumpers on SLU backplane J3 connector or S1A-S1D on breakout board (Standalone). Factory default is remote sense.

DAC 1 and **DAC 2** outputs.

J201-J221 are the slot connectors for Pin Matrix Card or Load Card, slots 1-21 respectively. The top half of each slot 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.

J801 and J802 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.

J803 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 and READY LED indicate the status of SLU ready to operate. If one or more LEDs is NOT illuminated, the most likely problem was an overcurrent situation that opened the non-resettable fuse(s). To change fuse(s), remove power from the Switch/Load Unit for approximately 20 seconds. The fuse(s) will reset when power is re-applied. (Non-resettable fuses need to be replaced rather than power off to reset, refer to Table 3-11 for fuse ratings.)

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.

J102 Pinouts

Switch/Load Unit backplane connector J102 carries signals such as the Digital I/O, DAC 1 and 2, and ISense (current sense) lines. When configured as part of a standard Agilent system, J102 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 J102 or to the exposed end of an Agilent E3750-61607, Agilent E6170-61610, or Agilent E6198-61625 cable connected to J102. Figure 3-9 is a J102 connector pinout and Figure 3-10 shows the pinouts for the exposed cable connector end. Table 3-6 defines the signals available on J102.

Figure 3-9 Switch/Load Unit J102 Connector Pinouts

	A		B	C	
Row 32	94	DAC2	NC	96	System Gnd
Row 31	91	DAC1	NC	93	System Gnd
Row 30	88	No Connection	NC	90	No Connection
Row 29	85	System Gnd	NC	87	System Gnd
Row 28	82	System Gnd	NC	84	System Gnd
Row 27	79	Spare Supply	NC	81	-12 Vdc Supply
Row 26	76	+12 Vdc Supply	NC	78	+12 Vdc Supply
Row 25	73	+12 Vdc Supply	NC	75	+12 Vdc Supply
Row 24	70	Open Drain Out (7)	NC	72	Open Drain Out (6)
Row 23	67	Open Drain Out (5)	NC	69	Open Drain Out (4)
Row 22	64	Open Drain Out (3)	NC	66	Open Drain Out (2)
Row 21	61	Open Drain Out (1)	NC	63	Open Drain Out (0)
Row 20	58	Power Bus Sense 4	NC	60	Power Bus Sense 3
Row 19	55	Power Bus Sense 2	NC	57	Power Bus Sense 1
Row 18	52	ISense+ (4)	NC	54	ISense- (4)
Row 17	49	ISense+ (3)	NC	51	ISense- (3)
Row 16	46	ISense+ (2)	NC	48	ISense- (2)
Row 15	43	ISense+ (1)	NC	45	ISense- (1)
Row 14	40	Spare_DigOut (7)	NC	42	Spare_DigOut (6)
Row 13	37	Spare_DigOut (5)	NC	39	Spare_DigOut (4)
Row 12	34	Spare_DigOut (3)	NC	36	Spare_DigOut (2)
Row 11	31	Spare_DigOut (1)	NC	33	Spare_DigOut (0)
Row 10	28	Digital In (7)	NC	30	Digital In (6)
Row 9	25	Digital In (5)	NC	27	Digital In (4)
Row 8	22	Digital In (3)	NC	24	Digital In (2)
Row 7	19	Digital In (1)	NC	21	Digital In (0)
Row 6	16	System Gnd	NC	18	System Gnd
Row 5	13	Fixture ID (7)	NC	15	Fixture ID (6)
Row 4	10	Fixture ID (5)	NC	12	Fixture ID (4)
Row 3	7	Fixture ID (3)	NC	9	Fixture ID (2)
Row 2	4	Fixture ID (1)	NC	6	Fixture ID (0)
Row 1	1	System Gnd	NC	3	System Gnd

NOTE

For E6198B Standalone option, connector J102 is extended from the backplane to the breakout board. See Figure 3-8.

Figure 3-10 Cable 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

Table 3-6 J102 signal definitions

+12Vdc, –12Vdc Supply	+12V and –12V from the Switch/Load Unit Power Supply. The +12V supply can deliver 12.5A, the –12V supply can deliver 2.1A.
Spare Supply	Connection for a user installed power supply not included in the standard system. Refer to "Connecting an Additional (Spare) Power Supply" for details.
DAC1 DAC2	The Switch/Load Unit provides two 14-bit channels of DAC which supply ±16 V 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 lets you 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 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 select from toggle switches. Refer to page 12 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.

J1 Pinout

Table 3-7 shows pinout of J1 Frame Select & Spare Supply (SS). Frame 0 is selected if FS0 and FRAME are both are connected; Frame 1 is selected if FS1 and FRAME are both are connected, and so on. Default setting is frame 0 (zero). More detail about SS (Spare Supply), please refer "Connecting an Additional (Spare) Power Supply" .

Table 3-7 Switch/Load Unit J1 Pinout

FS1	FS3	FS5	FS7	NC	GND	SS
FS0	FS2	FS4	FS6	FRAME	GND	SS

J2 Pinout

Table 3-8 show pinouts of J2 ISENSE Bussed/Split. Default setting for J2 is ISENSE Bussed.

Table 3-8 Switch/Load Unit J2 Pinout

IS(-2)	IS(+2)	IS(-3)	IS(+3)	IS(-4)	IS(+4)	NC
IS(-1)	IS(+1)	IS(-2)	IS(+2)	IS(-3)	IS(+3)	NC

J3 Pinout

Table 3-9 shows pinouts of Power Bus Sense Local/Remote. Local 1 is selected if LOC_S1 is connected with PB1; Remote 1 is selected if REM_S1 is connected with PB1, and so on. Default setting for J3 is Local.

Table 3-9 Switch/Load Unit J3 Pinout

LOC_S1	PB2	REM_S2	LOC_S3	PB4	REM_S4	LOC_S1
PB1	REM_S1	LOC_S2	PB3	REM_S3	LOC_S4	PB1

T1-T14 SLU Logic Power Supply Connector

T1-T14 provides the required +5 V and ±12 V for powering the backplane and Load Cards. Table 3-10 lists each jumper and its corresponding input voltage.

Table 3-10 Power Supply Input for each Jumpers

Jumper	Input Voltage
T1	+5 V
T2	+5 V
T3	+5 V
T4	–12 V
T5	+12 V
T6	+12 V
T7	+12 V
T8	GND
T9	GND
T10	GND
T11	GND
T12	GND
T13	GND
T14	GND

Differentiating E6198B Standalone Option and System Integrated Option

The key differences between the standalone and system integrated option can be found at the SLU rear cover.

On a standalone unit, the backplane connectors are extended to the breakout board attached to the SLU rear cover. At the SLU rear, you will find toggle switches for SLU configuration, and power and sense buses connectors protected by a cable enclosure. (See Figure 3-11.)

On a system integrated unit, you will find cut-outs on the SLU rear cover to allow cable routing from the SLU backplane. Jumpers are used for SLU configuration.

Figure 3-11 Switch/Load Unit Rear View (Standalone Option)

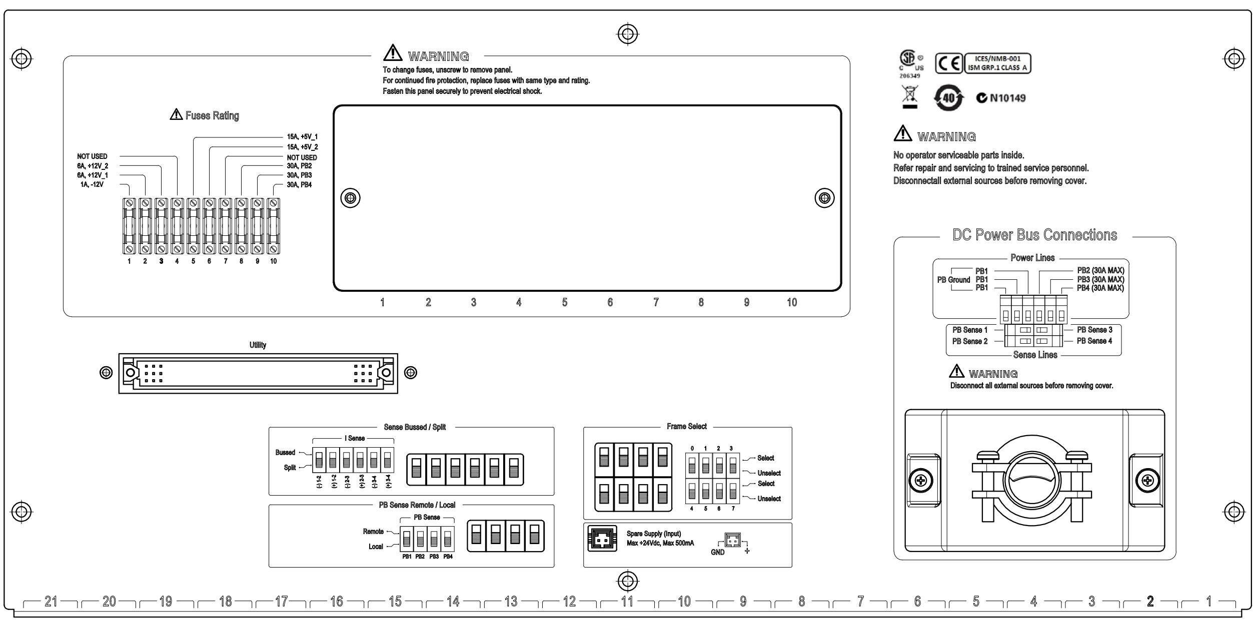
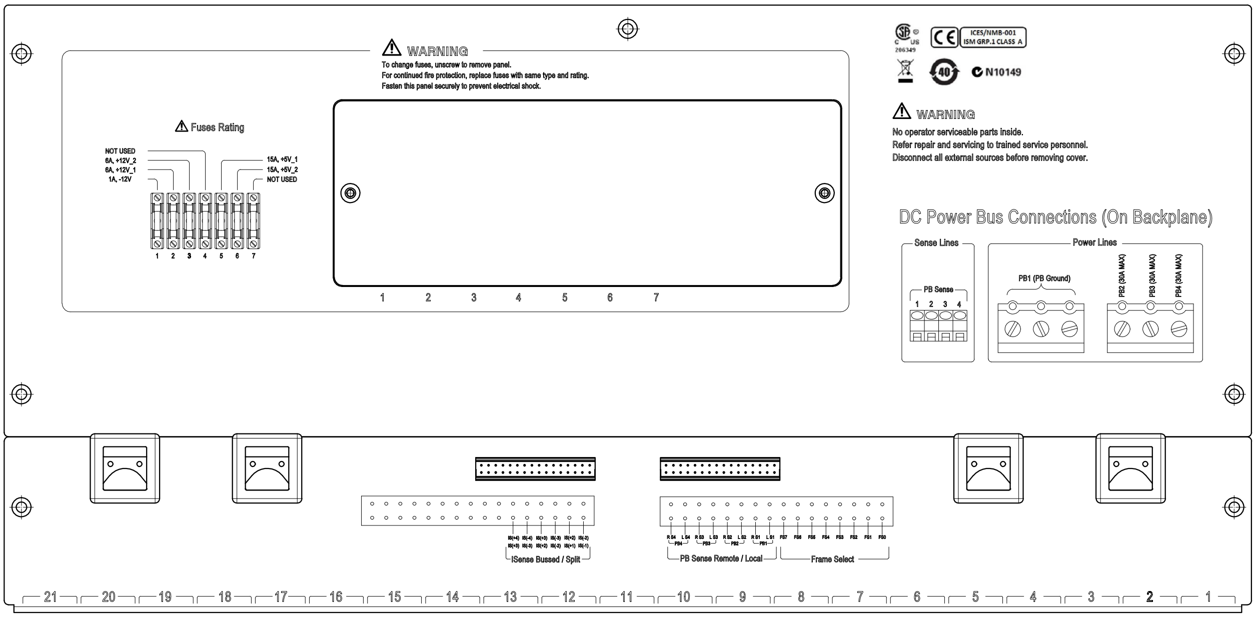


Figure 3-12 Switch/Load Unit Rear View (System Integrated Option)



Fuse Ratings

Fuses are incorporated inside E6198B Switch/Load Unit. There are 10 fuses and 7 fuses for Standalone SLU and Integrated SLU respectively. Please refer Table 3-11 for more detail.

Table 3-11 Fuses Ratings

Standalone	Integrated	Description
Fuse1	Fuse1	1 A, –12 V
Fuse2	Fuse2	6 A, +12 V_1
Fuse3	Fuse3	6 A, +12 V_2
Fuse4	Fuse4	Not Used
Fuse5	Fuse5	15 A, +5 V_1
Fuse6	Fuse6	15 A, +5 V_2
Fuse7	Fuse7	Not Used
Fuse8	-	30 A, PB2
Fuse9	-	30 A, PB3
Fuse10	-	30 A, PB4

DC Power Bus Connections

PB1 to PB4 are the DC power bus connections as seen in Figure 3-11 for the standalone unit. Notice the protective cable enclosure covering both the power bus cabling and power sense cabling for better protection.

For the integrated unit, there is no protective cable enclosure, and you will need to configure the cabling directly onto the backplane, behind the SLU backcover.

4
Configuring the Switch/Load Unit

This chapter shows you how to configure the Switch/Load Unit.

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 installing or removing a card in the Switch/Load Unit or whenever working on a card.

Card Location Recommendations

Slot 1 to 21 of a Switch/Load Unit are identical and able to take any supported Pin Matrix or Load Cards. This sections provides an example on card installation guideline to maintain consistency between test systems. Your test system may use a different guideline that fits your application.

For a single Agilent E6198B 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:

- Agilent Pin Matrix and Instrument Multiplexer Card (E8792A or E8782A)
- Agilent Pin Matrix Card(s) (E8793A and/or E8783A)
- Agilent E8794A Custom Card(s)

Install the load cards using the following rules:

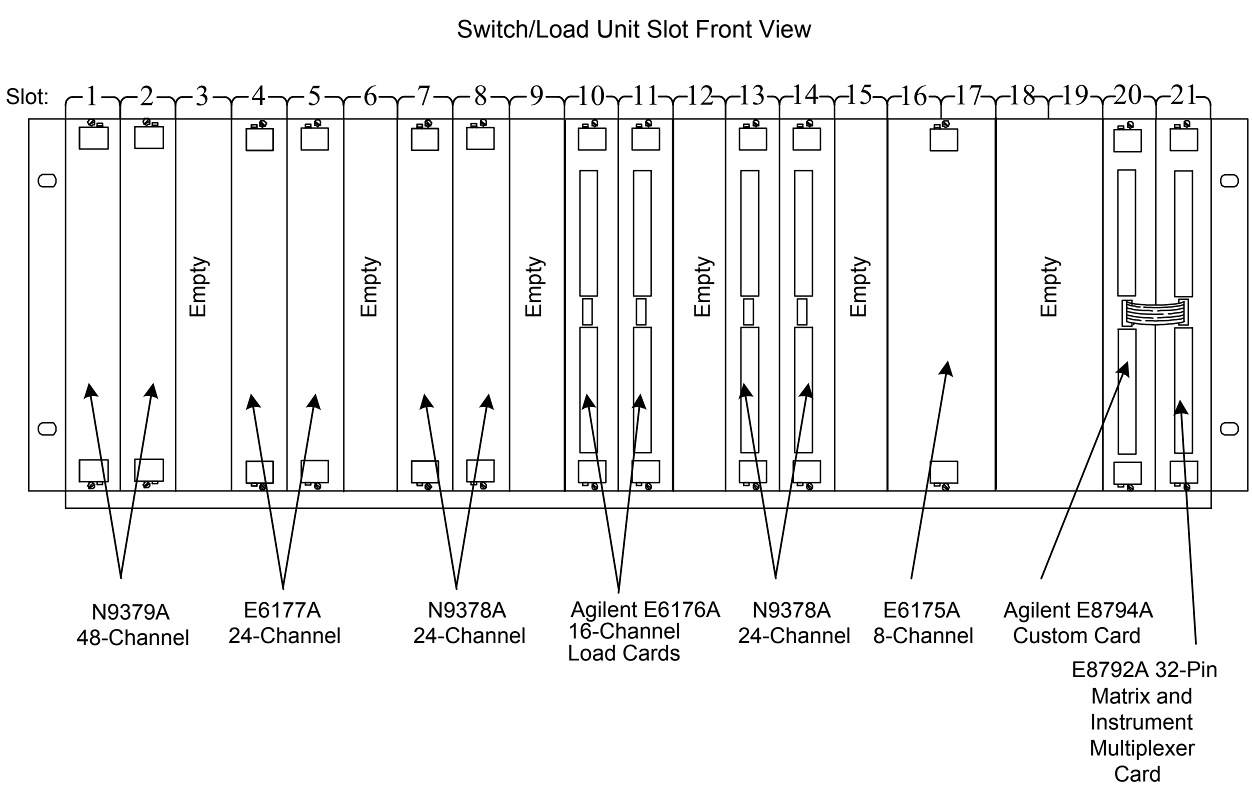
- **Agilent N9379A 48-Channel Load Cards**
  Install any N9379A cards first, starting at slot #1.
- **Agilent E6177A 24-Channel Load Cards**
  Install any E6177A cards next.
- **Agilent U7177A 24-Channel Load Cards with Current Sense**
  Install any U7177A cards next.
- **Agilent N9378A 24-Channel Load Cards**
  Install any N9378A cards next. To allow for future expansion, leave an open slot after the last N9378A card.
- **Agilent E6176A 16-Channel Load Cards**
  Install any Agilent E6176A cards next.
- **Agilent N9377A 16-Channel Load Cards**
  Install any Agilent N9377A cards next. To allow for future expansion, leave an open slot after the last N9377A card.
- **Agilent E6178B 8-Channel Heavy Duty Load Cards**
  Agilent E6178B 8 channel Heavy Duty cards require two 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.

- **Agilent E6175A 8-Channel Load Cards**
  Agilent E6175A 8 channel cards require two 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.

CAUTION Please close the gap for rear side of the connector if using own fabricated cable with connector.

For example, Figure 4-1 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 4-1 Example of Load/Matrix/Custom Cards Loading Order



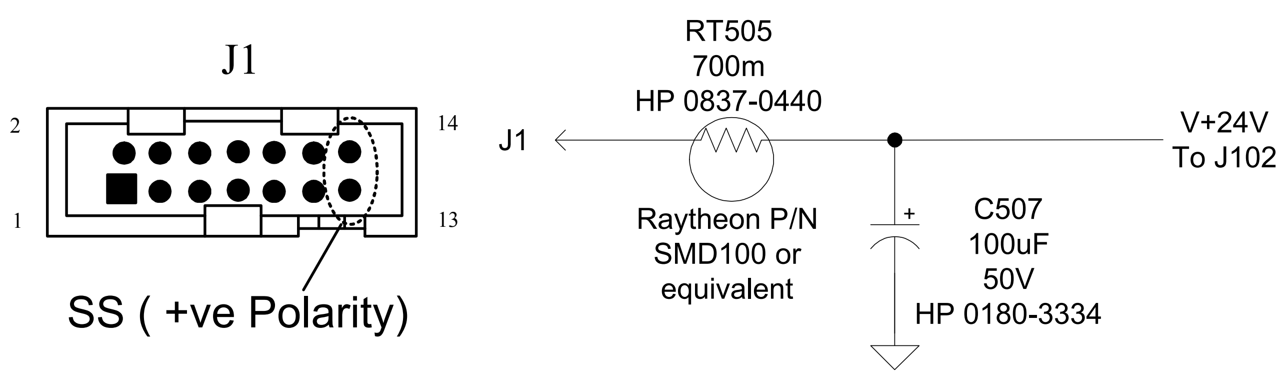
Load Card Types and IDS

Each card is assigned a different type and has a 10-pin connector that lets you assign a unique binary code ID number to each card. See“Load Card Type and Configuration ID" for more information.

Connecting an Additional (Spare) Power Supply

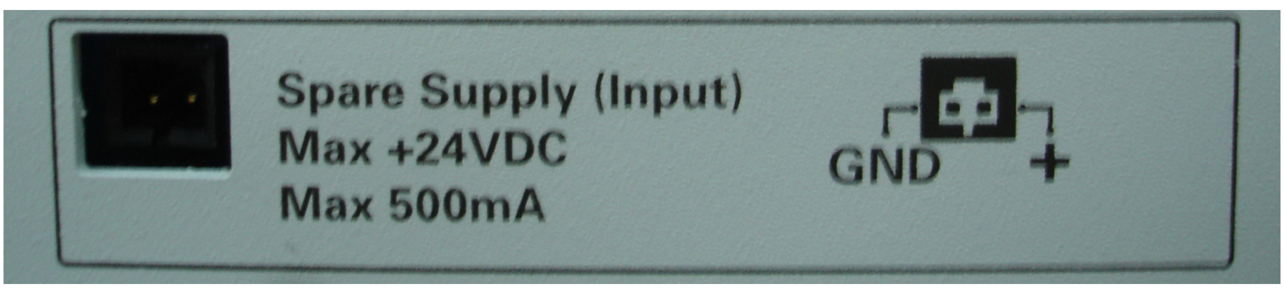
The Spare Supply pinout located at SLU backplane connector J1 (Integrated) allows you to add an additional power supply such as a +24 V power supply for powering higher voltage relays. It is necessary to remove the SLU rear cover to access this connector. Figure 4-2 shows the placement and orientation on the backplane for the power supply components. Both Connector J1 and Capacitor C507 are loaded at the factory. Capacitor C507 is to minimize high-frequency noise on the supply line. The auxiliary supply output (Spare Supply) appears on Switch/Load Unit connector J102 pin 79.

Figure 4-2 Component Location/Schematic for User-Installed External Power Supply



For SLU Standalone option, you can connect to the Spare Supply Input directly from SLU rear. See Figure 4-3.

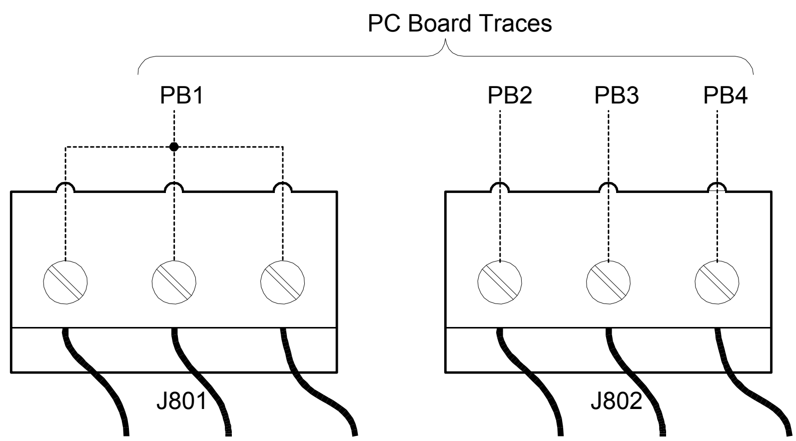
Figure 4-3 Spare Supply (Input) Connector on SLU rear (SLU standalone)



Configuring the Power Busses

The UUT power supplies are connected to the power busses PB1-PB4. Figure 4-4 shows the power bus connectors J801 and J802 located on the Switch/Load Unit backplane for integrated option. These connectors use screw terminations for high current. The J801 connectors are shorted on board, providing a common connection for up to three supplies. Example A and B below show the two most common ways of configuring the power busses.

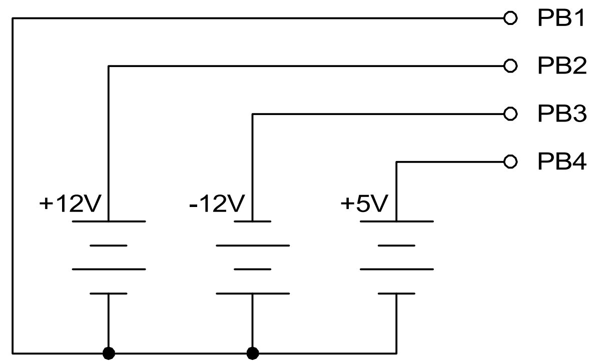
Figure 4-4 Power Bus Connectors J801 and J802



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

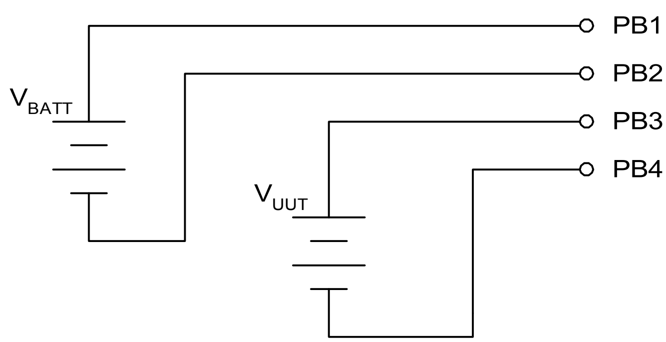
Example A shows three separate supplies attached to the busses, with all three sharing a common ground on Power Bus 1 (PB1). This is the factory default configuration. The grounds for all three supplies are connected together on connector J801.

Figure 4-5 Example A: Three Separate Supplies on PB1 - PB4



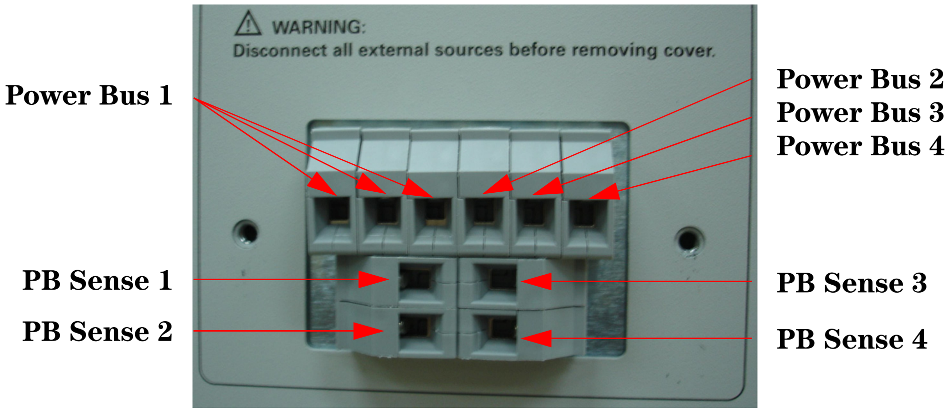
Example B (available only as a special configuration) shows two isolated power supplies with separate grounds connected to the power bus. This configuration can be used if, for example, one supply requires local sensing, while the other requires remote sensing at the UUT.

Figure 4-6 Example B: Isolated Power Supplies



For the standalone SLU, users can directly connect to the external connector “DC Power Bus Connection”. (See Figure 4-7.)

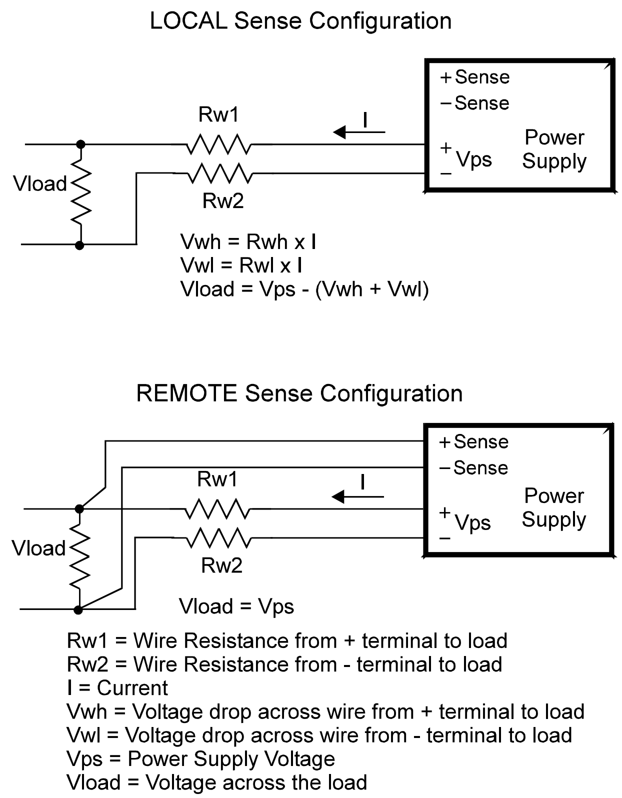
Figure 4-7 DC Power Bus Connector Of Standalone SLU



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 4-8.

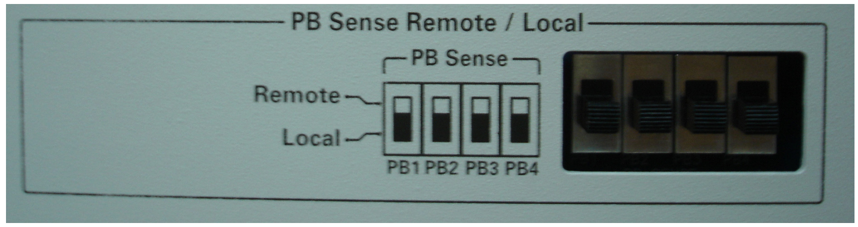
Figure 4-8 Conceptional View of Local/Remote Sensing



Set the power supply sense jumpers in the LOCAL position for sensing the power supply outputs at the PB1 - PB4 terminals.

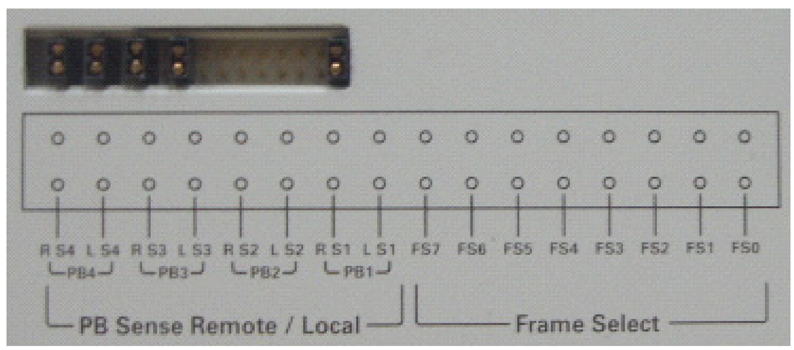
For Standalone, toggle PB Sense Remote/Local switches to select either Remote or Local mode. See Figure 4-9.

Figure 4-9 PB Sense Remote/Local Interface (Standalone SLU)



For Integrated, use Jumper to select the mode on PB Sense Remote/Local. See Figure 4-10.

Figure 4-10 PB Sense Remote/Local and Frame Select Interface (Integrated SLU)



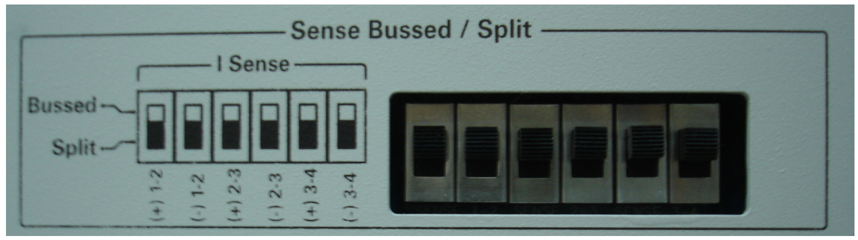
Configuring the Current-Sense Jumpers

The Switch/Load Unit is shipped from the factory with the current-sense jumpers J2 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 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.

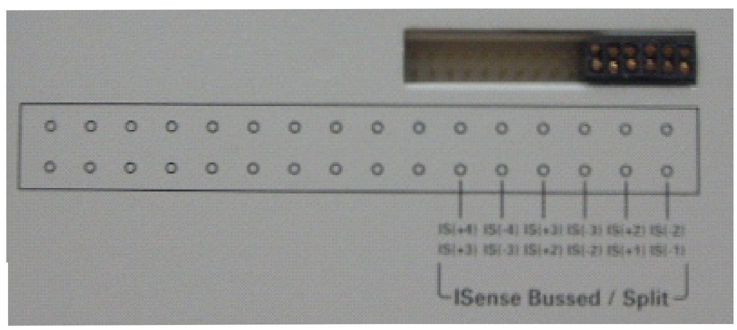
Figure 4-11 shows the ISense Bussed/Split interface for Standalone SLU. Toggle the switch to choose either Bussed or Split mode.

Figure 4-11 ISense Bussed/Split Interface (Standalone SLU)



For system integrated SLU, jumpers are used to select between Bussed/Split, see Figure 4-12.

Figure 4-12 ISense Bussed/Split Interface (Integrated SLU)



NOTE

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

Connecting E6198B to the Computer via USB Interface or Parallel Port

USB interface is introduced in E6198B, on top of parallel port interface which is available on the older version on SLU. The USB interface connects to the PC controller using a standard USB cable. See Figure 4-13.

Figure 4-13 USB Cable Connections

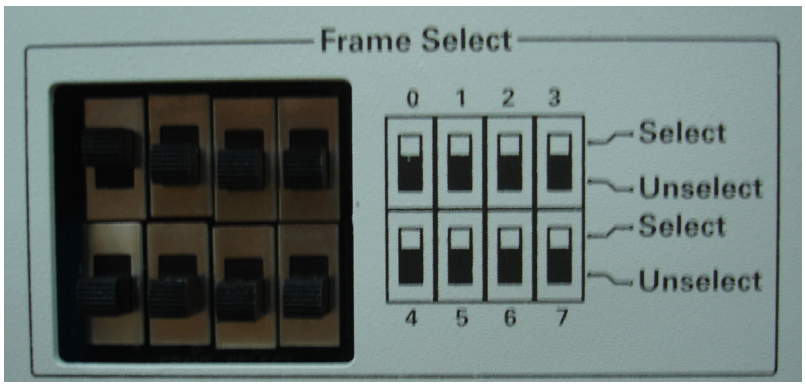
Adding a Second Switch/Load Unit

You can add a second Switch/Load Unit to the system as the load and switching requirements increase. Connection to the PC controller can be made to any existing USB port or via an externally powered USB hub.

For Standalone SLU, the Frame Select toggle switches, sets the address of each Switch/Load Unit (see Figure 4-14). The toggle switches can be set for any address from zero to seven.

However, for the Integrated SLU, jumpers must be used for frame select. 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 4-14 Frame Select Interface (Standalone SLU)



Load Box Installation

Figure 4-15 Load Box Installed

- Install 4 tinnermans (0590-0804) at the proper locations on the back of the rack.
- From the back of the rack, position the load box onto the rails and secure to the rack using 4 spacers (0380-0317*) and 4 dress screws (0570-1272).
- Spacers are only required for the first loadbox (to clear the door latch).
- Check the build list for the number of load boxes (E6198B) required. If a second load box (Option E6198B-FG) is required, another set of rails will need to be installed. Allow space for the first load box and 1 EIA space for venting between the two load boxes.
- Secure the second loadbox (if required) with 4 dress screws (E9900-06001).

* This is the standard spacer. For E8972 (TS-5400), use 0380-4697 spacers.

5
Using Load Cards and Loads

This chapter discusses how to configure load cards and how to use loads with the various load cards.

Load Card Capabilities

Table 5-1 Load Card Capabilities

Function	Slot Size	No. of Channels (Max.)	No. of Channels - Unshared Relays	Maximum Current per Channel	Current Measuring with Sense Resistor	Current Measuring with Current Transducer	Flyback Protection Available (User Installed)
E6175A	2	8	4	7.5 A (15 A peak)	Yes	Yes	Yes
E6176A	1	16	16	7.5 A (15 A peak)	Yes	No	Yes
E6177A	1	24	24	2 A	No	No	No
E6178B	2	8	8	30 A	No	Yes	Yes
N9377A	1	16 dual load	16	7.5 A (15 A peak)	Yes	No	Yes
N9378A	1	24 dual load	24	2 A	No	No	No
N9379A	1	48 dual load	48	2 A	No	No	No
U7177A	1	24	24	2 A	Yes	No	No
U7178A	2	8	8	40 A	No	Yes	Yes
U7179A	2	16	16	15 A	Yes	No	Yes

- The Agilent 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 Agilent 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 Agilent 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 2A continuous carry current.

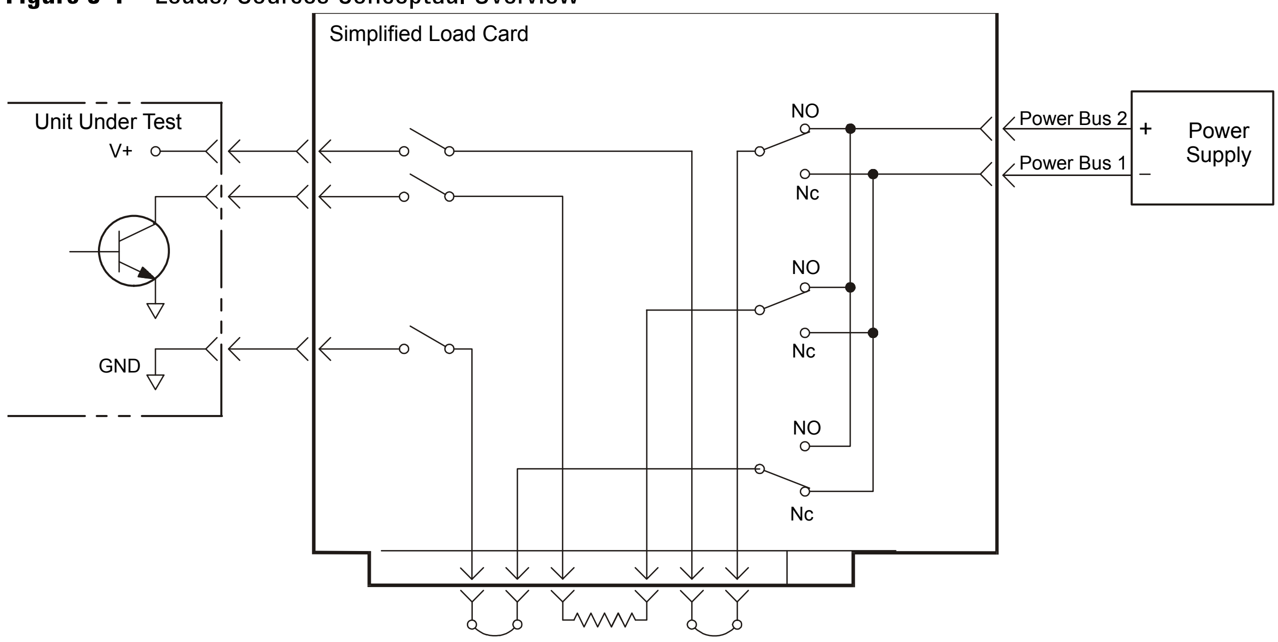
- The Agilent U7177A 24-Channel Medium Current Load Card (for non-inductive loads), with integral current sensing, is intended to be used with externally mounted loads. This card is one slot wide and capable of up to 2A continuous carry current.
- The Agilent E6178B 8-Channel Heavy Duty Load Card is designed for very high current applications of up to 30A per channel.
- The N937xA load cards support multiple loads per channel, either dual loads (two loads per channel) or quad loads (four loads per channel).
- The Agilent U7178A 8-Channel Heavy Duty Load Card is designed for very high current applications of up to 40 A per channel.
- The Agilent U7179A 16-Channel High Current Load Card is designed for high current applications, requiring externally mounted loads. This card is capable of up to 15 A continuous carry current.

Loads Overview

Figure 5-1 shows a conceptual block diagram of a typical load application having these four main areas:

- Power Supply
- Load Card
- Loads
- Unit Under Test (UUT)

Figure 5-1 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:

Agilent E6175A 8-Channel: Card Type is 1

Agilent E6176A 16-Channel: Card Type is 2

Agilent E6177A 24-Channel: Card Type is 3

Agilent U7177A 24-Channel: Card Type is 24

Agilent E6178B 8-Channel Heavy Duty: Card Type is 4

Agilent N9378A 24-Channel Low Resistance: Card Type is 5

Agilent N9379A 48-Channel High Density: Card Type is 6

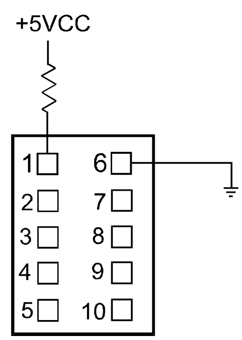
Agilent N9377A 16-Channel Dual Load: Card Type is 7

Agilent U7178A 8-Channel Heavy Duty: Card Type is 25

Agilent U7179A 16-Channel High Current: Card Type is 32

Except for the N9378A and N9379A, 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 SLU. Refer to Figure 5-2.

Figure 5-2 Pin Assignments on the Card Configuration Jack



- Pin 1 is used for bit 8 on the N9377A card only
- Pins 2-5 correspond to bits 0-3, respectively
- Pins 7-10 correspond to bits 4-7, respectively

- See “Connecting Loads" for more information on addressing loads on the N9378A load card.
- See “Connecting Loads" for more information on addressing loads on the N9379A load card.

The configuration pins are normally high with a 10 KΩ pull-up resistor resident on the load card, producing a value of FF_h. Grounding selected pins creates binary codes which can be read back through the interface using the loadCardGetInfo action. See the *TS-5000 System Software User’s Guide* for more information.

Using the Agilent E6175A 8-Channel Load Card

The Agilent 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. Figure 5-3 shows a block diagram of the Agilent E6175A 8-Channel Load Card. The card layout is shown in Figure 5-4.

- 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 you mount it on the left side (slots 1-4) of the Agilent E6198B Switch/Load Unit enclosure, closest to the incoming power buses. “Card Location Recommendations"
- The card type is 01_h. “Load Card Type and Configuration ID".
- The factory default is to load a 0.05Ω, 0.1% Isense resistor in each channel. If you prefer to use a current transducer, you **must** remove the Isense resistor and add the current transducer described in “Selecting a Current-Sense Method".
- 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. “Connecting Loads".
- Each channel is capable of up to 7.5 amperes continuous carry current or up to 15 amperes with a two percent duty cycle.
- There is a slow blow fuse on each channel to protect the card traces against extended high current operation.

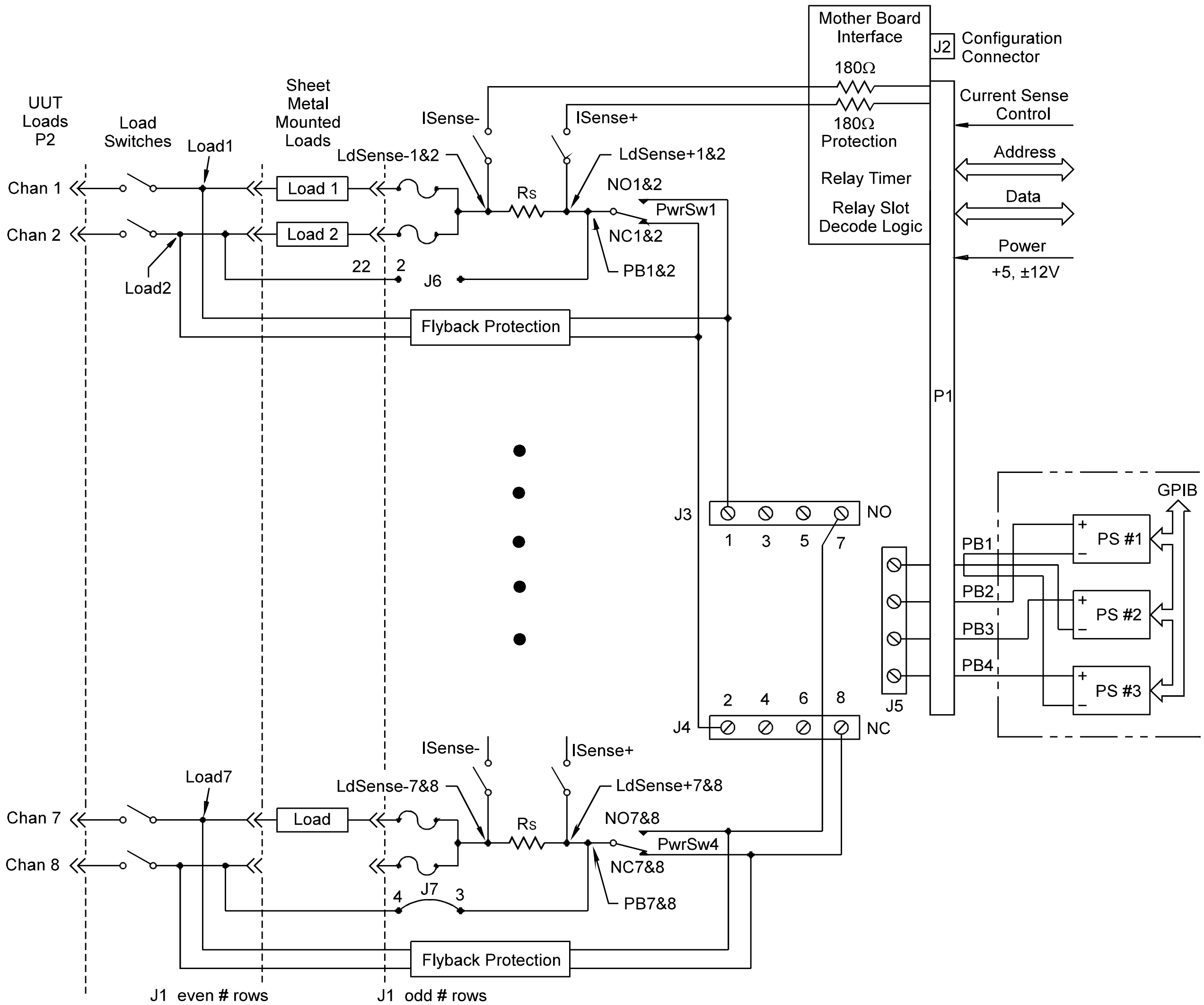
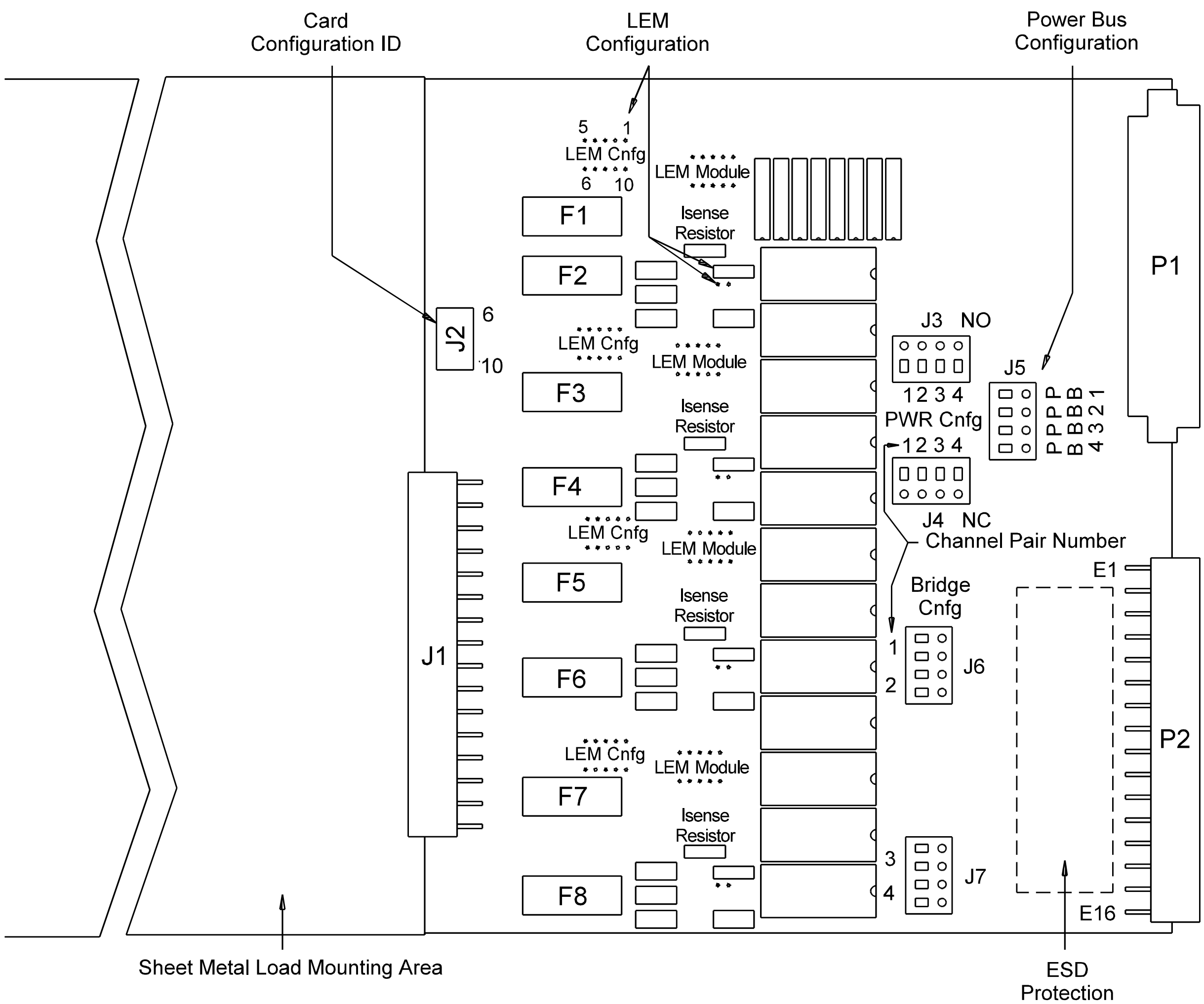


Figure 5-3 Agilent E6175A 8-Channel High-Current Load Card Block Diagram

Figure 5-4 Agilent E6175A 8-Channel Load Card Layout



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. 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 Agilent E6175A 8-Channel Load Card; using a sense resistor, or using a LA 25-NP current transducer from LEM Inc.* Figure 5-5 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

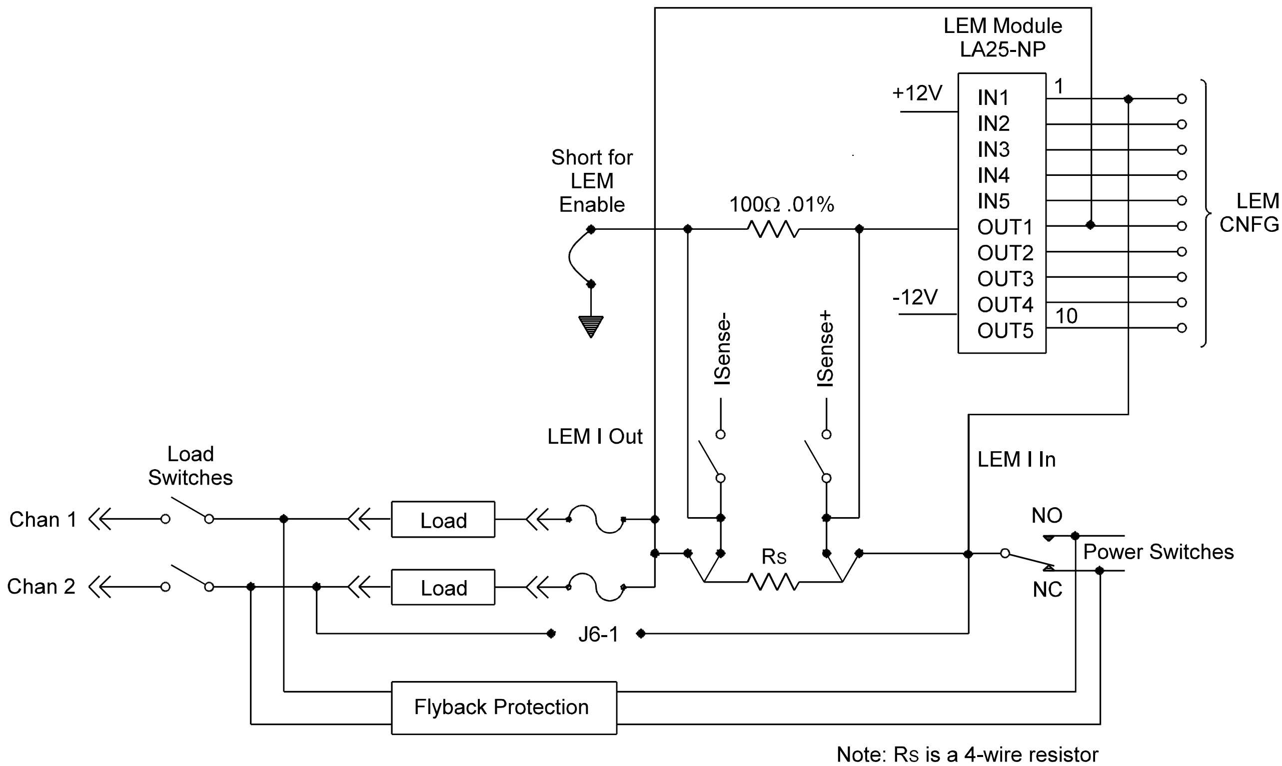
The card comes factory loaded with a 3-watt, 0.05 Ω, 0.1% sense resistor already installed. This is the lowest value sense resistor that can safely be installed. If lower value currents are being measured, requiring a larger resistance value to make the sense voltage readable, then this sense resistor 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.

* 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

Figure 5-5 LEM Current Transducer



Installing a LEM Current Transducer

Figure 5-6 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 5-2 are silk-screened on the load card's printed circuit board. Installing 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 Agilent E6175A PC board.**

2 Install the LEM module.

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

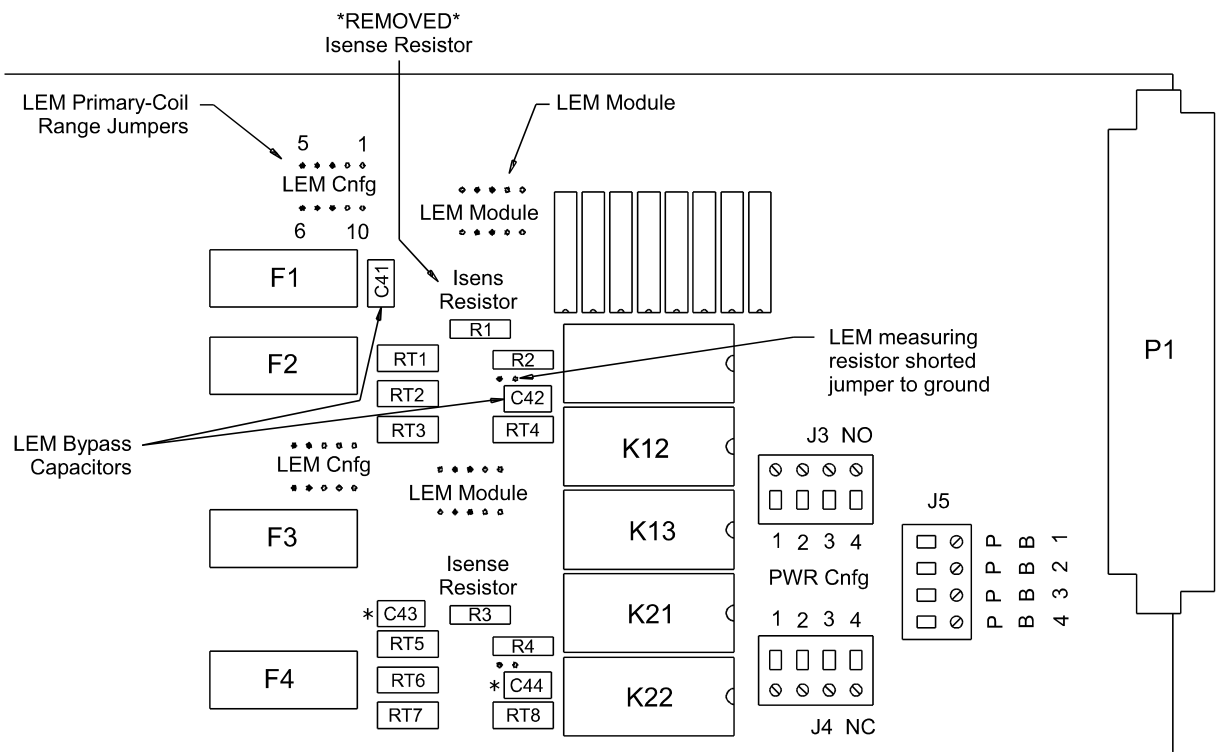
4 Install the shorting jumper from R2 to ground, TP41 to TP42.

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

6 Install the appropriate primary-coil range jumpers. See Figure 5-7.

NOTE Use a wire gauge appropriate for the current through the load.

Figure 5-6 Component Location for Installing LEM Current Transducer Module



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

Figure 5-7 Wiring Options of LEM Model LA25-NP Primary for Various Current Ranges

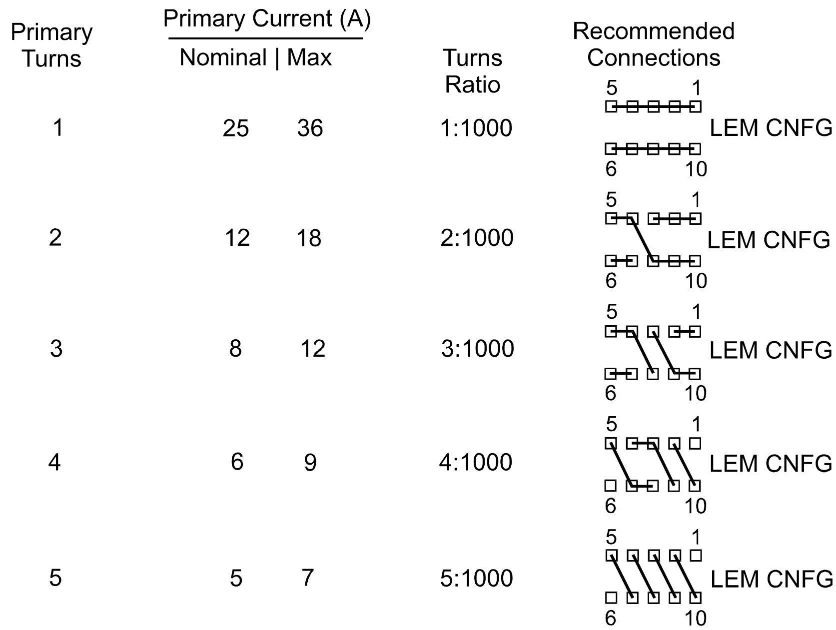


Table 5-2 details the components that need to be installed/replaced for each of the two channel pairs of the Agilent E6175A 8-Channel Load Card.

Table 5-2 Components involved in LEM Module Installation

Channel(s)	Isense Resistor (Rmvd)	Measuring Resistor	Shorting Jumper	Bypass Capacitors (0.01 µf)	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*. Additional information about the use of this current transducer is available from the manufacturer.

* 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

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.

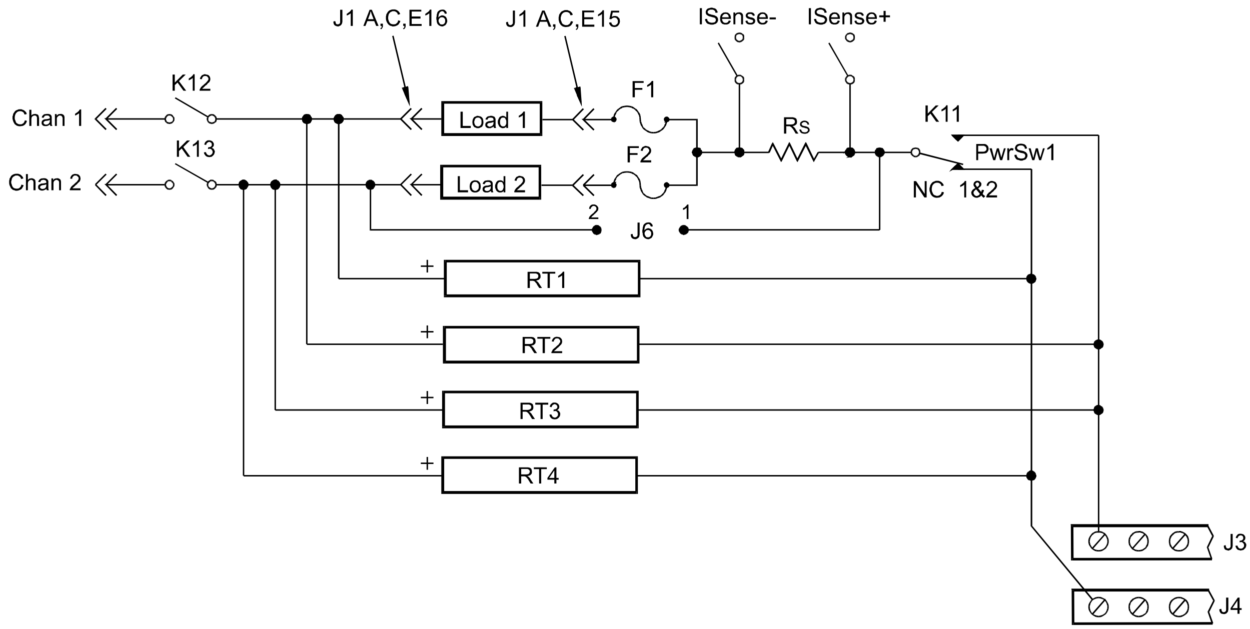
CAUTION

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 SLU.

The Agilent E6175A 8-Channel Load Card comes with provisions for user-installed flyback voltage protection. Figure 5-9 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.

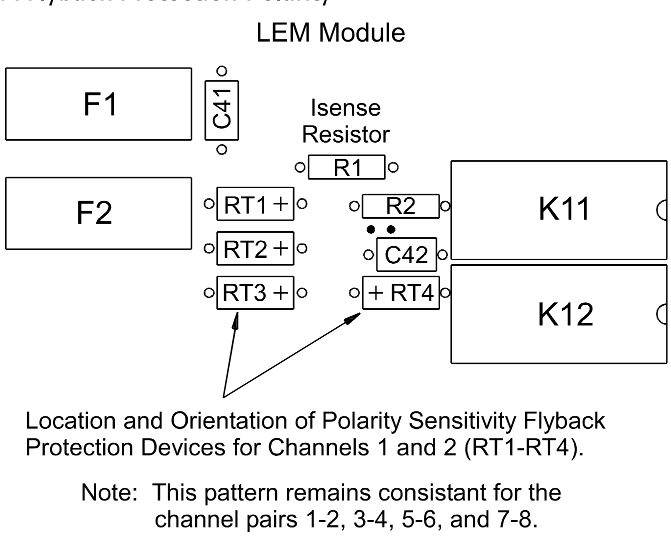
As an example, in Figure 5-8 Chan1 has two potential input lines connected to the input Form C switch K11. RT1 connects input line J4 and RT2 connects alternate input line J3, to the output of Load1. When a voltage spike occurs on the UUT that exceeds the rating on the flyback device, the device clamps the surge voltage to the device’s predetermined value.

Figure 5-8 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 5-9.

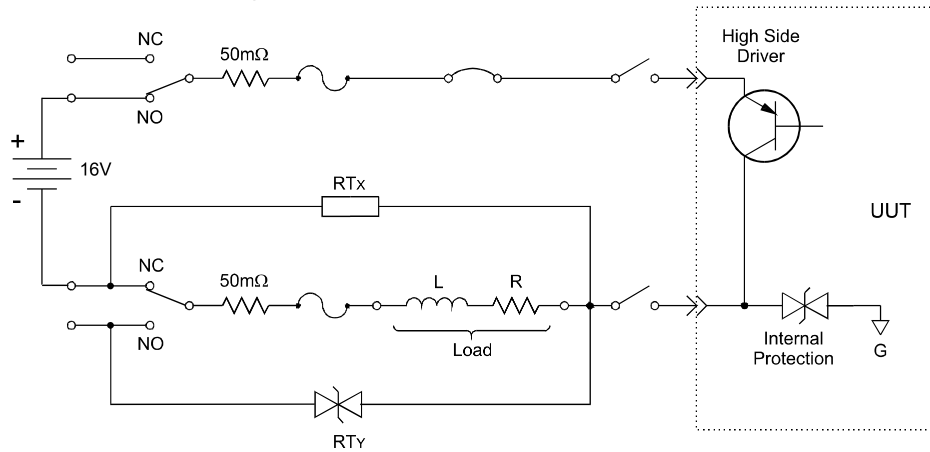
Figure 5-9 Agilent E6175A Flyback Protection Polarity



Protection Devices

MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.* Refer to Figure 5-10. 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 5-10 Typical Agilent E6175A Load Card Flyback Protection Circuit



Typical small MOV (3mm) axial lead mounted specifications are:
- Continuous DC voltage: 220 V
- Transient energy (10/1000mS)†: 0.90 Joules (watt-seconds)
- Transient peak current (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: 300 V max at 1mA
- Reverse Standoff voltage: 250 volts
- Maximum reverse leakage: 5 mA
- Maximum peak pulse current: 5 A
- Maximum Clamping voltage: 400 volts
- Maximum temperature coefficient: 0.110%/°C

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

† 10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.

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

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.*

Sample Load Configurations

Four sets of tandem loads, each set sharing a current-sense resistor, may be mounted on the Agilent 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 5-3 shows four other examples of how loads could be configured.

In the NPN Pull-up example #1 (Figure 5-11, 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 5-11, 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.

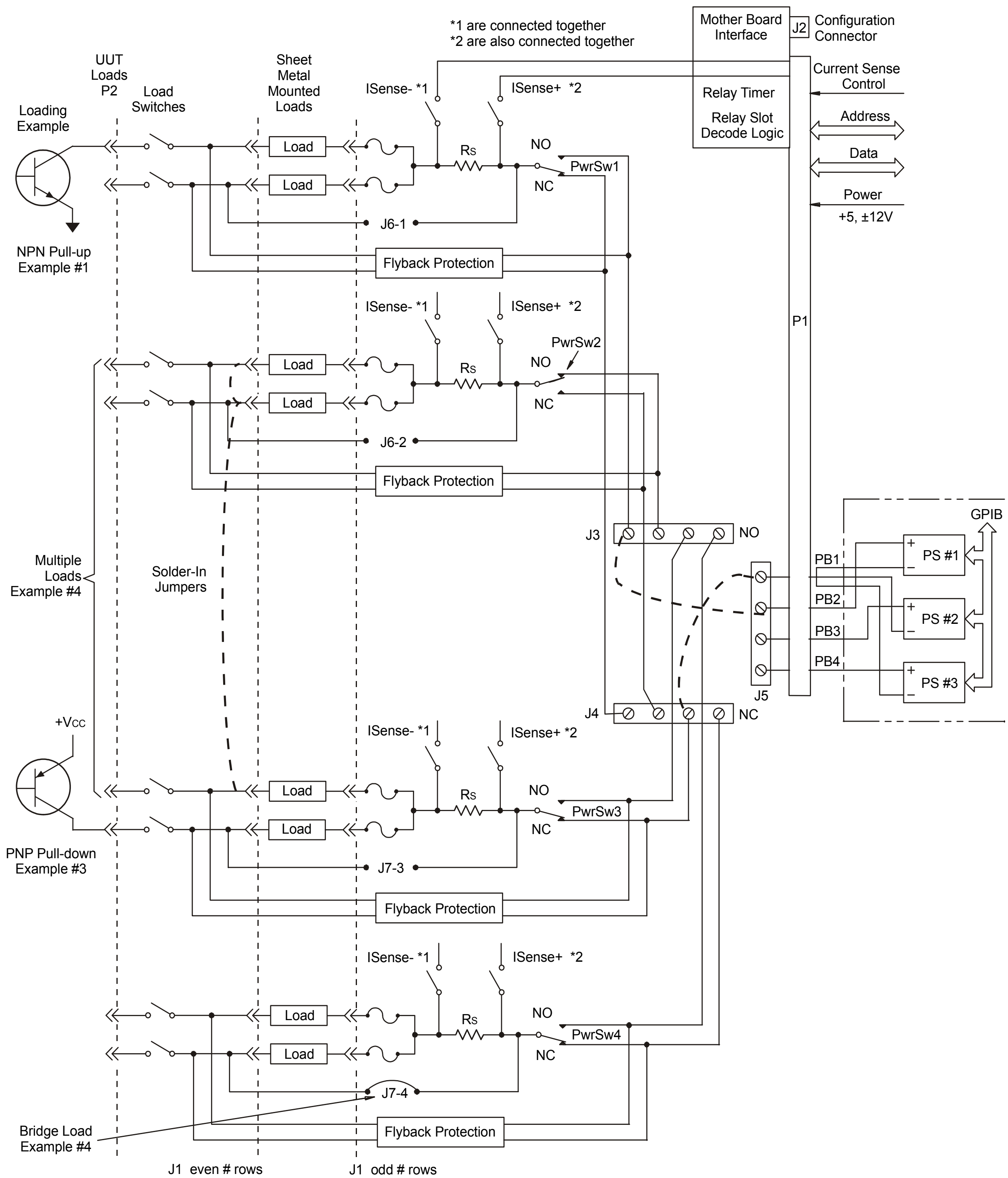
In the PNP pull-down example #3 (Figure 5-11, middle), power switch three (PwrSw3), in its normally closed state, supplies a switched ground to the PNP transistor. The positive source to the transistor is assumed to be switched through another load card to the UUT.

In bridge load example #4 (Figure 5-11, bottom), both load switches and power switch four (PwrSw4) through the bridge configuration jumper J7, provide a sensed current path for pin-to-pin loads on the UUT. Each channel pair (1-4) is shown

* 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)

by J6-1, J6-2, J7-3 and J7-4. Both the power source and return are assumed to be switched through another load card to the UUT.

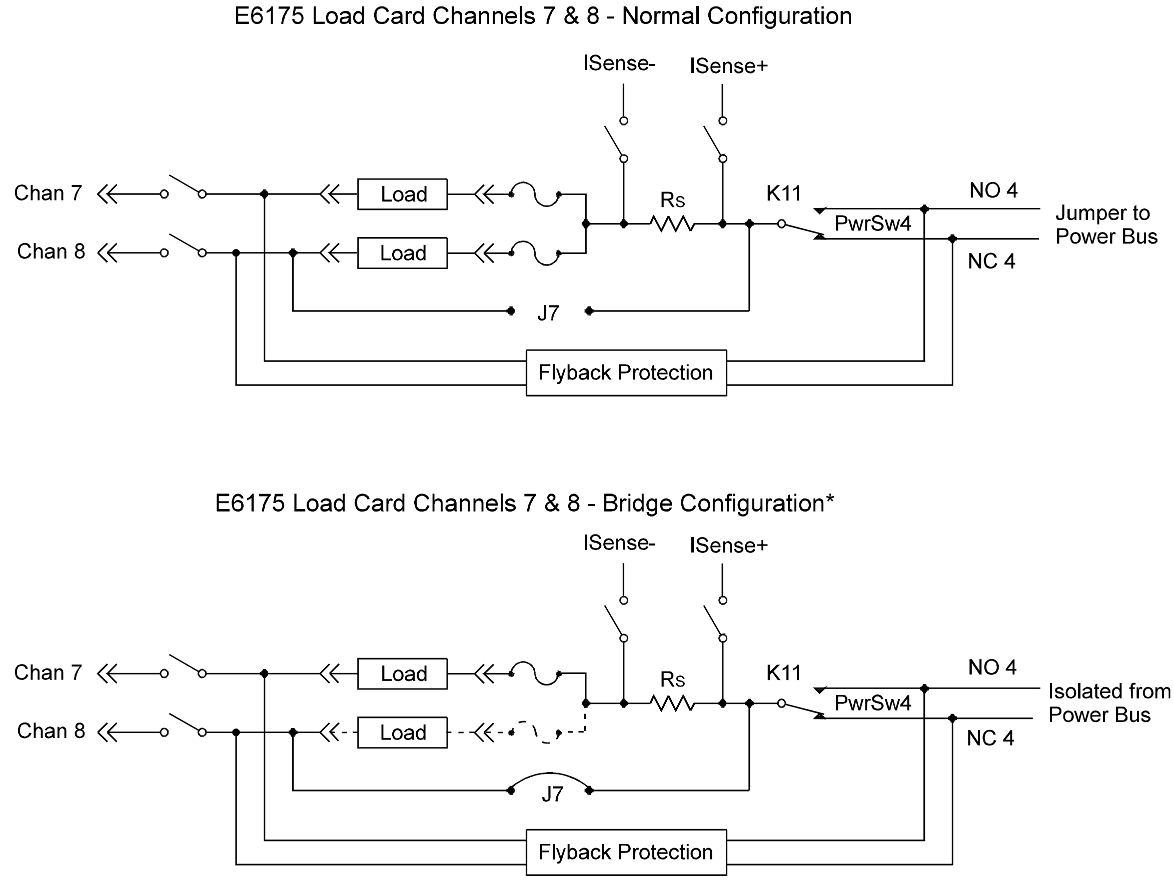
Figure 5-11 Agilent E6175A Load Examples



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 5-12.

Figure 5-12 Bridge Configuration for Channels 7 and 8 on 8-Channel Load Card



* Note that load on channel 8 is effectively removed from the circuit by jumper J7.
This pattern is consistant for the three other channel pairs, 1-2, 3-4, and 5-6.

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

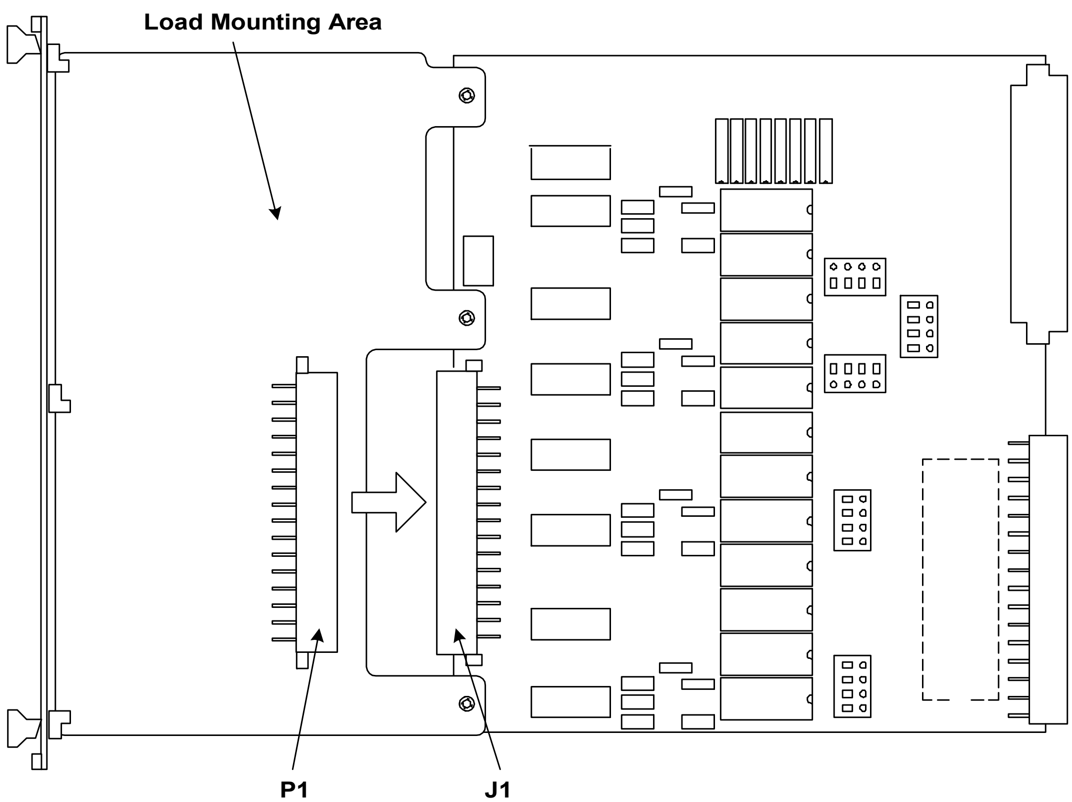
Bridge Circuit on:	Jumper Pins:
Channels 1 and 2	J6, 1 and 2
Channels 3 and 4	J6, 3 and 4
Channels 5 and 6	J7, 1 and 2
Channels 7 and 8	J7, 3 and 4

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 Agilent E6175A's sheet-metal mounting area. The loads are wired to connector CN1 which mates to the Agilent E6175A's J1 connector. Figure 5-13 shows the Agilent E6175A's load mounting area and connectors J1 and CN1.

Figure 5-13 Agilent E6175A Load Mounting Area and CN1/J1 Connectors



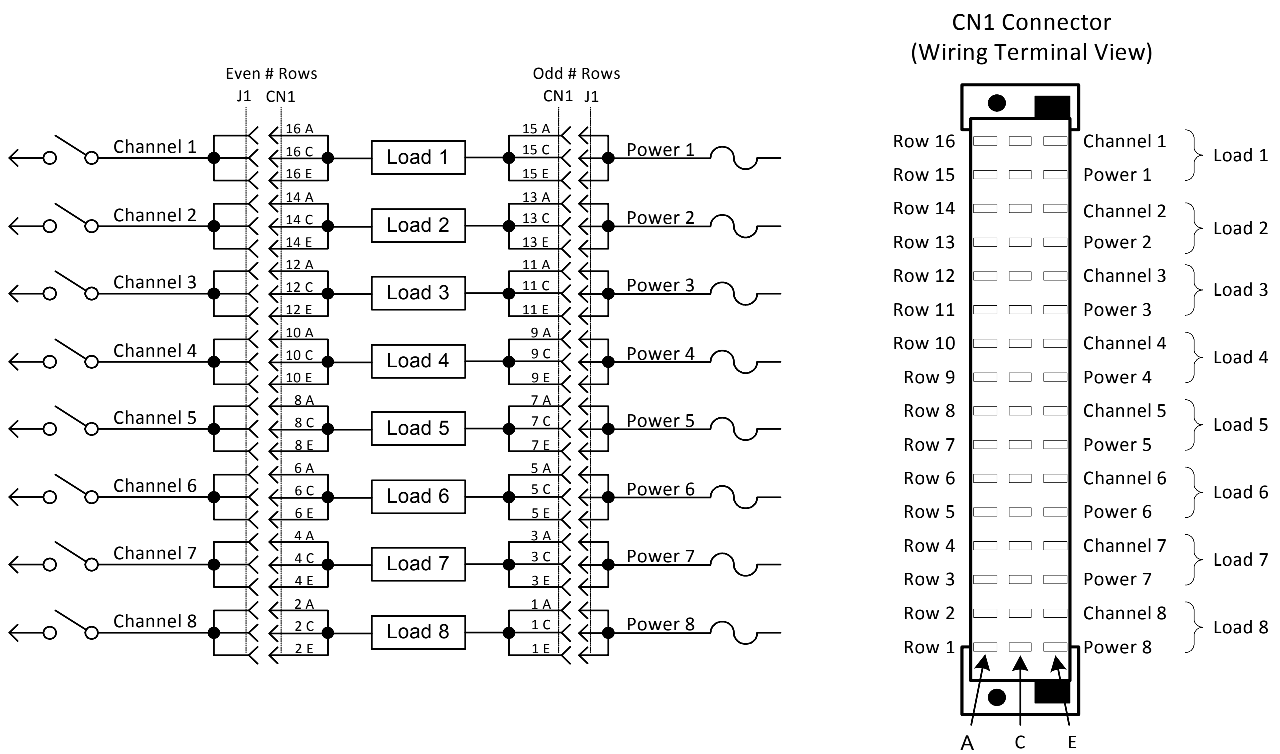
Load Wiring

Figure 5-14 is a simplified schematic and CN1 connector pinout showing how loads are connected to CN1. Load 1 connects to Channel 1 (CN1 row 16) and Power 1 (CN1 row 15); Load 2 connects to Channel 2 (CN1 row 14) and Power 2 (CN1 row 13), and so on.

CAUTION

To prevent premature pin failure from excessive current flow, when connecting high-current (>3 amp) loads to CN1, wire across all three pins in each row (see Figure 5-15 on page 22).

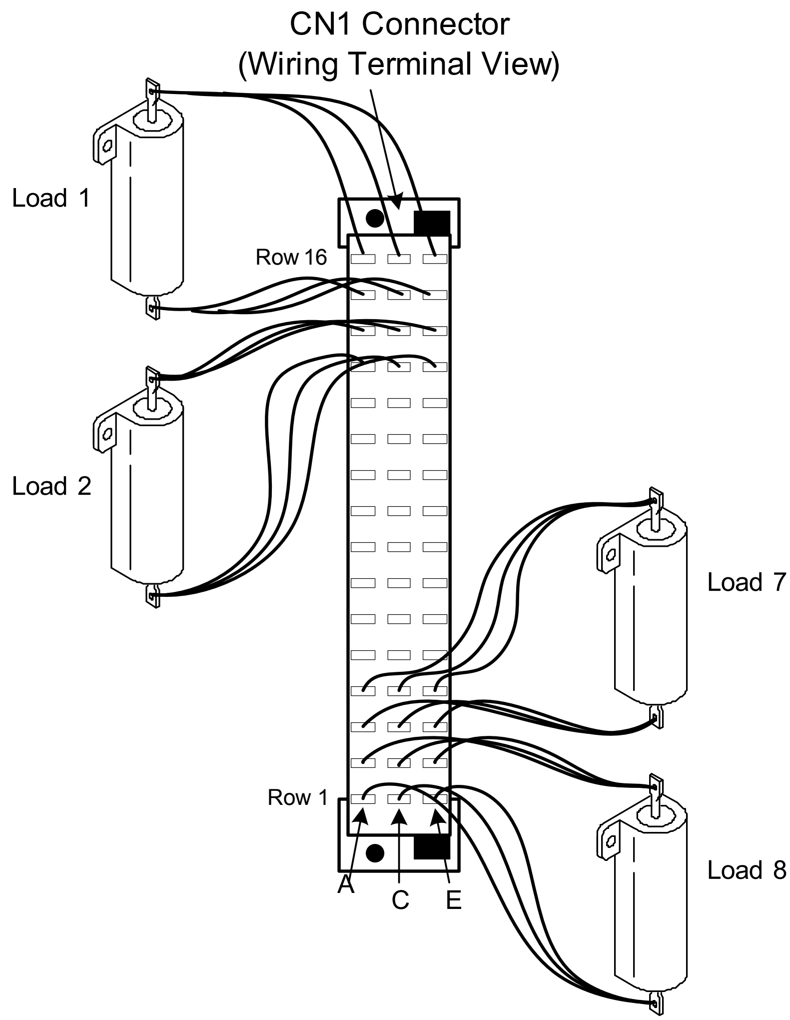
Figure 5-14 Agilent E6175A Load Wiring Schematic and CN1 Pinouts



Current Sharing

Notice in the wiring schematic (Figure 5-14) 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 CN1 (see Figure 5-15). This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

Figure 5-15 Agilent E6175A Current Sharing Example



UUT Connections

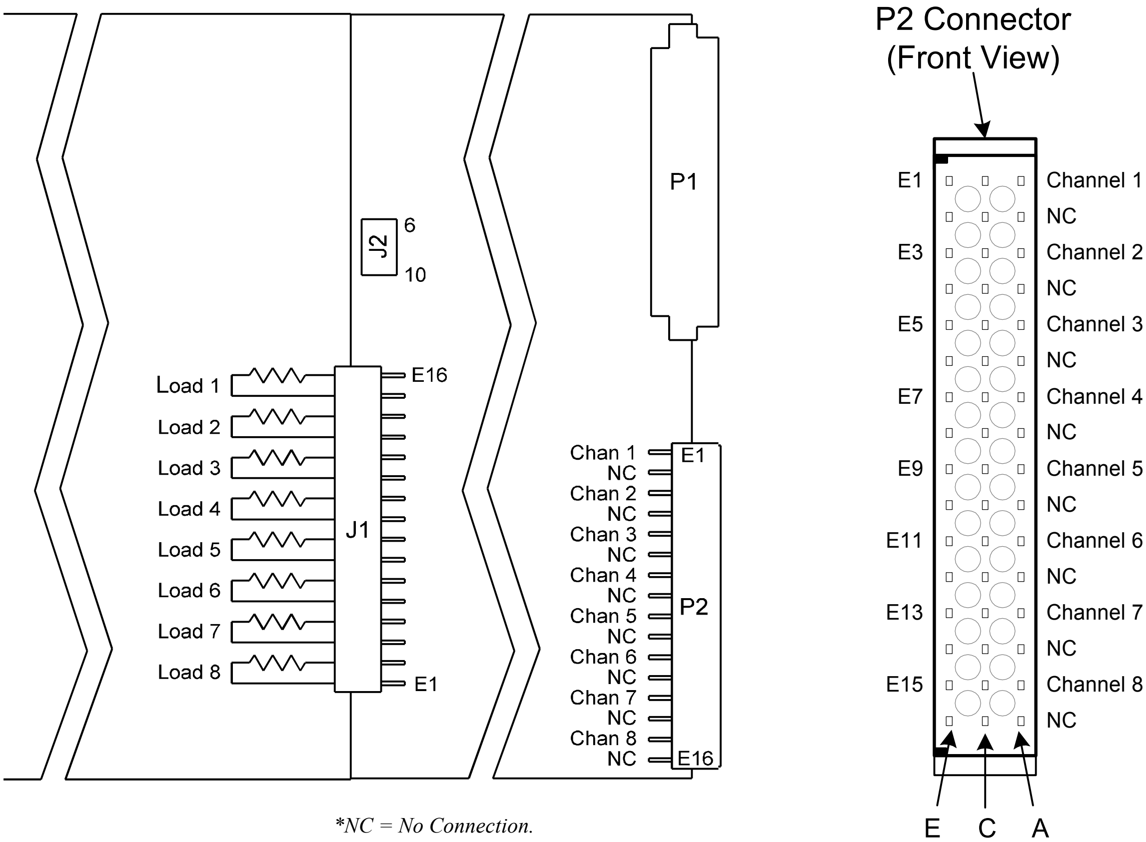
When configured as part of a standard Agilent system, CN2 of the load card is typically connected via cables to a mass interconnect panel. User connections to the UUT are then made from the mass interconnect panel. Refer to the appropriate mass interconnect wiring guide for connection details.

You can also make connections directly to CN2. Figure 5-16 is a CN2 connector pinout showing the details. Each even-numbered row of CN2 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.

CAUTION

Connecting high-current (>4 amp) loads without wiring across all three pins in the row can cause premature pin failure.

Figure 5-16 Agilent E6175A 8-Channel High-Current Load Card UUT Connections



**NC = No Connection.*

Using the Agilent E6176A 16-Channel Load Card

A block diagram of the Agilent E6176A 16-Channel High-Current Load Card is shown in Figure 5-17. The load card layout is shown in Figure 5-18. The single-slot design offers high load density for high-current loads where current transducers and bridge drive configurations are not required.

- The card is one slot wide. “Card Location Recommendations"
- The card type is 02_h. “Load Card Type and Configuration ID"
- The factory default configuration is explained in “Selecting a Power Supply Configuration".
- The factory default is to load a 0.05Ω, 0.1% Isense resistor in each channel. “Selecting a Current-Sense Resistor Value"
- The flyback protection is connected from both the normally open (NO) and normally closed (NC) power switch connections. “Selecting and Loading Flyback Protection"
- Loads are mounted externally and interface to the card using two load connectors, J1 and J2. “Connecting Loads"

Figure 5-17 Agilent E6176A 16-Channel High-Current Load Card Block Diagram

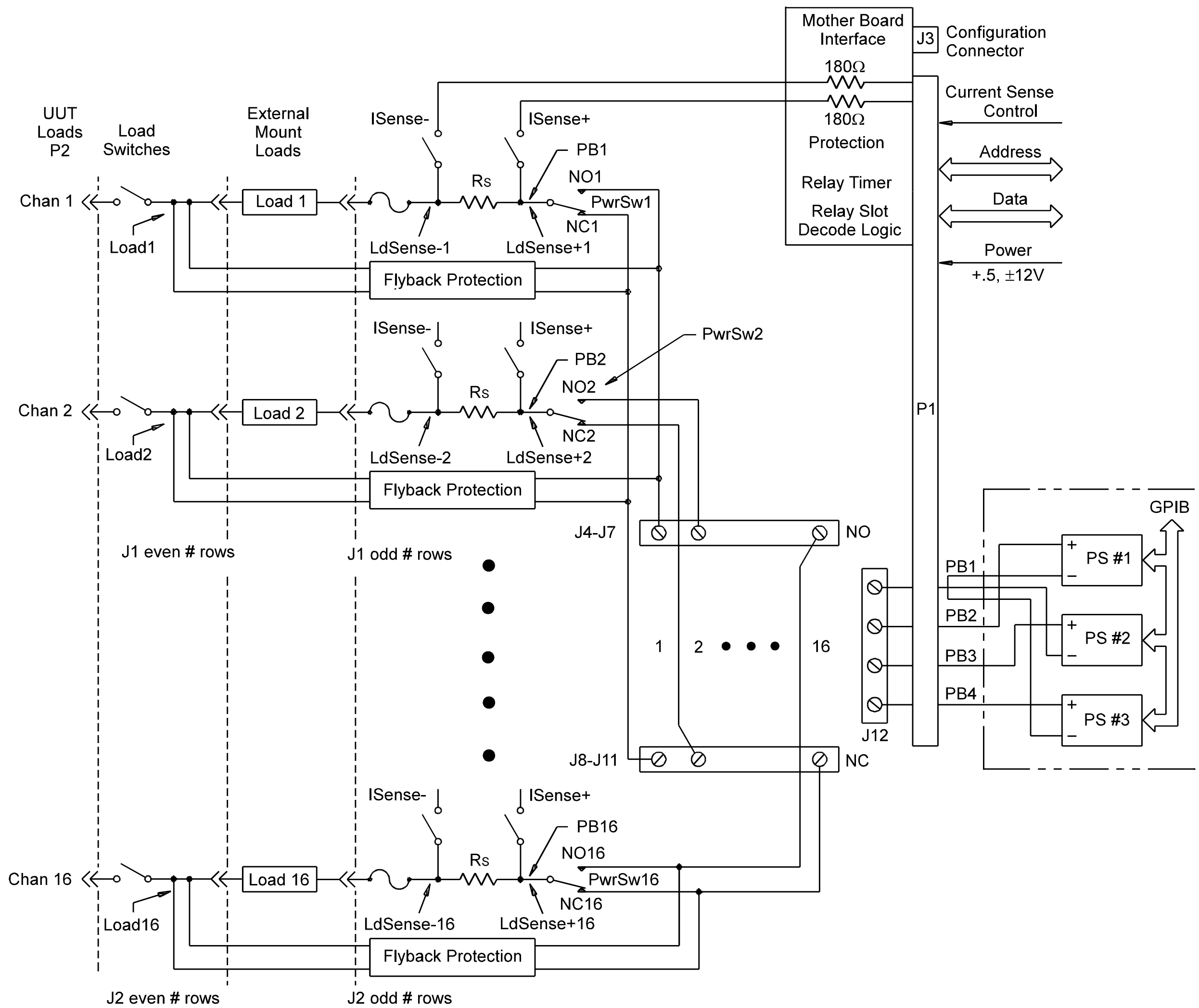
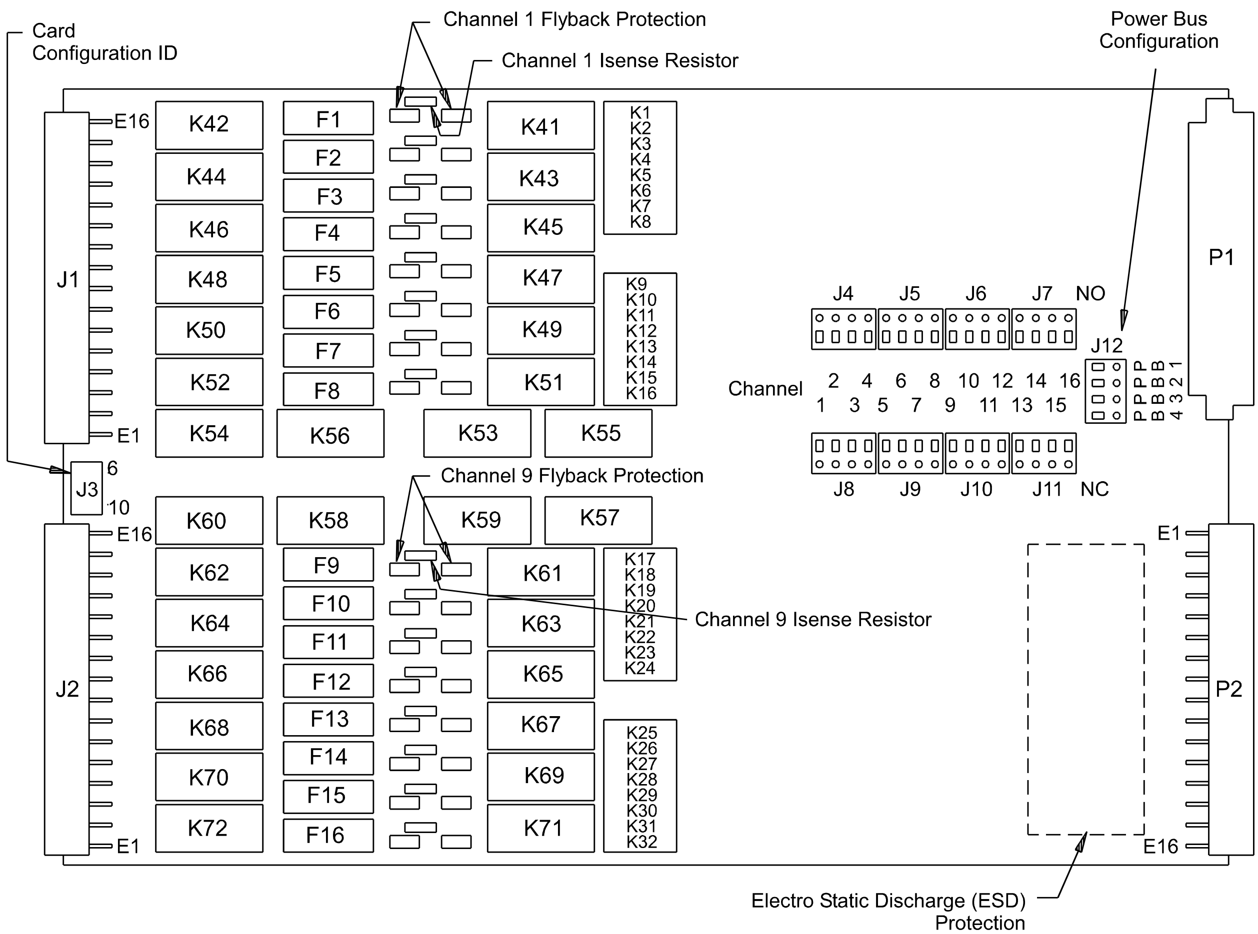


Figure 5-18 Agilent E6176A 16-Channel Load Card Layout



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 5-27.

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]

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)

Selecting and Loading Flyback Protection

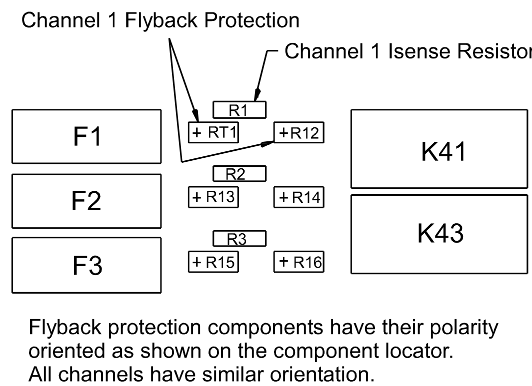
Coils used as loads may have large flyback voltages which have the potential to damage other electronic components. Generally the UUTs are equipped with flyback protection, so flyback protection on the load cards is redundant but provides backup protection in case a defective UUT is tested. The system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

The Agilent E6176A Load Card comes with provisions for user-installed flyback voltage protection. Figure 5-40 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.

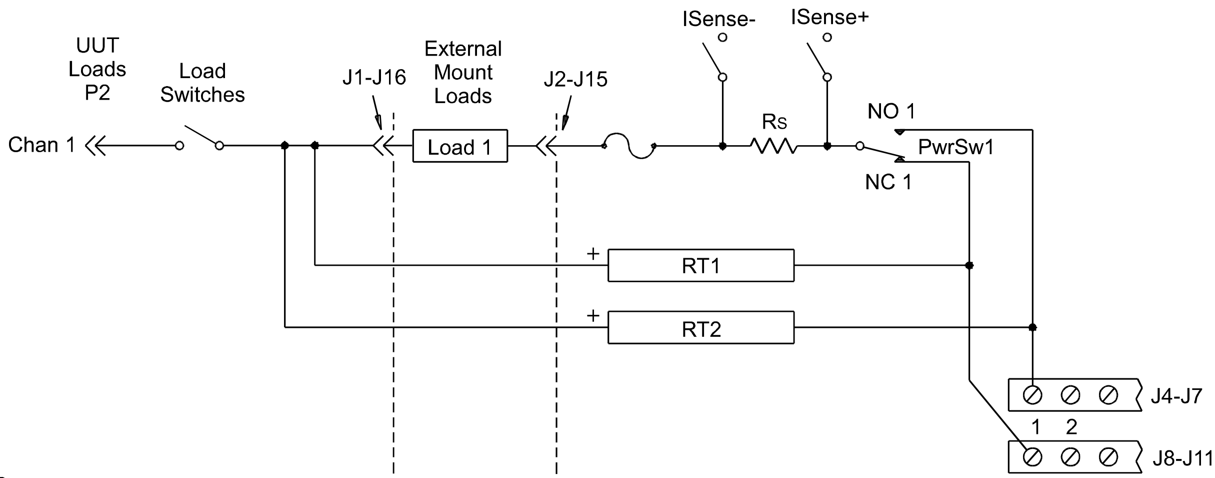
Figure 5-19 16-Channel Load Card - Flyback Device Polarity Orientation



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 5-41, 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 5-20 16-Channel Load Card - Flyback Circuit Detail



l

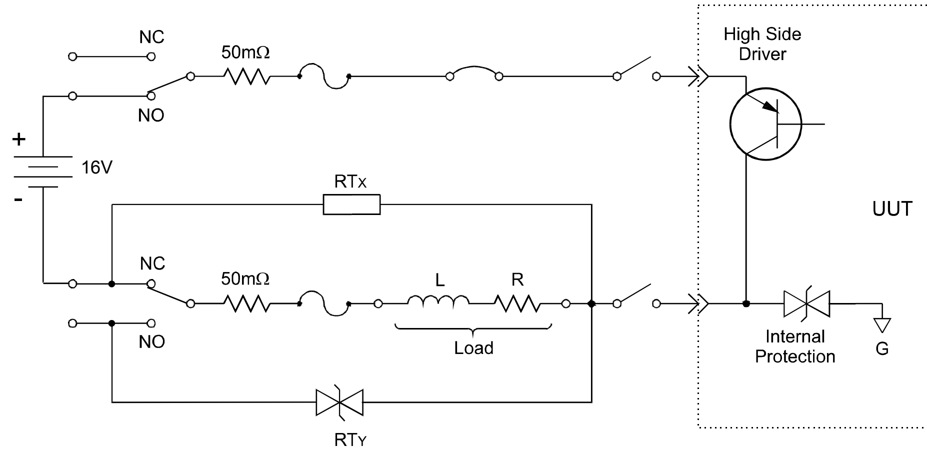
The flyback protection devices should be installed with the positive side towards the UUT. On each of the 16 channels the high (+) side should be located as shown in the component locator diagram, Figure 5-41. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.*

Protection Devices

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.

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

Figure 5-21 Typical Agilent E6176A Load Card Flyback Protection Circuit



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

Continuous DC voltage: 220 V
Transient energy (10/1000mS*): 0.90 Joules (watt-seconds)
Transient peak current (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

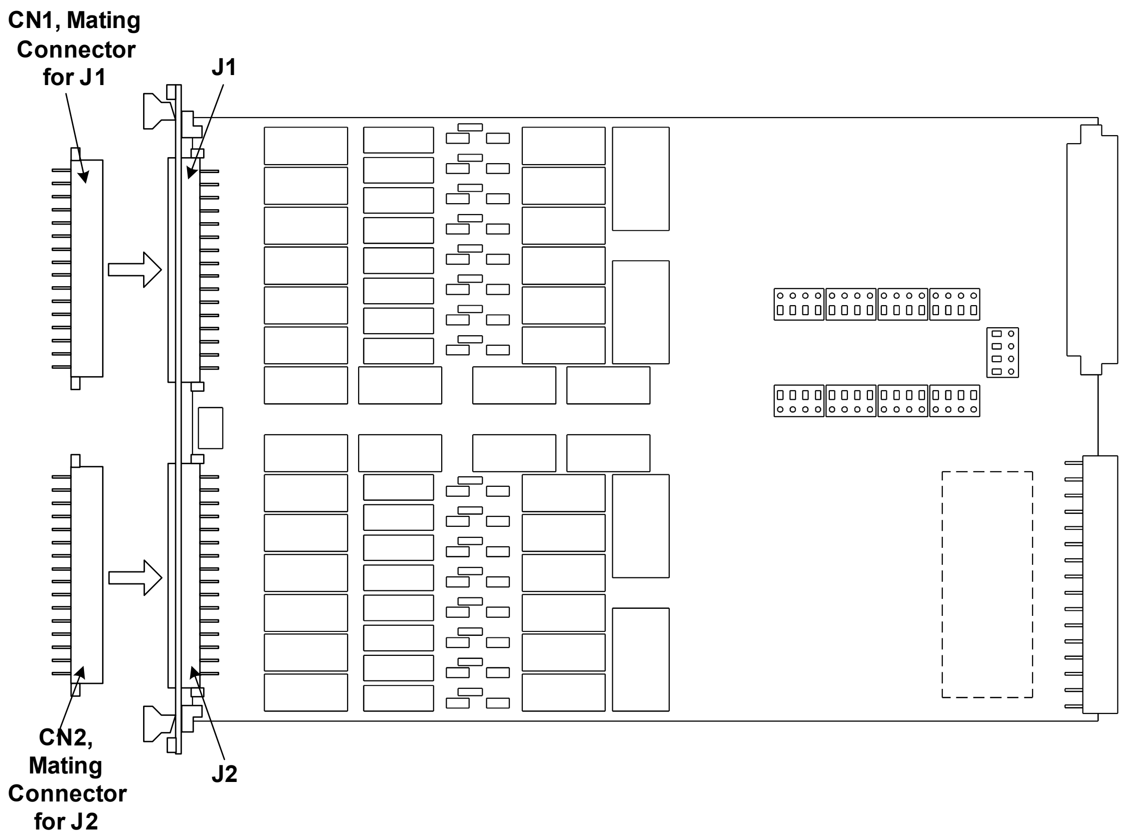
* 10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.

† 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 CN1 and CN2 which mate to the Agilent E6176A's J1 and J2 connectors, respectively. Figure 5-13 shows these connectors.

Figure 5-22 Agilent E6176A Connectors J1/J2 and Mating Connectors CN1/CN2

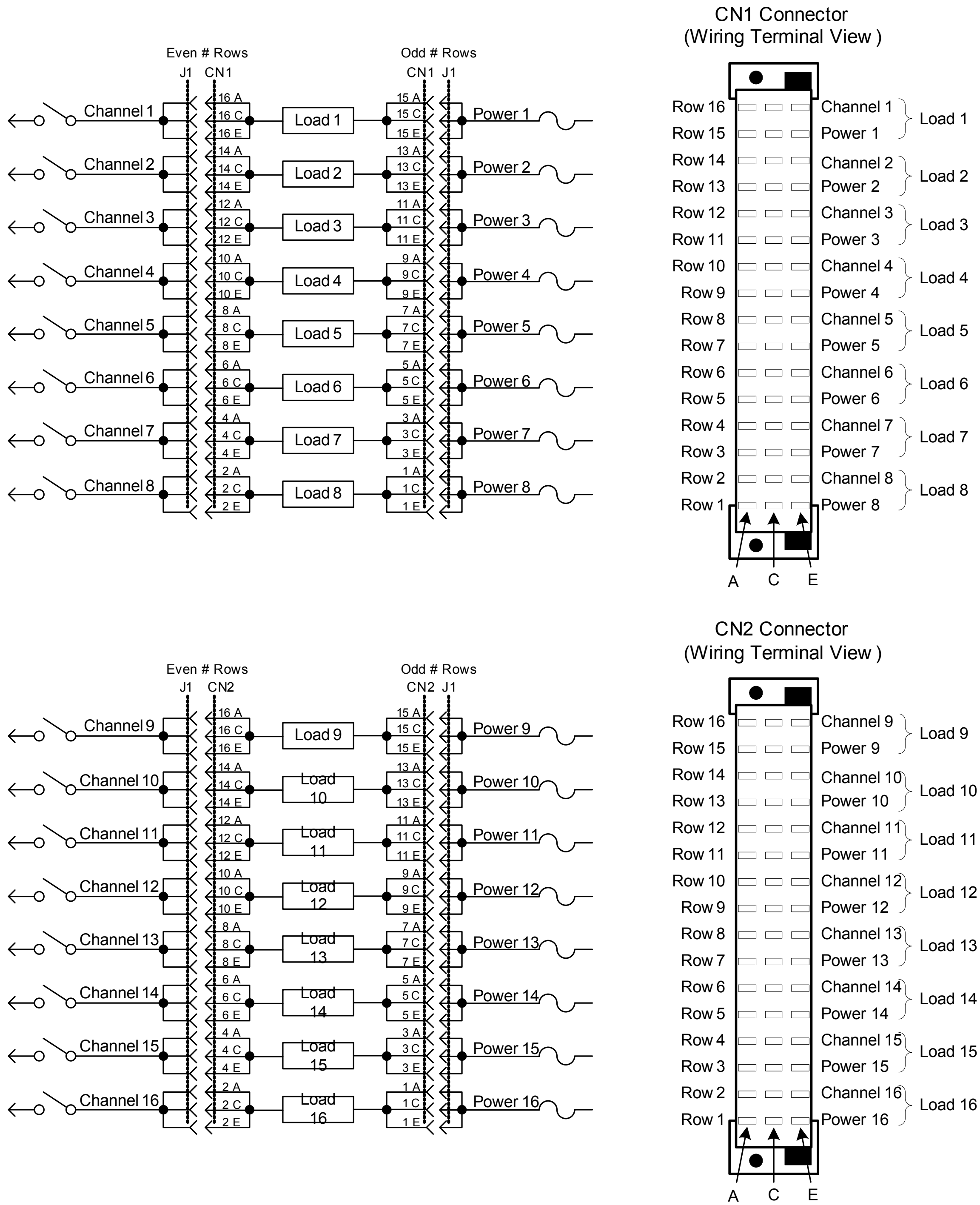


Load Wiring

Figure 5-23 is a simplified schematic and connector pinouts showing how loads are connected to CN1/CN2. Loads 1 through 8 connect to CN1 and loads 9 through 16 connect to CN2.

CAUTION **To prevent premature pin failure from excessive current flow, when connecting high-current (>3 amp) loads to CN1, wire across all three pins in each row (see Figure 5-24 on page 34).**

Figure 5-23 Agilent E6176A Load Wiring Schematic and CN1/CN2 Pinouts

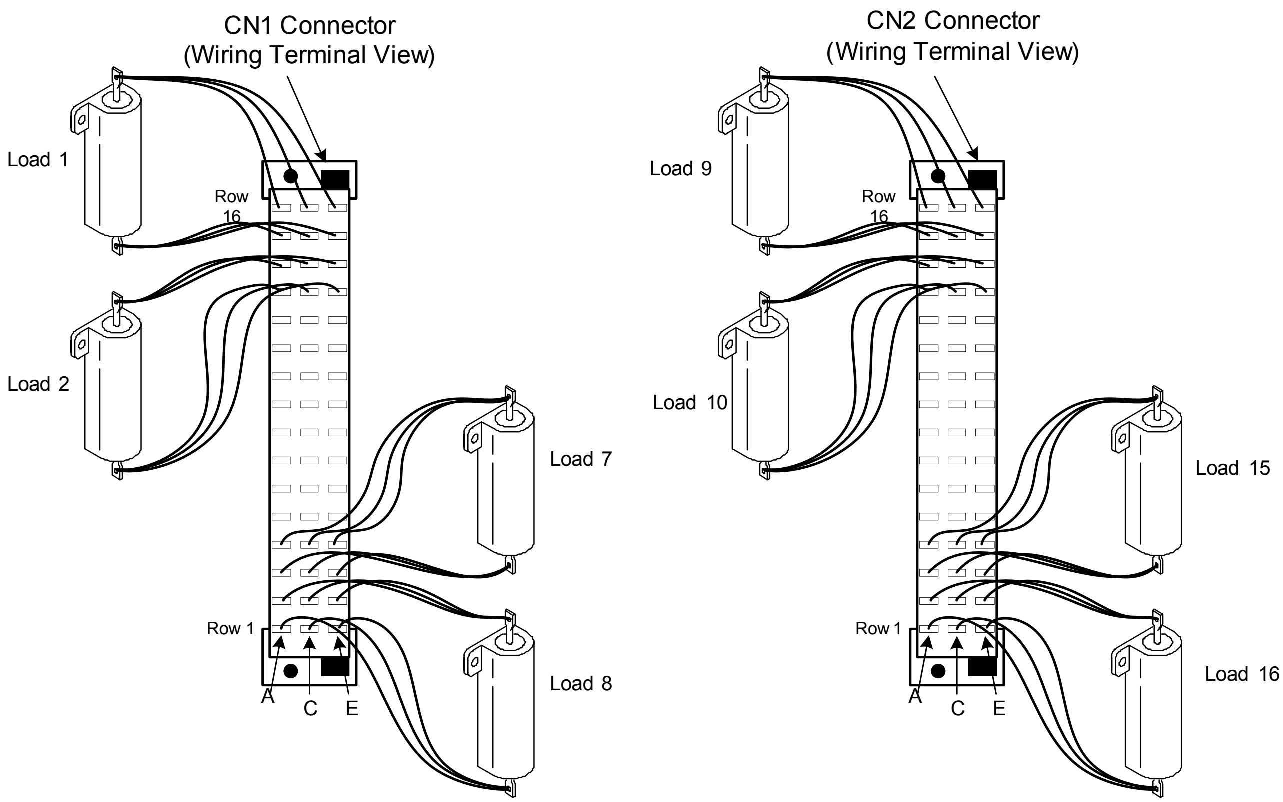


Current Sharing

Notice in the wiring schematic (Figure 5-23) 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 CN1/CN2 (see Figure 5-24). This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

CAUTION Connecting high-current (>4 amp) loads without wiring across all three pins in the row can cause premature pin failure.

Figure 5-24 Agilent E6176A Current Sharing Example

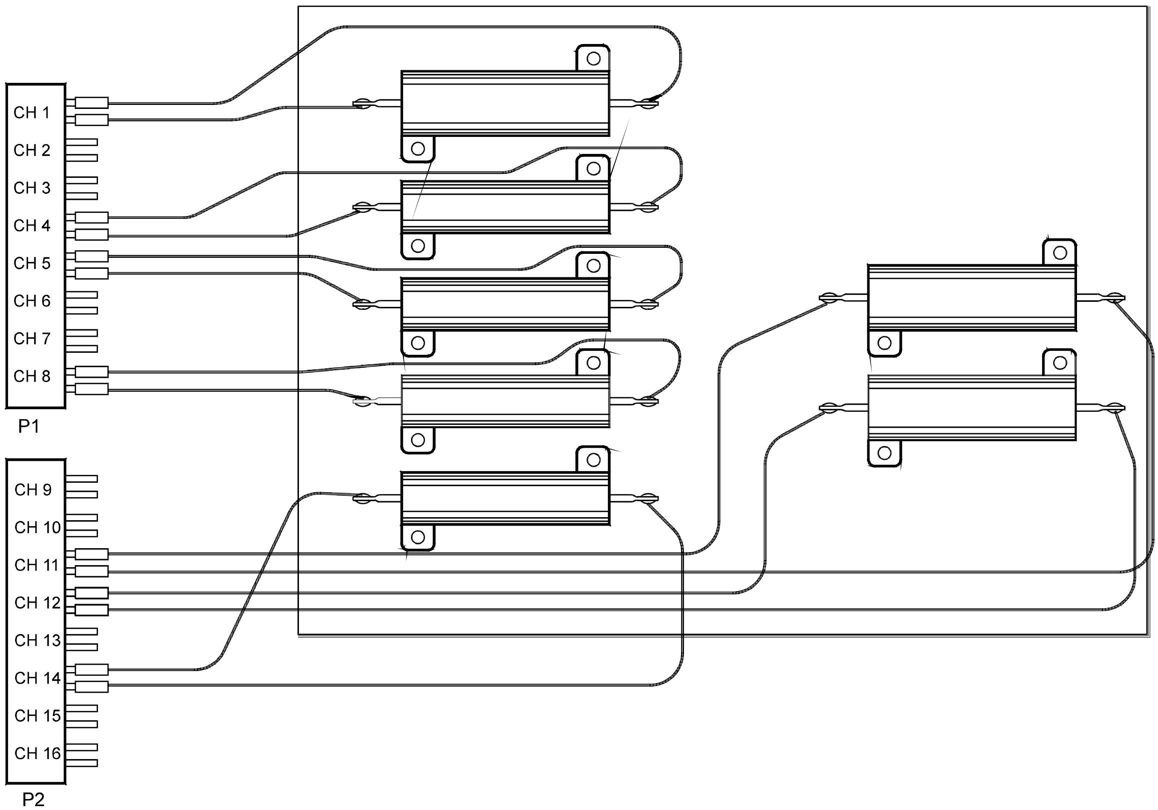


External Load Mounting Options

Loads typically consist of “real” devices (injectors, actuators, etc.) that cannot be mounted on the load card. If cable resistance is a significant factor (such as for low form-factor or low-value resistive loads), one solution is to mount the loads on a metal plate that fits into the SLU slots adjacent to the load card (Figure 5-25). Follow these guidelines if you choose to mount the loads externally:

- Mount the loads as close to the load card as possible.
- 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 cable runs to the externally mounted loads so that you can remove other cards without having to disconnect any wiring.
- Clearly identify all cables to externally mounted loads, including those on a load plate. Use labels, numbers, color coding, or some combination of these methods. Cabling to polarity sensitive devices should be labeled appropriately.

Figure 5-25 Example: Load Plate with Loads

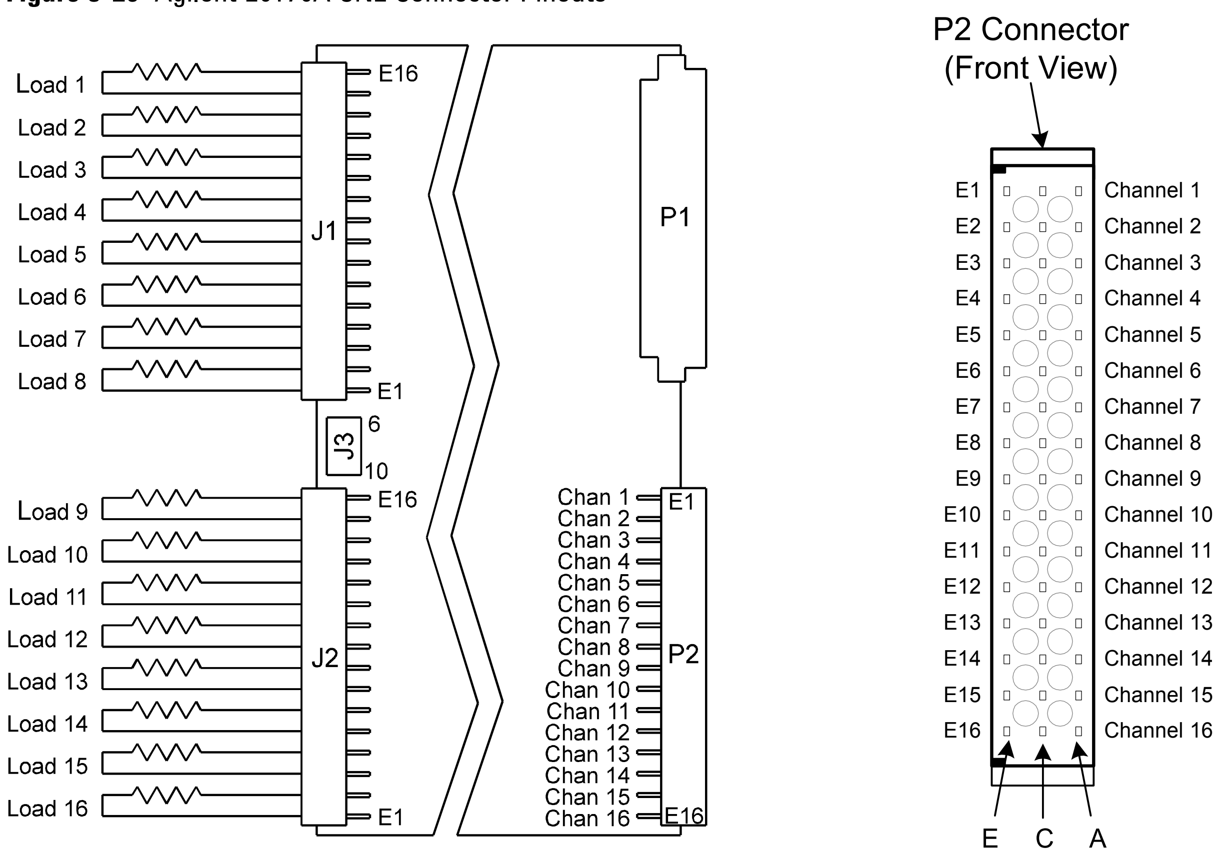


UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. Figure 5-26 is a simplified load card schematic and CN2 connector pinout showing the details. Each row of CN2 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 5-26 Agilent E6176A CN2 Connector Pinouts

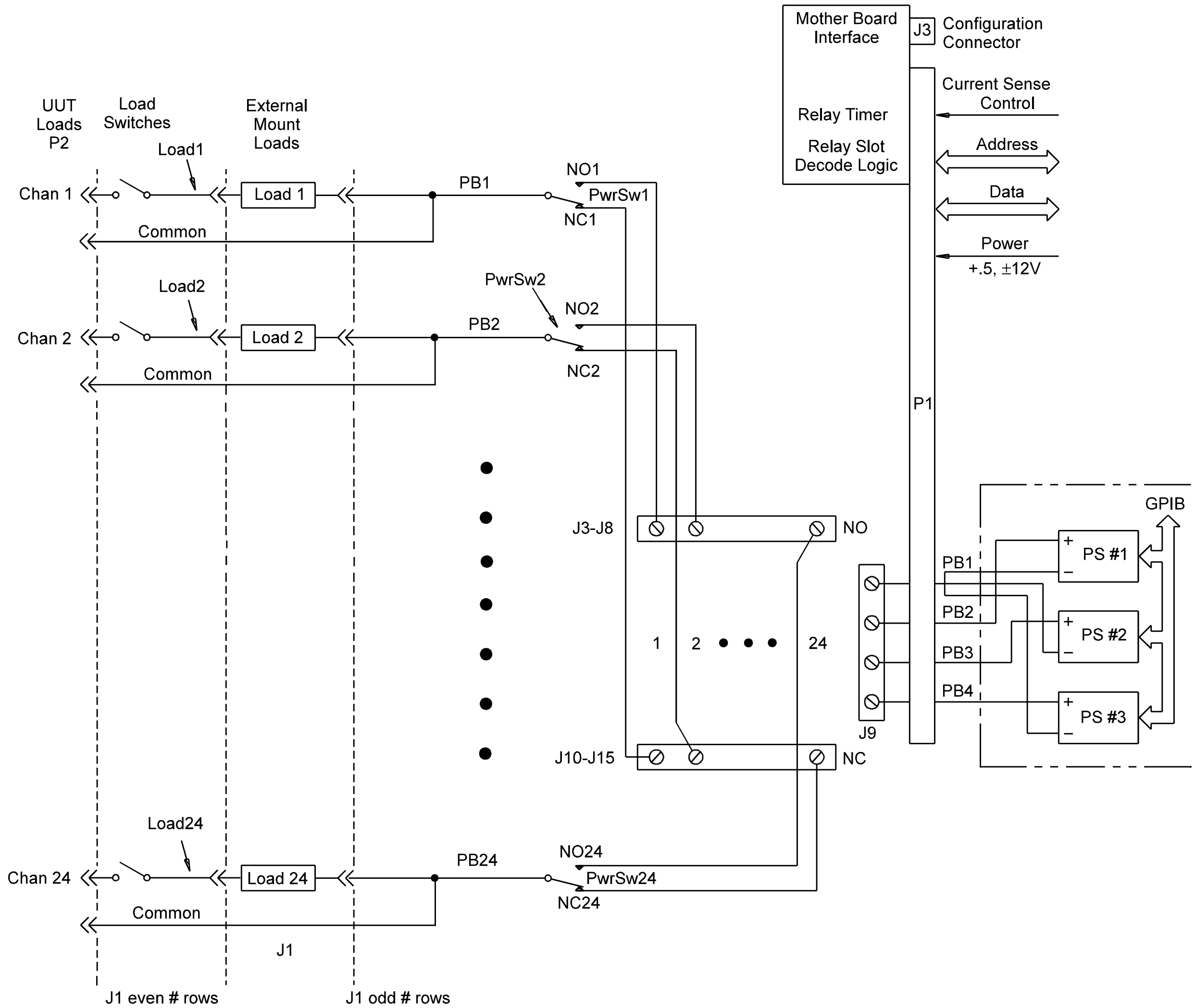


Using the Agilent E6177A 24-Channel Load Card

The Agilent E6177A 24-channel medium-current load card is intended to be used with loads mounted inside the Switch/Load Unit. Figure 5-27 shows a block diagram of the E6177A.

- The card is one slot wide. "Card Location Recommendations"
- The card type is 03_h. "Load Card Type and Configuration ID"
- The factory default configuration is explained in "Selecting a Power Supply Configuration" on page 41.
- 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 lets you switch in a special external power supply while bypassing the power bus of the SLU, for example. "Using the Power Switches as General Purpose Relays"
- 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. "Connecting Loads"
- Each channel is capable of up to 2A continuous carry current.
- The card is *not* equipped for current sensing
- There is not any flyback voltage protection

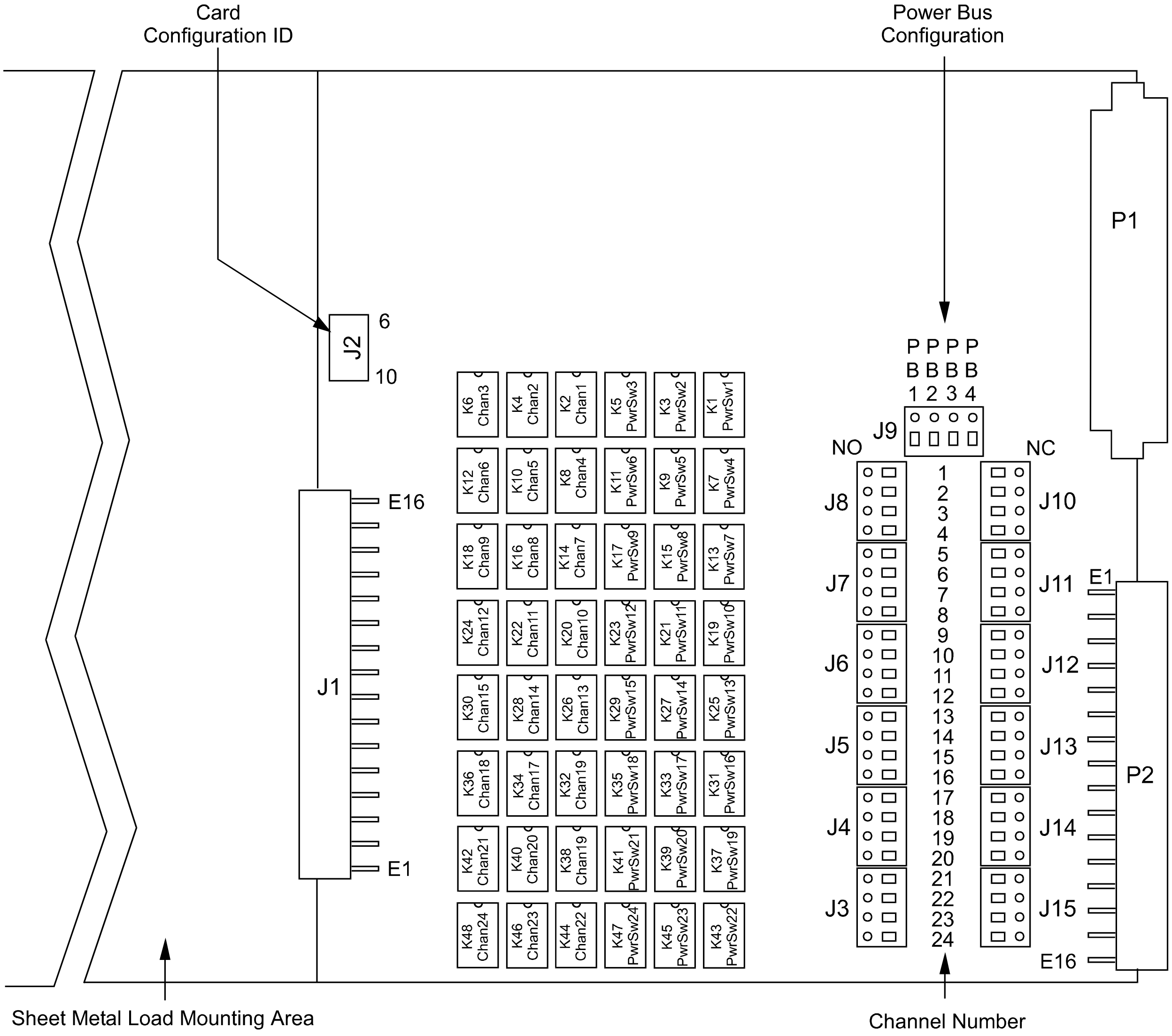
Figure 5-27 Agilent E6177A 24-Channel Medium-Current Load Card Block Diagram



Card Layout

Figure 5-28 shows the E6177A layout.

Figure 5-28 Agilent E6177A 24-Channel Load Card Layout



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. 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.

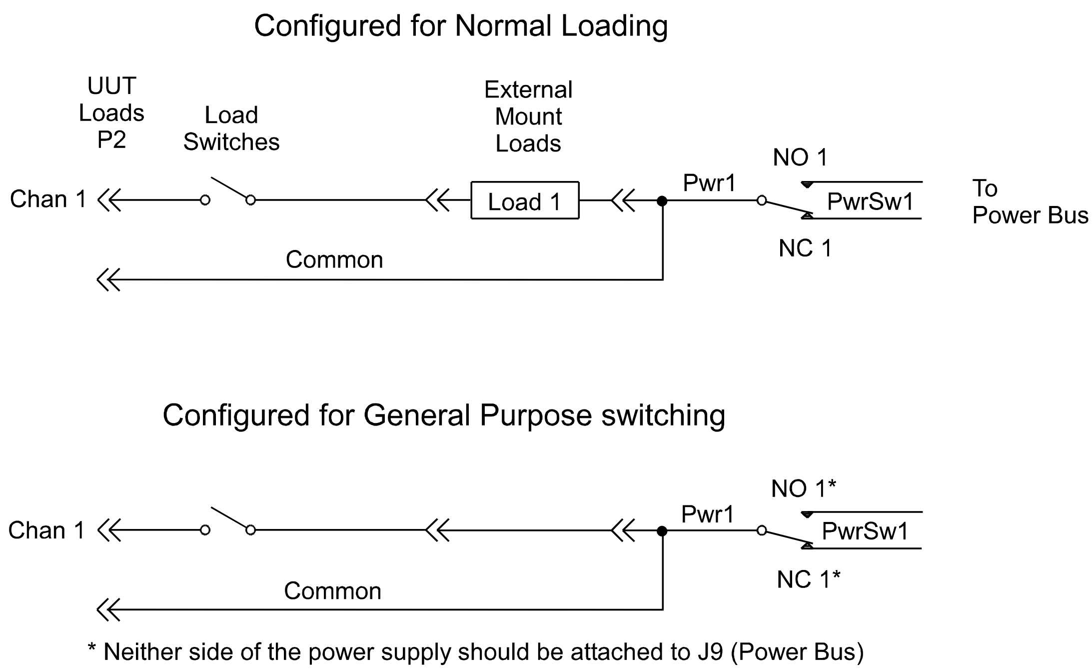
Using the Power Switches as General Purpose Relays

The E6177A has a special feature that is not available on the other E617x 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.

CAUTION

When using a channel of the Agilent 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.

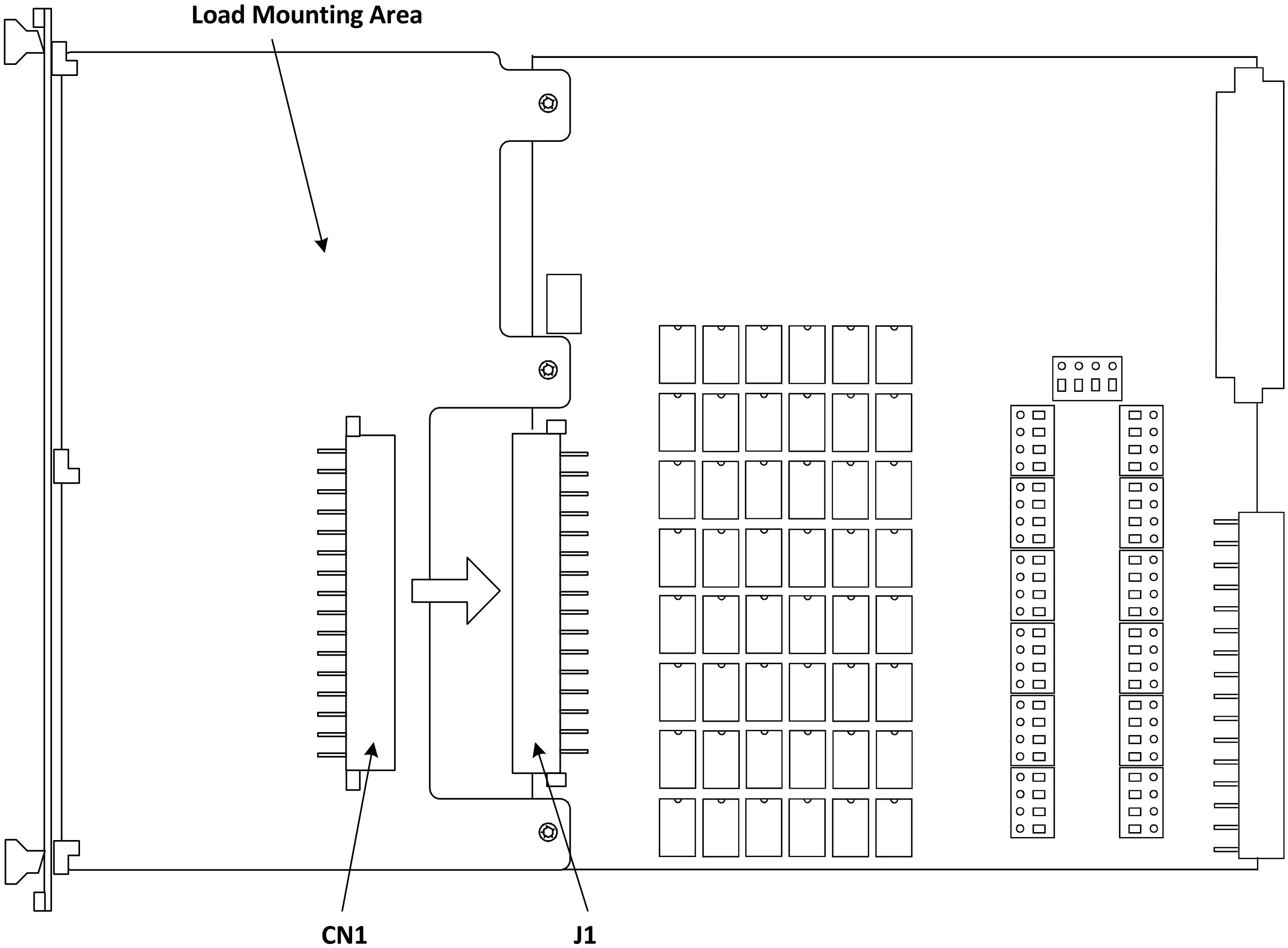
Figure 5-29 Using the 24-Channel Load Card Switches as GP Relays



Connecting Loads

Loads are mounted on the Agilent E6177A's sheet-metal mounting area. The loads are wired to connector CN1 which mates to the Agilent E6177A's J1 connector. Figure 5-30 shows the Agilent E6177A's load mounting area and connectors J1 and CN1.

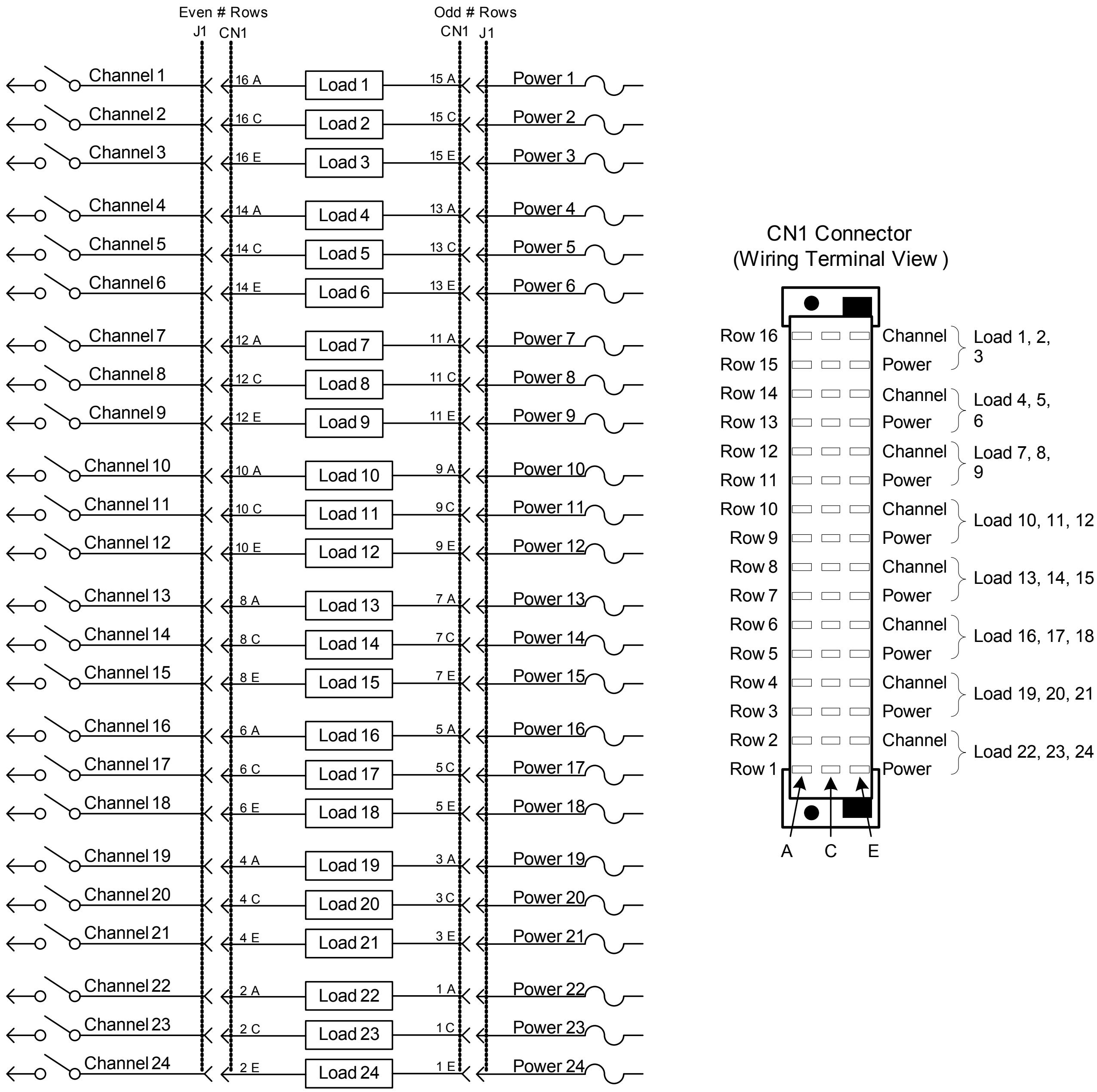
Figure 5-30 Agilent E6177A Load Mounting Area and CN1/J1 Connectors



Load Wiring

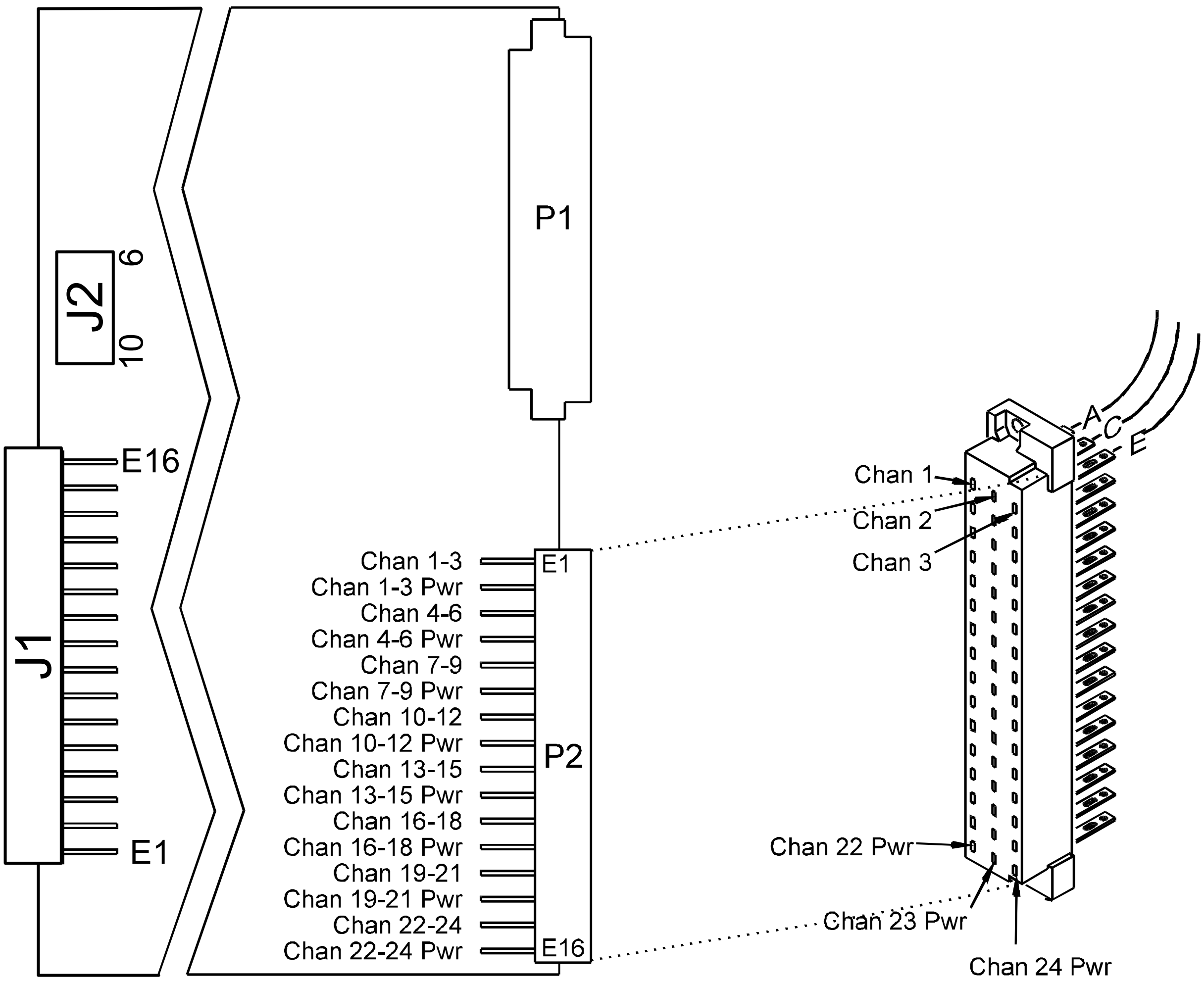
Figure 5-31 is a simplified schematic and CN1 connector pinout showing how loads are connected to CN1.

Figure 5-31 Agilent E6177A Load Wiring Schematic and CN1 Pinouts



UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. Figure 5-32 is a CN2 connector pinout showing the details.

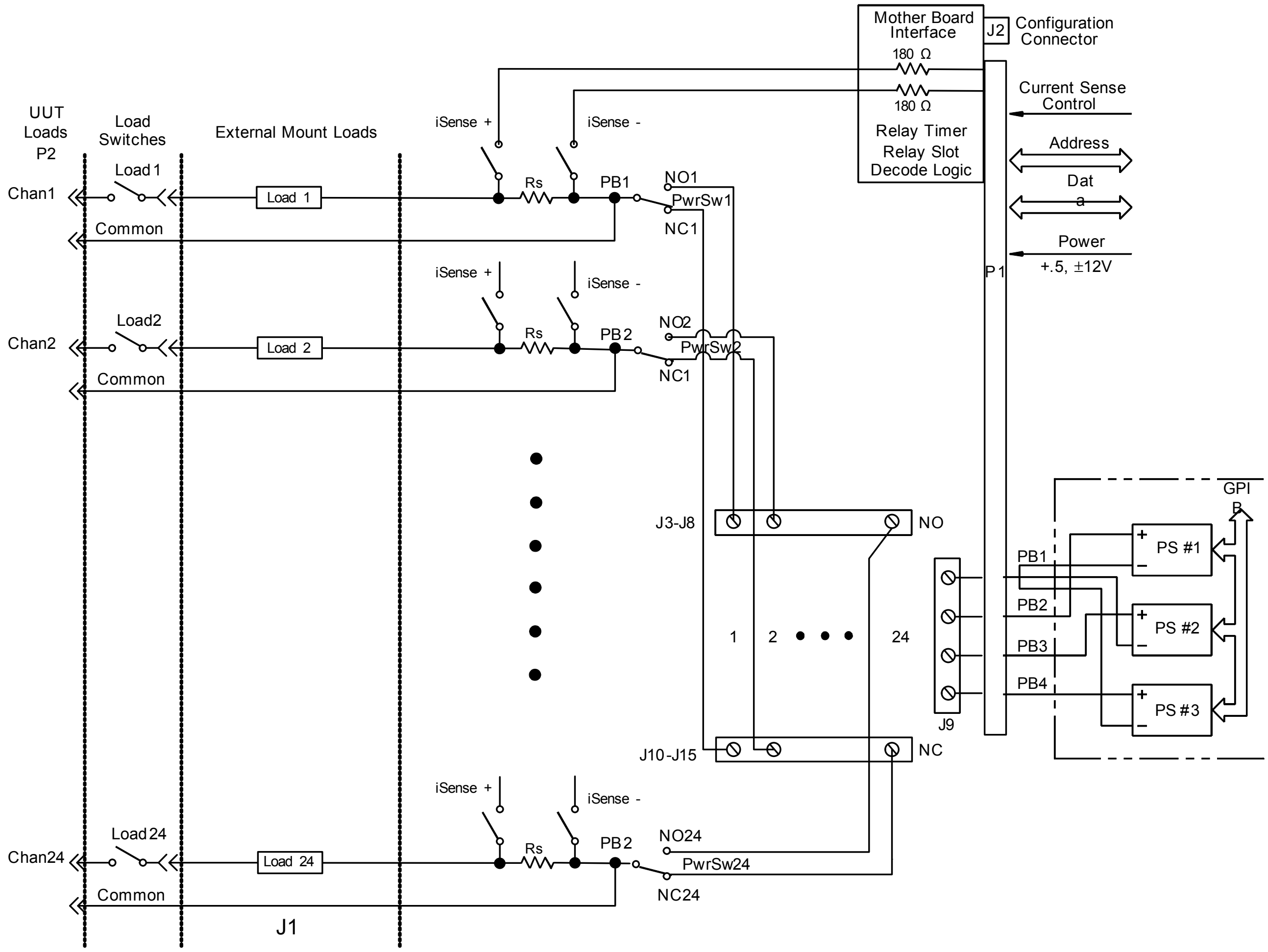
Figure 5-32 Agilent E6177A 24-Channel Medium-Current Load Card UUT Connections

Using the Agilent U7177A 24-Channel Load Card

The Agilent U7177A 24-channel medium-current load card is intended to be used with loads mounted external to the Switch/Load Unit. Figure 5-33 shows a block diagram of the U7177A.

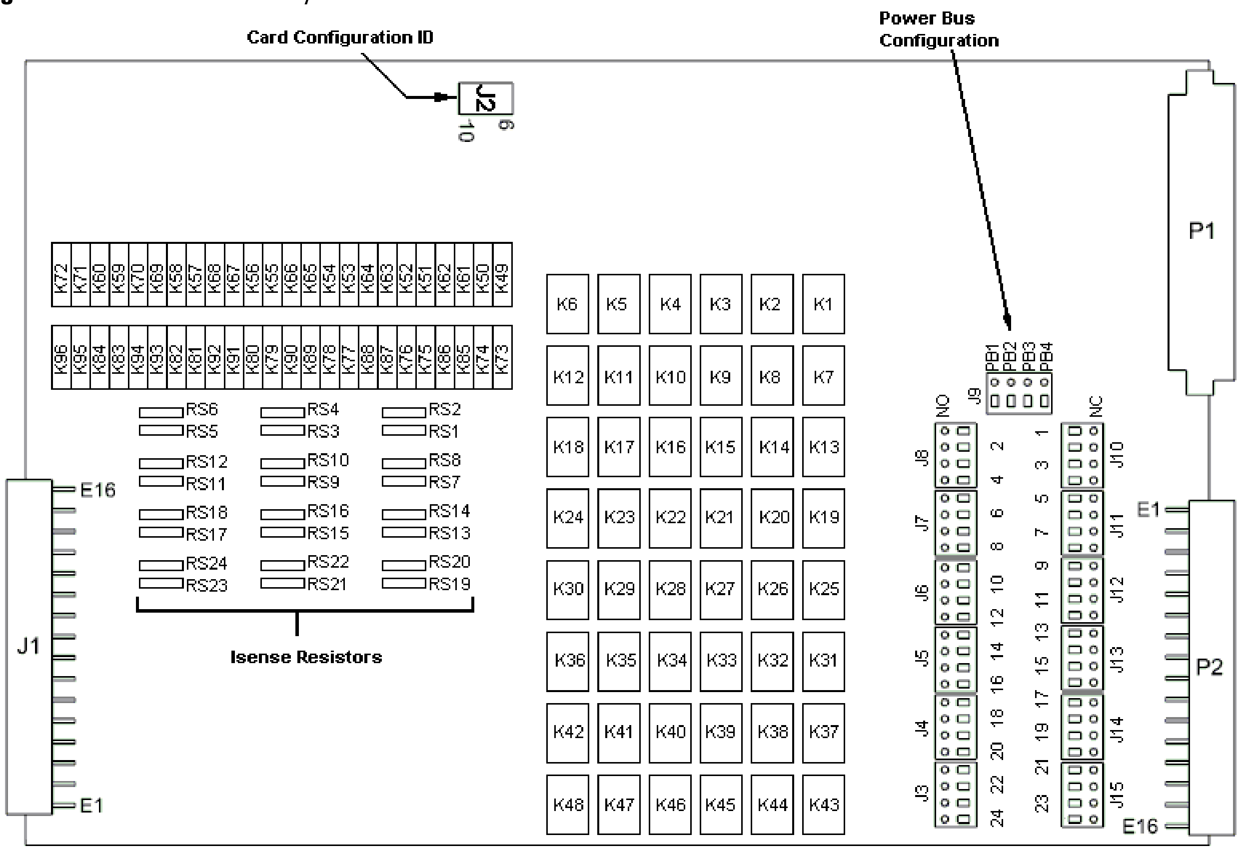
- The card is one slot wide. See “Card Location Recommendations".
- The card type is 18_h. See “Load Card Type and Configuration ID".
- The factory default configuration is explained in “Selecting a Power Supply Configuration".
- The factory default is to load a 0.05 Ω, 0.1% sense resistor in each channel. See “Selecting a Current-Sense Resistor Value".
- 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 lets you switch in a special external power supply while bypassing the power bus of the SLU, for example. See “Using the Power Switches as General Purpose Relays".
- Each channel is capable of up to 2 A continuous carry current.
- The card is equipped for current sensing.
- There is no flyback voltage protection.

Figure 5-33 Agilent U7177A 24-Channel Medium-Current Load Card Block Diagram



Card Layout

Figure 5-34 The U7177A Layout



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 5-33. The terminal block jumper 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.

Selecting a Current-Sense Resistor Value

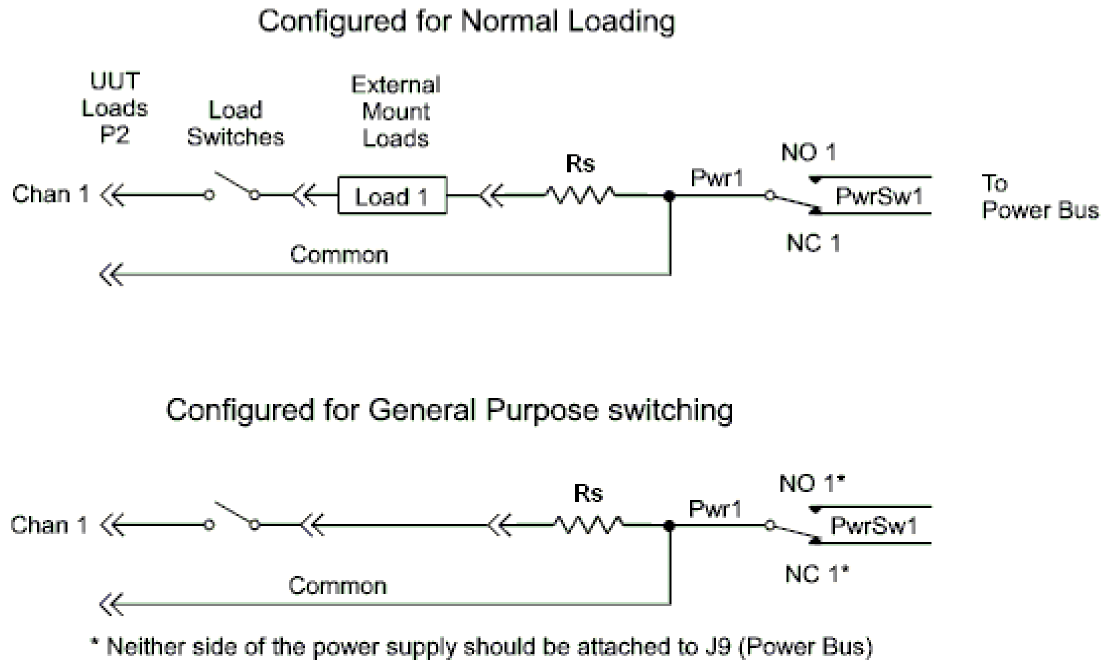
The card comes with a factory loaded with a three watt, 0.05 Ω, 0.1% sense resistor already installed. If lower value currents are being measured, requiring a larger resistance value to make the sense voltage readable, then replace the sense resistor with a four-wire resistor of higher value.

CAUTION Be sure to size the power dissipation of the sense resistor large enough to handle the expected current of the load.

Using the Power Switches as General Purpose Relays

The U7177A has a special feature that is similar to E6177A load card. 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 5-35.

Figure 5-35 Using the 24-Channel Load Card Switches as GP Relays



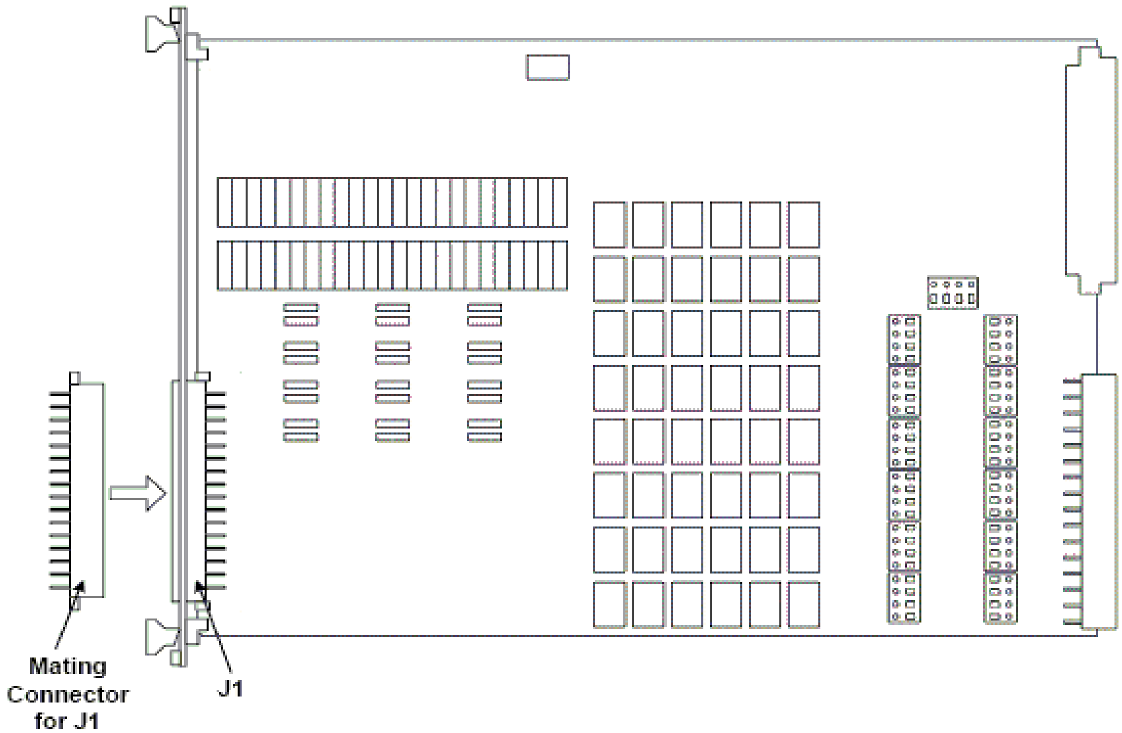
CAUTION

When using a channel of the Agilent U7177A 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 externally and connected to the load card via wires or cables. The loads are wired to connector CN1 which mates to the Agilent U7177A's J1 connector. Figure 5-36 shows these connectors.

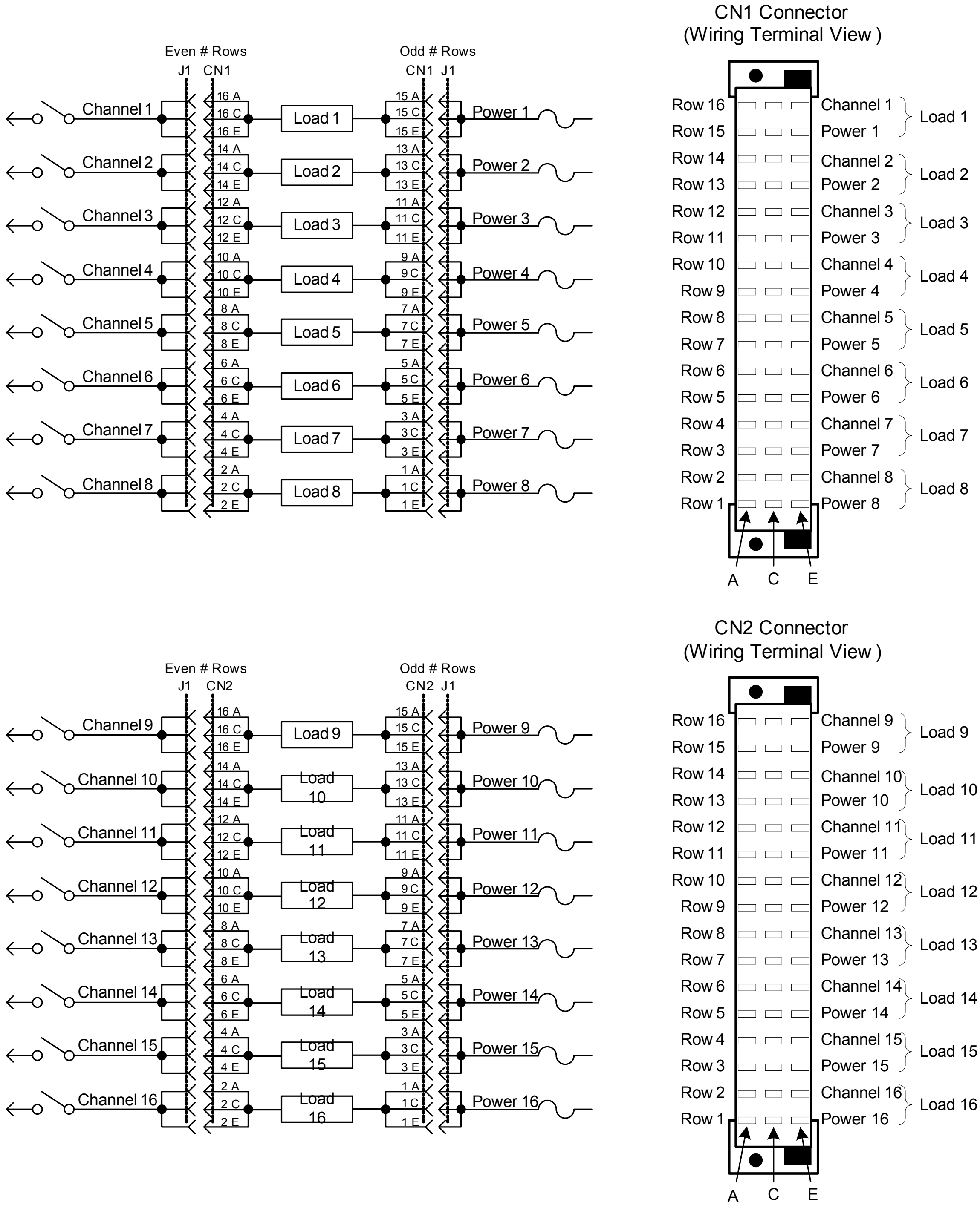
Figure 5-36 Agilent U7177A Connector J1 and Mating Connector CN1



Load Wiring

Figure 5-37 is a simplified schematic and CN1 connector pinout showing how loads are connected to CN1.

Figure 5-37 Agilent U7177A Load Wiring Schematic and CN1 Pinouts

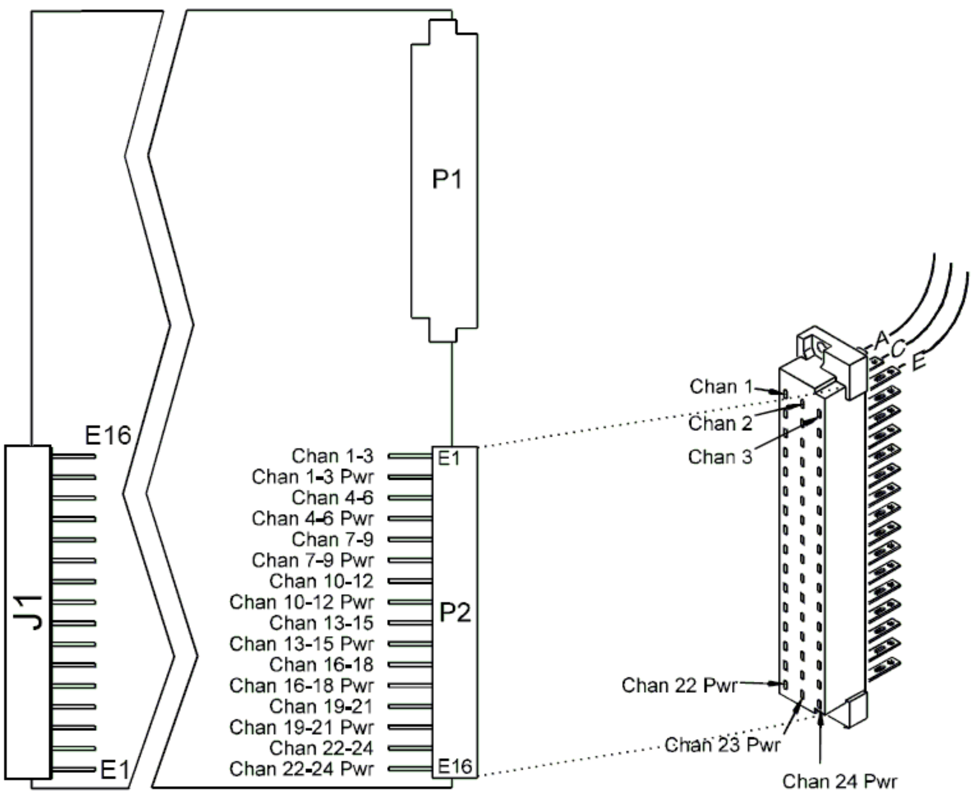


UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. Figure 5-38 is a CN2 connector pinout showing the details.

Figure 5-38 Agilent U7177A 24-Channel Medium-Current Load Card UUT Connections



Using the Agilent E6178B 8-Channel Load Card

The Agilent E6178B 8-channel heavy duty load card with current sensing is intended to be used with high power loads mounted outside the Switch/Load Unit. Figure 5-39 shows a block diagram of the Agilent E6178B. Figure 5-40 shows the layout of the E6178B card.

- The card occupies two slots in the Switch/Load Unit. “Card Location Recommendations"
- The card type is 04_h. “Load Card Type and Configuration ID"
- Power supply connections are made directly from the external power supplies to the load card - not through the Agilent E6198B Switch/Load Unit Power Supply Buses. Each channel is capable of up to 30 Amps continuous carry into a resistive load. “Selecting a Power Supply Configuration"

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 5-39 Agilent E6178B 8-Channel Heavy Duty Load Card Block Diagram

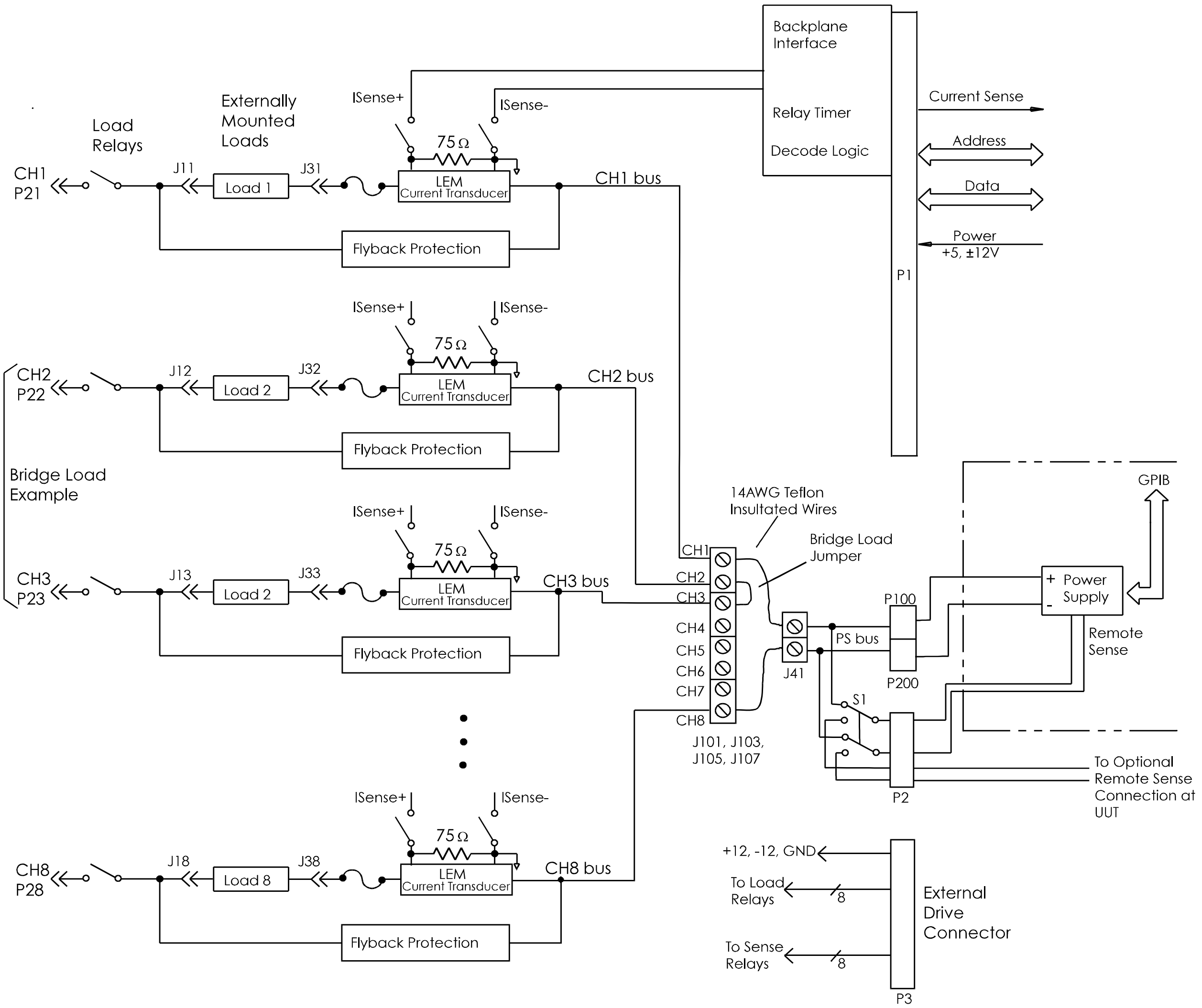
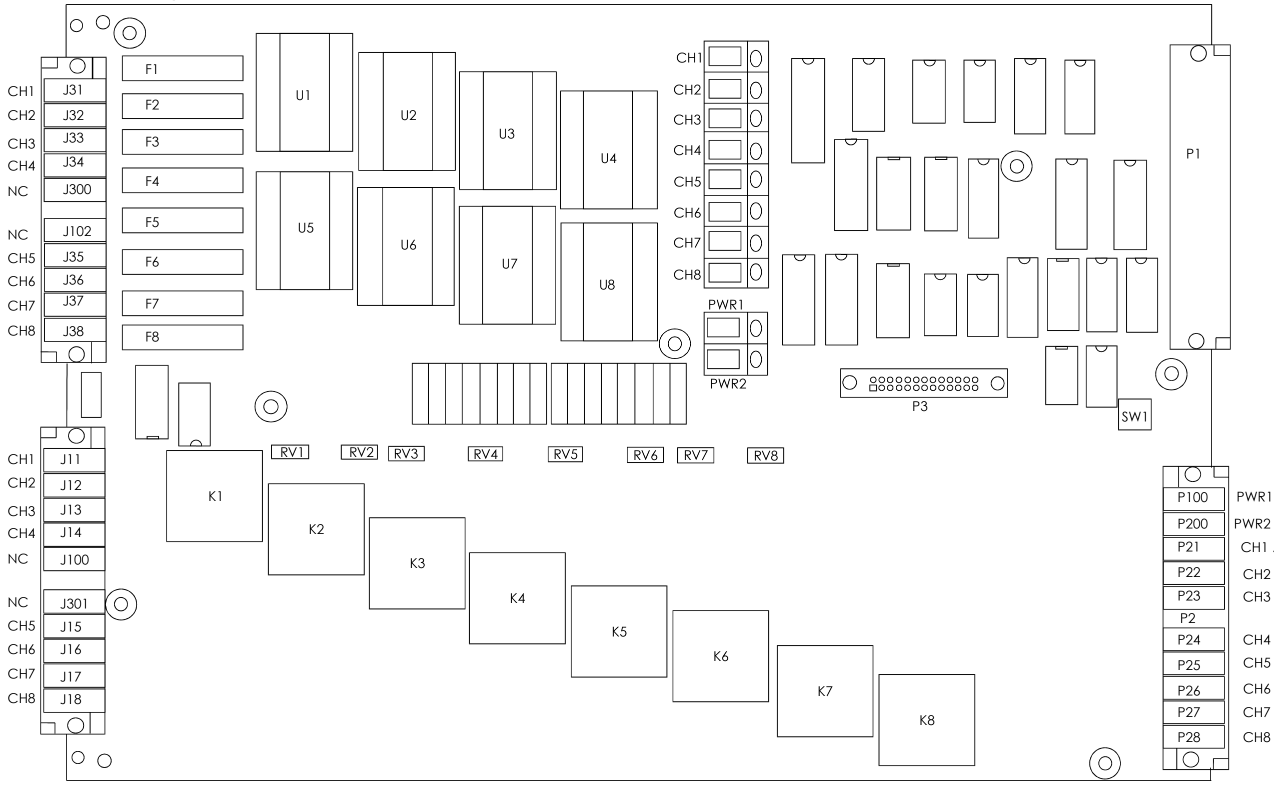


Figure 5-40 Agilent E6178B 8-Channel Heavy Duty Load Card Layout



Selecting a Power Supply Configuration

As shown in Figure 5-39, 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 5-39 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 CN2 to UUT). Refer to Figure 5-39.

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 Agilent 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 Agilent E6178 surge current specifications. Refer to the module specifications for more information.

CAUTION To maintain Agilent E6178 safety and reliability, replace fuse with Bussman type MDL-30 fuse only.

Current Monitor

Each channel on the Agilent E6178 uses a LEM[*] model LA 55-TP Current Transducers with a 75 Ω 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 5-39. 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

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.

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

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 SLU.

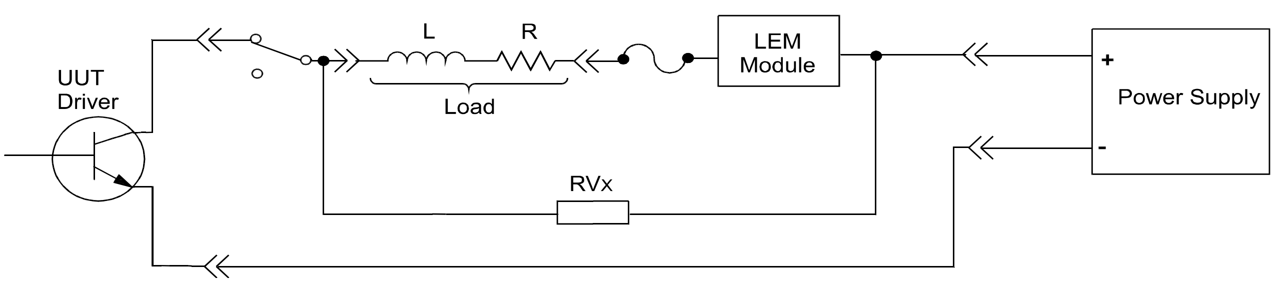
The Agilent E6178 Load Card comes with provisions for user-installed flyback voltage protection. Figure 5-40 shows the location for the flyback protection devices RV1 to RV8.

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 5-40. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.

Protection Devices

Refer to Figure 5-41. 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 5-41 Typical Agilent E6178B Load Card Flyback Protection Circuit



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

Continuous DC voltage: 220 V

Transient energy* (10/1000mS): 0.90 Joules (watt-seconds)

Transient peak current† (8/20mS): 100 Amperes

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

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

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

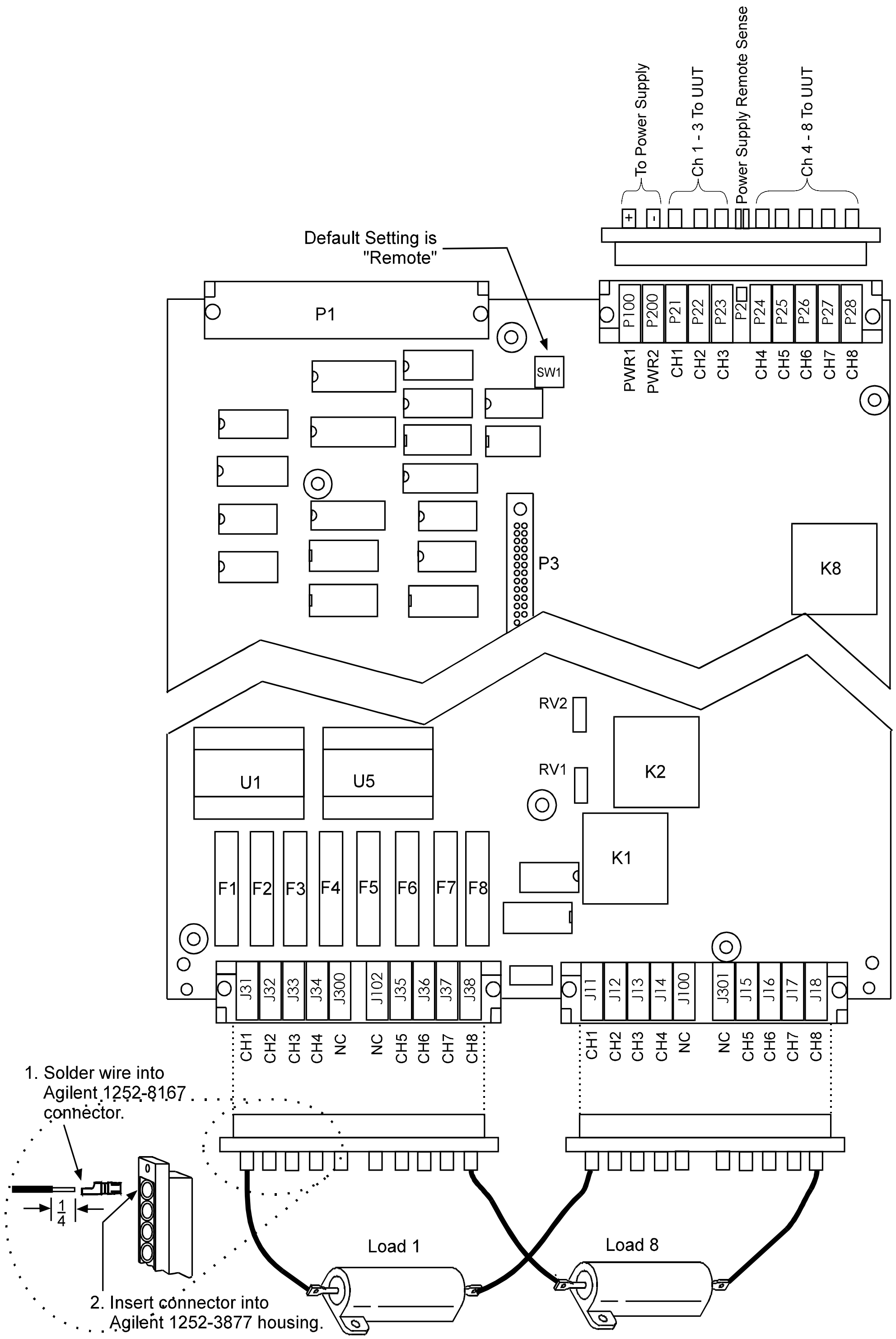
Load and UUT Connections

Figure 5-42 shows how the Agilent E6178B 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 Agilent system, CN2 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 CN2 as shown in Figure 5-42.

Figure 5-42 Agilent E6178B Load Card Wiring



Using the Agilent U7178A 8-Channel Heavy Duty Load Card

The Agilent U7178A 8-channel heavy duty load card with current sensing is intended to be used with high power loads mounted outside the switch/load unit. Figure 5-43 shows a block diagram of the Agilent U7178A. Figure 5-44 shows the layout of the U7178A card.

- The card occupies two slots in the switch/load unit. “Card Location Recommendations"
- The card type is 19h. “Load Card Type and Configuration ID"
- The factory default is to load a 100 Ω, x% I_{sense} resistor in each channel. “Selecting a Current-Sense Resistor Value"
- Power supply connections are made directly from the external power supplies to the load card - not through the Agilent E6198B Switch/Load Unit Power Supply Buses. Each channel is capable of up to 40 A continuous carry into a resistive load. “Selecting a Power Supply Configuration"
- Loads are mounted externally and interface to the card using two load connectors, J1 and J2. “Connecting Loads"

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 40 A maximum continuous. Do not exceed these specifications.

Figure 5-43 Agilent U7178A 8-Channel Heavy Duty Load Card Block Diagram

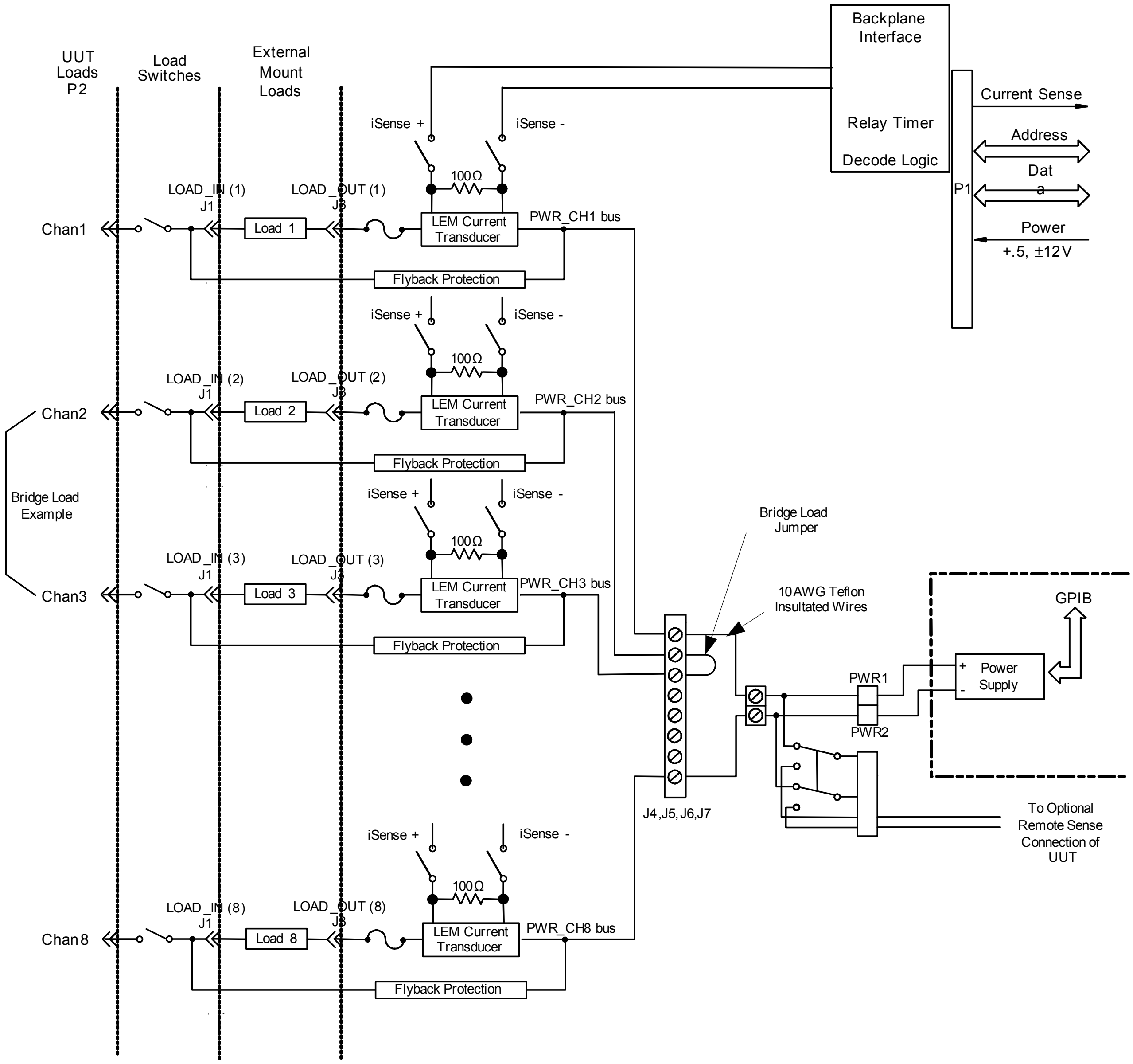
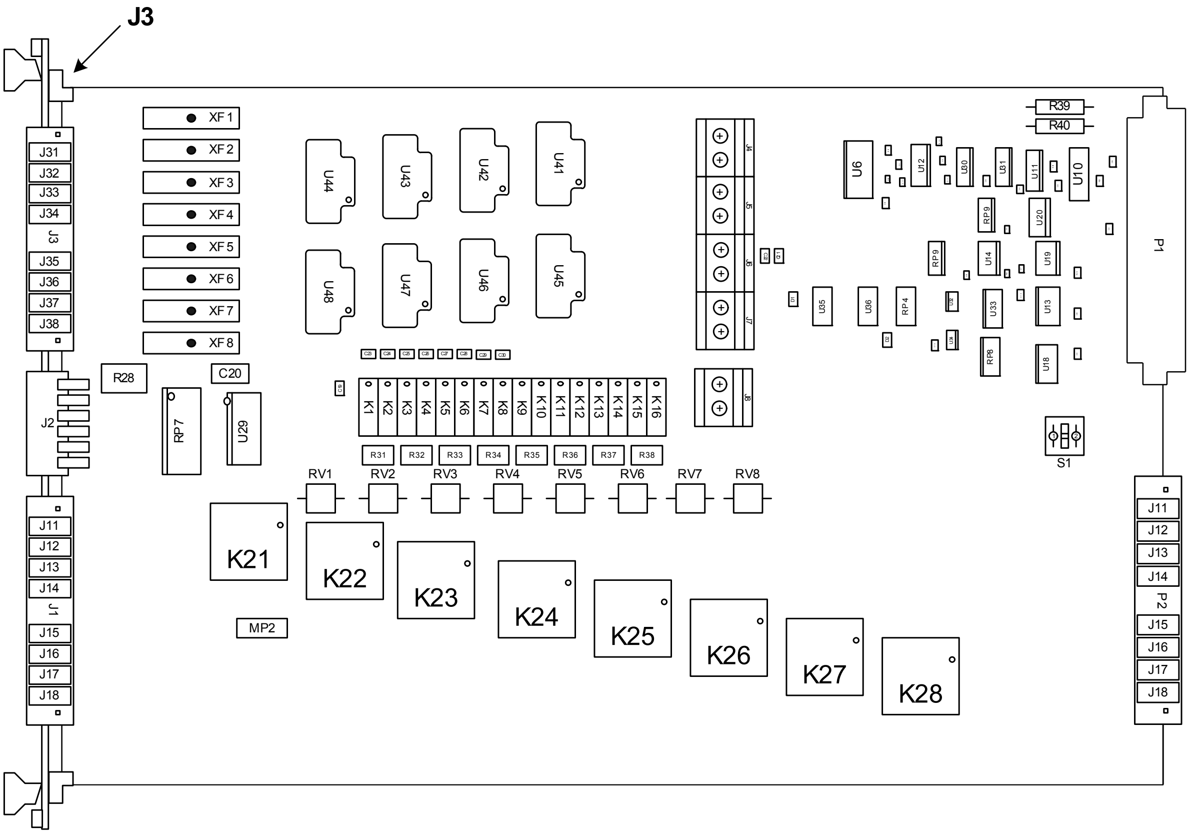


Figure 5-44 Agilent U7178A 8-Channel Heavy Duty Load Card Layout



Selecting a Power Supply Configuration

As shown in Figure 5-44, power supply connections for the loads are through P100 and P200 to PWR1 and PWR2 (J8) respectively. You must wire the power supply connectors to the individual channel connectors CH1 through CH8 (J4, J5, J6, and J7). Use at least a 10 AWG PTFE insulated or 8 AWG vinyl insulated wire to carry 40 A.

Figure 5-43 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 40 A continuous. Thus you can run 40 A 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 40 A.

CAUTION

It is possible to close more than one channel at a time. The power supply connections to the load card are rated for 40 A maximum continuous and individual channels are rated at 40 A 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 CN2 to UUT). Refer to Figure 5-43.

Selecting a Load Fuse

The factory installed load fuses are 40 A fuses. These fuses may be replaced by fuses with a lower value depending on your load requirements. The Agilent U7178A was qualified with an ATO Blade Fuse. Refer to the module specifications for more information.

CAUTION

To maintain Agilent U7178A safety and reliability, replace fuse with ATO Blade 40 A Fuse only.

Current Monitor

Each channel on the Agilent U7178A uses a LEM model LAH 50-P Current Transducers with a 100 Ω 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 2000:1 (primary to secondary, i.e., for a 2 A primary current the secondary current is 1 mA). The secondary of the LEM current transducer is connected across a precision 100 Ω resistor, see Figure 5-44. The primary current is calculated by making a voltage measurement across this precision resistor and is determined by the equation:

$$I_{ch} = V_{Isense} \times 20$$

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: ±0.2 A typical over the temperature range, ±0.6 A maximum over the temperature range

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 A 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.

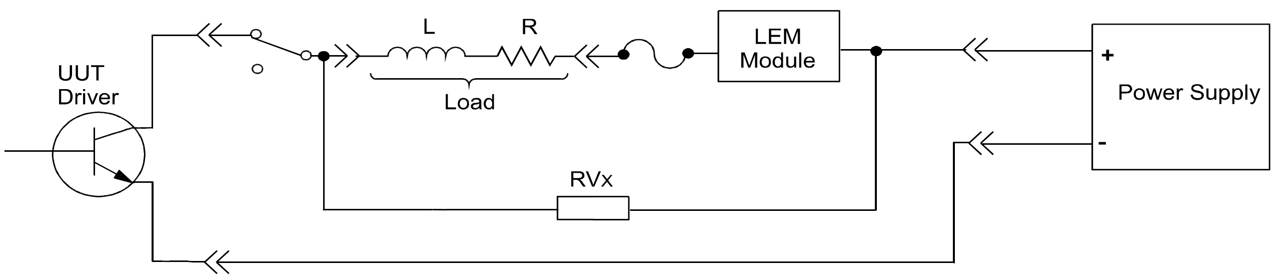
CAUTION The load cards are designed for a maximum of 500 V_{peak} flyback voltage. Operating the load cards without flyback protection installed on the appropriate channels, or with flyback voltages in excess of 500 V_{peak}, may results in damage to the load card or SLU.

The Agilent U7178A Load Card comes with provisions for user-installed flyback voltage protection. Figure 5-45 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 5-45. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.

Protection Devices

Refer to Figure 5-45. 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 5-45 Typical Agilent U7178A load card flyback protection circuit



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

Continuous DC voltage: 220 V

Transient energy* (10/1000mS): 0.90 Joules (watt-seconds)

Transient peak current† (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

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

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

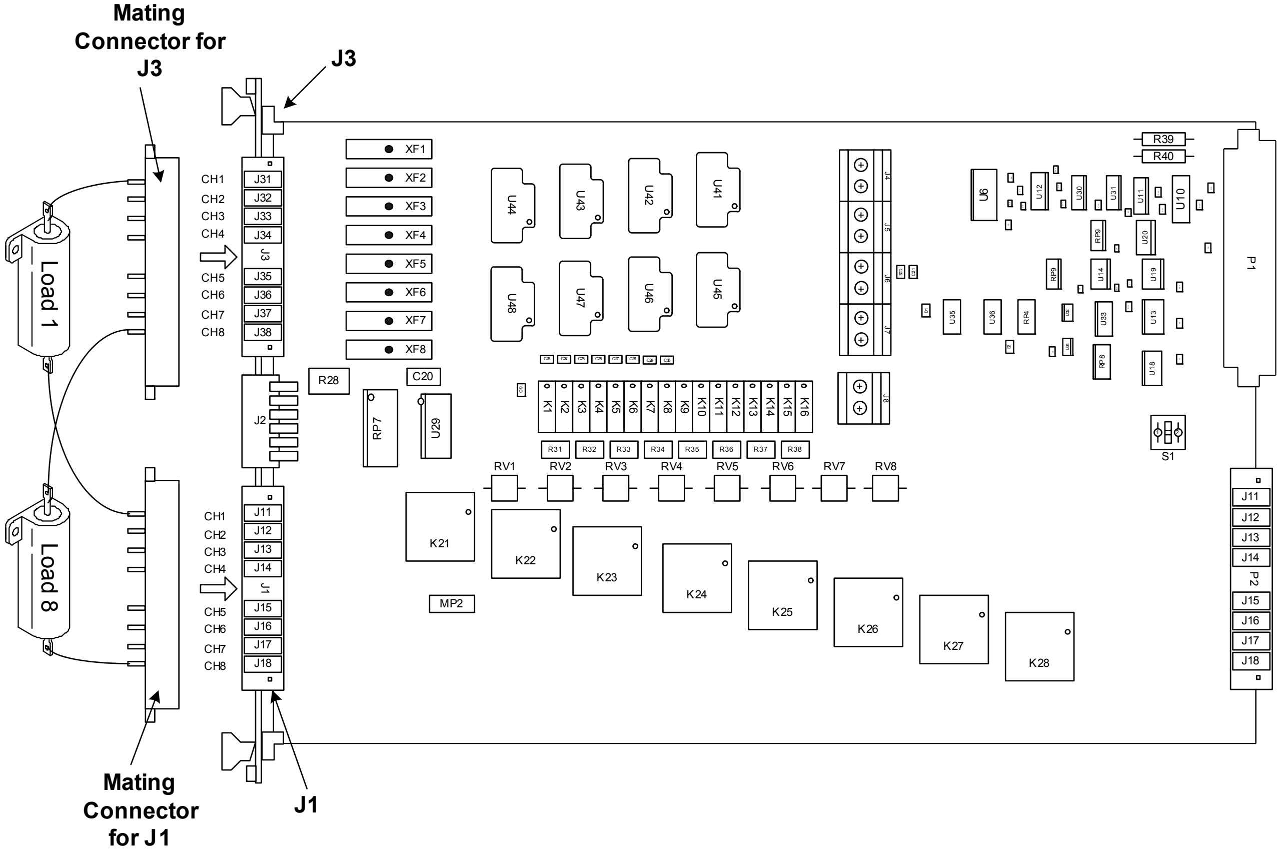
Load and UUT connections

Figure 5-46 shows how the Agilent U7178A 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 Agilent system, CN2 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 CN2 as shown in Figure 5-46.

Figure 5-46 Agilent U7178A load card wiring



Using the Agilent U7179A 16-Channel High Current Load Card

A block diagram of the Agilent U7179A 16-Channel High-Current Load Card is shown in Figure 5-47. The load card layout is shown in Figure 5-48.

- The card is two slots wide. “Card Location Recommendations"
- The card type is 20h. “Load Card Type and Configuration ID"
- The factory default configuration is explained in “Selecting a Power Supply Configuration"
- The factory default is to load a 0.005 Ω, 1% Isense resistor in each channel. “Selecting a Current-Sense Resistor Value"
- The flyback protection is connected from both the normally open (NO) and normally closed (NC) power switch connections. “Selecting and Loading Flyback Protection"
- Loads are mounted externally and interface to the card using two load connectors, J1 and J2. “Connecting Loads"

Figure 5-47 Agilent U7179A 16-Channel High-Current Load Card Block Diagram

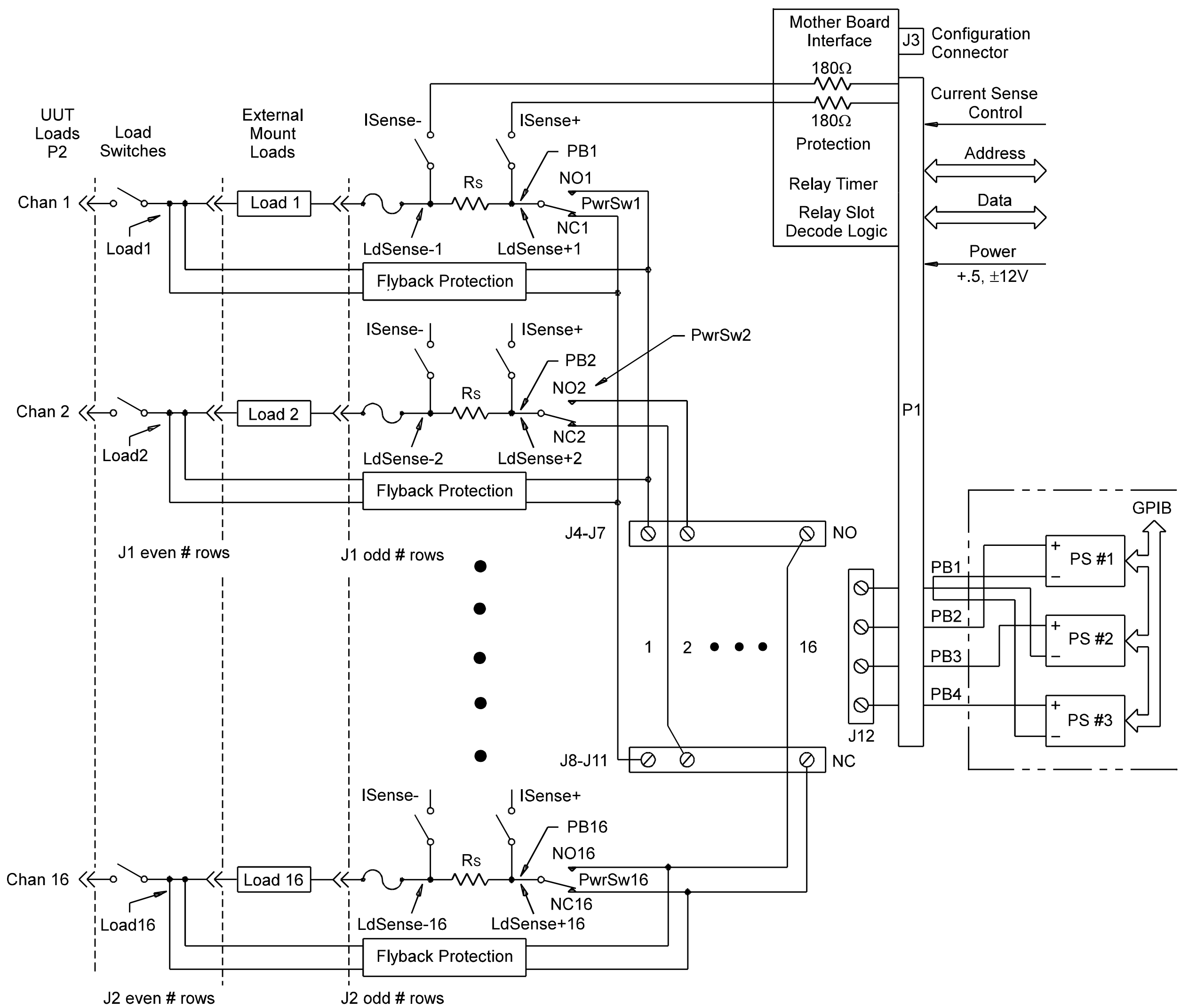
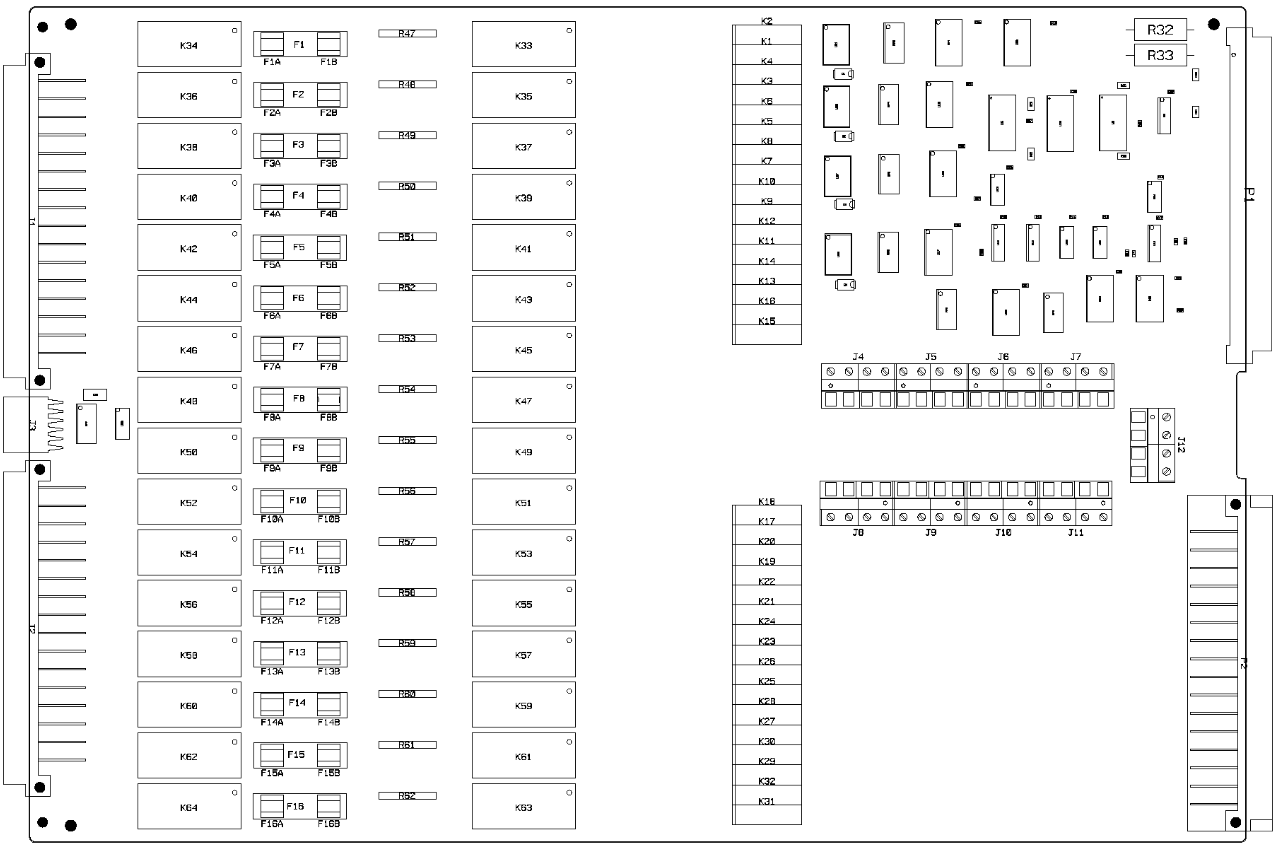


Figure 5-48 Agilent U7179A 16-Channel Load Card Layout



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 5-47.

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 1.5 watt, 0.005 Ω, 1% sense resistor already installed for every channel. 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 Littelfuse 0218015MXP, 5x20 millimeter, 15-amp. These fuses may be replaced with other fuses but the fuse value must not be higher than 15-amps.

CAUTION The maximum fuse rating must not exceed an I2T value of 1405.[1]

1 The I^2T figure is an industry standard term. For example, if a fuse with a rating of I2T = 100 experiences a current surge of 10 A, it can maintain that current for 1 second before its capacity is exceeded. (10 A * 10 A * 1 Second = 100)

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 SLU.

The Agilent U7179A load card provides location for user to install through-hole flyback protection components.

Flyback protection component can be place between load and NC or between load and NO. Factory does not provide flyback protection component. Example flyback protection component are diodes and MOV (metal oxide varistor).Flyback protection component is installed mostly in application where inductive load is used with the load card. Table 1 shows the reference designator for each of the flyback protection component and their respective channel.

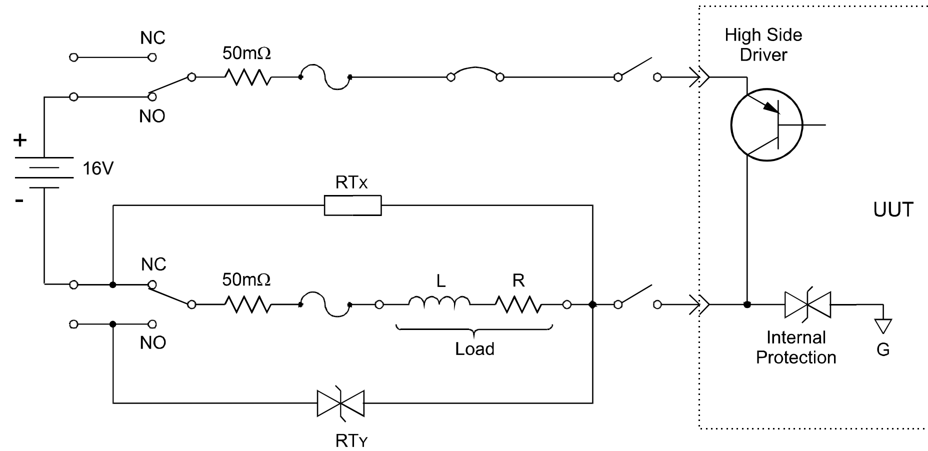
Table 5-3 CH1 to CH16 flyback protection

Channel	Load to NO	Load to NC
CH1	RV33	RV34
CH2	RV35	RV36
CH3	RV37	RV38
CH4	RV39	RV40
CH5	RV41	RV42
CH6	RV43	RV44
CH7	RV45	RV46
CH8	RV47	RV48
CH9	RV49	RV50
CH10	RV51	RV52
CH11	RV53	RV54
CH12	RV55	RV56
CH13	RV57	RV58
CH14	RV59	RV60
CH15	RV61	RV62
CH16	RV63	RV64

Protection Devices

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 5-49 Typical Agilent U7179A Load Card Flyback Protection Circuit



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

Continuous DC voltage: 220 V

Transient energy (10/1000 mS*): 0.90 Joules (watt-seconds)

Transient peak current (8/20 mS†): 100 Amperes

Varistor voltage @ 1.0mA DC: 300 Vdc

Max Maximum Clamping Voltage (8/20 mS): 450 volts

Capacitance: 17 pF

Typical Transzorb® specifications are:

Breakdown voltage: 300V max at 1 mA

Reverse Standoff voltage: 250 volts

Maximum reverse leakage: 5 mA

Maximum peak pulse current: 5 A

Maximum Clamping voltage: 400 volts

Maximum temperature coefficient: 0.110%/°C

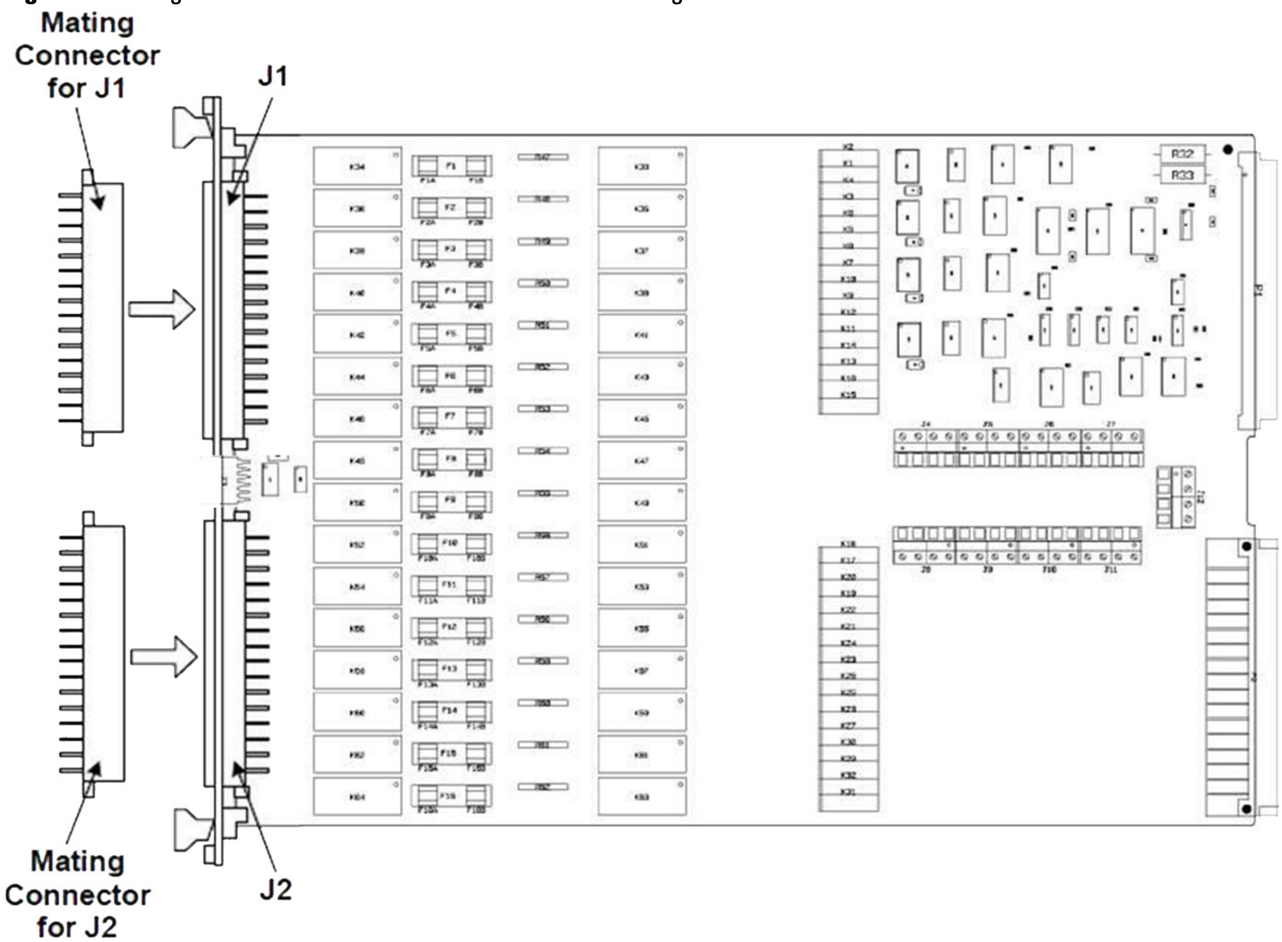
* 10/1000 mS refers to a standard pulse of 10 mS rise and 1000 mS to 50% decay of peak value.

† 8/20 mS refers to a standard pulse of 8 mS rise and 20 mS 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 CN1 and CN2 which mate to the Agilent U7179A's J1 and J2 connectors, respectively. Figure 5-50 shows these connectors.

Figure 5-50 Agilent U7179A Connectors J1/J2 and Mating Connectors CN1/CN2

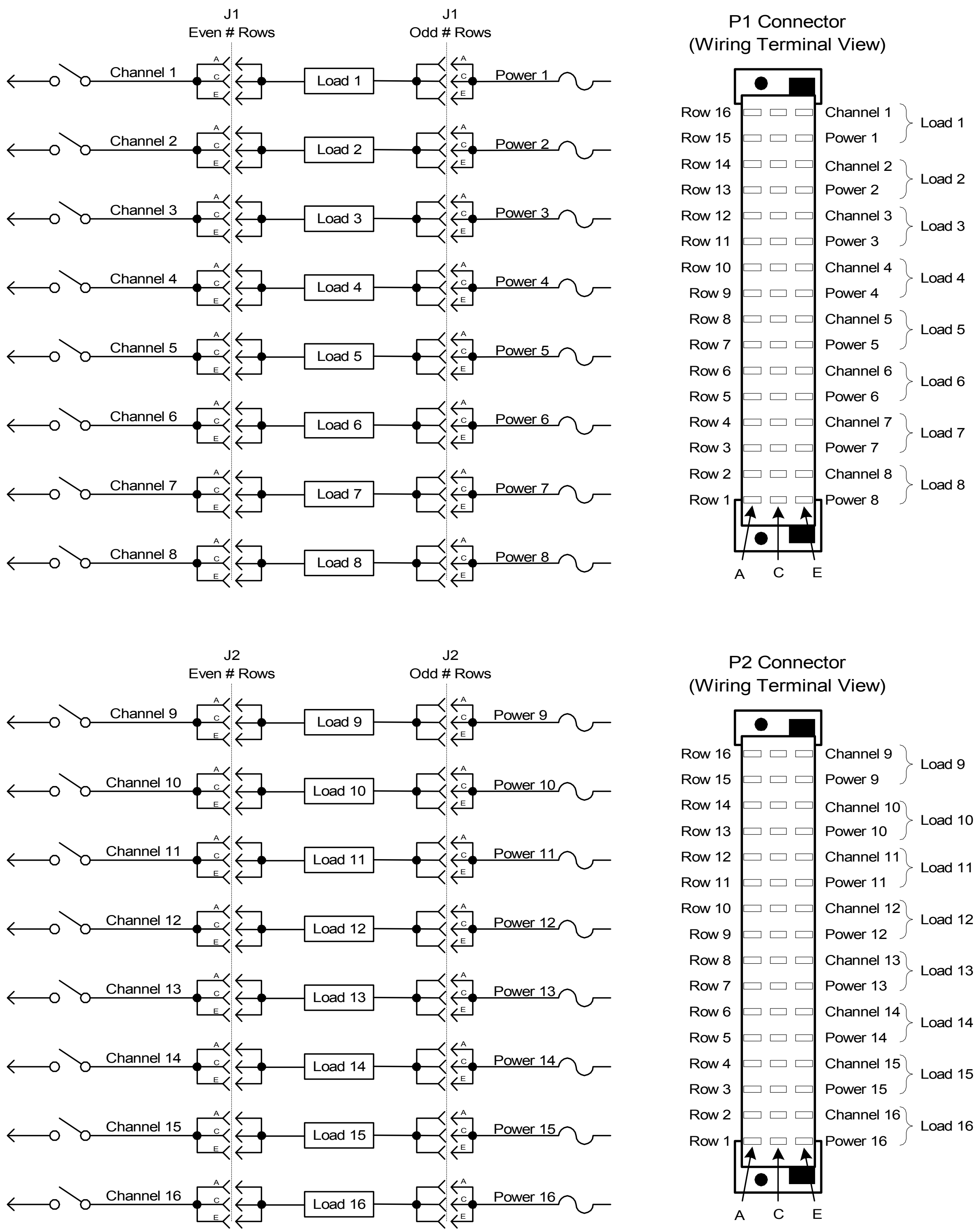


Load Wiring

Figure 5-51 is a simplified schematic and connector pinouts showing how loads are connected to CN1/CN2. Loads 1 through 8 connect to CN1 and loads 9 through 16 connect to CN2.

CAUTION To prevent premature pin failure from excessive current flow, when connecting high-current (>5 amp) loads to CN1, wire across all three pins in each row (see Figure 5-52).

Figure 5-51 Agilent U7179A Load Wiring Schematic and CN1/CN2 Pinouts

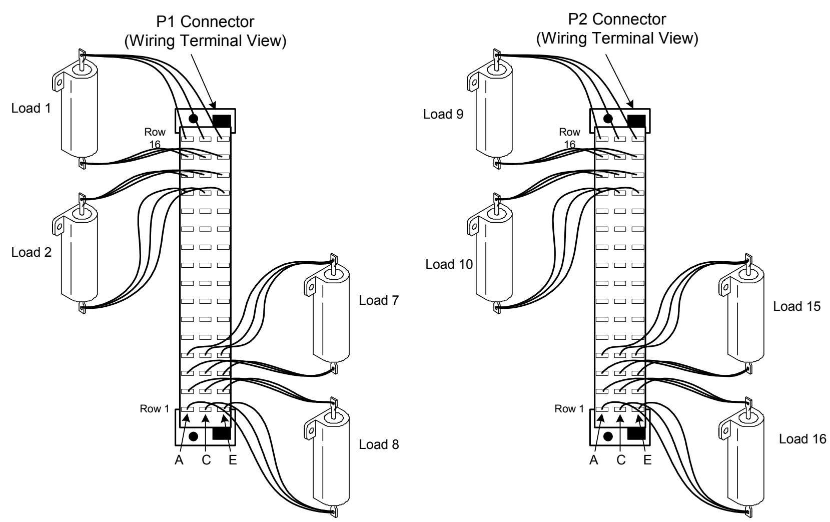


Current Sharing

Notice in the wiring schematic (Figure 5-52) that pins A, C and E in each row of J1/J2 are connected together on the PC board. When connecting high-current (>5 amp) loads, wire across all three pins in each row of CN1/CN2 (see Figure 5-24). This ensures current sharing across all pins and prevents premature pin failure from excessive current flow.

CAUTION Connecting high-current (>5 amp) loads without wiring across all three pins in the row can cause premature pin failure.

Figure 5-52 Agilent U7179A Current Sharing Example



External Load Mounting Options

In industrial applications, there will be a large variety of loading. Some loads are large and cannot be mounted directly onto the load card. For such a situation, there are two possible solutions. One would be to mount the load on a load plate, which fits into the SLU slots adjacent to the load card. The second solution would be to have a load box, with all the loads fitted neatly inside and have wires from the load box to the mating connector on the load card.

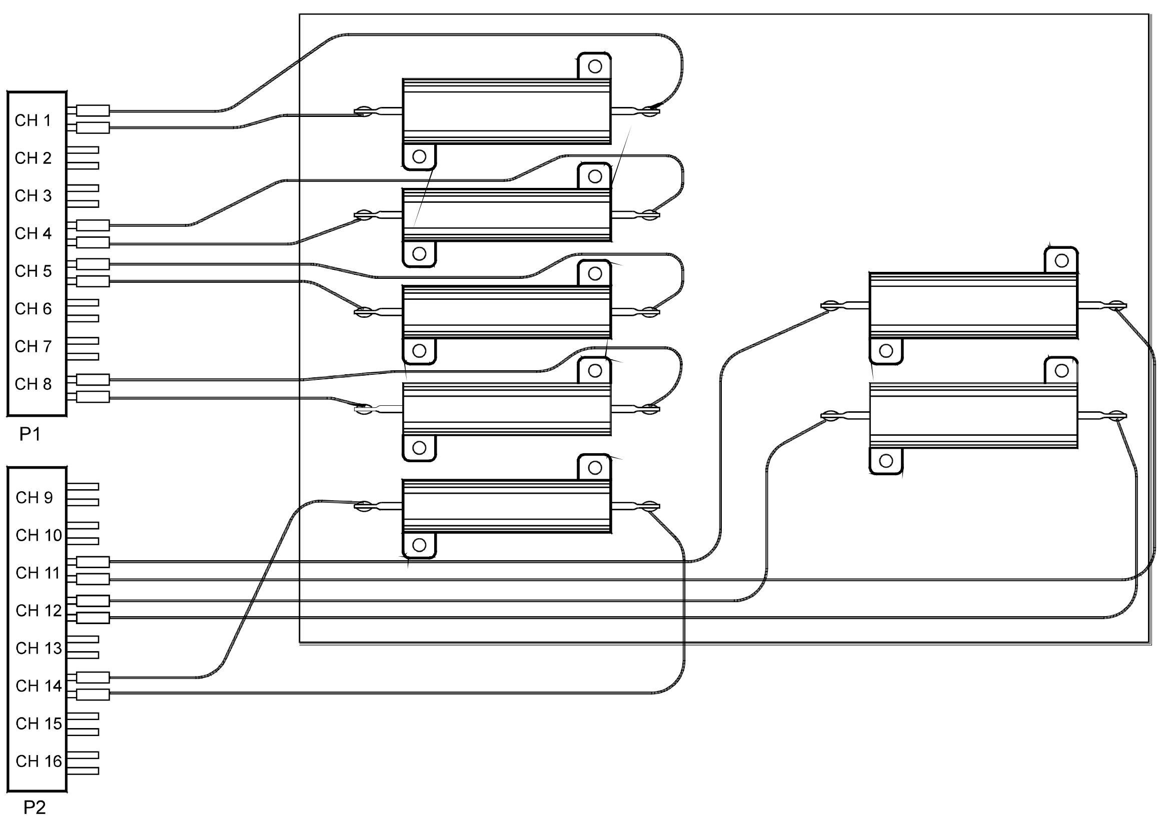
To use load plates, SLU slots have to be reserved for them. There are guidelines to follow when mounting the loads on load plates:

- Mount the loads as close to the load card as possible.
- 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 cable runs to the externally mounted loads so that you can remove other cards without having to disconnect any wiring.
- Clearly identify all cables to externally mounted loads, including those on a load plate. Use labels, numbers, color coding, or some combination of these methods. Cabling to polarity sensitive devices should be labeled appropriately.

Figure 5-53 Example: Load Plate with loads



Load boxes would be suitable for use in systems as it can be installed into the system and the wires routed to the load card on the SLU. Consider the following when designing load boxes:

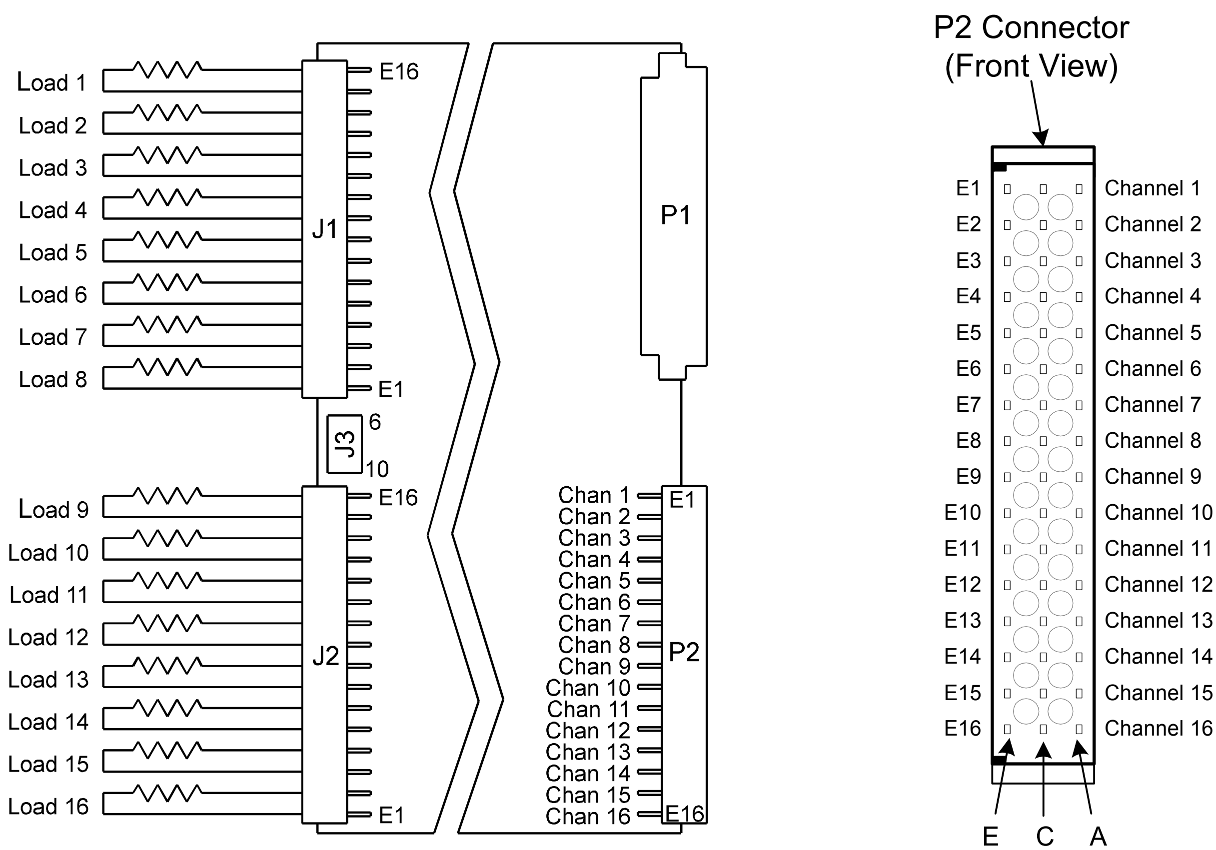
- Make sure there is enough heat dissipation by using heat sinks and fans to prevent overheating
- Label clearly the wires coming from the load box to the load cards to avoid wrong connections
- If load impedances are very small, try not to have the load box too far away from the load card

UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. Figure 5-54 is a simplified load card schematic and CN2 connector pinout showing the details. Each row of CN2 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 5-54 Agilent U7179A CN2 Connector Pinouts



Using the Agilent N9377A 16-Channel Dual-Load Load Card

The Agilent N9377A 16-channel dual-load load card with current sensing is intended to be used with high power loads mounted outside the Switch/Load Unit. The dual-load feature permits testing for some common test scenarios:

- An engine control unit smart driver may need to check for shorts to ground and Vbatt.
- Some tests require one load (such as a pure resistance) for part of the test and a second load (such as a real inductive load) for another part of the same test.

Figure 5-55 shows a block diagram of the N9377A. Figure 5-56 shows the load card layout. Other features include:

- The card is one slot wide. "Card Location Recommendations"
- The card type is 07_h. "Load Card Type and Configuration ID"
- Each channel is capable of up to 7.5 amp continuous carry into a resistive load, 15 amp peak. The factory default configuration is explained in "Selecting a Power Supply Configuration".
- The factory default is to load a 0.05Ω, 0.1% Isense resistor in each channel. "Selecting a Current-Sense Resistor Value"
- The flyback protection is connected from both the normally open (NO) and normally closed (NC) power switch connections. "Selecting and Loading Flyback Protection"
- Loads are mounted externally and interface to the card using two load connectors, J1 and J2. "Connecting Loads"

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 7.5 amps maximum continuous. Do not exceed these specifications.

Figure 5-55 Agilent N9377A 16-Channel Dual-Load Load Card Block Diagram

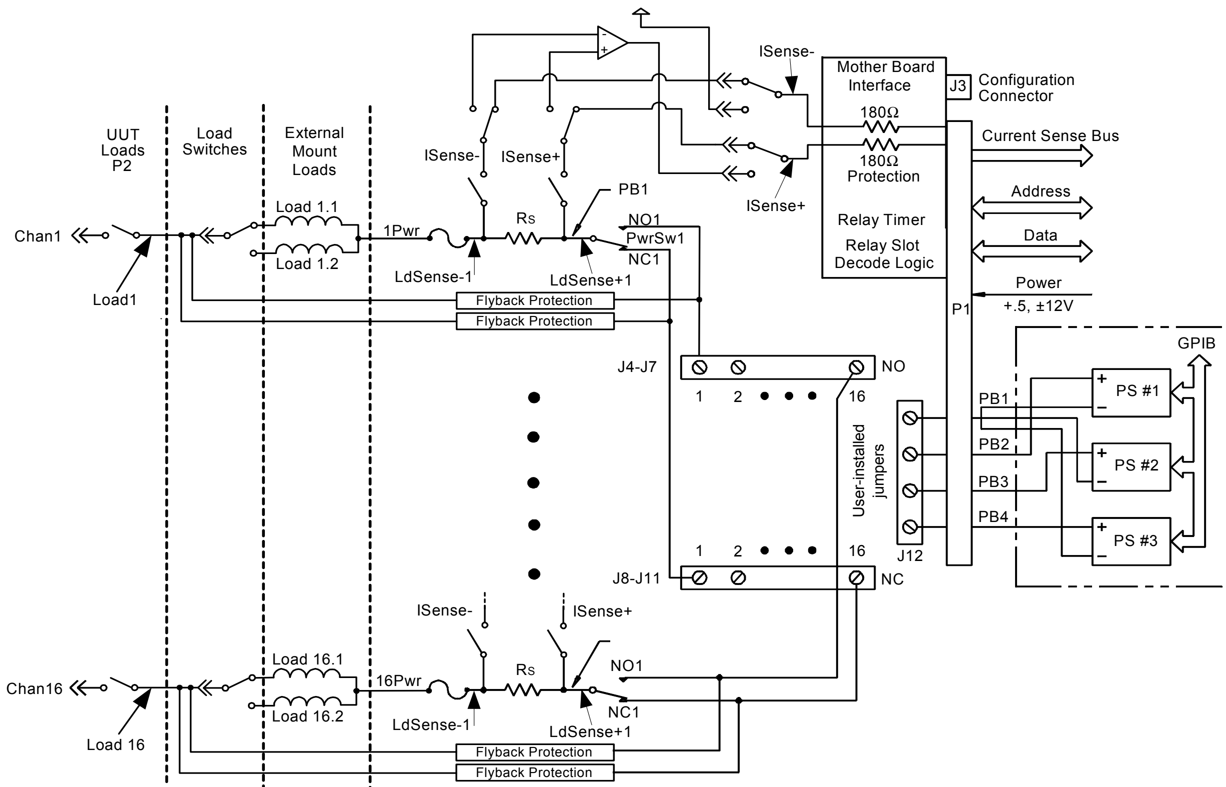
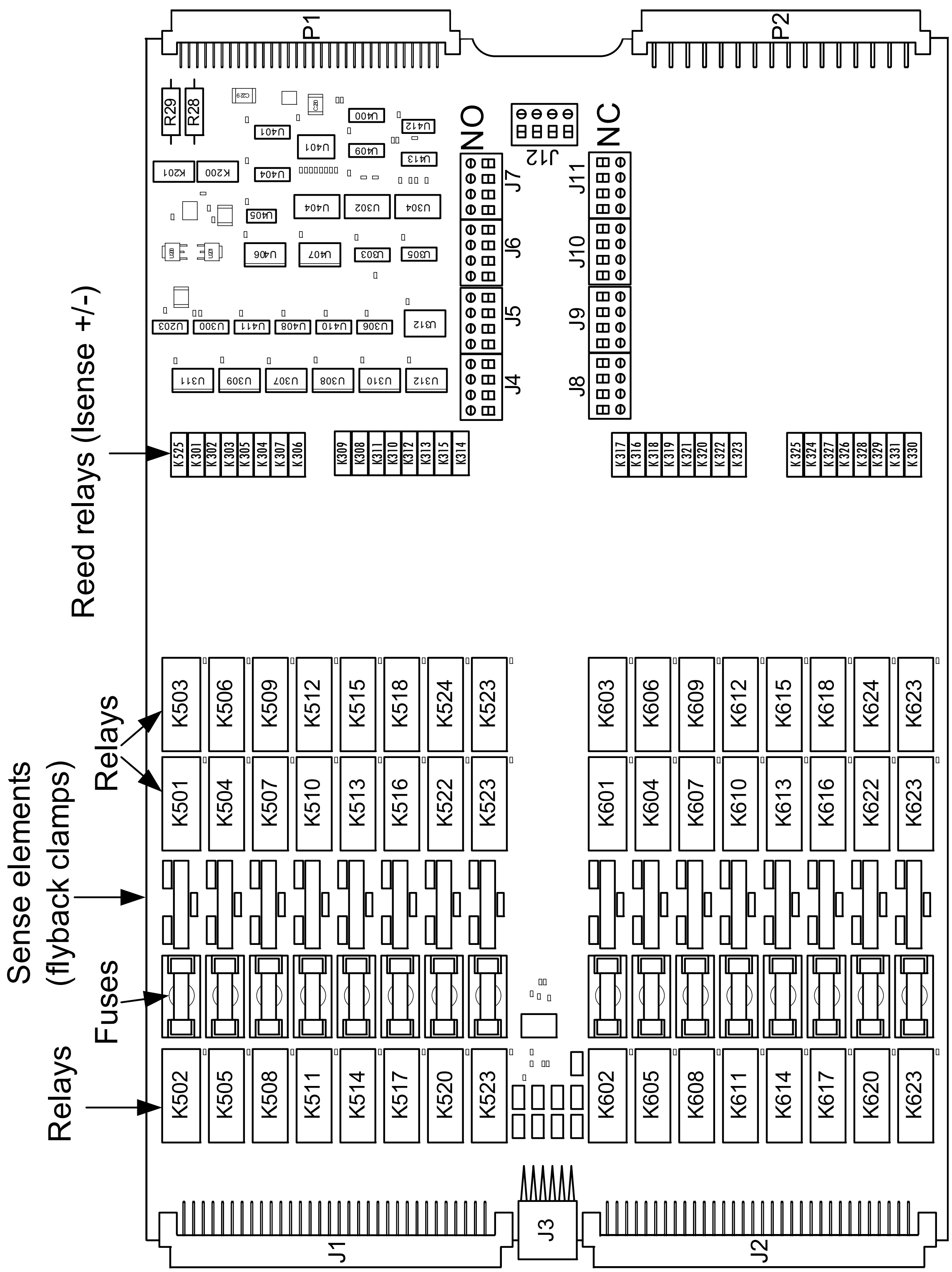


Figure 5-56 N9377A 16-Channel Load Card Layout



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 J4-J11 can be connected to any of the four power bus lines on J12 via jumper wires. See Figure 5-55.

The terminal block jumper lets you conveniently connect pull-up or pull-down voltages to the various inputs. You can also terminate a UUT load at a different voltage than ground. For example, you can connect the channel 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. 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. The N9377A provides a footprint for another current sense element so that you can replace the factory provided resistor with one selected for your specific UUT.

CAUTION Be sure to size the power dissipation of the sense resistor large enough to handle the expected current of the load.

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]

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)

Selecting and Loading Flyback Protection

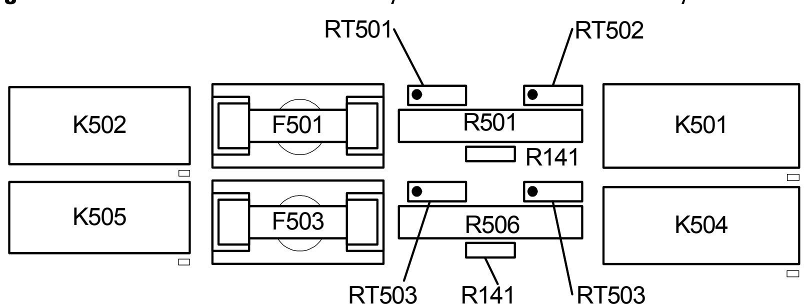
Coils used as loads may have large flyback voltages, which have the potential to damage other electronic components. Generally the UUTs are equipped with flyback protection, so flyback protection on the load cards is redundant except to provide backup protection in case you test a defective UUT. If flyback protection devices are required, you are responsible for installing them 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 SLU.

The N9377A load card comes with provisions for user-installed flyback voltage protection. Figure 5-57 shows a detail of the first two channels on the component locator diagram of the load card. It shows the location and polarity orientation for the channel 1 (RT501 and RT502) and channel 2 (RT503 and RT504) flyback protection devices when they are installed. This pattern is repeated for the other fourteen channels.

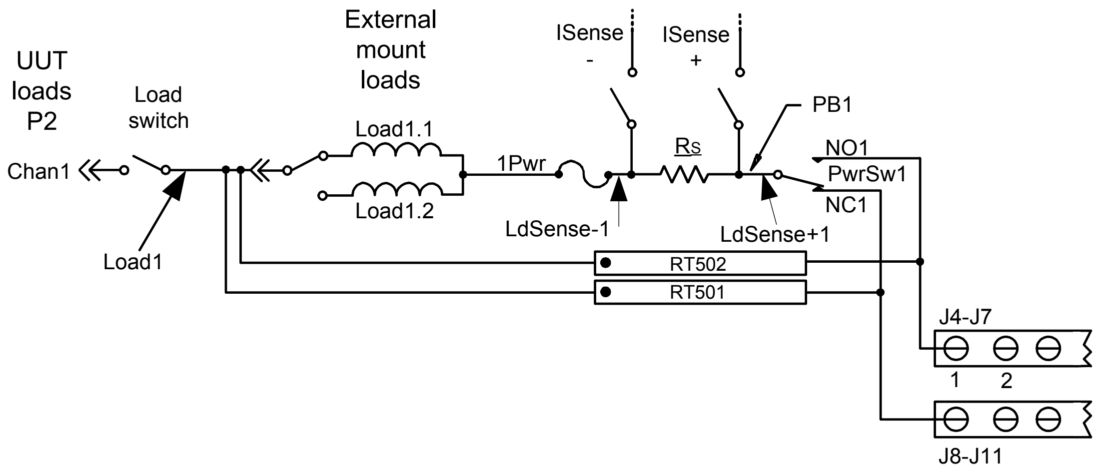
Figure 5-57 N9377A Load Card - Flyback Locator and Polarity Orientation



The flyback protection devices have 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 5-58, Channel 1 has two input lines connected to the input Form C switch. RT502 connects input line J4-J7, and RT501 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 device’s predetermined value. The flyback protection is installed similarly on each input line.

Figure 5-58 N9377A Load Card - Flyback Circuit Detail

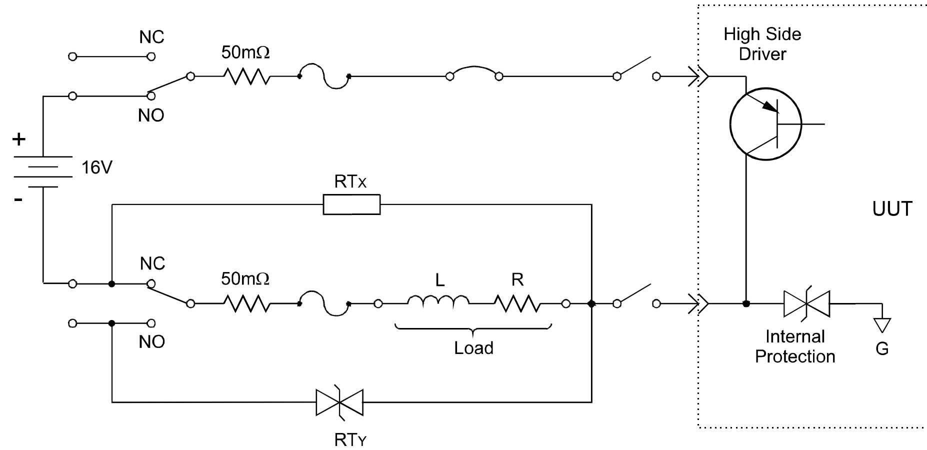


Install the flyback protection devices with the positive or negative side towards the UUT as appropriate for your application. On each of the 16 channels, note the location of the polarization dot as shown in the flyback component locator diagram, Figure 5-57. MOV (Metal Oxide Varistor), or back-to-back zener diodes are recommended for flyback voltage protection.

Protection Devices

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 5-59 Typical Agilent N9377A Load Card Flyback Protection Circuit



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

Continuous DC voltage: 220 V

Transient energy (10/1000mS*): 0.90 Joules (watt-seconds)

Transient peak current (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

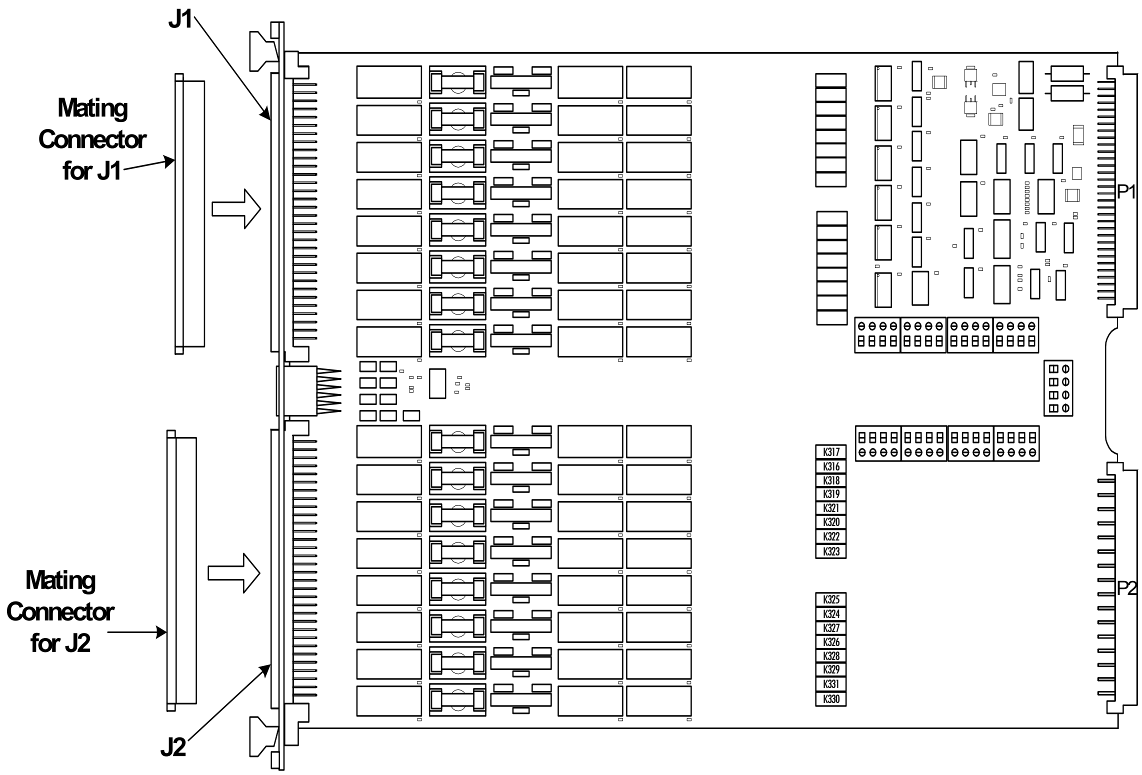
* 10/1000mS refers to a standard pulse of 10mS rise and 1000mS to 50% decay of peak value.

† 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 which mate to the Agilent N9377A's J1 and J2 connectors, respectively. Figure 5-60 shows these connectors.

Figure 5-60 Agilent N9377A Connectors J1/J2 and Mating Connectors J1/J2



Load Wiring

Loads 1 through 8 connect to the J1 connector and loads 9 through 16 connect to the J2 connector. Each pin is rated for 2A continuous. The following figures show details to help you correctly wire loads to the connectors.

- Figure 5-61 shows a load wiring schematic.
- Figure 5-62 shows the connector pin layout.
- Figure 5-63 shows the connector pinouts for J1 and J2.

CAUTION

Connecting high-current loads (>2 amp per pin) can cause premature pin failure. Be sure to read "Current Sharing" of this manual before wiring high-current loads.

Figure 5-61 N9377A Load Wiring Schematic

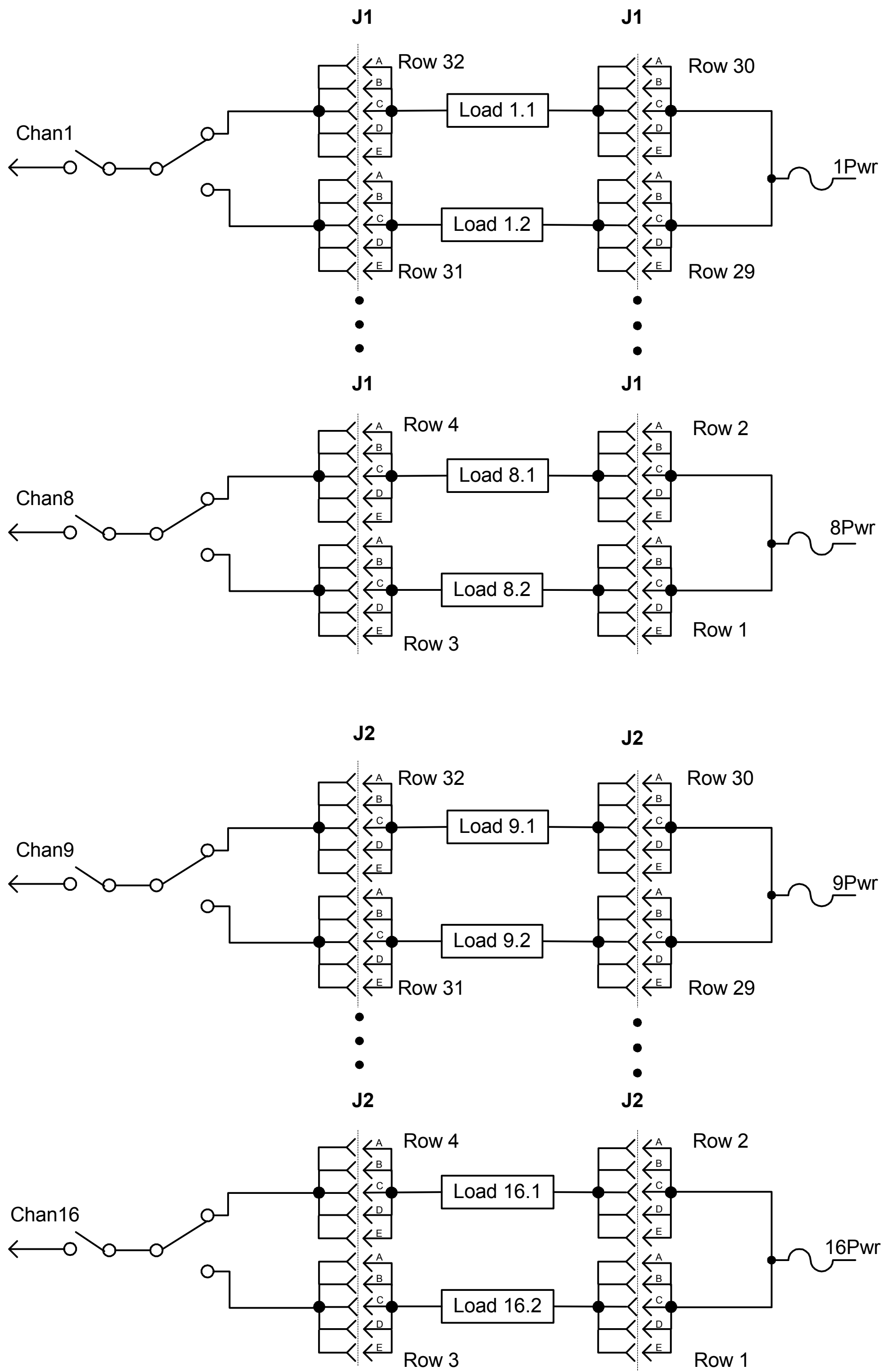


Figure 5-62 J1 and J2 Connector Layout

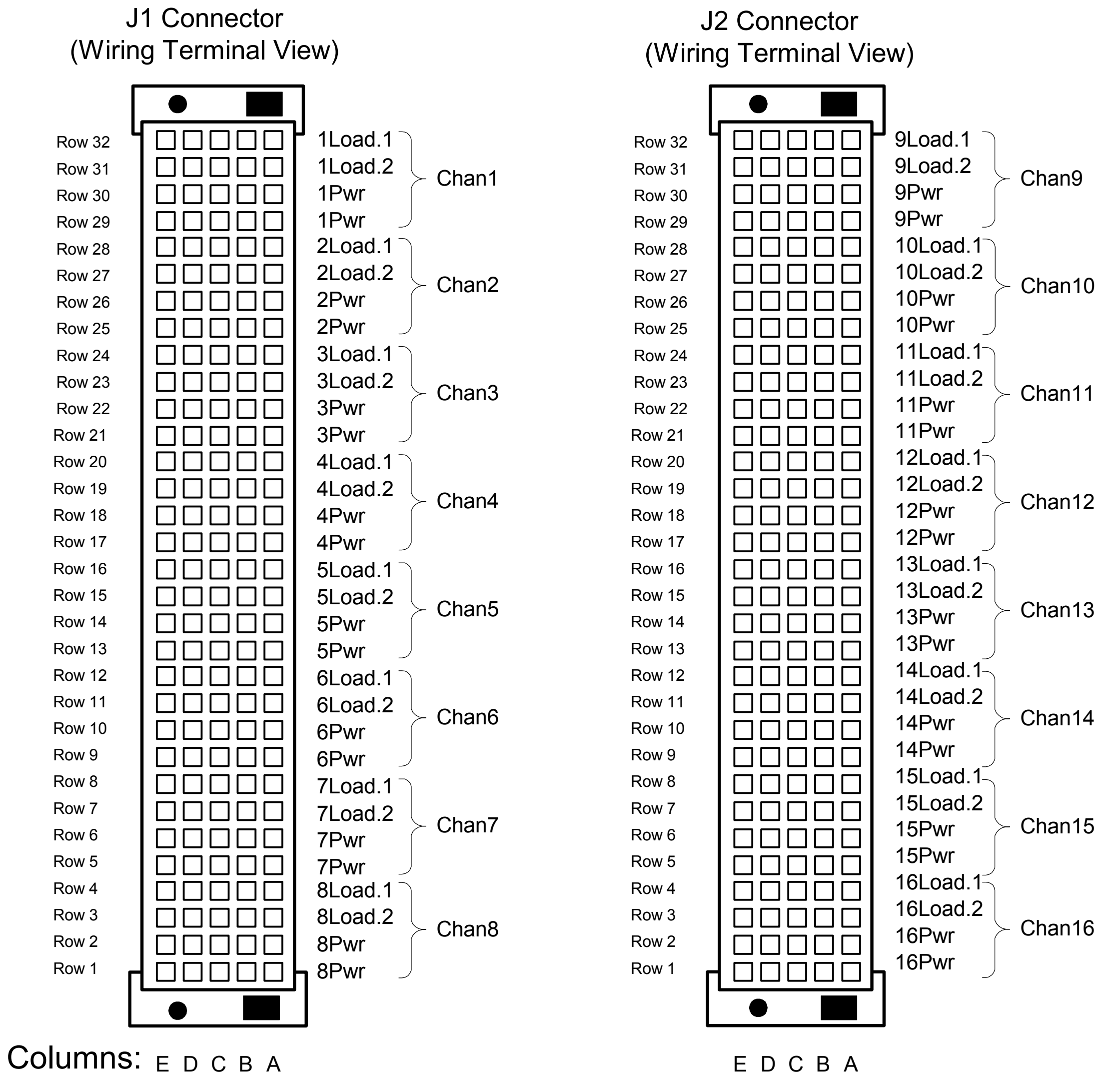


Figure 5-63 Agilent N9377A Pinout Table (160-pin option)

	J1						J2				
32	1Load.1	1Load.1	1Load.1	1Load.1	1Load.1	32	9Load.1	9Load.1	9Load.1	9Load.1	9Load.1
31	1Load.2	1Load.2	1Load.2	1Load.2	1Load.2	31	9Load.2	9Load.2	9Load.2	9Load.2	9Load.2
30	1Pwr	1Pwr	1Pwr	1Pwr	1Pwr	30	9Pwr	9Pwr	9Pwr	9Pwr	9Pwr
29	1Pwr	1Pwr	1Pwr	1Pwr	1Pwr	29	9Pwr	9Pwr	9Pwr	9Pwr	9Pwr
28	2Load.1	2Load.1	2Load.1	2Load.1	2Load.1	28	10Load.1	10Load.1	10Load.1	10Load.1	10Load.1
27	2Load.2	2Load.2	2Load.2	2Load.2	2Load.2	27	10Load.2	10Load.2	10Load.2	10Load.2	10Load.2
26	2Pwr	2Pwr	2Pwr	2Pwr	2Pwr	26	10Pwr	10Pwr	10Pwr	10Pwr	10Pwr
25	2Pwr	2Pwr	2Pwr	2Pwr	2Pwr	25	10Pwr	10Pwr	10Pwr	10Pwr	10Pwr
24	3Load.1	3Load.1	3Load.1	3Load.1	3Load.1	24	11Load.1	11Load.1	11Load.1	11Load.1	11Load.1
23	3Load.2	3Load.2	3Load.2	3Load.2	3Load.2	23	11Load.2	11Load.2	11Load.2	11Load.2	11Load.2
22	3Pwr	3Pwr	3Pwr	3Pwr	3Pwr	22	11Pwr	11Pwr	11Pwr	11Pwr	11Pwr
21	3Pwr	3Pwr	3Pwr	3Pwr	3Pwr	21	11Pwr	11Pwr	11Pwr	11Pwr	11Pwr
20	4Load.1	4Load.1	4Load.1	4Load.1	4Load.1	20	12Load.1	12Load.1	12Load.1	12Load.1	12Load.1
19	4Load.2	4Load.2	4Load.2	4Load.2	4Load.2	19	12Load.2	12Load.2	12Load.2	12Load.2	12Load.2
18	4Pwr	4Pwr	4Pwr	4Pwr	4Pwr	18	12Pwr	12Pwr	12Pwr	12Pwr	12Pwr
17	4Pwr	4Pwr	4Pwr	4Pwr	4Pwr	17	12Pwr	12Pwr	12Pwr	12Pwr	12Pwr
16	5Load.1	5Load.1	5Load.1	5Load.1	5Load.1	16	13Load.1	13Load.1	13Load.1	13Load.1	13Load.1
15	5Load.2	5Load.2	5Load.2	5Load.2	5Load.2	15	13Load.2	13Load.2	13Load.2	13Load.2	13Load.2
14	5Pwr	5Pwr	5Pwr	5Pwr	5Pwr	14	13Pwr	13Pwr	13Pwr	13Pwr	13Pwr
13	5Pwr	5Pwr	5Pwr	5Pwr	5Pwr	13	13Pwr	13Pwr	13Pwr	13Pwr	13Pwr
12	6Load.1	6Load.1	6Load.1	6Load.1	6Load.1	12	14Load.1	14Load.1	14Load.1	14Load.1	14Load.1
11	6Load.2	6Load.2	6Load.2	6Load.2	6Load.2	11	14Load.2	14Load.2	14Load.2	14Load.2	14Load.2
10	6Pwr	6Pwr	6Pwr	6Pwr	6Pwr	10	14Pwr	14Pwr	14Pwr	14Pwr	14Pwr
9	6Pwr	6Pwr	6Pwr	6Pwr	6Pwr	9	14Pwr	14Pwr	14Pwr	14Pwr	14Pwr
8	7Load.1	7Load.1	7Load.1	7Load.1	7Load.1	8	15Load.1	15Load.1	15Load.1	15Load.1	15Load.1
7	7Load.2	7Load.2	7Load.2	7Load.2	7Load.2	7	15Load.2	15Load.2	15Load.2	15Load.2	15Load.2
6	7Pwr	7Pwr	7Pwr	7Pwr	7Pwr	6	15Pwr	15Pwr	15Pwr	15Pwr	15Pwr
5	7Pwr	7Pwr	7Pwr	7Pwr	7Pwr	5	15Pwr	15Pwr	15Pwr	15Pwr	15Pwr
4	8Load.1	8Load.1	8Load.1	8Load.1	8Load.1	4	16Load.1	16Load.1	16Load.1	16Load.1	16Load.1
3	8Load.2	8Load.2	8Load.2	8Load.2	8Load.2	3	16Load.2	16Load.2	16Load.2	16Load.2	16Load.2
2	8Pwr	8Pwr	8Pwr	8Pwr	8Pwr	2	16Pwr	16Pwr	16Pwr	16Pwr	16Pwr
1	8Pwr	8Pwr	8Pwr	8Pwr	8Pwr	1	16Pwr	16Pwr	16Pwr	16Pwr	16Pwr

Recommended Connectors

Agilent recommends using the following:

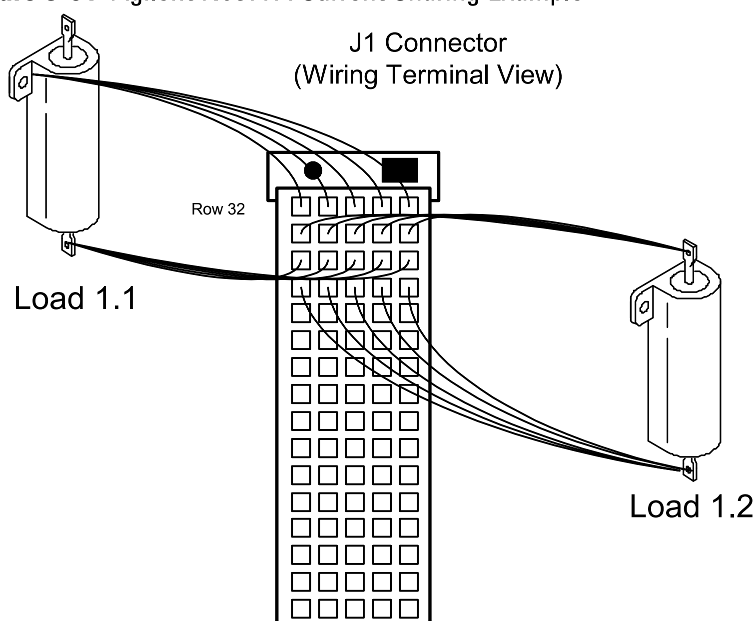
- ERNI female connector (part number 024070) as the mating connector for J1 and J2
- ERNI crimp contact (part number 014728) as the contact for the connector.

Current Sharing

Each pin in the J1 and J2 connectors is rated for 2 amps, but the N9377A load card is rated for 7.5 amps. You can accommodate higher amperage loads by sharing pins on the connector. (Notice in the wiring schematic, Figure 5-61 that pins A-E in each row of J1 and J2 are connected together on the PC board.) When connecting high-current (>2 amp) loads, wire across all five pins in each row of the connectors (see Figure 5-64). This ensures current sharing across all pins and prevents premature pin failure from the excessive current flow.

CAUTION Connecting high-current (>2 amp) loads without wiring across all five pins in the row can cause premature pin failure.

Figure 5-64 Agilent N9377A Current Sharing Example



External Load Mounting Options

As with the E6176A 16-channel load card, you can mount the loads externally on a metal plate that fits into the SLU slots adjacent to the load card. For guidelines on mounting loads externally, see “External Load Mounting Options".

UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. The pinouts are the same as for the E6176A 16-channel load card. See “UUT Connections" for details.

Using the Agilent N9378A 24-Channel Low Resistance Load Card

The Agilent N9378A 24-channel high-density load card is designed to work with loads mounted on mezzanine cards inside the Switch/Load Unit with up to eight quadruple loads per card. Figure 5-65 shows a block diagram of the Agilent N9378A.

- The card is one slot wide. “Card Location Recommendations"
- The card type is 05_h. “Load Card Type and Configuration ID"
- The factory default configuration is explained in “Selecting a Power Supply 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 lets you switch in an external power supply while bypassing the power bus of the SLU, for example. “Using the Power Switches as General Purpose Relays"
- The card is *not* equipped for current sensing.
- The card does *not* provide flyback voltage protection.
- Loads are mounted onboard on a series of mezzanine cards that plug into the load card. You can attach as many as four loads per channel. “Connecting Loads"
- Each channel is capable of up to 2A continuous carry into a resistive load.

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 a maximum of 2 A continuous. Do not exceed these specifications.

Figure 5-65 Agilent N9378 24-Channel Low-Resistance Load Card Block Diagram

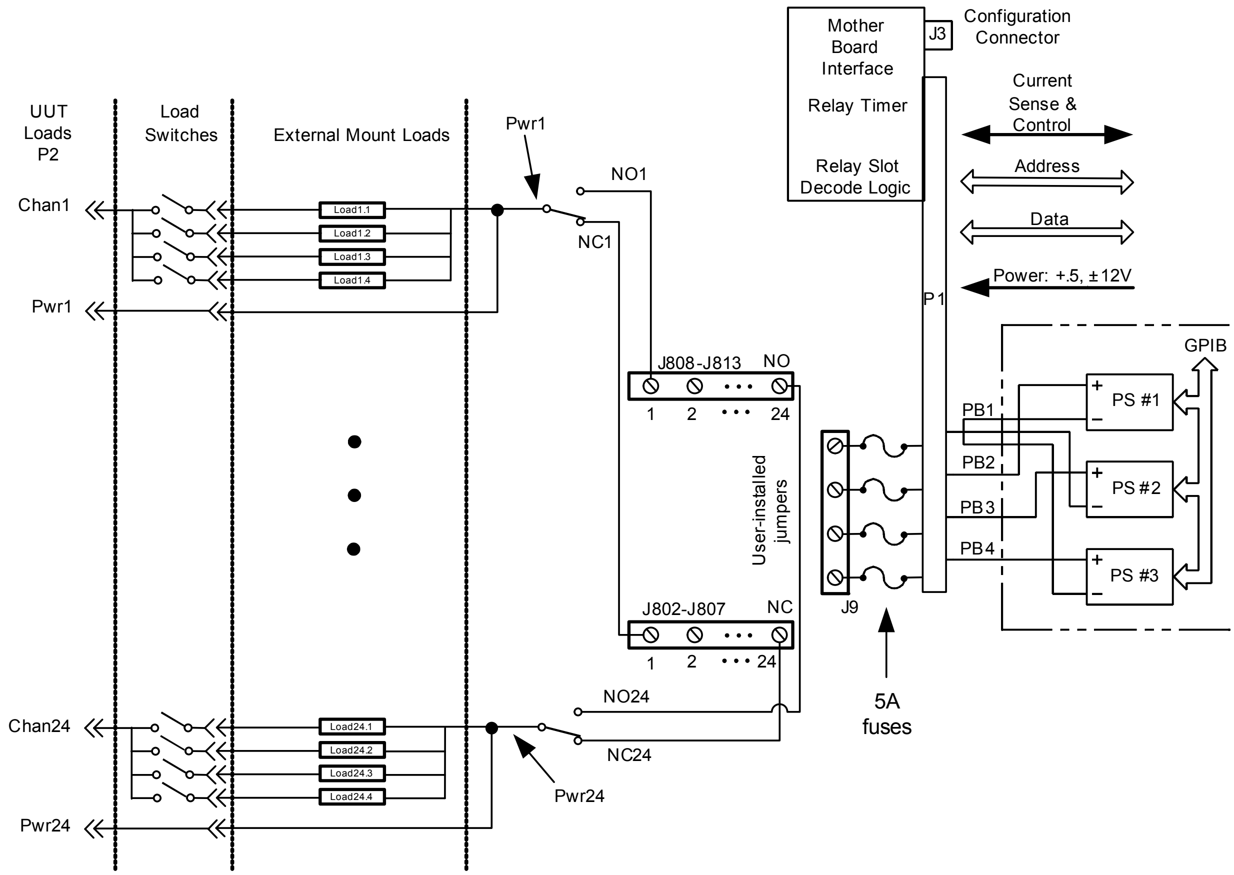
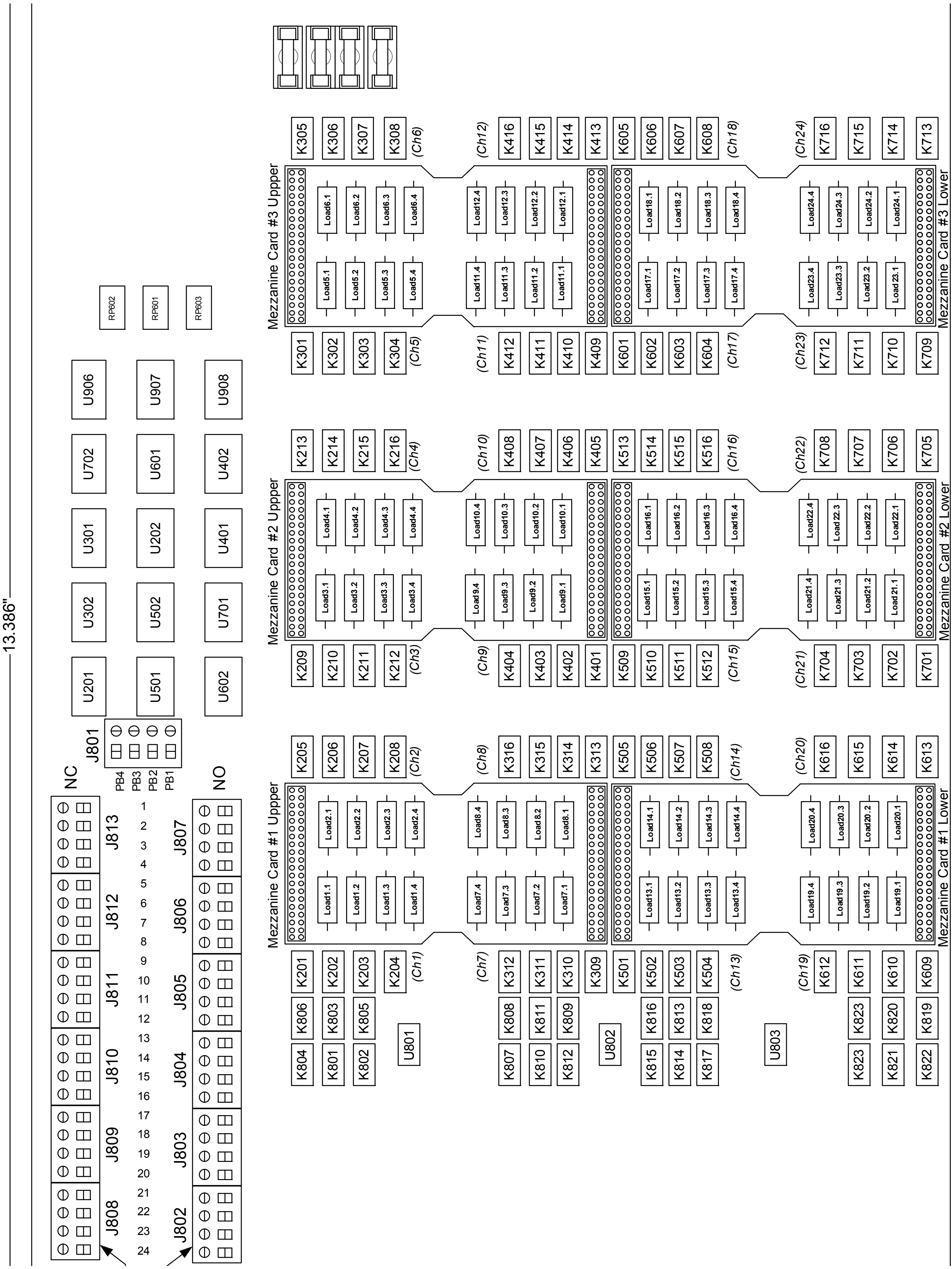


Figure 5-66 Agilent N9378A 24-Channel Load Card Layout



Selecting a Power Supply Configuration

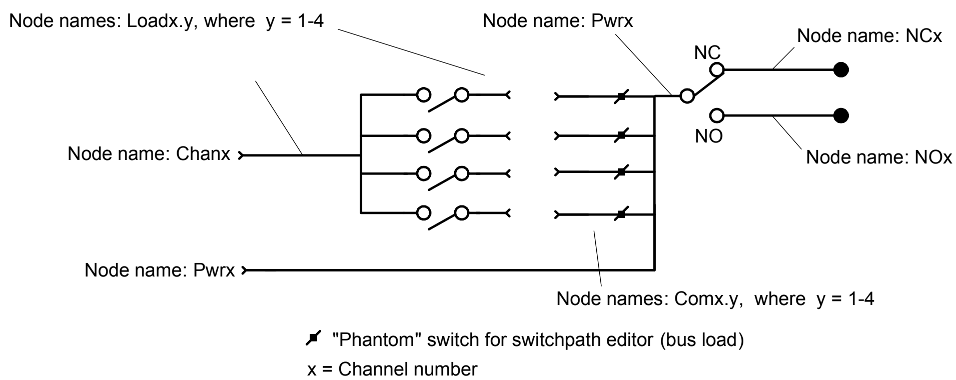
Each channel connects to the power bus via a Form C SPDT (single-pole, double-throw) relay. This relay has a NO (normally-open) and a NC (normally-closed) terminal. Each NO terminal is connected to a pin on J808–J813, and each NC terminal is connected to a pin on J802–J807. Each pin on J802–J813 can be connected to any of the four power busses on J801 via jumper wires (Figure 5-66). The terminal block jumpering allows convenient pull-up or pull-down of the various inputs. It also lets you terminate 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 J802–J807 together and one that ties all the pins on J808–J813 together. The NO pins are also jumpered to power bus 2, and the NC pins are jumpered to power bus 1. You can easily cut the combs for J802–J807 and J808–J813 to provide bus or pin isolation between the various input/power bus connections.

Using the Power Switches as General Purpose Relays

As with the E6177A and N9379A load cards, the N9378A 24-channel load card lets you use the load switching relay as a general-purpose switching relay. 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 lets you, for example, switch in an external power supply while bypassing the power bus of the SLU. Figure 5-67 shows details of the load configuration circuit.

Figure 5-67 Load circuit details

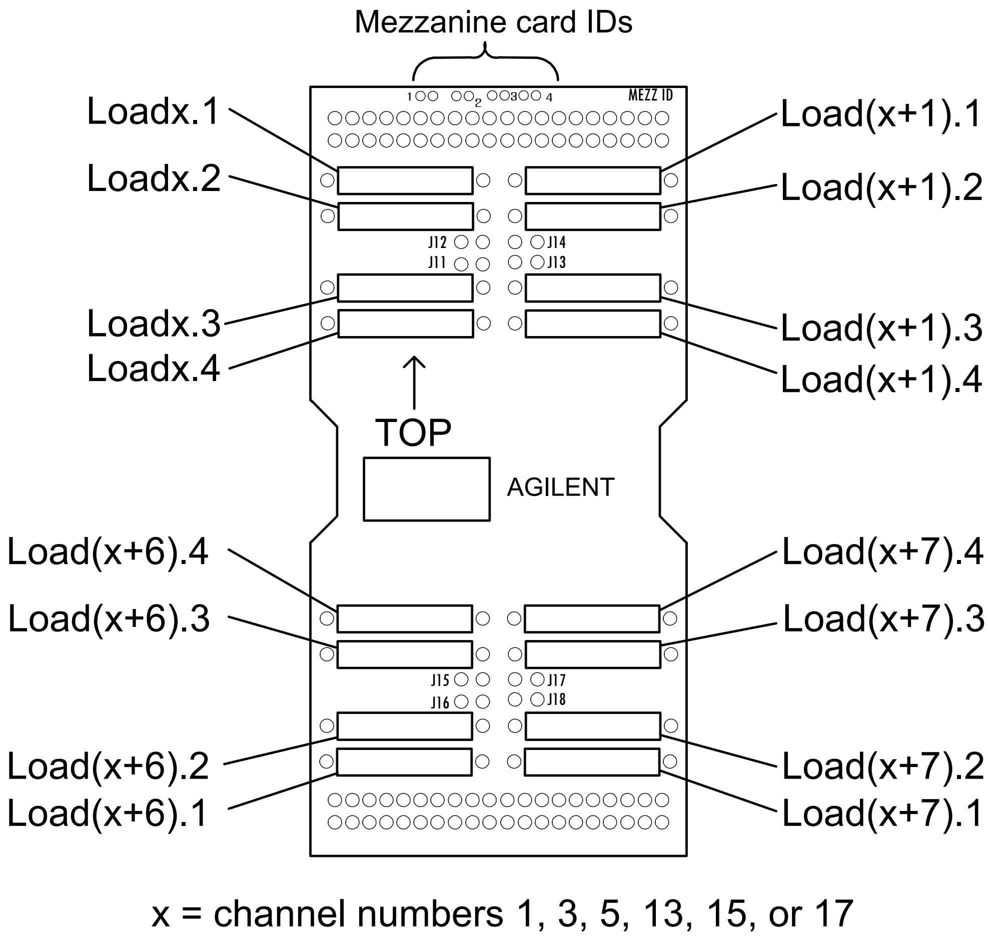


Connecting Loads

Loads are mounted on the Agilent N9378A's mezzanine cards (Figure 5-68). Up to four loads per channel can fit on each mezzanine card.

- The mezzanine cards plug into the 1-3 upper and 1-3 lower positions on the load card. The channel number depends on the placement of the mezzanine card. See Figure 5-66 for details of card placement and channel locations. You can also read the channel assignments from the printing on the front or back of the load card. (You may need to hold the load card at an angle to see the printing from the front when the mezzanine cards are installed.)
- The Mezzanine ID pins are located in pairs numbered 1-4 at the top of the card. This lets you identify each mezzanine card using a four-digit binary number (least-significant digit on the left at ID 1) that you can read back through the interface using the `loadCardGetInfo` action. (See the *TS-5000 System Software User's Guide* for more information.) All four bits are pulled to a high state on the load card PCA, so the default readback value is $0xF_h$. The left pin of each pair is the digital input, and the right pin is ground. Shorting a wire across the pair pulls the bit to the low binary state.

Figure 5-68 Agilent N9378A Load Mounting Area and CN1/J1 Connectors



Installing and Removing Mezzanine Cards

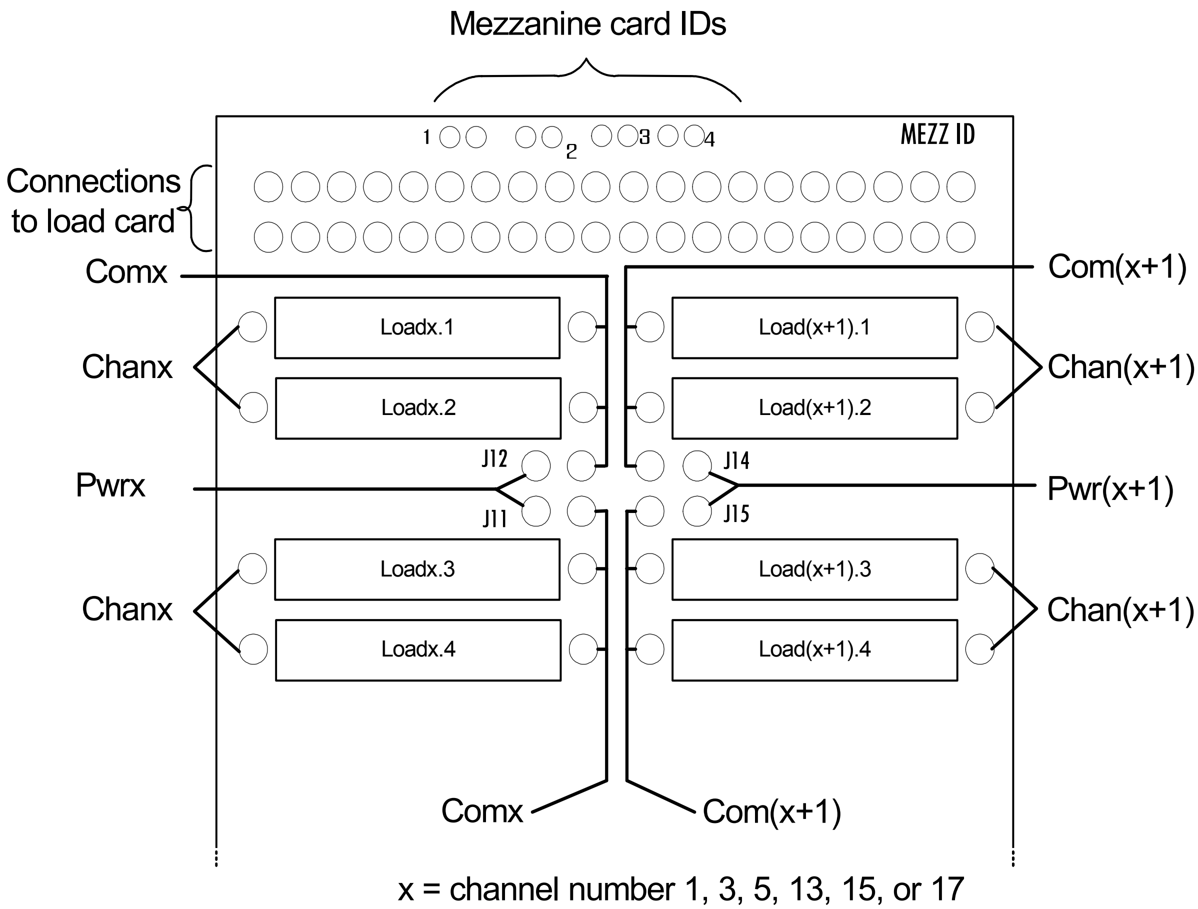
The mezzanine cards are held to the load card by the friction of the connector at the top and bottom. When installing a mezzanine card, apply even pressure to both top and bottom connectors to ensure good contact.

When removing a load card, you may need an appropriate prying tool to loosen the card from the connectors, especially when multiple cards are installed. Use the indentations on the sides of the card to loosen the card with the prying tool, then grasp the card and gently rock it back and forth until it is free of the connectors.

Wiring the Mezzanine Cards

Figure 5-69 shows a detailed view of the top half of a mezzanine card. The physical layout of the mezzanine card is identical for the N9378A (24-channel) and the N9379A (48-channel) load cards. However, the internal wiring of the N9378A card uses the mezzanine pin arrangements differently.

Figure 5-69 Mezzanine Card Pinouts for N9378A 24-Channel Load Card

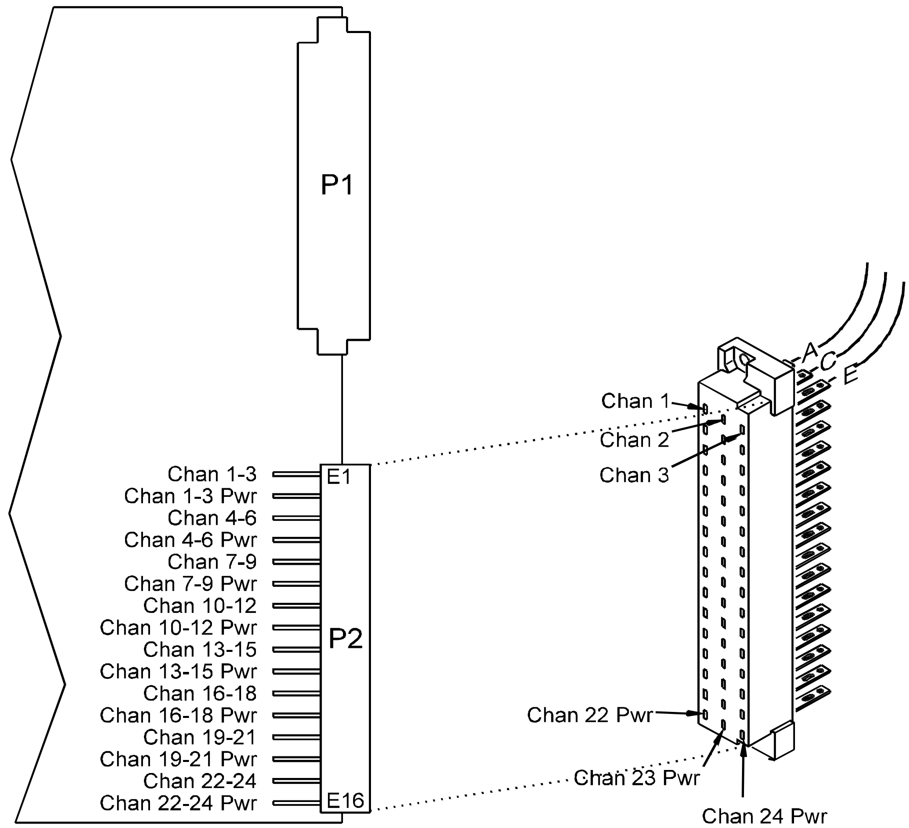


UUT Connections

When configured as part of a standard Agilent system, CN2 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 CN2. Figure 5-70 is a CN2 connector pinout showing the details.

Figure 5-70 Agilent N9378A UUT Connector



Using the Agilent N9379A 48-Channel High-Density Load Card

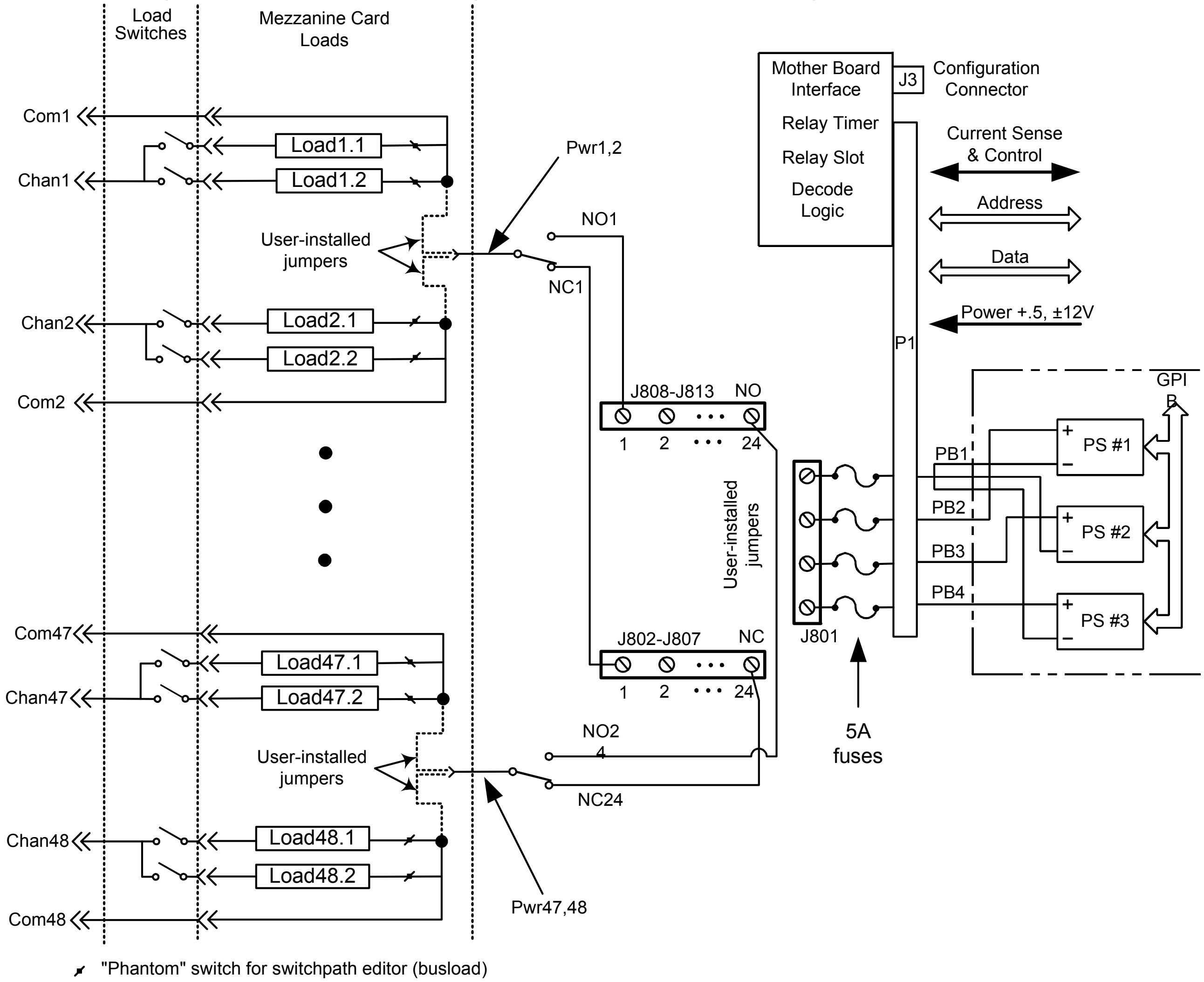
The Agilent N9379A 48-channel high-density load card is designed to work with loads mounted on mezzanine cards inside the Switch/Load Unit with up to eight dual loads per card. Figure 5-71 shows a block diagram of the Agilent N9379A.

- The card is one slot wide. “Card Location Recommendations"
- The card type is 06_h. “Load Card Type and Configuration ID"
- The factory default configuration is explained in “Selecting a Power Supply 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 lets you switch in an external power supply while bypassing the power bus of the SLU, for example. “Using the Power Switches as General Purpose Relays"
- The card is *not* equipped for current sensing.
- The card does *not* provide flyback voltage protection.
- Loads are mounted onboard on a series of mezzanine cards that plug into the load card. You can attach as many as two loads per channel. “Connecting Loads"
- Each channel is capable of up to 2A continuous carry into a resistive load.

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 a maximum of 2 A continuous. Do not exceed these specifications.

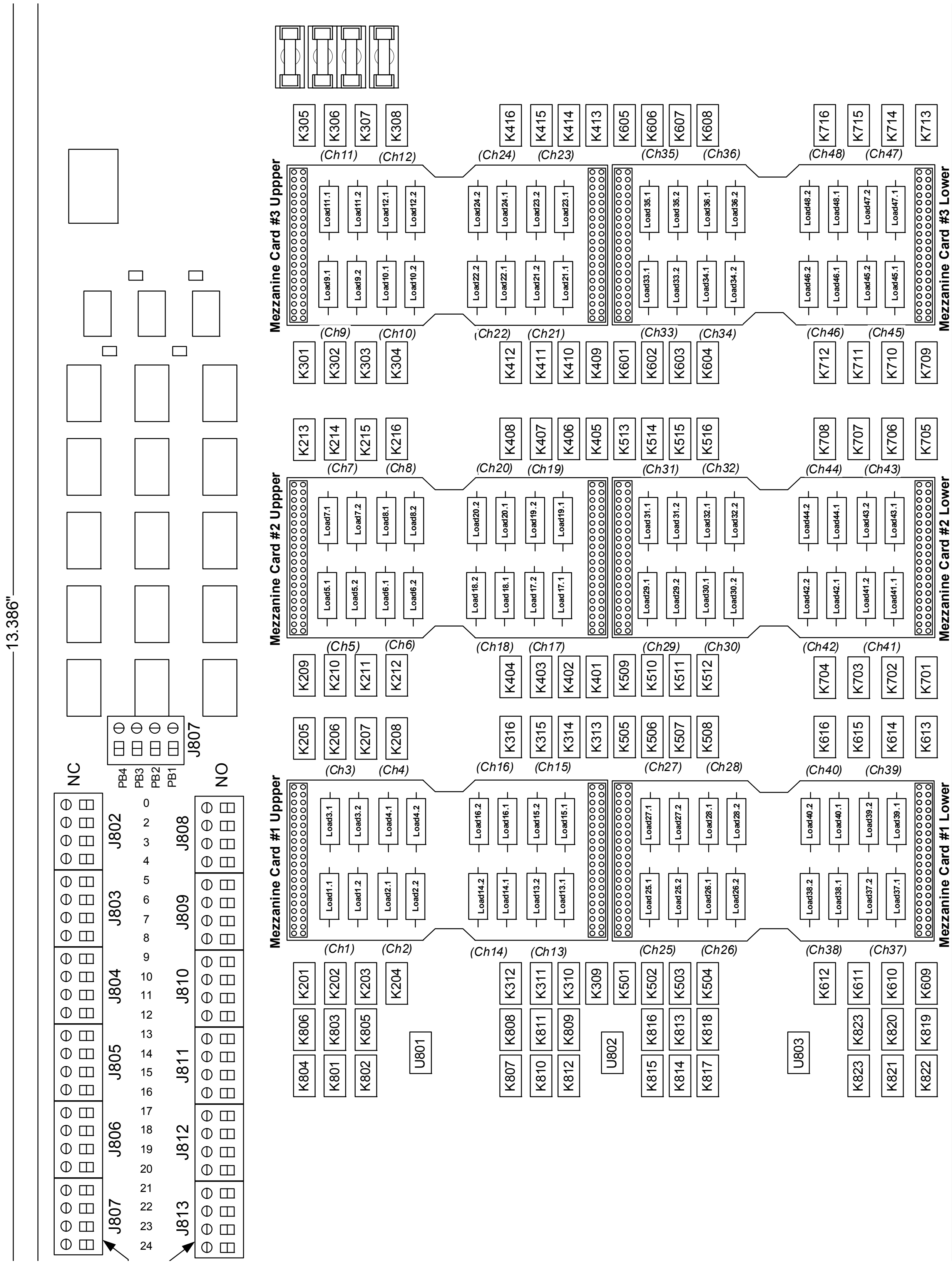
Figure 5-71 Agilent N9379A 48-Channel High-Density Load Card Block Diagram



Card Layout

Figure 5-72 shows the Agilent N9379A layout.

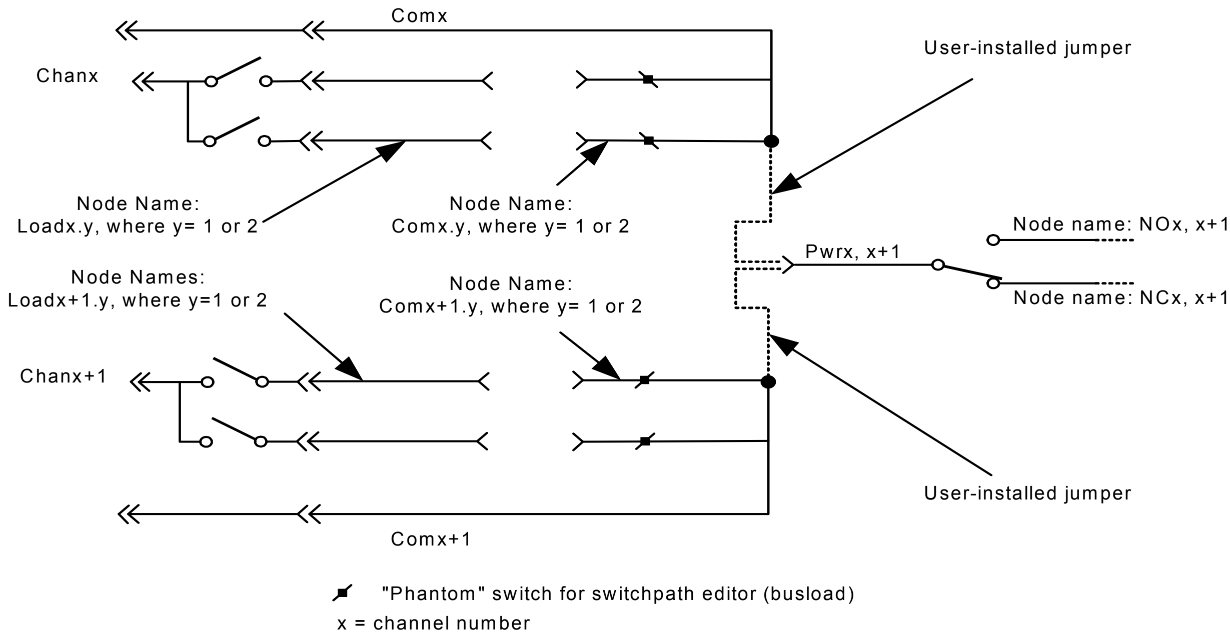
Figure 5-72 Agilent N9379A Layout



Load Circuit Details

Figure 5-73 shows the details of the load configuration circuit. Note that each power node is shared by two channels. (See "Connecting Loads" for details on connecting power to loads on the mezzanine cards.)

Figure 5-73 Load Circuit Details



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 J808–J813, and each NC terminal is connected to a pin on J802–J807. Each pin on J802–J813 can be connected to any of the four power busses on J801 via jumper wires (Figure 5-66). The terminal block jumpering allows convenient pull-up or pull-down of the various inputs. It also lets you terminate 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 J802–J807 together and one that ties all the pins on J808–J813 together. The NO pins are also jumpered to power bus 2, and the NC pins are jumpered to power bus 1. You can easily cut the combs for J802–J807 and J808–J813 to provide bus or pin isolation between the various input/power bus connections.

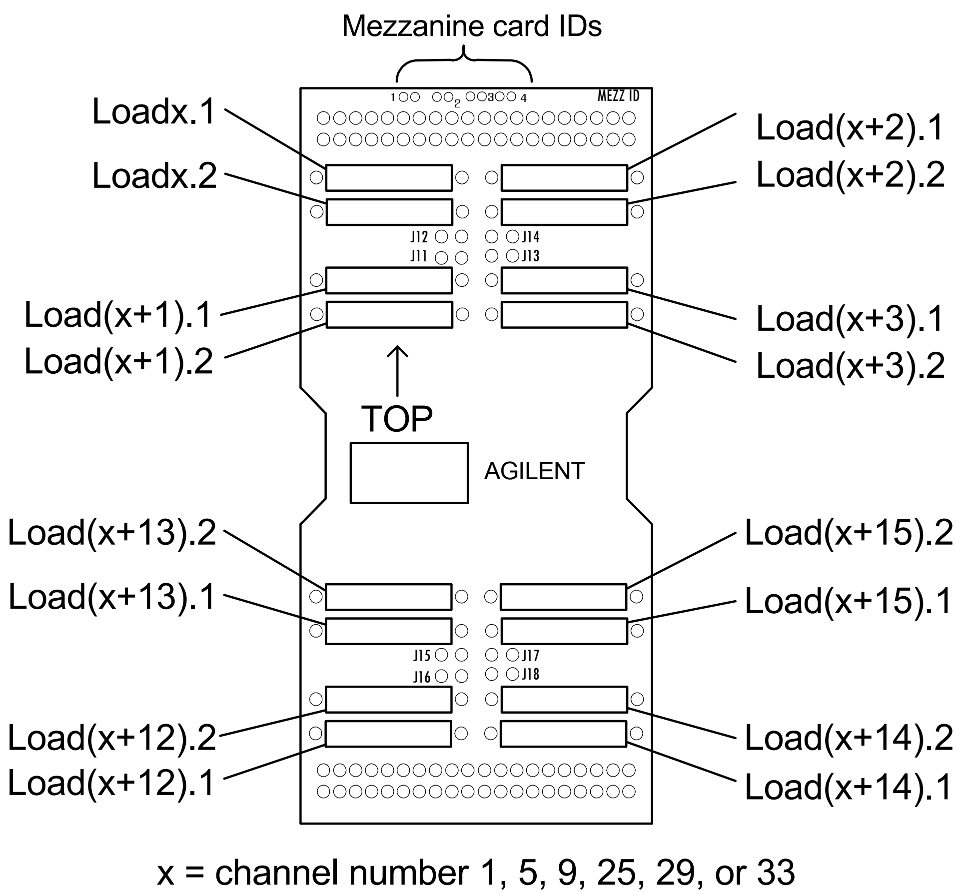
Using the Power Switches as General Purpose Relays

As with the E6177A and N9378A load cards, the N9379A 48-channel load card lets you use the load switching relay as a general-purpose switching relay. See "Using the Power Switches as General Purpose Relays" for more information.

Connecting Loads

Loads are mounted on the Agilent N9379A's mezzanine cards (Figure 5-74). Up to 16 loads can fit on each mezzanine card with two loads per channel. See Figure 5-72 for details of card placement and channel locations.

Figure 5-74 Agilent N9379A Mezzanine Card



- The mezzanine cards plug into the 1-3 upper and 1-3 lower positions on the load card. The channel number depends on the placement of the mezzanine card. You can also read the channel assignments from the printing on the front or back of the load card. (You may need to hold the load card at an angle to see the printing from the front when the mezzanine cards are installed.)
- The Mezzanine ID pins are located in pairs numbered 1-4 at the top of the card. This lets you identify each mezzanine card using a four-digit binary number (least-significant digit on the left at ID 1) that you can read back through the interface using the loadCardGetInfo action. (See the *TS-5000 System Software User's Guide* for more information.) All four bits are pulled to a high state on the load card PCA, so the default readback value is $0xF_h$. The left pin of each pair is the digital input, and the right pin is ground. Shorting a wire across the pair pulls the bit to the low binary state.

THIS PAGE IS INTENTIONALLY LEFT BLANK.

6
Using the Pin Matrix Cards

This chapter describes how to configure and use the Agilent Pin Matrix Cards which slots into the Switch/Load unit.

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

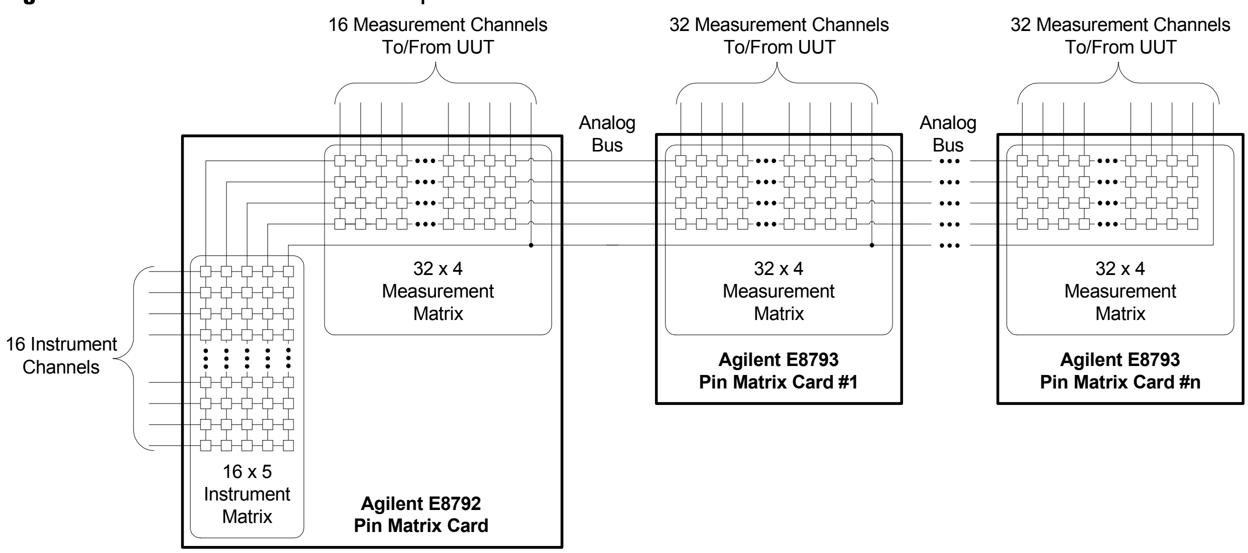
NOTE This chapter describes using the Agilent 8792A or 8782A as the Instrument Matrix. In some systems, the Agilent E6171B measurement Control Module may be used as the Instrument Matrix. Refer to the Agilent E6171B User's Manuals for more information.

Using the 32-Pin Matrix Cards

Conceptual Overview

Both the Agilent E8792A and E8793A 32-Pin Matrix Modules contain a 32 x 4 Measurement Matrix for switching signals to and from the Analog Bus. The Agilent E8792A also contains a 16 x 5 Instrument Matrix that connects external measuring instruments to the Analog Bus. Figure 6-1 is a simplified block diagram showing how the Agilent E8792A and E8793A are typically used together in a system. As shown in Figure 6-1, if you need more UUT connections, simply add more Agilent E8793A 32-Pin Matrix Cards to the bus.

Figure 6-1 Pin Matrix Cards Conceptual Overview



NOTE The AUX channels are not shown in Figure 6-1. Refer to Figure 6-3 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 (Agilent 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 6-2 is a detailed block diagram of the Agilent E8792A 32-Pin Matrix Card and Figure 6-3 is a detailed block diagram of the Agilent E8793A 32-Pin Matrix Card.

Differences Between the Cards

The primary difference between the two cards is that the Agilent 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 6-2 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 Agilent 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 discussion 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 6-2 and Figure 6-3, 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 Agilent 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 6-7.

Figure 6-2 Agilent E8792A Detailed Block Diagram

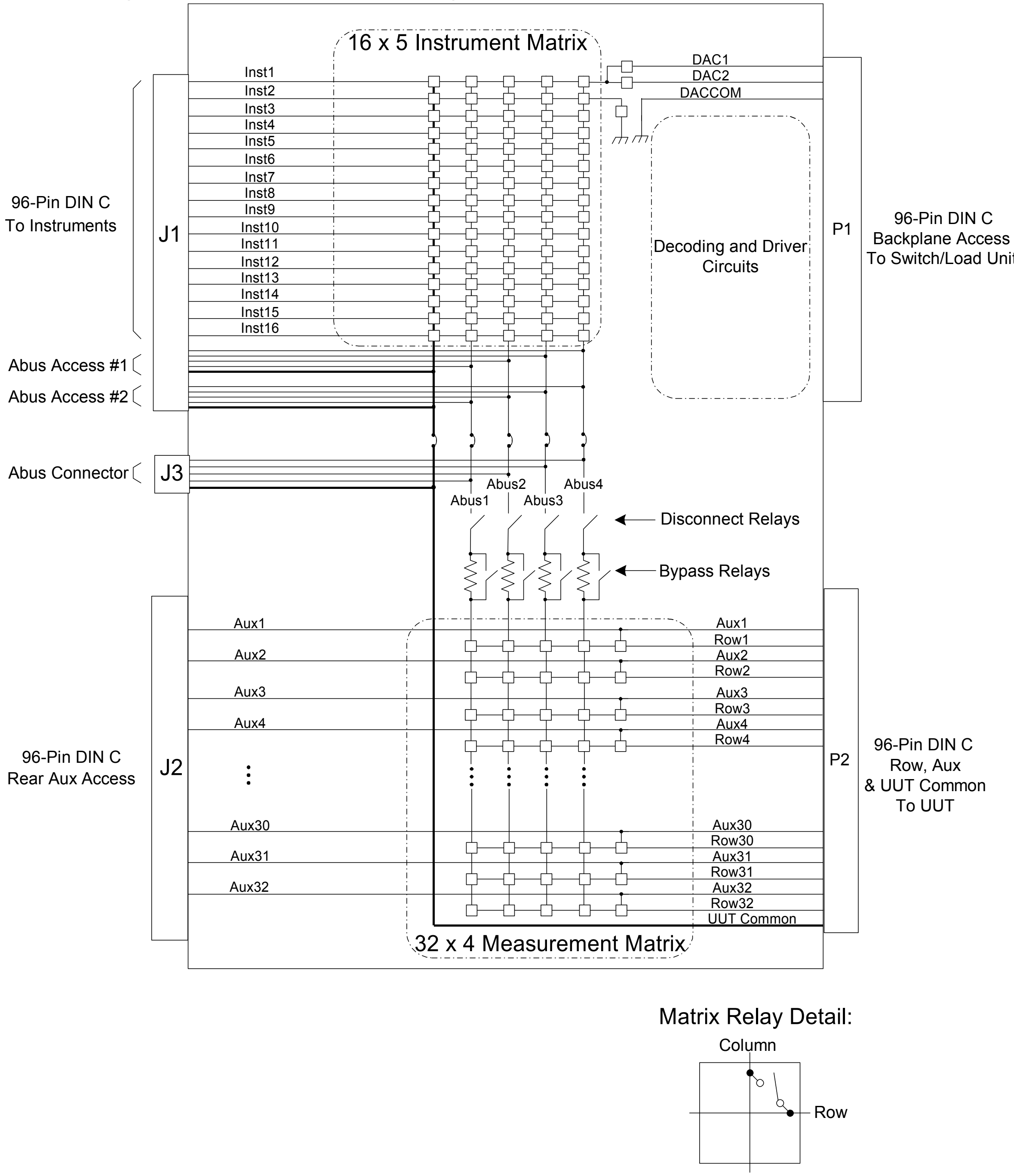
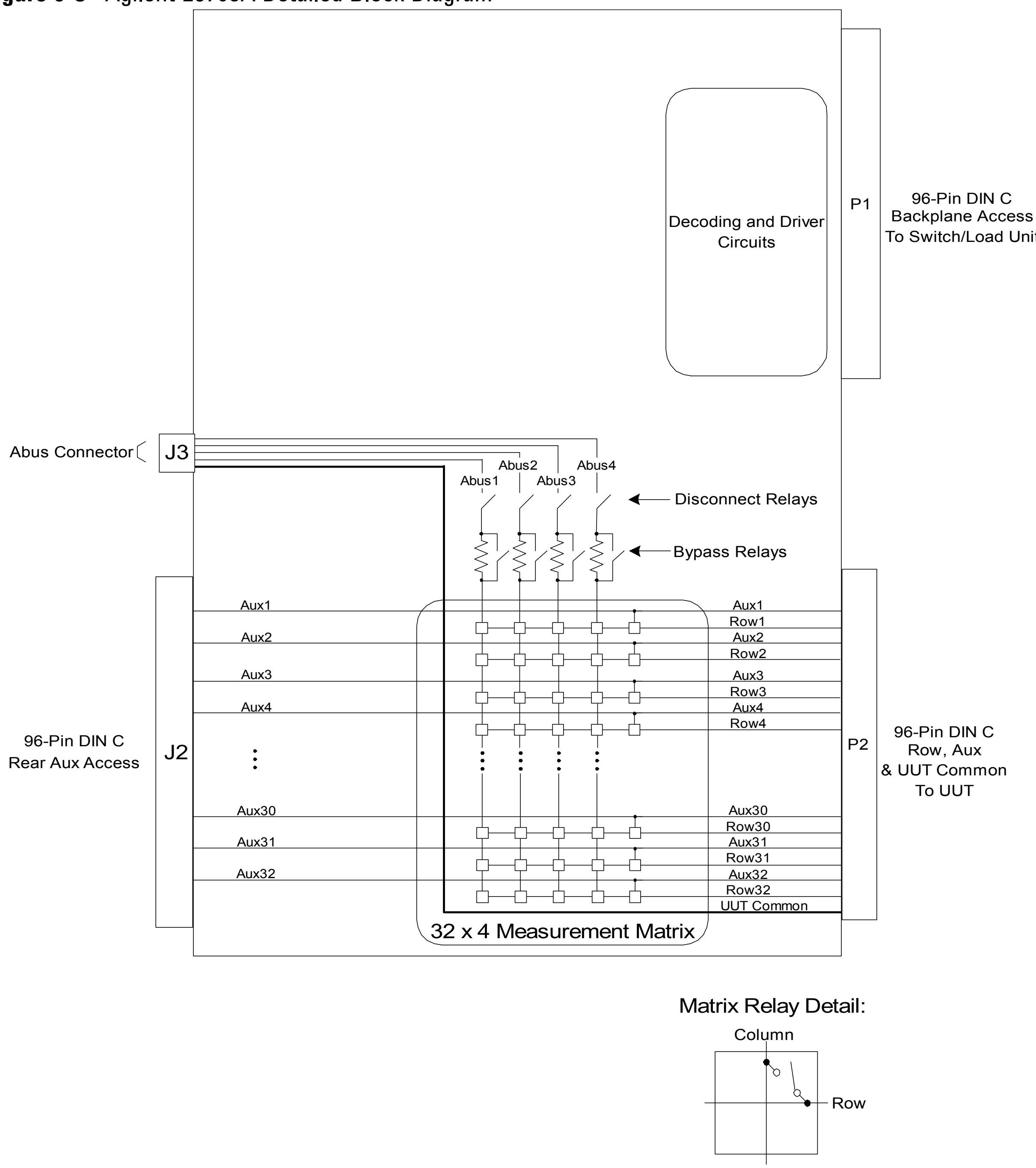


Figure 6-3 Agilent E8793A Detailed Block Diagram



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 (see Appendix B), relays may not yet be in the desired state. If the status is “not busy,” then the relays 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. Resetting also clears all relay registers, sets column disconnect relay control to automatic mode, and starts the relay timer.

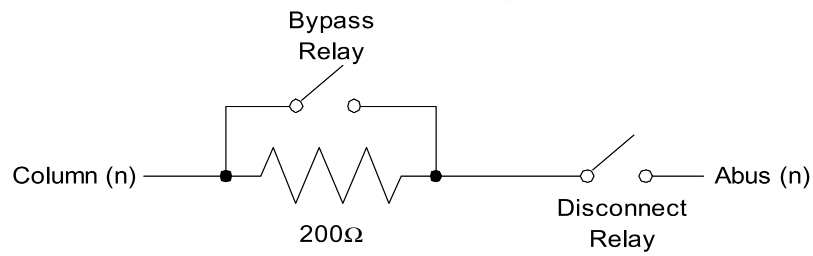
Protection Bypass

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 6-4 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 Agilent 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.

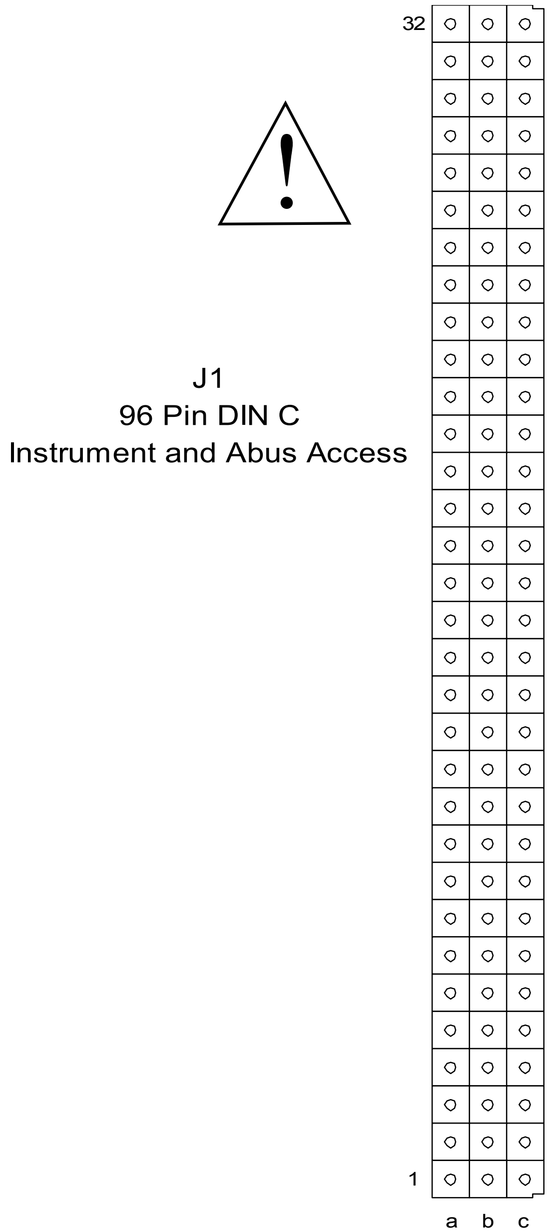
CAUTION

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 6-5 shows the pinouts for connector J1 which provides instrument and Abus access. J1 is available only on the Agilent E8792A 32-Pin Matrix Card.

Figure 6-5 J1 Pinouts--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

J1 Instrument Connections

Figure 6-6 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 lets you make either floating or earth-referenced connections as shown in Figure 6-6.

Figure 6-6 J1 Example Instrument Connections

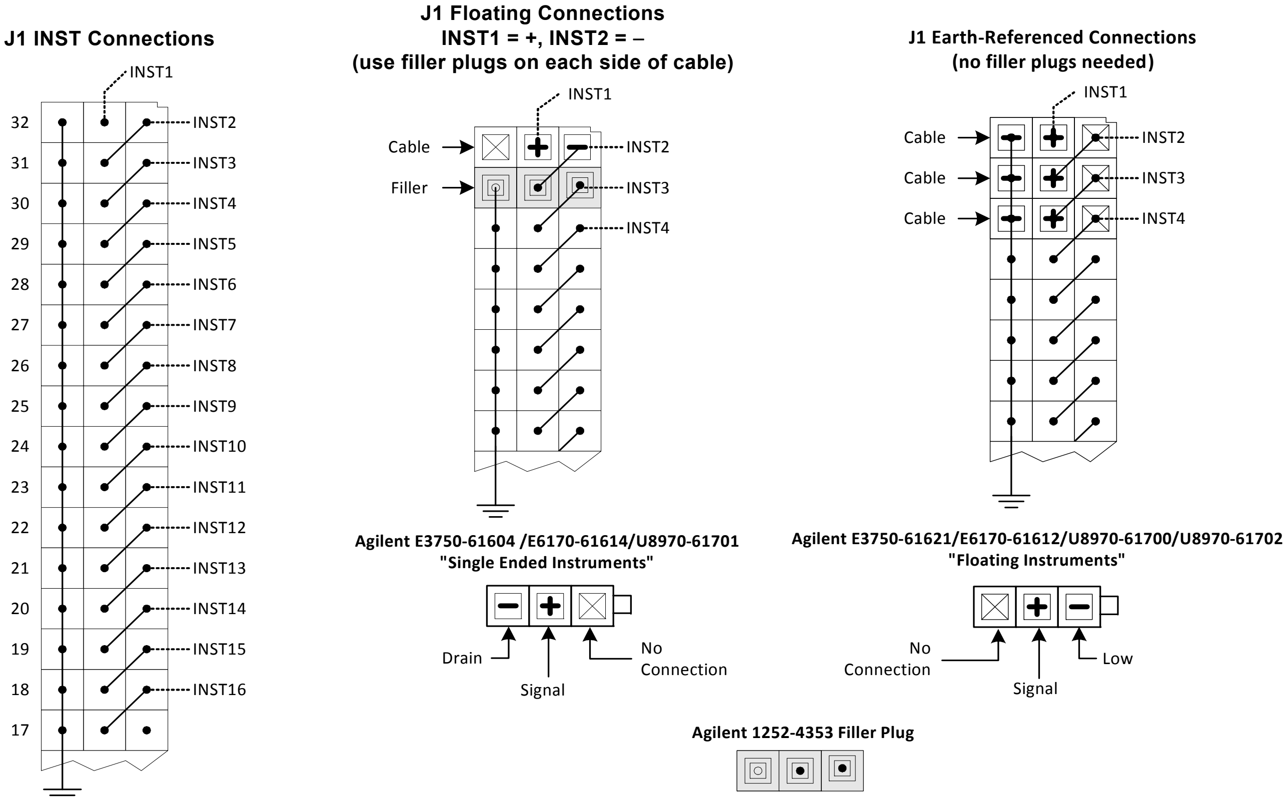


Figure 6-7 shows two typical BNC cables used for instrument connetions to J1 J2 Connector Pinouts.

Figure 6-7 Instrument BNC Cables

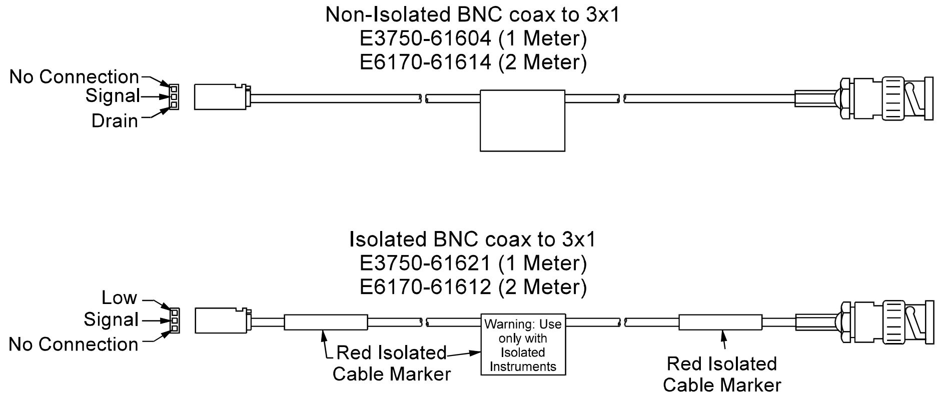
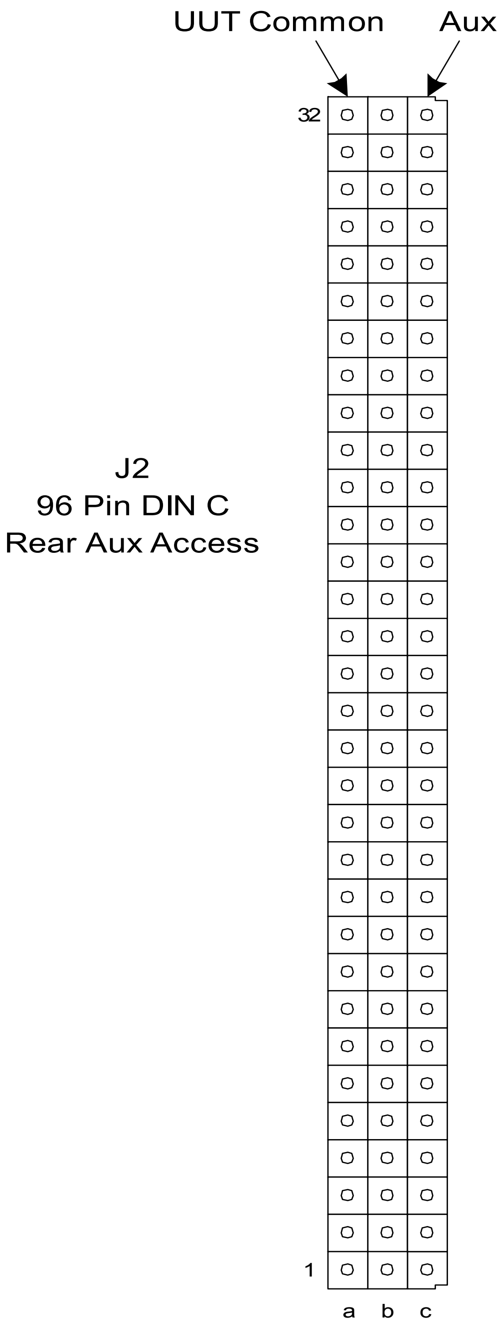


Figure 6-8 shows the pinouts for connector J2 which provides rear Aux line access.

Figure 6-8 J2 Pinouts--Rear Aux Access

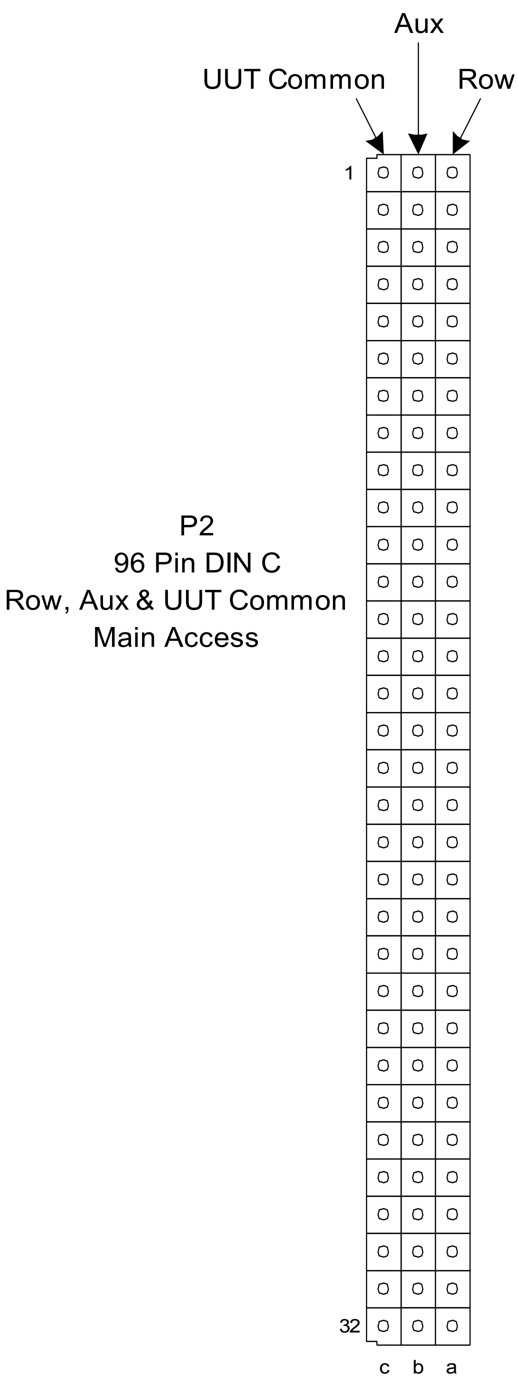


Row	a	b	c
32	UUT Common	System Ground	Aux32
31	UUT Common	System Ground	Aux31
30	UUT Common	System Ground	Aux30
29	UUT Common	System Ground	Aux29
28	UUT Common	System Ground	Aux28
27	UUT Common	System Ground	Aux27
26	UUT Common	System Ground	Aux26
25	UUT Common	System Ground	Aux25
24	UUT Common	System 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

P2 Connector Pinouts

Figure 6-9 shows the pinouts for connector P2 which provides Row, Aux and UUT Common access.

Figure 6-9 P2 Pinouts--Row, Aux, and UUT Common Main Access

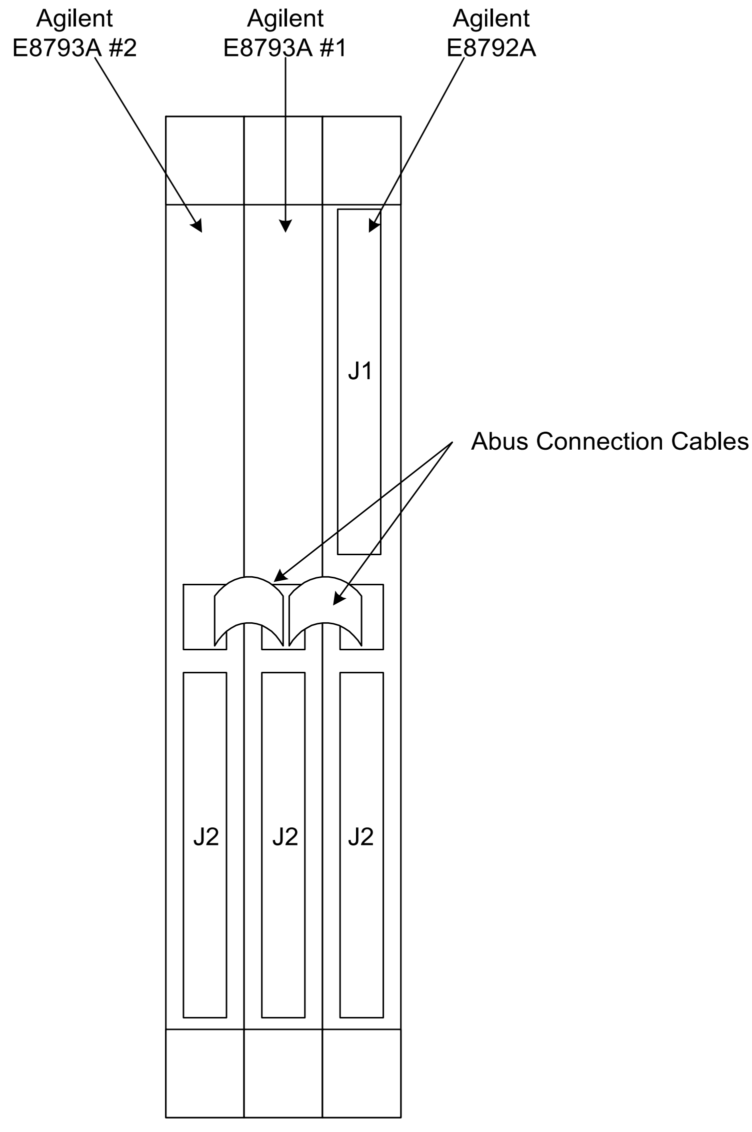


Row	c	b	a
1	UUT Common	Aux1	Row1
2	UUT Common	Aux2	Row2
3	UUT Common	Aux3	Row3
4	UUT Common	Aux4	Row4
5	UUT Common	Aux5	Row5
6	UUT Common	Aux6	Row6
7	UUT Common	Aux7	Row7
8	UUT Common	Aux8	Row8
9	UUT Common	Aux9	Row9
10	UUT Common	Aux10	Row10
11	UUT Common	Aux11	Row11
12	UUT Common	Aux12	Row12
13	UUT 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

Installing in the Switch/Load Unit

The Agilent 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 6-10 shows a typical installation.

Figure 6-10 Installed 32-Pin Matrix Cards

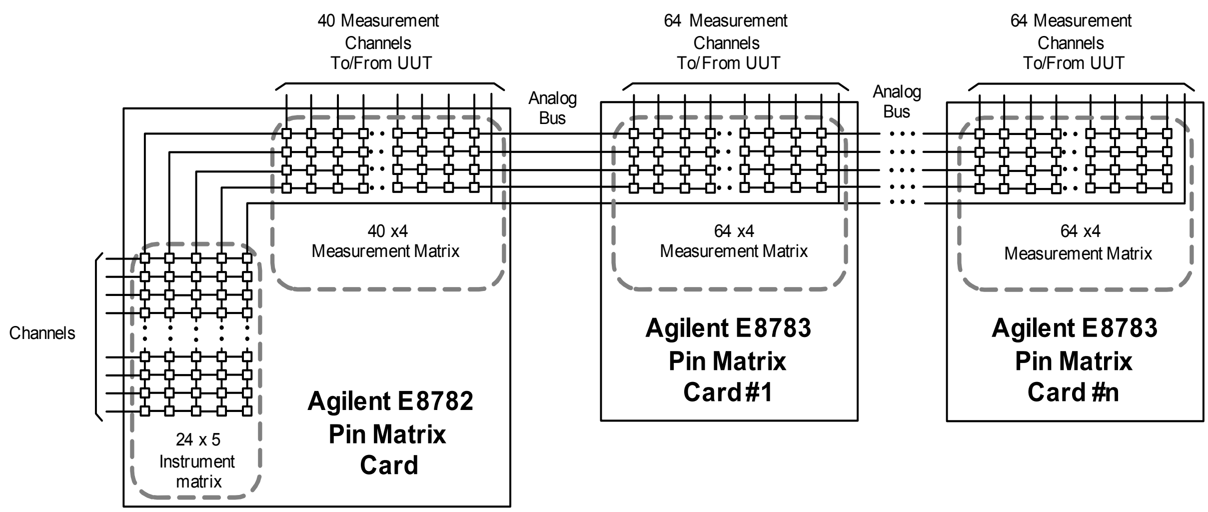


Using the 64-Pin Matrix Cards

Conceptual Overview

The Agilent E8782A Pin Matrix contains 40 x 4 Measurement Matrix for switching signals to and from the Analog Bus. It also contains a 24 x 5 Instrument Matrix that connects external measuring instruments to the Analog Bus. The E8783A Pin Matrix Modules contain only a 64 x 4 Measurement Matrix for switching signals to and from the Analog Bus. Figure 6-11 is a simplified block diagram showing how the Agilent E8782A and E8783A are typically used together in a system. As shown in Figure 6-11, if you need more UUT connections, simply add more Agilent E8783A Pin Matrix Cards to the bus.

Figure 6-11 Pin Matrix Cards Conceptual Overview



NOTE The AUX channels are not shown in Figure 6-11. Refer to Figure 6-12 and Figure 6-13 for detailed schematics of the pin matrix cards.

Features

Key features of the cards include:

- 24 x 5 high-speed reed relay Instrument Matrix and 40 x 4 high-speed reed relay Measurement Matrix (Agilent E8782A) 64 x 4 high-speed reed relay Measurement Matrix (Agilent E8783A)
- 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 6-12 is a detailed block diagram of the Agilent E8782A Pin Matrix Card and Figure 6-13 is a detailed block diagram of the Agilent E8783A Pin Matrix Card.

Differences Between the Cards

The Agilent E8782A contains a 24 x 5 Instrument Matrix and 40 x 4 Measurement Matrix. The Instrument Matrix is used to connect measurement or source instruments to the Analog Bus. Also notice in Figure 6-12 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. It also contains two additional sets of Analog Bus access on connector J1. The Agilent E8783A contains 64 x 4 Measurement Matrix only.

Features Common to Both Cards

The Pin Matrix Modules contain a 40 x 4 matrix of relays (for E8782A) or 64 x 4 matrix of relays (for E8783A), 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 6-12 and Figure 6-13, the Measurement Matrix is arranged in 64 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 Agilent E8782A. This 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 matrix of relays, there are switched auxiliary I/O lines (AUX) connected to each of the 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 rows, and on 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 in the following paragraphs starting on page 6-21.

Figure 6-12 Agilent E8782A Detailed Block Diagram

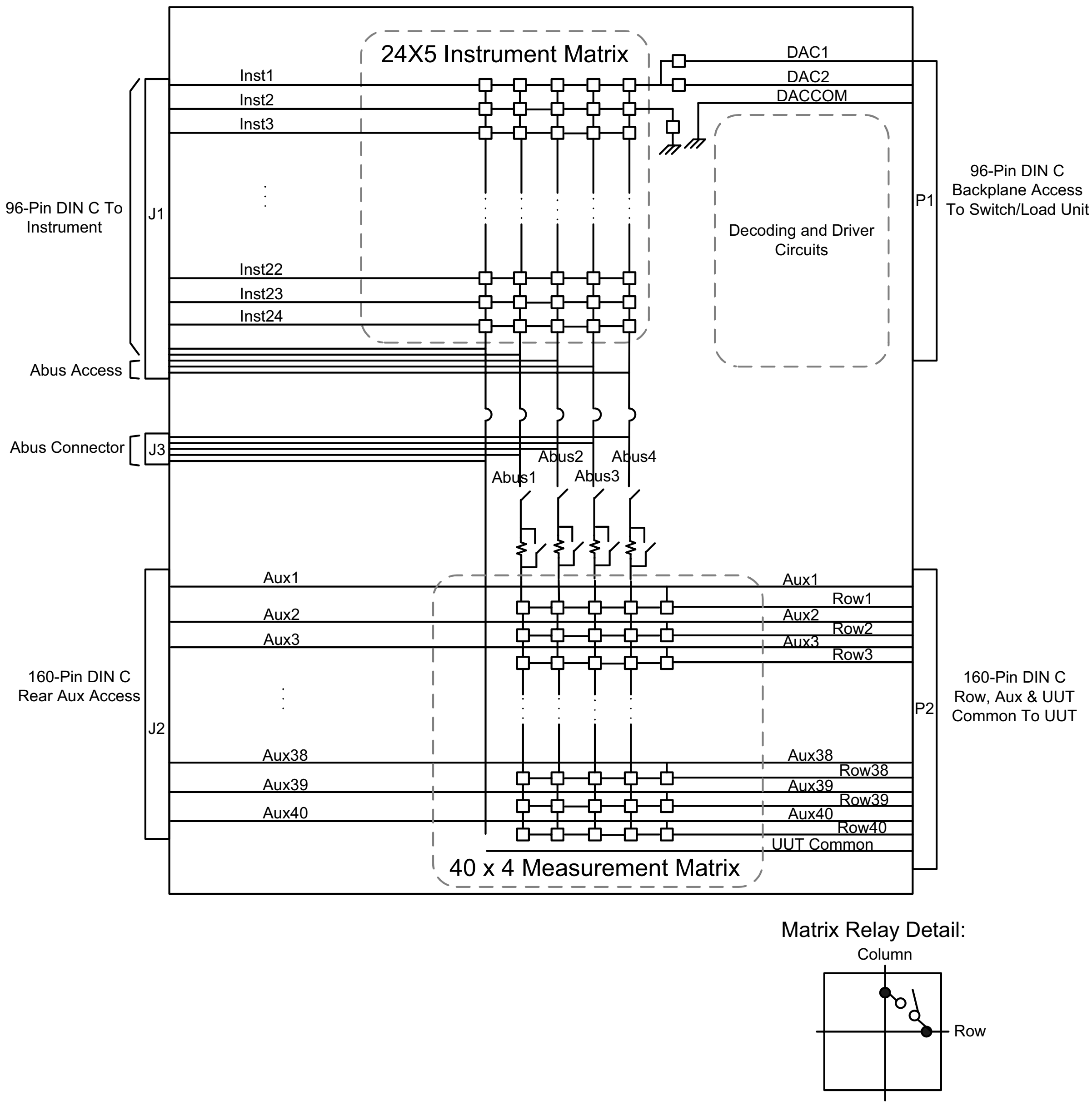
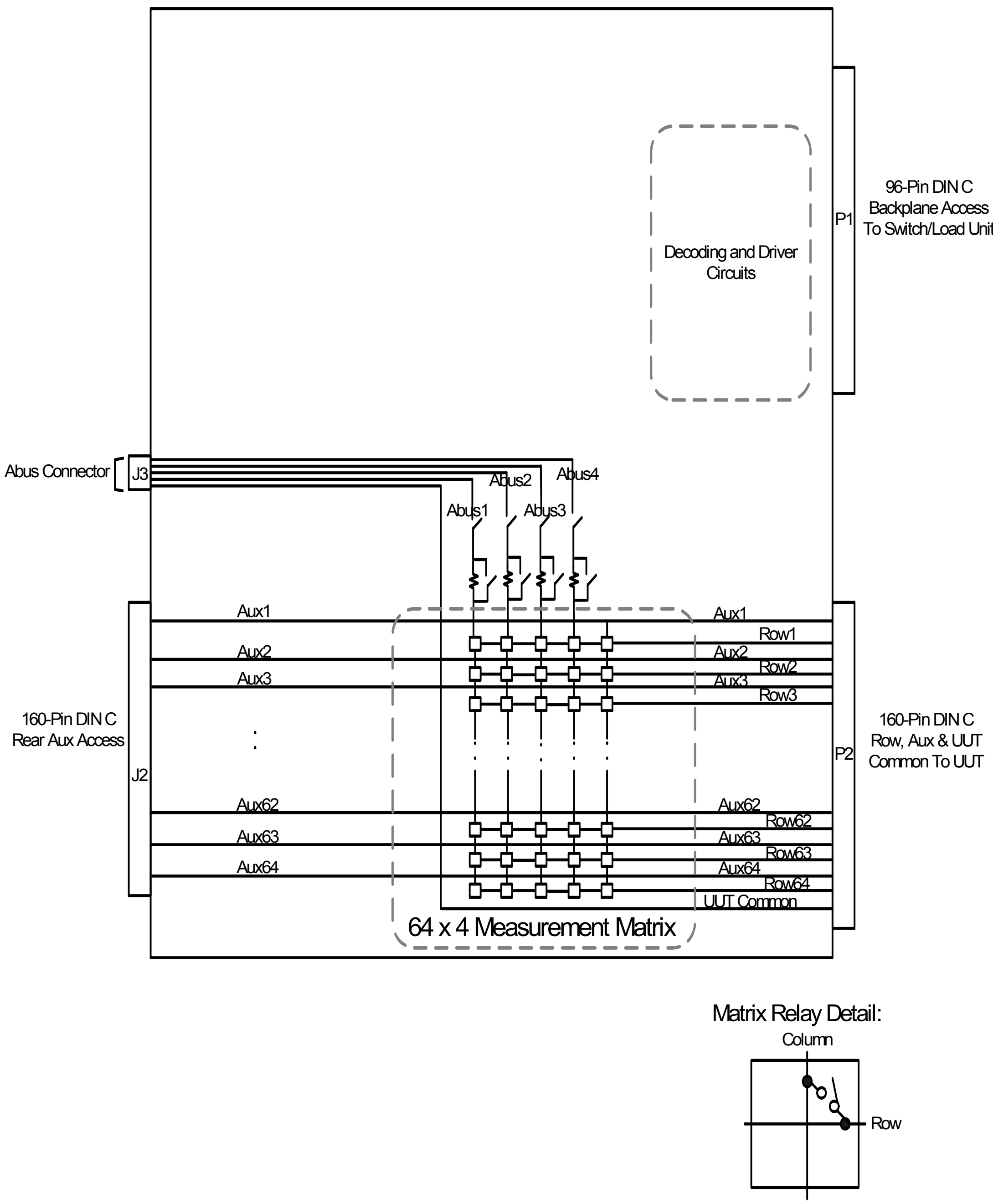


Figure 6-13 Agilent E8783A Detailed Block Diagram



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 (see Appendix B), relays may not yet be in the desired state. If the status is "not busy," then the relays have reached their newly programmed state. The nominal time-out value of the relay counter is 500 us.

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

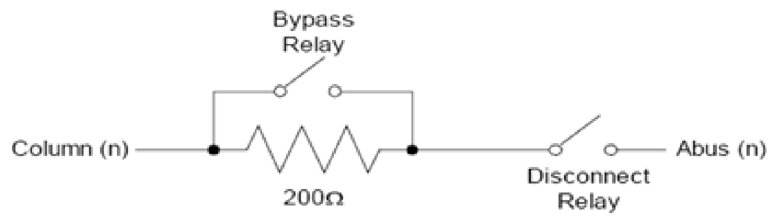
Bit 0 in the Control Register programmatically resets the card. Resetting the card clears all internal registers, which resets all board functionality to its default, power-up state. Resetting also clears all relay registers and starts the relay timer.

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 3-0 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, bypas the protection resistors only when absolutely necessary.

Figure 6-14 Column Disconnect and Bypass Protection 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 shows the pinouts for the Agilent E8782A and E8783A user connectors.

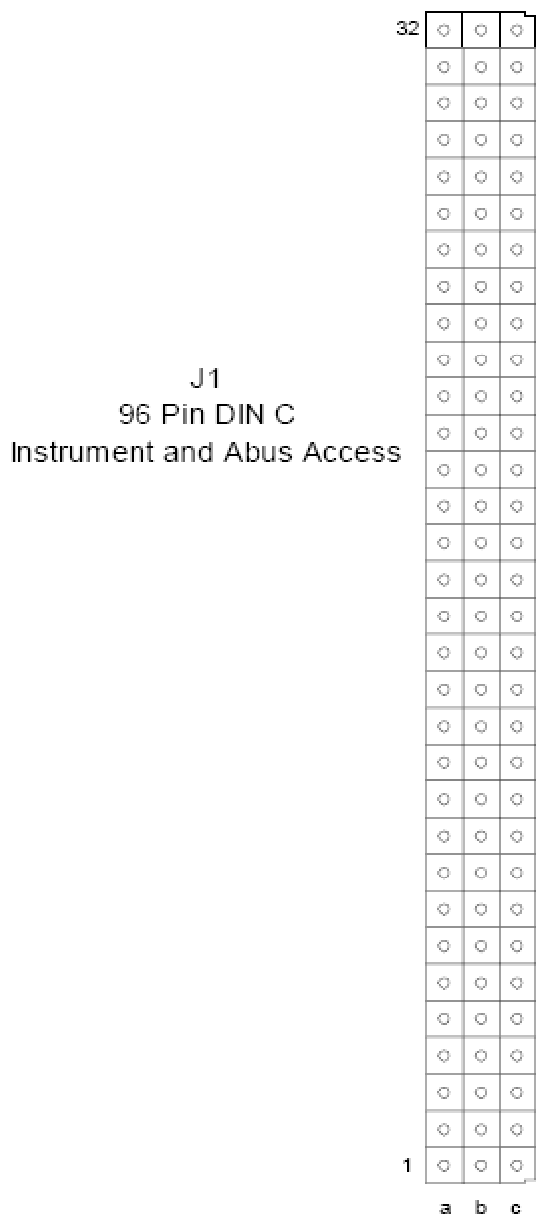
WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the Switch/Load Unit or plug-in cards. Before you remove any installed card, disconnect AC power from the mainframe and from other cards that may be connected to the cards**

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 6-15 shows the pinouts for connector J1 which provides instrument and Abus access. J1 is available only on the Agilent E8782A 64-Pin Matrix Card.

Figure 6-15 J1 Pinouts--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	INST17
16	Gnd	INST17	INST18
15	Gnd	INST18	INST19
14	Gnd	INST19	INST20
13	Gnd	INST20	INST21
12	Gnd	INST21	INST22
11	Gnd	INST22	INST23
10	Gnd	INST23	INST24
9	Gnd	INST24	NC
8	Gnd	Abus1	UUT Common
7	Gnd	Abus2	UUT Common
6	Gnd	Abus3	UUT Common
5	Gnd	Abus4	UUT Common
4	Gnd	Abus1	UUT Common
3	Gnd	Abus2	UUT Common
2	Gnd	Abus3	UUT Common
1	Gnd	Abus4	UUT Common

J1 Instrument Connections

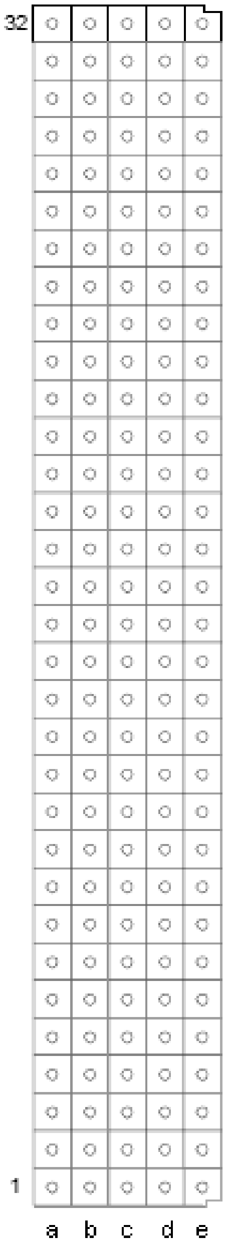
The instrument connection on J1 connector is illustrated in Figure 6-6. For E8782A, the instrument number extends to instrument 24.

The typical BNC cables used for instrument connections to J1, J2 Connector Pinouts are shown in Figure 6-7.

Figure 6-16 shows the pinouts for connector J2 which provides rear Aux line access for E8782A.

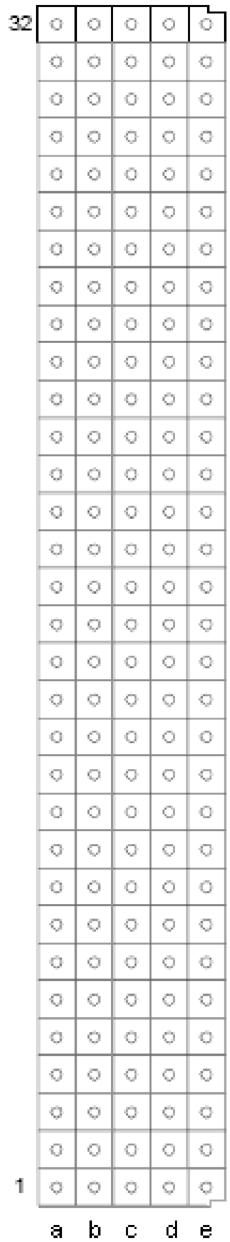
Figure 6-17 shows the pinouts for connector J2 which provides rear Aux line access for E8783A.

Figure 6-16 J2 Pinouts--Rear Aux Access for E8782A



Row	a	b	c	d	e
32	Aux1	UUT Common	System Ground	UUT Common	AUX 33
31	Aux2	UUT Common	System Ground	UUT Common	AUX 34
30	Aux3	UUT Common	System Ground	UUT Common	AUX 35
29	Aux4	UUT Common	System Ground	UUT Common	AUX 36
28	Aux5	UUT Common	System Ground	UUT Common	AUX 37
27	Aux6	UUT Common	System Ground	UUT Common	AUX 38
26	Aux7	UUT Common	System Ground	UUT Common	AUX 39
25	Aux8	UUT Common	System Ground	UUT Common	AUX 40
24	Aux9	UUT Common	System Ground	NC	NC
23	Aux10	UUT Common	System Ground	NC	NC
22	Aux11	UUT Common	System Ground	NC	NC
21	Aux12	UUT Common	System Ground	NC	NC
20	Aux13	UUT Common	System Ground	NC	NC
19	Aux14	UUT Common	System Ground	NC	NC
18	Aux15	UUT Common	System Ground	NC	NC
17	Aux16	UUT Common	System Ground	NC	NC
16	Aux17	UUT Common	System Ground	NC	NC
15	Aux18	UUT Common	System Ground	NC	NC
14	Aux19	UUT Common	System Ground	NC	NC
13	Aux20	UUT Common	System Ground	NC	NC
12	Aux21	UUT Common	System Ground	NC	NC
11	Aux22	UUT Common	System Ground	NC	NC
10	Aux23	UUT Common	System Ground	NC	NC
9	Aux24	UUT Common	System Ground	NC	NC
8	Aux25	UUT Common	System Ground	NC	NC
7	Aux26	UUT Common	System Ground	NC	NC
6	Aux27	UUT Common	System Ground	NC	NC
5	Aux28	UUT Common	System Ground	NC	NC
4	Aux29	UUT Common	System Ground	NC	NC
3	Aux30	UUT Common	System Ground	NC	NC
2	Aux31	UUT Common	System Ground	NC	NC
1	Aux32	UUT Common	System Ground	NC	NC

Figure 6-17 J2 Pinouts--Rear Aux Access for E8783A



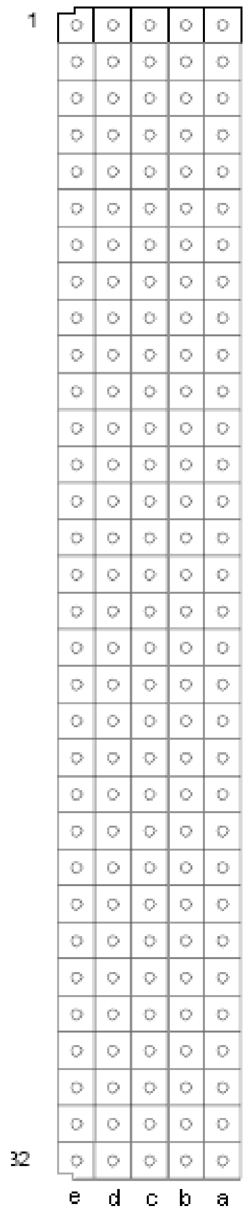
J2 160 Pin DIN Rear Aux Access

Row	a	b	c	d	e
32	Aux1	UUT Common	System Ground	UUT Common	AUX 33
31	Aux2	UUT Common	System Ground	UUT Common	AUX 34
30	Aux3	UUT Common	System Ground	UUT Common	AUX 35
29	Aux4	UUT Common	System Ground	UUT Common	AUX 36
28	Aux5	UUT Common	System Ground	UUT Common	AUX 37
27	Aux6	UUT Common	System Ground	UUT Common	AUX 38
26	Aux7	UUT Common	System Ground	UUT Common	AUX 39
25	Aux8	UUT Common	System Ground	UUT Common	AUX 40
24	Aux9	UUT Common	System Ground	UUT Common	AUX 41
23	Aux10	UUT Common	System Ground	UUT Common	AUX 42
22	Aux11	UUT Common	System Ground	UUT Common	AUX 43
21	Aux12	UUT Common	System Ground	UUT Common	AUX 44
20	Aux13	UUT Common	System Ground	UUT Common	AUX 45
19	Aux14	UUT Common	System Ground	UUT Common	AUX 46
18	Aux15	UUT Common	System Ground	UUT Common	AUX 47
17	Aux16	UUT Common	System Ground	UUT Common	AUX 48
16	Aux17	UUT Common	System Ground	UUT Common	AUX 49
15	Aux18	UUT Common	System Ground	UUT Common	AUX 50
14	Aux19	UUT Common	System Ground	UUT Common	AUX 51
13	Aux20	UUT Common	System Ground	UUT Common	AUX 52
12	Aux21	UUT Common	System Ground	UUT Common	AUX 53
11	Aux22	UUT Common	System Ground	UUT Common	AUX 54
10	Aux23	UUT Common	System Ground	UUT Common	AUX 55
9	Aux24	UUT Common	System Ground	UUT Common	AUX 56
8	Aux25	UUT Common	System Ground	UUT Common	AUX 57
7	Aux26	UUT Common	System Ground	UUT Common	AUX 58
6	Aux27	UUT Common	System Ground	UUT Common	AUX 59
5	Aux28	UUT Common	System Ground	UUT Common	AUX 60
4	Aux29	UUT Common	System Ground	UUT Common	AUX 61
3	Aux30	UUT Common	System Ground	UUT Common	AUX 62
2	Aux31	UUT Common	System Ground	UUT Common	AUX 63
1	Aux32	UUT Common	System Ground	UUT Common	AUX 64

P2 Connector Pinouts

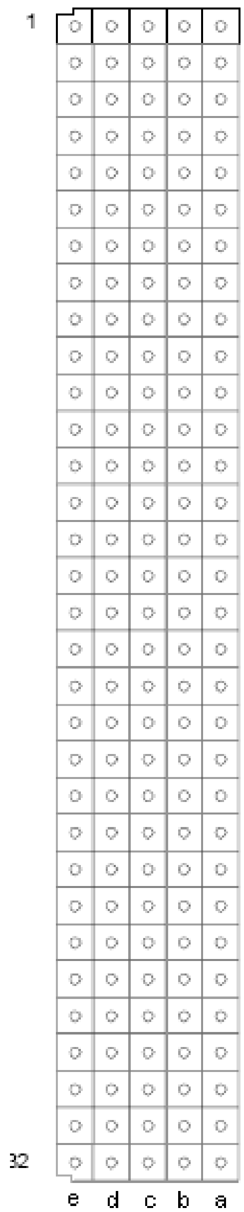
Figure 6-18 shows the pinouts for connector P2 which provides Row, Aux and UUT Common access.

Figure 6-18 P2 Pinouts--Row, Aux, and UUT Common Main Access for E8782A



Row	e	d	c	b	a
1	Row 1	Row 33	Aux1	Aux33	UUT Common
2	Row 2	Row 34	Aux2	Aux34	UUT Common
3	Row 3	Row 35	Aux3	Aux35	UUT Common
4	Row 4	Row 36	Aux4	Aux36	UUT Common
5	Row 5	Row 37	Aux5	Aux37	UUT Common
6	Row 6	Row 38	Aux6	Aux38	UUT Common
7	Row 7	Row 39	Aux7	Aux39	UUT Common
8	Row 8	Row 40	Aux8	Aux40	UUT Common
9	Row 9	NC	Aux9	NC	UUT Common
10	Row 10	NC	Aux10	NC	UUT Common
11	Row 11	NC	Aux11	NC	UUT Common
12	Row 12	NC	Aux12	NC	UUT Common
13	Row 13	NC	Aux13	NC	UUT Common
14	Row 14	NC	Aux14	NC	UUT Common
15	Row 15	NC	Aux15	NC	UUT Common
16	Row 16	NC	Aux16	NC	UUT Common
17	Row 17	NC	Aux17	NC	UUT Common
18	Row 18	NC	Aux18	NC	UUT Common
19	Row 19	NC	Aux19	NC	UUT Common
20	Row 20	NC	Aux20	NC	UUT Common
21	Row 21	NC	Aux21	NC	UUT Common
22	Row 22	NC	Aux22	NC	UUT Common
23	Row 23	NC	Aux23	NC	UUT Common
24	Row 24	NC	Aux24	NC	UUT Common
25	Row 25	NC	Aux25	NC	UUT Common
26	Row 26	NC	Aux26	NC	UUT Common
27	Row 27	NC	Aux27	NC	UUT Common
28	Row 28	NC	Aux28	NC	UUT Common
29	Row 29	NC	Aux29	NC	UUT Common
30	Row 30	NC	Aux30	NC	UUT Common
31	Row 31	NC	Aux31	NC	UUT Common
32	Row 32	NC	Aux32	NC	UUT Common

Figure 6-19 P2 Pinouts-Row, Aux, and UUT Common Main Access for E8783A



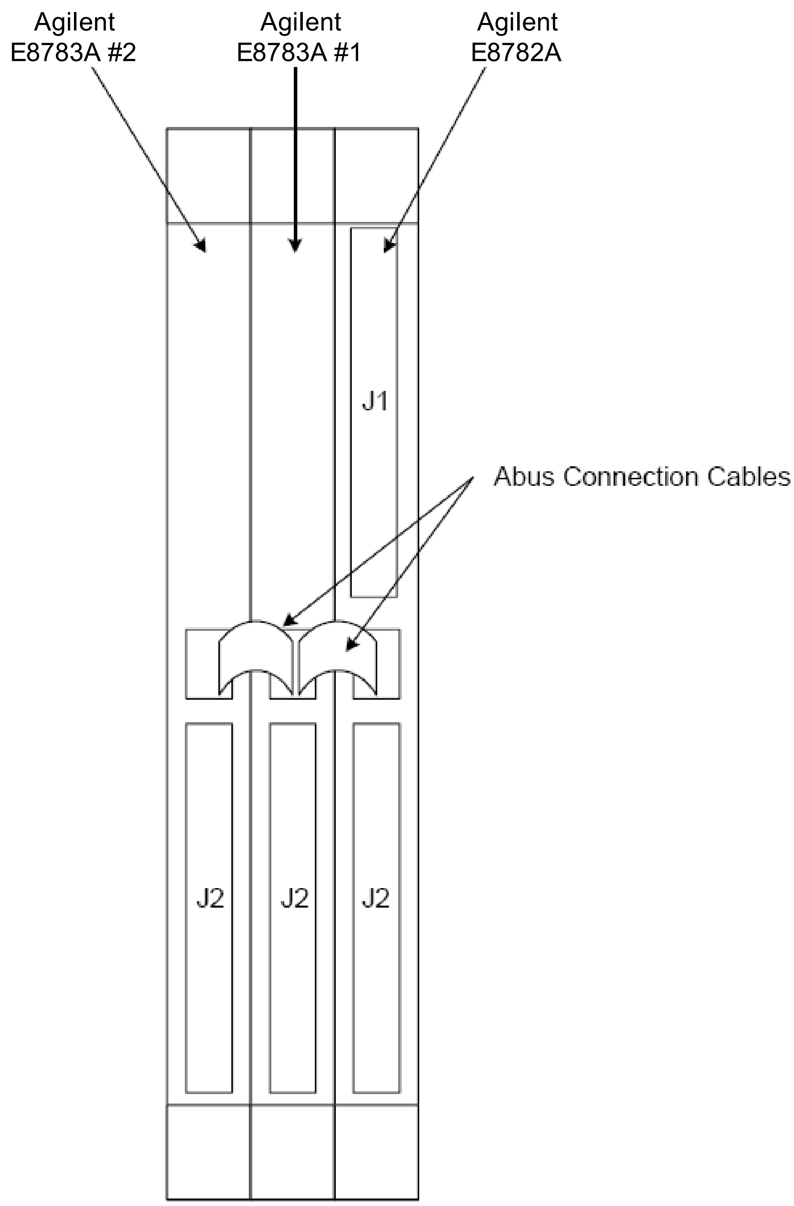
P2 160 Pin DIN
Row, Aux & UUT
Common To UUT

Row	e	d	c	b	a
1	Row 1	Row 33	Aux1	Aux33	UUT Common
2	Row 2	Row 34	Aux2	Aux34	UUT Common
3	Row 3	Row 35	Aux3	Aux35	UUT Common
4	Row 4	Row 36	Aux4	Aux36	UUT Common
5	Row 5	Row 37	Aux5	Aux37	UUT Common
6	Row 6	Row 38	Aux6	Aux38	UUT Common
7	Row 7	Row 39	Aux7	Aux39	UUT Common
8	Row 8	Row 40	Aux8	Aux40	UUT Common
9	Row 9	Row 41	Aux9	Aux41	UUT Common
10	Row 10	Row 42	Aux10	Aux42	UUT Common
11	Row 11	Row 43	Aux11	Aux43	UUT Common
12	Row 12	Row 44	Aux12	Aux44	UUT Common
13	Row 13	Row 45	Aux13	Aux45	UUT Common
14	Row 14	Row 46	Aux14	Aux46	UUT Common
15	Row 15	Row 47	Aux15	Aux47	UUT Common
16	Row 16	Row 48	Aux16	Aux48	UUT Common
17	Row 17	Row 49	Aux17	Aux49	UUT Common
18	Row 18	Row 50	Aux18	Aux50	UUT Common
19	Row 19	Row 51	Aux19	Aux51	UUT Common
20	Row 20	Row 52	Aux20	Aux52	UUT Common
21	Row 21	Row 53	Aux21	Aux53	UUT Common
22	Row 22	Row 54	Aux22	Aux54	UUT Common
23	Row 23	Row 55	Aux23	Aux55	UUT Common
24	Row 24	Row 56	Aux24	Aux56	UUT Common
25	Row 25	Row 57	Aux25	Aux57	UUT Common
26	Row 26	Row 58	Aux26	Aux58	UUT Common
27	Row 27	Row 59	Aux27	Aux59	UUT Common
28	Row 28	Row 60	Aux28	Aux60	UUT Common
29	Row 29	Row 61	Aux29	Aux61	UUT Common
30	Row 30	Row 62	Aux30	Aux62	UUT Common
31	Row 31	Row 63	Aux31	Aux63	UUT Common
32	Row 32	Row 64	Aux32	Aux64	UUT Common

Installing in the Switch/Load Unit

The Agilent E8782A/E8783A 64-Pin Matrix Card can be installed in any available Switch/Load Unit slot. The Analog Bus connection cables require that all 64-Pin Matrix Cards be in adjacent slots (so the cables will be able to reach each slot). Figure 6-20 shows a typical installation.

Figure 6-20 Installed 32-Pin Matrix Cards



THIS PAGE IS INTENTIONALLY LEFT BLANK.

7
Using the Custom Card

The Agilent E8794A Custom Card provides a general-purpose breadboard card for system integrators to add custom circuitry. The card can also emulate the Agilent TS-5430 Series I. This chapter describes how to configure and use the E8794A.

Register descriptions for the custom card are located in Appendix B of this manual.

General-Purpose Breadboard

The custom card contains a breadboard area of through-holes on 0.1" centers for soldering custom circuitry (see Figure 7-1).

TS-5430 Series I Emulation

The E8794A may be used to provide routing and breadboard support similar to that found on the Agilent 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.

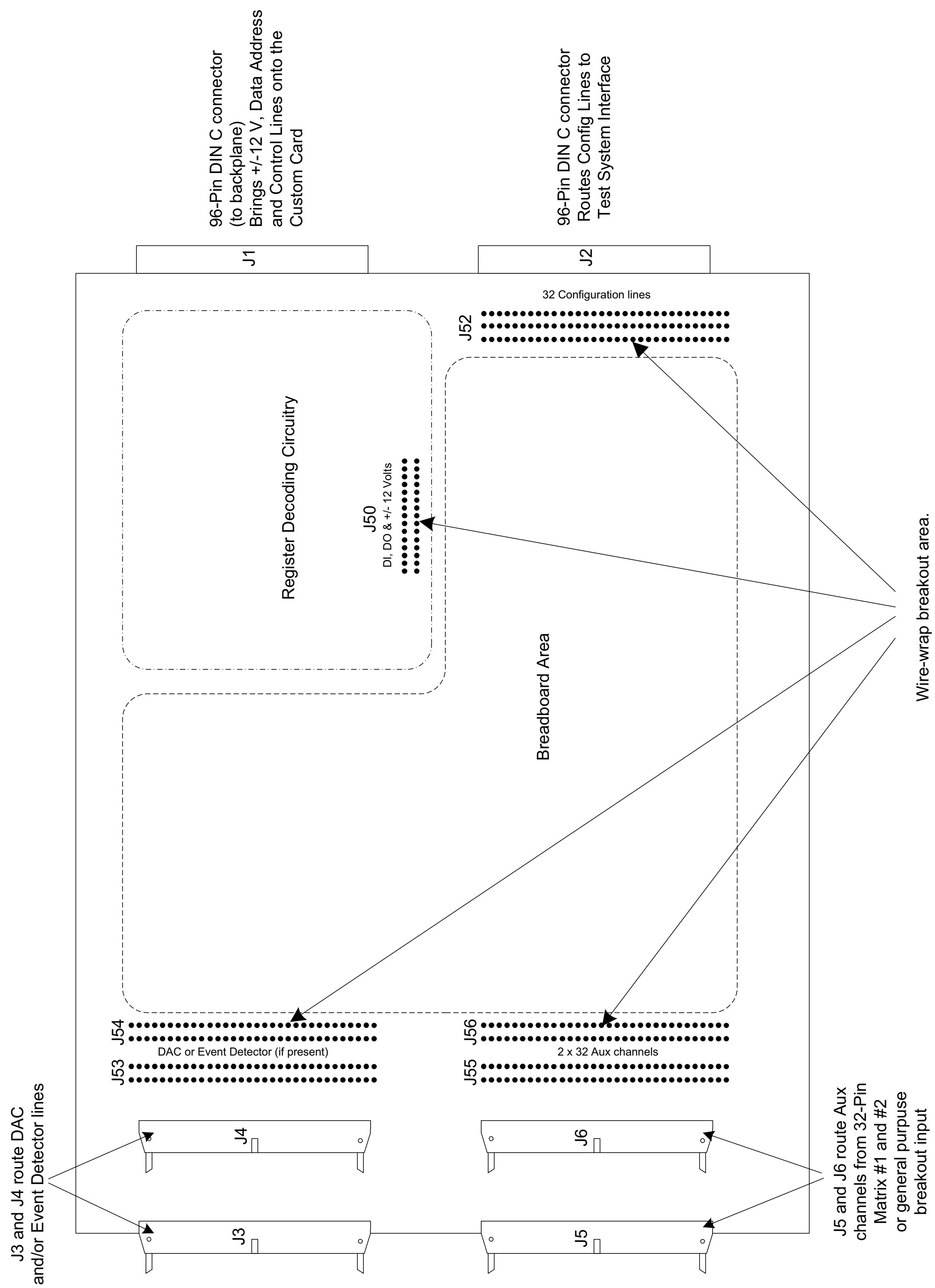
- 64 Aux Channels (from up to two 32-Pin Matrix Cards),
- 8 system DAC channels,
- 32 event detector channels.

In addition, 32 configuration lines are brought from the custom card to the TC connectors on the Test System Interface. Figure 7-1 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" for details). The custom card digital I/O is available in breakout area J50 (see Figure 7-1).

Figure 7-1 Custom Card Features



Connector Breakouts

The figures and tables on the following pages show the breakouts for connectors J2 through J6. See Figure 7-8 for details on the J50 (Digital I/O) breakouts.

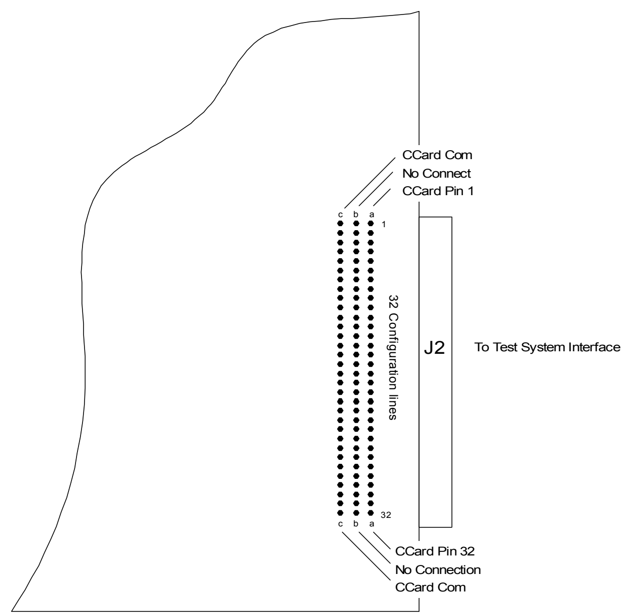
WARNING

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 7-2 shows the J2 connector breakouts when cable part number E6170-61604 is used to connect J2 to the Test System Interface

Figure 7-2 J2 Configuration Lines Pinouts



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

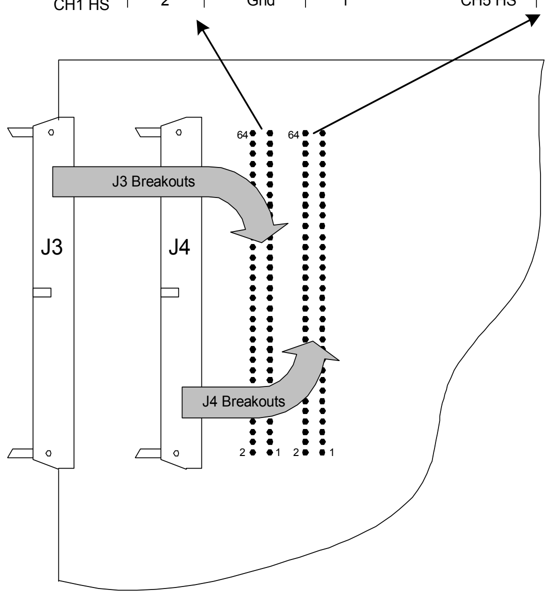
J3/J4 Connector Breakouts (DAC)

Figure 7-3 shows the J3/J4 connector breakouts when cable part number E6170-61615 is used to connect J3/J4 to the Agilent E1418 16-Channel DAC. The DAC's top connector is cabled to J3, the DAC's bottom connector is cabled to J4.

Figure 7-3 J3/J4 Breakouts for Agilent E1418 DAC

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

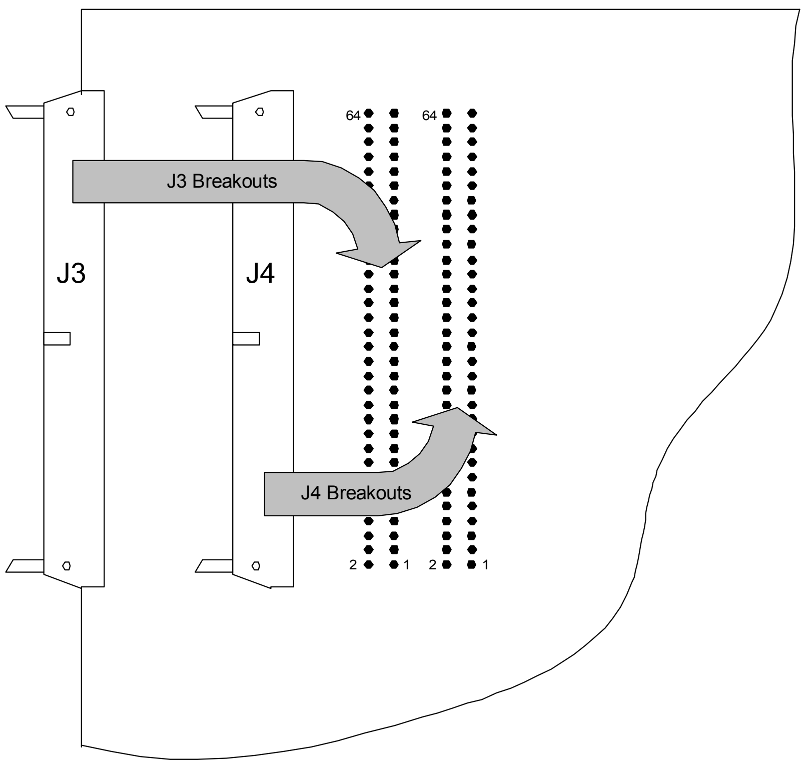


Note: DAC channel break-out is valid when using cable part number E6170-61615 (DAC top connector to J3, bottom connector to J4).

J3 or J4 Connector Breakouts (Event Detector)

The Event Detector can be cabled to either J3 or J4. Figure 7-4 shows the J3 or J4 connector breakouts. Connections are made to either J3 or J4 to the Agilent E6174 Event Detector.

Figure 7-4 J3 or J4 Connector Breakouts for Agilent E6174 Event Detector



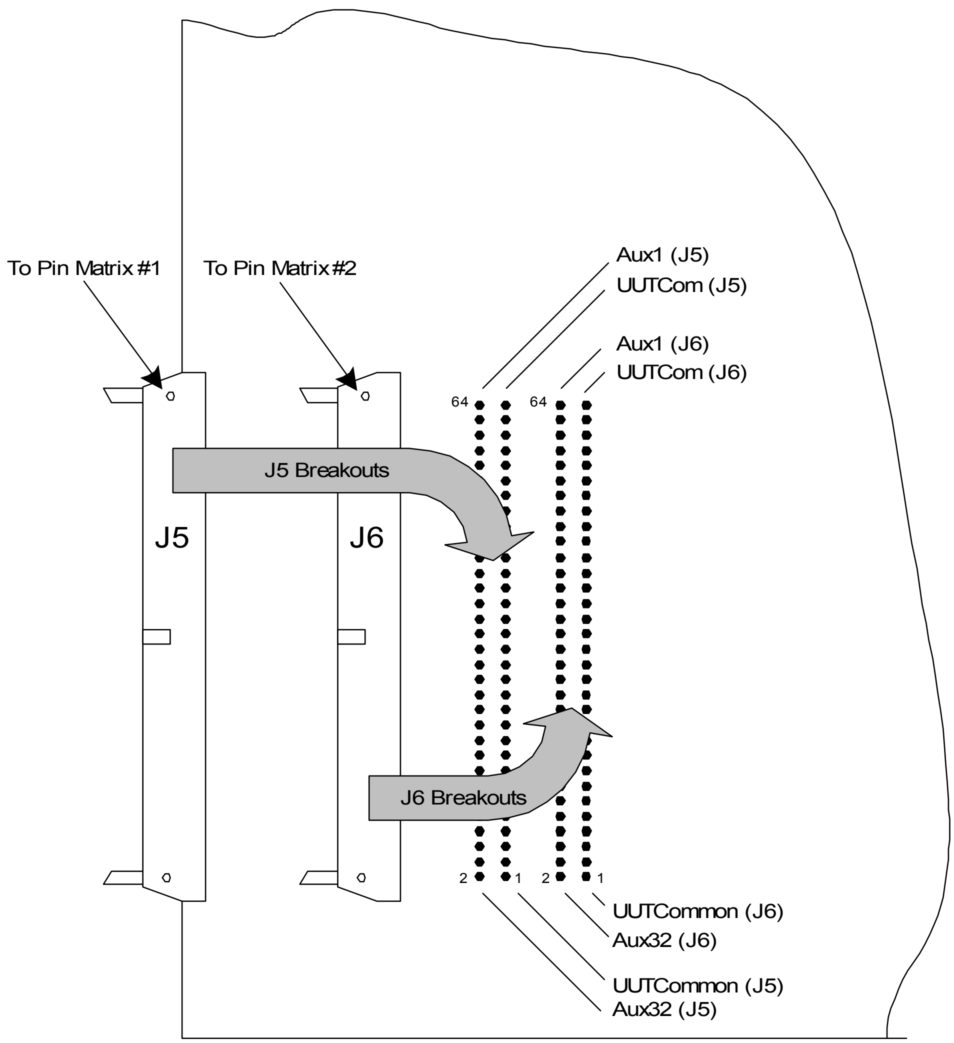
Signal	Pin Number	Signal	Pin Number
Gnd	64	CH31	63
Gnd	62	CH30	61
Gnd	60	CH29	59
Gnd	58	CH28	57
Gnd	56	CH27	55
Gnd	54	CH26	53
Gnd	52	CH25	51
Gnd	50	CH24	49
Gnd	48	CH23	47
Gnd	46	CH22	45
Gnd	44	CH21	43
Gnd	42	CH20	41
Gnd	40	CH19	39
Gnd	38	CH18	37
Gnd	36	CH17	35
Gnd	34	CH16	33
Gnd	32	CH15	31
Gnd	30	CH14	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.

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 7-4 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.

Figure 7-5 J5 and J6 Breakouts (32-Pin Matrix Cards)



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

E8794A Components and Schematics

Figure 7-6 shows the E8794 layout. Figure 7-7 shows a more detailed view for locating components. Figure 7-9 shows a schematic view of the E8794A custom card. Figure 7-9 shows a schematic for the status and control interface.

Figure 7-6 E8794A Layout

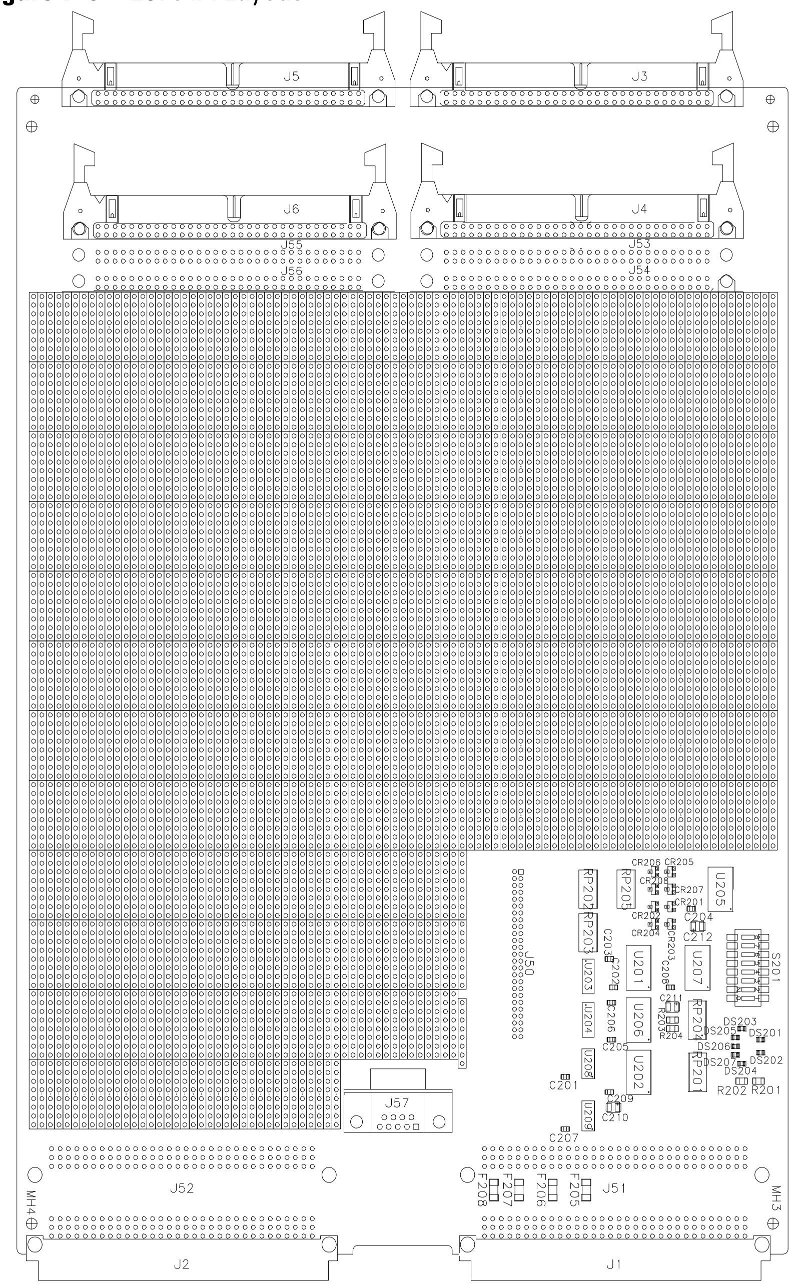


Figure 7-7 E8794A Component Locator

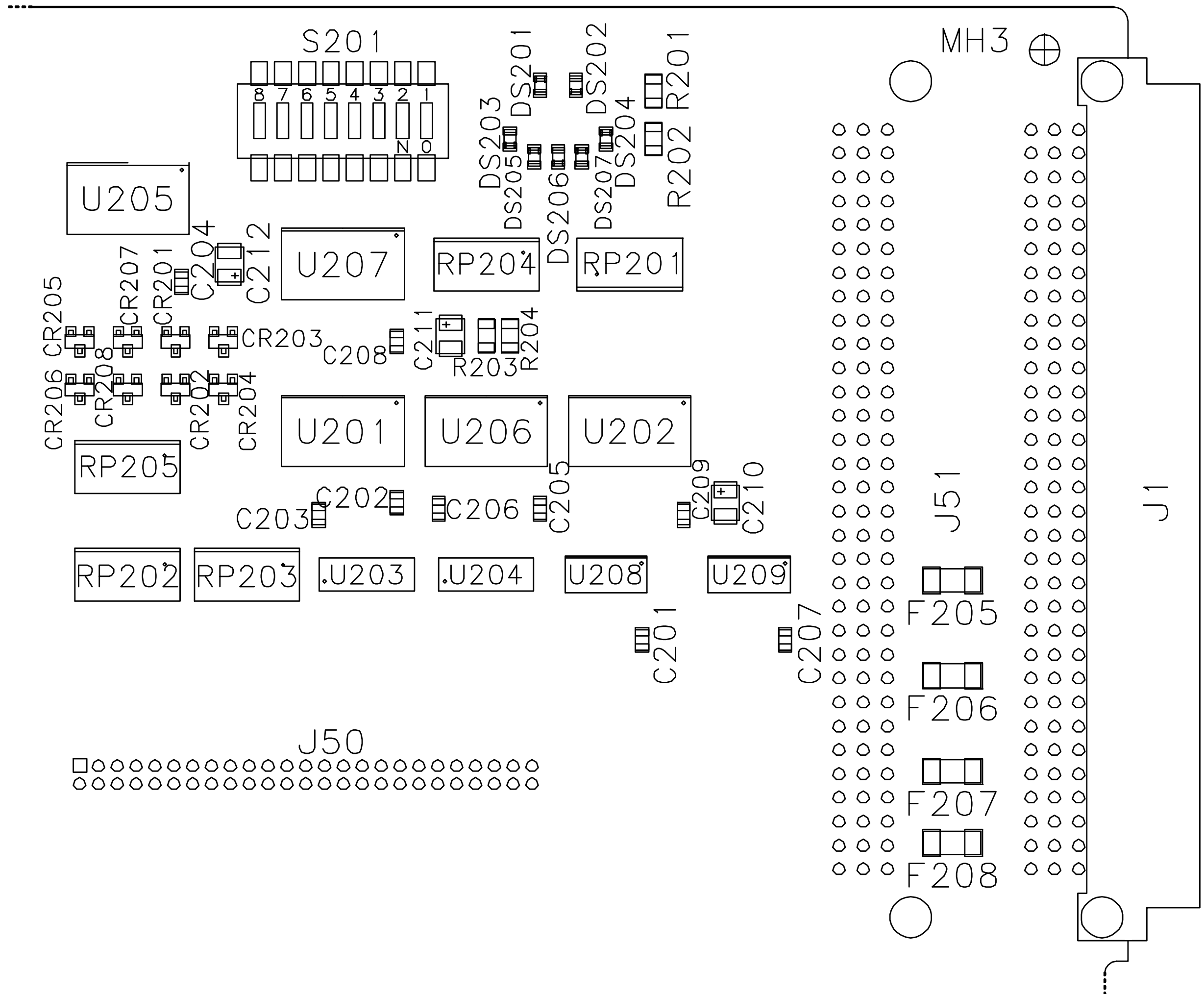


Figure 7-8 E8794A Schematic

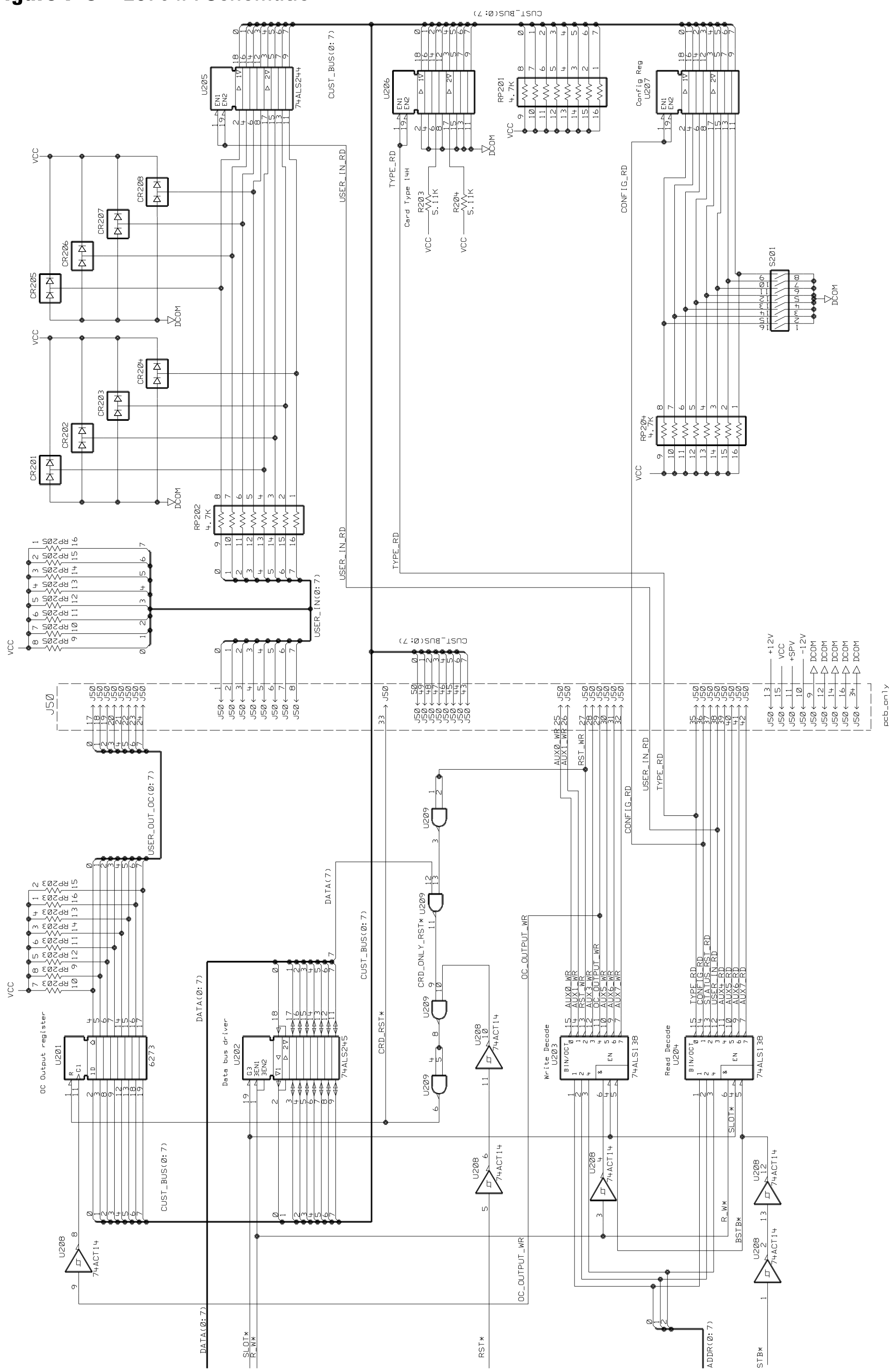
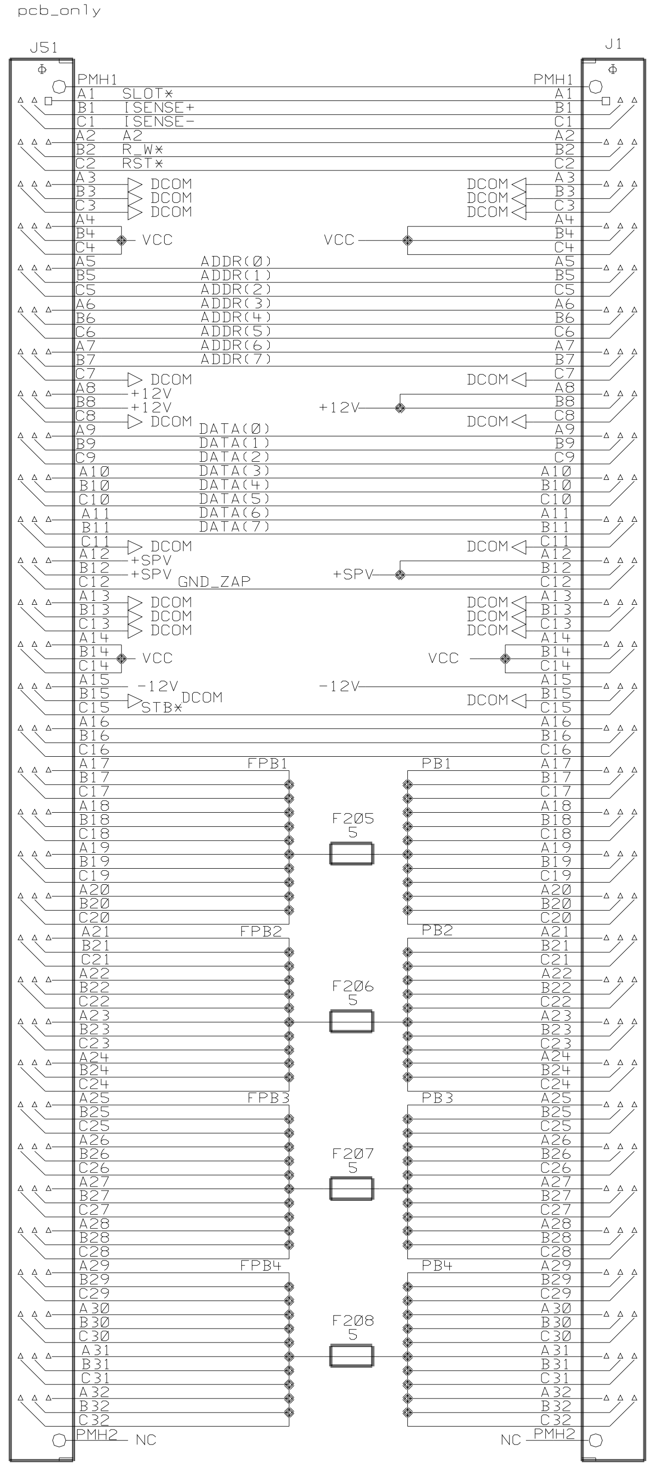


Figure 7-9 Status and Control Interface



THIS PAGE IS INTENTIONALLY LEFT BLANK.

A
Switch/Load Unit And Card Specifications

Agilent E6198B Switch/Load Unit Specifications

Parameter	Specification
Power Bus Resistance	0.02 Ω maximum
Power Bus Current	30 A maximum continuous
Peak Power Bus Current	40 A maximum (<0.1 second, duty cycle <10%)
Peak Power Bus Voltage	60 V maximum
Combined Power Bus Current (all buses)	60 A maximum continuous
Switch/Load Unit to Power Supply Cable Resistance (per bus)	0.03 Ω (standard supplied Agilent cable with connectors included)
Switch/Load Unit to Load Card Connection Resistance	0.03 Ω maximum
Average Load Power for all loads mounted in Switch/Load Unit	250 Watts average 500 Watts maximum
Maximum Current Consumption	30 A at 5 V 12.5 A at +12 V 1 A at -12 V
DAC Channels	Vout: -16 V to +16 V Iout: 10 mA Resolution: 14 bit Gain Error: .3% typical Offset Error: 20 mV typical

Agilent E6175A 8-Channel High-Current Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.25 Ω maximum (Exclusive of load, with standard 0.05 Ω sense resistor and 10 A slo-blo fuse installed. (5 Ω for load currents <1A.)
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 (delays to <60V in 200 mS)
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	1 mA, 1V
Basic current sense accuracy with standard 0.05W sense resistor	0.1 % maximum
Maximum Current Consumption	0.4 A at 5 V 0.3 A at 12 V

Agilent E6176A 16-Channel High-Current Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.4 Ω maximum Exclusive of load, with standard 0.05 Ω sense resistor and 10 A slo-blo fuse installed. (5 Ω for load currents < 1 A.)
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 (delays to <60V in 200 mS)
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	1 mA, 1V
Basic current sense accuracy with standard 0.05Ω sense resistor	0.1 % maximum
Maximum Current Consumption	0.6 A at 5 V 0.7 A at 12 V

Agilent E6177A 24-Channel Medium-Current Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.5 Ω maximum Exclusive of load, with standard 0.05 Ω sense resistor and 10 A slo-blo fuse installed. (5 Ω for load currents <0.1 A.)
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 (delays to <60V in 200 mS)
Load carry/switching current	2 A maximum
Relay switching voltage	60 Vdc maximum
Minimum permissible load	10 uA, 10 mV DC
Maximum Current Consumption	2.2 A at 5 V

Agilent U7177A 24-Channel Medium-Current Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.5 Ω 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 (delays to <60V in 200 mS)
Load carry/switching current	2 A maximum
Relay switching voltage	60 Vdc maximum
Minimum permisissible load	10 μA 10 mV DC
Basic current sense accuracy with standard 0.05 Ω 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 <0.1A.)

Agilent E6178B 8-Channel Heavy Duty Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.030 Ω typical, 0.075 Ω maximum (Exclusive of load with factory installed fuse.)
Load path relay operate/release time	15/10 msec typical, 20 cps max w/o load, 6 cpm max w/rated load
Peak Voltage to Earth	60 V continuous 500 V maximum transient, non-switching (delays to <60V in 200mS)
Load Carry Current (continuous)	30 A maximum
Load Transient Peak Current (non-switched)	200 A maximum, <100 mS, <2% duty cycle (Exclusive of load with factory installed fuse.)
Load Transient Peak Current (switched)	120 A maximum, <10 mS, 14 Vdc (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 (Exclusive of load with factory installed fuse.)
Current Sense Accuracy	**Gain + Linearity accuracy:** 1.2% maximum **Zero Current Offset:** 0.1 A typical, when zero offset is adjusted per user manual. 0.3 A typical, no zero offset adjustment.
Cycle Lifetime (Relay) Mechanical	10^7 Cycles minimum
Cycle Lifetime (Relay) at rated power	10^5 Cycles minimum Switched @ 40 A, 14 Vdc resistive load
Auxiliary Relay Drive Requirements (via P3)	**Channel Relays:** 150 mA max. Requires low side driver @ +12 Vdc **Current Monitor Relays:** 15 mA max. Requires low side driver @ +12 Vdc
Factory Installed Fuse	Bussman MDL-30, DO NOT SUBSTITUTE
Maximum Current Consumption	0.3 A at 5 V 1.5 A at 12 V

Agilent U7178A 8-Channel Heavy Duty Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.030 Ω typical, 0.075 Ω maximum[1]
Load path relay operate/release time	7/2 ms typical
Peak voltage to earth	60 V continuous 500 V maximum transient, non-switching (delays to <60 V in 200 mS)
Load carry current (continuous)	40 A maximum
Power bus carry current (continuous)	40 A maximum
Load switching power	800 W max @ 30 Vdc max. resistive load 500 W max @ 35 Vdc max. resistive load 200 W max @ 40 Vdc max. resistive load 100 W max @ 60 Vdc max. resistive load
Load switching voltage	60 V max. V*I not to exceed Load Switching Power
Current sense accuracy	**Gain + Linearity accuracy:** 1% maximum **Zero Current Offset:** • 0. 1 A typical, when zero offset is adjusted as indicated in the User's Guide • 0.2 A typical, when there is no zero offset adjustment.\ • 0.3 A maximum at 25 °C • 0.6 A maximum over the system operating temperature range
Cycle lifetime (relay) mechanical	10^7 cycles minimum
Cycle lifetime (relay) mechanical at rated power	2×10^5 cycles minimum Switched @ 50 A, 13.5 V
Factory installed fuse	Littelfuse 0257040.PXPV (40 A ATO Blade Fuse)
Maximum current consumption	0.3 A at 5 V 1.8 A at 12 V

1 Exclusive of load with factory installed fuse.

Agilent U7179A 16-Channel High Current Load Card Specifications

Parameter	Specification
Path resistance from power bus to load card connect	0.5 Ω maximum[1]
Load path relay operate/release time	7/3 ms typical, 15/6 ms maximum
Peak voltage to earth	60 V continuous 500 V maximum transient, non-switching (delays to <60 V in 200 mS)
Load carry/Switching current	15 A maximum
Relay switching voltage	60 Vdc maximum
Load switching power	400 W max @ 25 Vdc max. resistive load 200 W max @ 30 Vdc max. resistive load 80 W max @ 40 Vdc max. resistive load 40 W max @ 60 Vdc max. resistive load
Load switching voltage	60 V max. V*I not to exceed Load Switching Power
Basic current sense accuracy with standard 0.005 Ω sense resistor	1% maximum
Factory installed fuse	Littelfuse 0218015MXP (15 A Fuse)
Maximum current consumption	0.3 A at 5 V 1.5 A at 12 V

1 Exclusive of load, with standard 0.005 Ω sense resistor and 15 A factory installed fuse.

Agilent N9377A 16-Channel Dual-Load Load Card Specifications

Parameter	Specification
Switch topology	16 channels with 2 loads per channel, off-board loads
Path resistance from power bus to load card connect	0.4 Ω maximum Exclusive of load, with standard 0.05 Ω sense resistor and 10 A slo-blo fuse installed. (5 Ω for load currents <1A).
Load path relay operate/release time	10/5 msec maximum, 30 cps max
Peak voltage to Earth	60 V continuous 500 V maximum transient, non-switching (decays 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	10 mA, 5 V
Basic current sense accuracy with standard 0.05W sense resistor	0.1% maximum
Basic current sense accuracy with differential amplifier engaged (Vcm=0V)	0.2% + 30mA
Basic current sense accuracy with differential amplifier engaged (Vcm=16V)	0.2% + 100mA
Isense differential amplifier 3 dB bandwidth	500 kHz typical
Isense differential amplifier slew rate	40 A/uS typical
Maximum Current Consumption	0.5 A at 5 V 1 A at 12 V

Agilent N9378A 24-Channel Low-Resistance Load Card Specifications

Parameter	Specification
Switch topology	24 channels with 4 loads per channel with common, on-board loads
Path resistance channel to common	0.130 Ω maximum (Exclusive of load.)
Path resistance from power bus to load card connect	0.5 Ω maximum (Exclusive of load.)
Load path relay operate/release time	4/4 msec max, 10 cps maximum
Peak voltage to Earth	60 V continuous 500 V maximum transient, non-switching (decays to <60V in 200mS)
Load carry current	2 A maximum
Load switching current	1 A maximum
Power dissipation, individual load mounted on load card	2 Watt maximum, each load
Average power for loads mounted on load card	20 Watts maximum total, per card
Relay switching voltage	30 V DC maximum
Minimum permissible load	10 uA, 10 mV DC
Maximum Current Consumption	0.3 A at 5 V 1.4 A at 12 V

Agilent N9379A 48-Channel High-Density Load Card Specifications

Parameter	Specification
Switch topology	48 channels with 2 loads per channel with common, on-board loads
Path resistance channel to common	0.300 Ω maximum (Exclusive of load)
Path resistance from power bus to load card connect	0.5 Ω maximum (Exclusive of load)
Load path relay operate/release time	4/4 msec max, 10 cps maximum
Peak voltage to Earth	60 V continuous 200 V maximum transient, non-switching (decays to <60V in 200mS)
Load carry current	2 A maximum
Load switching current	1 A maximum
Power dissipation, individual load mounted on load card	2 Watt maximum, each load
Average power for loads mounted on load card	20 Watts maximum total, per card
Relay switching voltage	30 V DC maximum
Minimum permissible load	10 uA, 10 mV DC
Maximum Current Consumption	0.3 A at 5 V 1.4 A at 12 V

Agilent E8792A and E8793A Specifications

Instrument Multiplexer (Agilent E8792A Only)

Parameter	Specification
Number of Analog Instrument Channels	16
Analog Channel	Voltage (Max.): 200 volts Resistance: <1 Ω Unbalanced Bandwidth: 10 MHz (Minimum) Balanced Pair Bandwidth: 5 MHz (Minimum)

General Specifications (Agilent E8792A and E8793A)

Parameter	Specification
Power Requirements	Voltage:+5 Vdc
Capacitance - DUT pin to UUT Common	Open channel:100 pF Closed channel:300 pF
Resistance	DUT pin to auxiliary input:1 Ω (Max.) DUT pin to analog bus connector:1 Ω* (Max.) * with 200 Ω 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
Maximum Current Consumption	2.9 A at 5 V for E8792A 2 A at 5 V for E8793A

Relay Characteristics (Agilent E8792A and E8793A)

Parameter	Specification
Type	Dry reed
Switching Speed	Close: 500 ms Open: 400 ms
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

Agilent E8782A and E8783A Specifications

Instrument Multiplexer (Agilent E8782A Only)

Parameter	Specification
Number of Analog Instrument Channels	24
Analog Channel	Voltage (Max.):200 volts Resistance:< 1Ω Unbalanced Pair Bandwidth:10MHz (Minimum) Balanced Pair Bandwidth:5MHz (Minimum)

General Specifications (Agilent E8782A and E8783A)

Parameter	Specification
Power Requirements	Voltage:+5 Vdc
Capacitance – DUT pin to UUT Common	Open channel:100 pF Closed channel:300 pF
Resistance	DUT pin to auxiliary input:1 Ω (Max.) DUT pin to analog bus connector: 1Ω* (Max.) * with 200 Ω 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
Maximum Current Consumption	3 A at 5 V

Relay Characteristics (Agilent E8782A and E8783A)

Parameter	Specification
Type	Dry reed
Switching Speed	Close: 500 µs Open: 300 µs
Switching Characteristics	1.0A carry 0.5A while switching 200VDC Switching voltage
Life Time	@ No load: 1×10^8 operations @ Full load: 1×10^5 operations

Relay Life

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

Relay Load. Higher power switching, 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 switching frequency increases, the contacts have less time to dissipate heat. The resulting increase in contact temperature reduces relay life.

End-of-Life Detection

Use preventative maintenance routine to reduce problems caused by relay failure. Use the methods below to determine when a relay may be near failure. The best method (or combination of methods) and the failure criteria depend on the application in which the relay is used.

Contact Resistance. As relays wear out, contact resistance increases. For the E8792A 32-Pin Matrix Card, the total resistance measured through an external instrument connector to an analog bus connector is less than 1Ω, mostly trace resistance. An increase of 1-2Ωs indicates relay deterioration.

Stability of Contact Resistance. The stability of contact resistance decreases with age. Measure the contact resistance several (5 - 10) times and note the variance. Increased variance indicates deteriorating performance.

Number of Operations. If you know the applied load and life specifications for a load, you can replace relays after a predetermined number of contact closures. 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 best strategy depends on your application. Replace individual relays if they are used more often or at higher loads than others. If all the relays see similar loads and switching frequencies, the entire circuit board can be replaced as end of relay life approaches. Weigh the sensitivity of the application 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.

THIS PAGE IS INTENTIONALLY LEFT BLANK.

B
Register Definitions

This appendix provides register-based programming information for the Agilent E6198B Switch/Load Unit backplane, the individual load cards, the pin cards, and the custom card. This information can help you with troubleshooting components of the load cards or Switch/Load Unit.

CAUTION

Agilent strongly recommends that you address the registers and relays 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 (E6918A)

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 depending on the slot availability; 1-21 for E6198B.

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 B-1.

Table B-1 Standard Registers

Register Offset	Register Name	Description
00_h	Card type	See Table B-2.
01_h	Card configuration	Defaults to FF_h unless changed by user.
02_h	Status/Control	Card specific controls.

Table B-2 shows the values returned from each card's Card Type register.

Table B-2 Standard Registers

Model Number	Card Type Value	Description
Agilent E6175A	01_{10} (01_h)	8-Channel Load Card
Agilent E6176A	02_{10} (02_h)	16-Channel Load Card
Agilent E6177A	03_{10} (03_h)	24-Channel Load Card
Agilent U7177A	24_{10} (18_h)	24-Channel Load Card
Agilent U7178A	25_{10} (19_h)	8-Channel 40 A Load Card
Agilent U7179A	32_{10} (20_h)	16-Channel 15 A Load Card
Agilent E6178B	04_{10} (04_h)	8-Channel Heavy Duty Load Card (30 A)
Agilent N9378A	05_{10} (05_h)	24-Channel Low Res Load Card

Table B-2 Standard Registers (continued)

Model Number	Card Type Value	Description
Agilent N9379A	06_{10} (06_h)	48-Channel Load Card
Agilent N9377A	07_{10} (07_h)	16-Dual Channel Load Card
Agilent E8792A	10_{10} ($0A_h$)	Fully loaded pin card (includes instrumentation multiplexer)
Agilent E8793A	11_{10} ($0B_h$)	Partially loaded pin card (w/out instrumentation multiplexer).
Agilent E8782A	67_{10} (43_h)	Fully loaded pin card (includes instrumentation multiplexer and with AUX pin)
Agilent E8783A	71_{10} (47_h)	Fully loaded pin card (includes AUX pin but w/out instrumentation multiplexer)
Agilent E8794A	20_{10} (14_h)	Custom Card
Agilent E6198B	50_{10} (32_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 numbers.

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 B-3 summarizes the Switch/Load Unit registers.

Table B-3 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 32_h (50_{10}) for E6198B for the Switch/Load Unit.

Bits	7-0
Read	Card Type
Setting (E6198B)	32_h

- Read Only
- Power On/Reset State = 32_h (50_{10}) for E6198B.

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	FFh

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".

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".

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 • 32) - 16

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

Table B-4 shows some example values of N, and the corresponding MSBs, LSBs, and DAC voltage outputs.

Table B-4 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 0 Vout.

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 drivers have 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 B-5 $OCout_x$ 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 = high, 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".

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".

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 is designated as W (Write-only) or R (Read-only). The $_h$ subscipt indicates a hexadecimal number.

Table B-6 summarizes the register mapping for all load cards.

Table B-6 Summary of Load Card Register Definitions

Register Offset	E6175A 8-Ch.	E6176A 16-Ch.	E6177A 24-Ch.	U7177A 24-Ch.	U7178A 8-Ch.	U7179A 16-Ch.	E6178B 8-Ch.	N9377A 16-Ch.	N9378A 24-Ch.	N9379A 48-Ch.
Base+0_h	Card type	Card type	Card type	Card type	Card type	Card type	Card type	Card type	Card type	Card type
Base+1_h	Card config.	Card config.	Card config.	Card config.	Card config.	Card config.	Card config.	Card config.	Card config.	Card config.
Base+2_h	Status	Status	Status	Status	Status register	Status register	Status	Status & card config. bit 8	Status & control	Status & control
Base+3_h	Current select	Current select	Load select 1-8	Current Sense	Current sense select	Current sense select	Current select	Current select	Mezzanine card #1 config.	Mezzanine card #1 config.
Base+4_h	Load select 1-8	Load select 1-8	Load select 9-16	Load select 1-8	Load select	Load select 1-8	Load select	Load select	Mezzanine card #2 config.	Mezzanine card #2 config.
Base+5_h	Power select 1-8	Load select 9-16	Load select 17-24	Load select 9-16	N/A	Load select 9-16	N/A	Load select	Mezzanine card #3 config.	Mezzanine card #3 config.
Base+6_h	N/A	Power select 1-8	Power select 1-8	Load select 17-24	N/A	Power select 1-8	N/A	Power select	Load select	Load select
Base+7_h	N/A	Power select 9-16	Power select 9-16	Power select 1-8	N/A	Power select 9-16	N/A	Power select	Load select	Load select
Base+8_h	N/A	N/A	Power select 17-24	Load select 1-8	N/A	N/A	N/A	Power select	Load select	Load select
Base+9_h	N/A	N/A	N/A	Power select 9-16	N/A	N/A	N/A	Power select	Load select	Load select

Table B-6 Summary of Load Card Register Definitions (continued)

Register Offset	E6175A 8-Ch.	E6176A 16-Ch.	E6177A 24-Ch.	U7177A 24-Ch.	U7178A 8-Ch.	U7179A 16-Ch.	E6178B 8-Ch.	N9377A 16-Ch.	N9378A 24-Ch.	N9379A 48-Ch.
Base+A_h	N/A	N/A	N/A	Power select 17-24	N/A	N/A	N/A	N/A	Load select	Load select
Base+B_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+C_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+D_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+E_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+F_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+10_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+11_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Load select	Load select
Base+12_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Power select	Load select
Base+13_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Power select	Power select
Base+14_h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Power select	Power select

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

Agilent E6175A 8-Channel High-Current Load Card

The Agilent 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. See “Using the Agilent E6175A 8-Channel Load Card" for more information.

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

Agilent E6176A 16-Channel High-Current Load Card

The Agilent 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. See “Using the Agilent E6176A 16-Channel Load Card" for more information.

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

Agilent E6177A 24-Channel Medium-Current Load Card

The Agilent 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. See “Using the Agilent E6177A 24-Channel Load Card" for more information.

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

Agilent U7177A 24-Channel Medium-Current Load Card With Current Sense

The Agilent U7177A Load Card is designed for moderate current loads mounted outside the load card. The card provides current sense, pull-up/down selection, Card Type, Card Configuration, and Status readback of the built in relay timers. See “Using the Agilent U7177A 24-Channel Load Card" for more information.

Register definitions for the card are as follows:

Card Type (R) Base + 0h

This register reads back the Card Type (18h) of the card.

Bit	7-0
Purpose	Card Type
Setting	18h

- Read Only
- Power On/Reset State = 18h

Card Configuration (R) Base + 1h

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 + 2h

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 (>8 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 is 1s	state

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

Current Sense Select (W) Base + 3h

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	7-6	5-0
Purpose	Undefined	Sense Select
Setting	X	Select No.

- Write Only
- Undefined bits are not used
- Valid current sense selection values are: 000001_2 - 011000_2.

  Selecting values 000000_2 or 011001_2 - 111111_2 will NOT select current sensing for any channel.

  000001_2 - corresponds to current sense select on channel 1.

  000010_2 - corresponds to current sense select on channel 2.

  001101_2 - corresponds to current sense select on channel 13.

  010000_2 - corresponds to current sense select on channel 16.

  000000_2 or $nnnnnn_2 > 011000_2$ - no current sense relays selected.

(Example: Setting the current sense register to 0001102 selects channel six. Therefore relays K59 and K60 would be closed.)

- Power On/Reset State = 0

Select	0, 25-63	1	2	3	4	5	6	7	8	9	10	11	12
Relays	None	K49, K50	K51, K52	K53, K54	K55, K56	K57, K58	K59, K60	K61, K62	K63, K64	K65, K66	K67, K68	K69, K70	K71, K72

Select	13	14	15	16	17	18	19	20	21	22	23	24
Relays	K73, K74	K75, K76	K77, K78	K79, K80	K81, K82	K83, K84	K85, K86	K87, K88	K89, K90	K91, K92	K93, K94	K95, K96

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

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	K32 CH8	K31 CH7	K30 CH6	K29 CH5	K28 CH4	K27 CH3	K26 CH2	K25 CH1
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 + 5h

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	K40 CH16	K39 CH15	K38 CH14	K37 CH13	K36 CH12	K35 CH11	K34 CH10	K33 CH9
Setting	state	state	state	state	state	state	state	state

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

Load Select 17-24 (W) Base + 6h

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 CH24	K47 CH23	K46 CH22	K45 CH21	K44 CH20	K43 CH19	K42 CH18	K41 CH17
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 + 7h

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	K8 CH8	K7 CH7	K6 CH6	K5 CH5	K4 CH4	K3 CH3	K2 CH2	K1 CH1
Setting	state	state	state	state	state	state	state	state

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

Power Select 9-16 (W) Base + 8h

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	K16 CH16	K15 CH15	K14 CH14	K13 CH13	K12 CH12	K11 CH11	K10 CH10	K9 CH9
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 + 9h

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	K24 CH24	K23 CH23	K22 CH22	K21 CH21	K20 CH20	K19 CH19	K18 CH18	K17 CH17
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

Agilent U7178A 8-Channel 40 A Load Card

The Agilent U7178A Load Card is a 8-Channel Heavy Duty Load Card. The card provides current sense and it is fuse protected at 40 A. Flyback protection can be added for each load. See “Using the Agilent U7178A 8-Channel Heavy Duty Load Card" for more information.

Register definitions for the card are as follows:

Card Type ID (R) Base + 0_h

Value = 19_h

Card Configuration (R) Base + 1_h

The value is determined by the user by configuring connector J2. When unused, a read of this register will be FFh.

Bit	7	6	5	4	3	2	1	0
Card Config	J2-10	J2-9	J2-8	J2-7	J2-5	J2-4	J2-3	J2-2

Status Register (R) Base + 2_h

Contains BUSY~ bit (bit 0) which reflects the state of all relay timers.

- BUSY~ returns 0 = busy
- BUSY~ returns 1 = ready

Bit	7-1	0
Status Value	1111111	BUSY~

Current Sense Select (W) Base + 3h

Only one current sense channel can be selected at any one time. At reset no channel is selected.

Select	Bit 7-5	Bit 4-0	Relays
No Channel	N/A	00000	None
Channel 1	N/A	00001	K1, K2
Channel 2	N/A	00010	K3, K4
Channel 3	N/A	00011	K5, K6
Channel 4	N/A	00100	K7, K8
Channel 5	N/A	00101	K9, K10
Channel 6	N/A	00110	K11, K12
Channel 7	N/A	00111	K13, K14
Channel 8	N/A	01000	K15, K16
No Channel	N/A	01001-01111	None

Load Select (W) Base + 4h

The register uses positive logic.

1 = Relay Close

0 = Relay Open

At reset no channel is selected.

Bit	7	6	5	4	3	2	1	0
Purpose	K28 CH8	K27 CH7	K26 CH6	K25 CH5	K24 CH4	K23 CH3	K22 CH2	K21 CH1
Setting	State	State	State	State	State	State	State	State

Agilent U7179A 16-Channel 15 A Load Card

The Agilent U7179A 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. See “Using the Agilent U7177A 24-Channel Load Card" for more information.

Register definitions for the card are as follows:

Card Type ID (R) Base + 0_h

Value = 20_h

Card Configuration (R) Base + 1_h

The value is determined by the user by configuring connector J2. When unused, a read of this register will be FFh.

Bit	7	6	5	4	3	2	1	0
Card Config	J2-10	J2-9	J2-8	J2-7	J2-5	J2-4	J2-3	J2-2

Status Register (R) Base + 2_h

Contains BUSY~ bit (bit 0) which reflects the state of all relay timers.

- BUSY~ returns 0 = busy
- BUSY~ returns 1 = ready

Bit	7-1	0
Status Value	1111111	BUSY~

Current Sense Select (W) Base + 3h

Only one current sense channel (I_{sense}+ and I_{sense}– pair) can be selected at any one time. At reset no channel is selected.

Select	Bit 7-5	Bit 4-0	Relays
No Channel	N/A	00000	None
Channel 1	N/A	00001	K1, K2
Channel 2	N/A	00010	K3, K4
Channel 3	N/A	00011	K5, K6
Channel 4	N/A	00100	K7, K8
Channel 5	N/A	00101	K9, K10
Channel 6	N/A	00110	K11, K12
Channel 7	N/A	00111	K13, K14
Channel 8	N/A	01000	K15, K16
Channel 9	N/A	01001	K17, K18
Channel 10	N/A	01010	K19, K20
Channel 11	N/A	01011	K21, K22
Channel 12	N/A	01100	K23, K24

Select	Bit 7-5	Bit 4-0	Relays
Channel 13	N/A	01101	K25, K26
Channel 14	N/A	01110	K27, K28
Channel 15	N/A	01111	K29, K30
Channel 16	N/A	10000	K31, K32
No Channel	N/A	10001-11111	None

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

The register uses positive logic.

1 = Relay Close

0 = Relay Open

At reset no channel is selected.

Bit	7	6	5	4	3	2	1	0
Purpose	K48 CH8	K46 CH7	K44 CH6	K42 CH5	K40 CH4	K38 CH3	K36 CH2	K34 CH1
Setting	State	State	State	State	State	State	State	State

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

The register uses positive logic.

1 = Relay Close

0 = Relay Open

At reset no channel is selected.

Bit	7	6	5	4	3	2	1	0
Purpose	K64 CH16	K62 CH15	K60 CH14	K58 CH13	K56 CH12	K54 CH11	K52 CH10	K50 CH9
Setting	State	State	State	State	State	State	State	State

Power Select 1-8 (W) Base + 4h

The register uses positive logic.

1 = Relay Close

0 = Relay Open

At reset no channel is selected.

Bit	7	6	5	4	3	2	1	0
Purpose	K47 CH8	K45 CH7	K43 CH6	K41 CH5	K39 CH4	K37 CH3	K35 CH2	K33 CH1
Setting	State	State	State	State	State	State	State	State

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

The register uses positive logic.

1 = Relay Close

0 = Relay Open

At reset no channel is selected.

Bit	7	6	5	4	3	2	1	0
Purpose	K63 CH16	K61 CH15	K59 CH14	K57 CH13	K55 CH12	K53 CH11	K51 CH10	K49 CH9
Setting	State	State	State	State	State	State	State	State

Agilent E6178B 8-Channel 30 Amp Load Card Register Definitions

The Agilent 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.

See “Using the Agilent N9377A 16-Channel Dual-Load Load Card" for more information.

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	RELAYS
No Channel	N/A	0000	None
Channel 1	N/A	0001	K11-G, K11-H
Channel 2	N/A	0010	K11-D, K11-A
Channel 3	N/A	0011	K11-E, K11-F
Channel 4	N/A	0100	K11-B, K11-C
Channel 5	N/A	0101	K12-G, K12-H
Channel 6	N/A	0110	K12-A, K12-B
Channel 7	N/A	0111	K12-E, K12-F
Channel 8	N/A	1000	K12-C, K12-D
No Channel	N/A	1001-1111	None

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
PURPOSE	CH 8	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1
SETTING	State	State	State	State	State	State	State	State

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.

Agilent N9377A 16-Channel Dual-Load Load Card

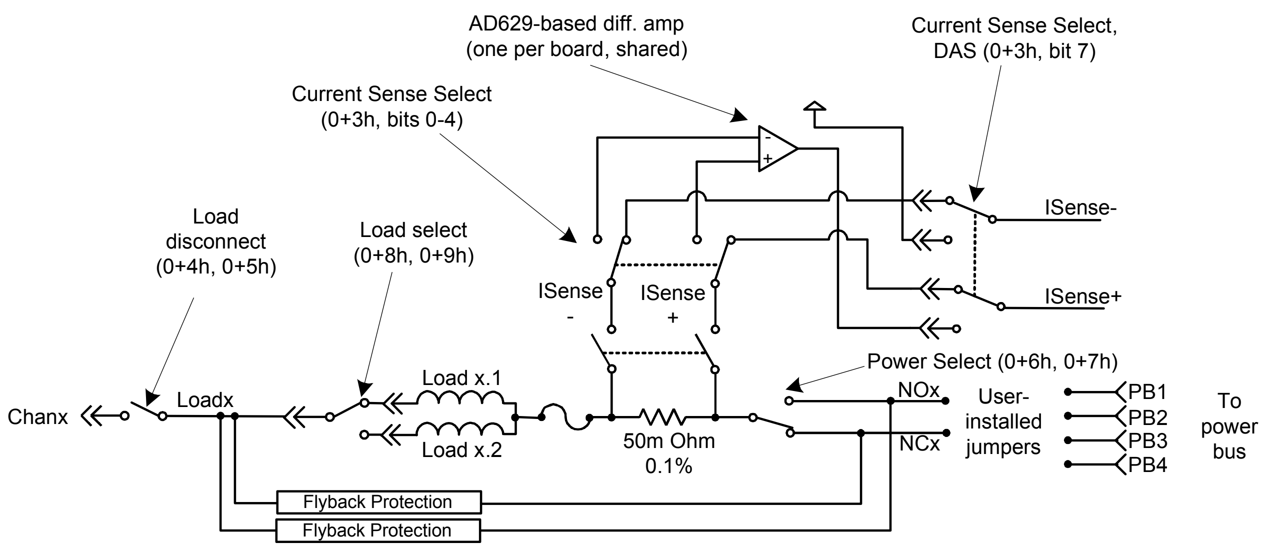
The Agilent N9377A dual-load load card lets you use the same channel to test of shorts to ground and Vbatt or tests that require two types of load for different parts of the test. The card provides current sense, pull-up/down, and flyback protection.

The card also provides Card Type, Card Configuration, and Status readback of the built in relay timers. See "Using the Agilent N9377A 16-Channel Dual-Load Load Card" for more information.

Unless otherwise noted, writing a 1 closes (energizes) a relay, and writing a 0 opens (de-energizes) the relay. The reset and power-on state for all relays is open.

The block diagram in Figure B-1 shows the location of the various registers.

Figure B-1 Relay controlled by registers Base+03h-Base+09h



Card Type (R) Base + 0_h

This register reads back the card type of the card. The N9377A is uniquely identified by card type 07_h.

Bit	7	6	5	4	3	2	1	0
Purpose	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type
Setting	0	0	0	0	0	1	1	1

- Read Only
- Power On/Reset State = 07_h

Card Configuration (R) Base + 1_h

This register reads back the card configuration. Card configuration is determined by the user to distinguish different load configurations on the same load card type. The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Use the actions loadCardGetInfo and GetLoadCardID to read this register.

Note also that the N9377A load card supports a CC8 bit for offset register base+2_h. (See "Status & Card Configuration, Bit 8 (R) Base + 2_h")

Bit	7	6	5	4	3	2	1	0
Purpose	CC7	CC6	CC5	CC4	CC3	CC2	CC1	CC0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Undefined bits read back as all 1s (FF_h)

Status & Card Configuration, Bit 8 (R) Base + 2_h

This register reads back the card's status and contains bit 8 of the card configuration port. 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	CC8	7-1	0
Purpose	CC8	Undefined	BUSY~
Setting	state	all 1s	state

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

Current Sense Select (W) Base + 3_h

This register controls the current sense (Isense) relays of the card and enables the differential amplifier. (See Figure B-1.) Since only one current sense channel at a time per slot is allowed, these channel selects are encoded. This allows selection of zero or only one current sense relay at a time. Writing to this register starts the reed relay timer.

Bit	7	6-5	4	3	2	1	0
Purpose	DSS	Undefined	CSS4	CSS3	CSS2	CSS1	CSS0
Setting	Select No.	all 1s	Select No.	Select No.	Select No.	Select No.	Select No.

DSS	0	1
State	Without Diff Amp	With Diff Amp
Relay	K200, K201	

CSS	0, 17-31	1	2	3	4	5	6	7	8
Relay	None	K301, K525	K303, K302	K304, K305	K306, K307	K308, K309	K310, K311	K312, K313	K314, K315

CSS	9	10	11	12	13	14	15	16
Relay	K316, K317	K318, K319	K320, K321	K322, K323	K324, K325	K326, K327	K328, K329	K330, K331

- Write Only
- Undefined bits read back as all 1s
- DSS: Differential amplifier select. Set to 1 to place diff amp into Isense path.
- CSS: current sense select (Isense). Bits 0-4 select the channel to connect to the Isense bus.
- Valid CSS values are: $01\text{-}10_{2h}$. For example,

  01_h selects ch1

  02_h selects ch2

  etc.

  $0F_h$ selects ch15

  10_h selects ch16
- Power on/Reset state is no current sense channels selected and differential amp disconnected from the Isense bus.

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

This register controls the relays that connect Loadx to Chanx for channels 1-8. (See Figure B-1.)

Bit	7	6	5	4	3	2	1	0
Purpose	K524 Chan8	K521 Chan7	K518 Chan6	K515 Chan5	K512 Chan4	K509 Chan3	K506 Chan2	K503 Chan1
Setting	State	State	State	State	State	State	State	State

- Write Only
- State: 0 = open, 1 = closed
- Power On/Reset State = 0 (all channels open)

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

This register controls the relays that connect Loadx to Chanx for channels 9-16. (See Figure B-1.)

Bit	7	6	5	4	3	2	1	0
Purpose	K624 Chan16	K621 Chan15	K618 Chan14	K615 Chan13	K612 Chan12	K609 Chan11	K606 Chan10	K603 Chan9
Setting	State	State	State	State	State	State	State	State

- Write Only
- State: 0 = open, 1 = closed
- Power On/Reset State = 0 (all channels open)

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

This register controls the Pull Up/Down Power Select armature relays for power to channels 1-8. (See Figure B-1.) 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	K522 Chan8	K519 Chan7	K516 Chan6	K513 Chan5	K510 Chan4	K507 Chan3	K504 Chan2	K501 Chan1
Setting	State	State	State	State	State	State	State	State

- Write Only

- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

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

This register controls the Pull Up/Down Power Select armature relays for power to channels 9-16. (See Figure B-1.) 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	K622 Chan16	K619 Chan15	K616 Chan14	K613 Chan13	K610 Chan12	K607 Chan11	K604 Chan10	K601 Chan9
Setting	State	State	State	State	State	State	State	State

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

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

This register controls the load selection relays for channels 1-8, letting you switch between two different loads for that channel. (See Figure B-1.) For x=1-8:.

Bit	7	6	5	4	3	2	1	0
Purpose	K523 Chan8	K520 Chan7	K517 Chan6	K514 Chan5	K511 Chan4	K508 Chan3	K505 Chan2	K502 Chan1
Setting	State	State	State	State	State	State	State	State

- Write Only
- State: 1 = Loadx.2 connected to Loadx
- State: 0 = Loadx.1 connected to Loadx
- Power On/Reset State = 0 (all Loadx.1 connected to Loadx)

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

This register controls the load selection relays for channels 9-16. (See Figure B-1.) For x=9-16:.

Bit	7	6	5	4	3	2	1	0
Purpose	K623 Chan16	K620 Chan15	K617 Chan14	K614 Chan13	K611 Chan12	K608 Chan11	K605 Chan10	K602 Chan9
Setting	State	State	State	State	State	State	State	State

- Write Only
- State: 1 = Loadx.2 connected to Loadx
- State: 0 = Loadx.1 connected to Loadx
- Power On/Reset State = 0 (all Loadx.1 connected to Loadx)

Agilent N9378A 24-Channel Low-Resistance Load Card

The Agilent N9378A low-resistance load card lets you attach as many as four loads per channel. Loads are mounted onboard on a series of mezzanine cards that plug into the load card. The N9378A card also provides an output relay in a general-purpose configuration. See "Using the Agilent N9378A 24-Channel Low Resistance Load Card" for a block diagram and more information.

Unless otherwise noted, writing a 1 closes (energizes) a relay, and writing a 0 opens (de-energizes) the relay. The reset and power-on state for all relays is open.

Card Type (R)Base + 0_h

This register reads back the card type of the card. The N9378A is uniquely identified by card type 05_h.

Bit	7	6	5	4	3	2	1	0
Purpose	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type
Setting	0	0	0	0	0	1	0	1

- Read Only
- Power On/Reset State = 05_h

Card Configuration (R) Base + 1_h

This register reads back the card configuration. The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed. (Note that you can use the mezzanine card registers described below for additional load configuration information.)

Use the actions `loadCardGetInfo` to read this register.

Bit	7	6	5	4	3	2	1	0
Purpose	undefined	undefined	undefined	undefined	undefined	undefined	CC1	CC0
Setting	x	x	x	x	x	x	state	state

- Read Only
- x = undefined

Status & Control (R & W) Base + 2_h

This register reads back the card's status. It also can be used to reset the board or open all relays (OAR).

Card 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	6	5	4	3	2	1	0
Read	1	1	1	1	1	1	1	Busy~
Write	not used	not used	OAR	not used	not used	not used	not used	Reset

- Read and Write
- Undefined bits read back as all 1s
- Unused bits for write can be either 0 or 1 (does not matter)
- For BUSY~ (Read Only):

  0 = Busy

  1 = Ready
- For Reset (Write Only):

  0 = no change

  1 = causes board reset (non-latched)

- For OAR (Write Only):

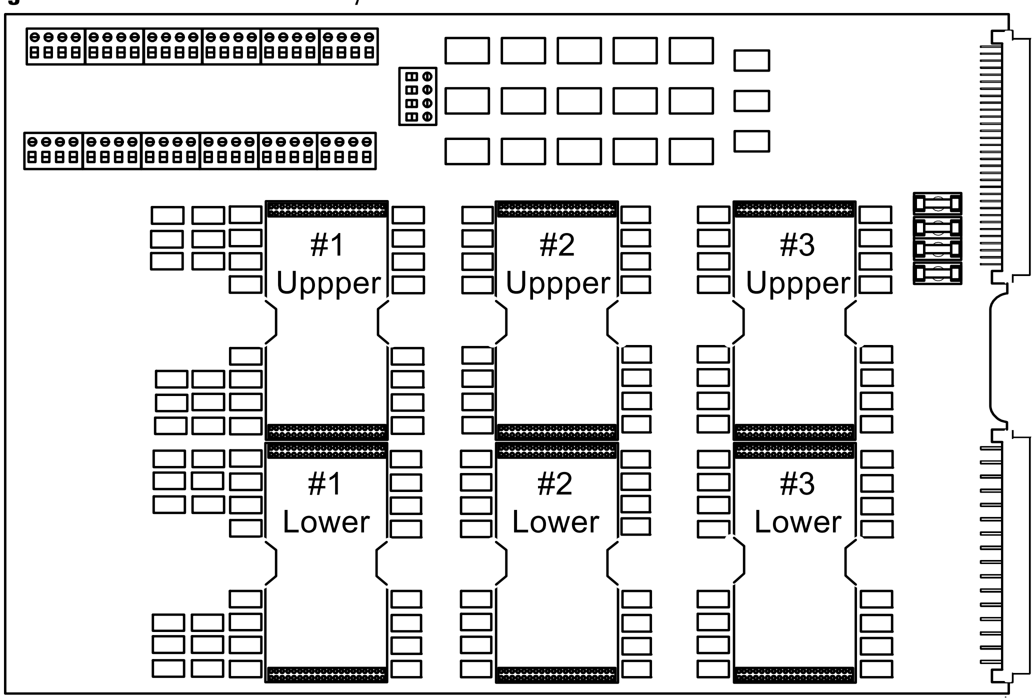
  0 = no change

  1 = causes all relays to open (non-latched)

Mezzanine Card #1 Configuration (R) Base + 3_h

This register reads configuration information from the #1 upper and #1 lower mezzanine cards. Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register. Figure B-2 shows the layout of the mezzanine cards.

Figure B-2 Mezzanine Card Layout



The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC1L.3	MC1L.2	MC1L.1	MC1L.0	MC1U.3	MC1U.2	MC1U.1	MC1U.0

Bit	7	6	5	4	3	2	1	0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC1U.0-MC1U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC1L.0-MC1L.3)
- Power On/Reset State = 1

Mezzanine Card #2 Configuration (R) Base + 4_h

This register reads configuration information from the #2 upper and #2 lower mezzanine cards. (See Figure B-2 for a picture of the mezzanine card layout.)

Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register.

The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC2L.3	MC2L.2	MC2L.1	MC2L.0	MC2U.3	MC2U.2	MC2U.1	MC2U.0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC2U.0-MC2U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC2L.0-MC2L.3)
- Power On/Reset State = 1

Mezzanine Card #3 Configuration (R) Base + 5_h

This register reads configuration information from the #3 upper and #3 lower mezzanine cards.

Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register.

The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC3L.3	MC3L.2	MC3L.1	MC3L.0	MC3U.3	MC3U.2	MC3U.1	MC3U.0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC3U.0-MC3U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC3L.0-MC3L.3)
- Power On/Reset State = 1

Load Select 1 & 2 (W) Base + 6_h

This register controls the power selection relays for channels 1 and 2 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K208 Chan2.4	K207 Chan2.3	K206 Chan2.2	K205 Chan2.1	K204 Chan1.4	K203 Chan1.3	K202 Chan1.2	K201 Chan1.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 3 & 4 (W) Base + 7_h

This register controls the power selection relays for channels 3 and 4 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K216 Chan4.4	K215 Chan4.3	K214 Chan4.2	K213 Chan4.1	K212 Chan3.4	K211 Chan3.3	K210 Chan3.2	K209 Chan3.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 5 & 6 (W) Base + 8_h

This register controls the power selection relays for channels 5 and 6 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K308 Chan6.4	K307 Chan6.3	K306 Chan6.2	K305 Chan6.1	K304 Chan5.4	K303 Chan5.3	K302 Chan5.2	K301 Chan5.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 7 & 8 (W) Base + 9_h

This register controls the power selection relays for channels 7 and 8 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K316 Chan8.4	K315 Chan8.3	K314 Chan8.2	K313 Chan8.1	K312 Chan7.4	K311 Chan7.3	K310 Chan7.2	K309 Chan7.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 9 & 10 (W) Base + A_h

This register controls the power selection relays for channels 10 and 9 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K408 Chan10.4	K407 Chan10.3	K406 Chan10.2	K405 Chan10.1	K404 Chan9.4	K403 Chan9.3	K402 Chan9.2	K401 Chan9.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 11 & 12 (W) Base + B_h

This register controls the power selection relays for channels 12 and 11 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K416 Chan12.4	K415 Chan12.3	K414 Chan12.2	K413 Chan12.1	K412 Chan11.4	K411 Chan11.3	K410 Chan11.2	K409Cha n11.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 13 & 14 (W) Base + C_h

This register controls the power selection relays for channels 14 and 13 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K508 Chan14.4	K507 Chan14.3	K506 Chan14.2	K505 Chan14.1	K504 Chan13.4	K503 Chan13.3	K502 Chan13.2	K501 Chan13.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 15 & 16 (W) Base + D_h

This register controls the power selection relays for channels 16 and 15 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K516 Chan16.4	K515 Chan16.3	K514 Chan16.2	K513 Chan16.1	K512 Chan15.4	K511 Chan15.3	K510 Chan15.2	K509 Chan15.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 17 & 18 (W) Base + E_h

This register controls the power selection relays for channels 18 and 17 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K608 Chan18.4	K607 Chan18.3	K606 Chan18.2	K605 Chan18.1	K604 Chan17.4	K603 Chan17.3	K602 Chan17.2	K601 Chan17.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 19 & 20 (W) Base + F_h

This register controls the power selection relays for channels 20 and 19 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K616 Chan20.4	K615 Chan20.3	K614 Chan20.2	K613 Chan20.1	K612 Chan19.4	K611 Chan19.3	K610 Chan19.2	K609 Chan19.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 21 & 22 (W) Base + 10_h

This register controls the power selection relays for channels 22 and 21 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K708 Chan22.4	K707 Chan22.3	K706 Chan22.2	K705 Chan22.1	K704 Chan21.4	K703 Chan21.3	K702 Chan21.2	K701 Chan21.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 23 & 24 (W) Base + 11_h

This register controls the power selection relays for channels 22 and 21 with four possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K716 Chan24.4	K715 Chan24.3	K714 Chan24.2	K713 Chan24.1	K712 Chan23.4	K711 Chan23.3	K710 Chan23.2	K709 Chan23.1
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 + 12_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	K808 Pwr8	K807 Pwr7	K806 Pwr6	K805 Pwr5	K804 Pwr4	K803 Pwr3	K802 Pwr2	K801 Pwr1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Power Select 9-16 (W) Base + 13_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	K816 Pwr16	K815 Pwr15	K814 Pwr14	K813 Pwr13	K812 Pwr12	K811 Pwr11	K810 Pwr10	K809 Pwr9
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Power Select 17-24 (W) Base + 14_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	K824 Pwr24	K823 Pwr23	K822 Pwr22	K821 Pwr21	K820 Pwr20	K819 Pwr19	K818 Pwr18	K817 Pwr17
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Agilent N9379A 48-Channel High-Density Load Card

The Agilent N9379A high-density load card provides 48 channels with two loads per channel. It is not equipped for current sensing and does not provide flyback voltage protection. It provides an output relay in a general-purpose configuration. Loads are mounted onboard on a series of mezzanine cards that plug into the load card. You can attach as many as two loads per channel. See “Using the Agilent N9379A 48-Channel High-Density Load Card" for a block diagram and more information.

Unless otherwise noted, writing a 1 closes (energizes) a relay, and writing a 0 opens (de-energizes) the relay. The reset and power-on state for all relays is open.

Card Type (R) Base + 0_h

This register reads back the card type of the card. The N9379A is uniquely identified by card type 06_h.

Bit	7	6	5	4	3	2	1	0
Purpose	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type	Card Type
Setting	0	0	0	0	0	1	1	0

- Read Only
- Power On/Reset State = 06_h

Card Configuration (R) Base + 1_h

This register reads back the card configuration. Card configuration is determined by the user to distinguish different load configurations on the same load card type. The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the card. (Note that you can use the mezzanine card registers described below for load configuration information.) Use the actions `loadCardGetInfo` to read this register.

Bit	7	6	5	4	3	2	1	0
Purpose	undefined	undefined	undefined	undefined	undefined	undefined	CC1	CC0
Setting	x	x	x	x	x	x	state	state

- Read Only
- x = undefined

Status & Control (R & W) Base + 2_h

This register reads back the card's status. It also can be used to reset the board or open all relays (OAR).

Card 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	6	5	4	3	2	1	0
Read	1	1	1	1	1	1	1	Busy~
Write	not used	not used	OAR	not used	not used	not used	not used	Reset

- Read and Write
- Undefined bits read back as all 1s
- Unused bits for write can be either 0 or 1 (does not matter)
- For BUSY~ (Read Only):

  0 = Busy

  1 = Ready
- For Reset (Write Only):

  0 = no change

  1 = causes board reset (non-latched)
- For OAR (Write Only):

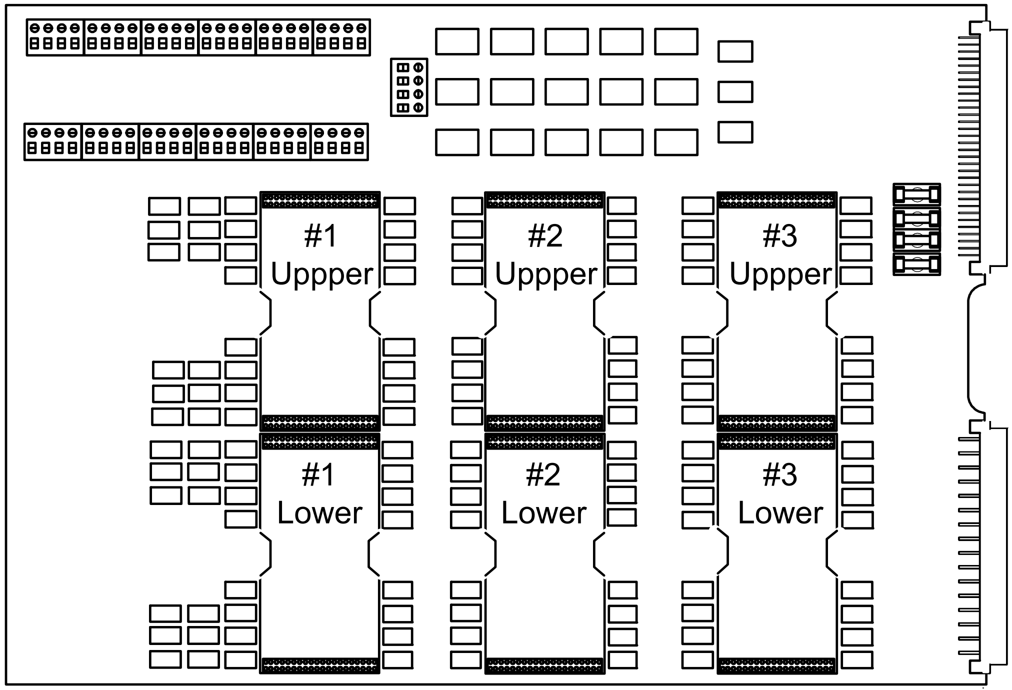
  0 = no change

  1 = causes all relays to open (non-latched)

Mezzanine Card #1 Configuration (R) Base + 3_h

This register reads configuration information from the #1 upper and #1 lower mezzanine cards. Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register. Figure B-3 shows the layout of the mezzanine cards.

Figure B-3 Mezzanine Card Layout



The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC1L.3	MC1L.2	MC1L.1	MC1L.0	MC1U.3	MC1U.2	MC1U.1	MC1U.0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC1U.0-MC1U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC1L.0-MC1L.3)
- Power On/Reset State = 1

Mezzanine Card #2 Configuration (R) Base + 4_h

This register reads configuration information from the #2 upper and #2 lower mezzanine cards. (See Figure B-3 for a picture of the mezzanine card layout.)

Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register.

The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC2L.3	MC2L.2	MC2L.1	MC2L.0	MC2U.3	MC2U.2	MC2U.1	MC2U.0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC2U.0-MC2U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC2L.0-MC2L.3)
- Power On/Reset State = 1

Mezzanine Card #3 Configuration (R) Base + 5_h

This register reads configuration information from the #3 upper and #3 lower mezzanine cards. (See Figure B-3 for a picture of the mezzanine card layout.)

Card configuration is determined by the user to distinguish different load configurations. There are four bits available for each card, which permits identification of the mezzanine card location and proper orientation. Use the action `loadCardGetInfo` to read this register.

The default read back is FF_h, but you can pull down bits to zero as required to create a configuration byte unique to the loads installed.

Bit	7	6	5	4	3	2	1	0
Purpose	MC3L.3	MC3L.2	MC3L.1	MC3L.0	MC3U.3	MC3U.2	MC3U.1	MC3U.0
Setting	state	state	state	state	state	state	state	state

- Read Only
- Lower nibble (bits 0-3) = #1 upper card (MC3U.0-MC3U.3)
- Upper nibble (bits 4-7) = #1 lower card (MC3L.0-MC3L.3)
- Power On/Reset State = 1

Load Select 1-4 (W) Base + 6_h

This register controls the power selection relays for channels 1 through 4 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K208 Chan4.2	K207 Chan4.1	K206 Chan3.2	K205 Chan3.1	K204 Chan2.2	K203 Chan2.1	K202 Chan1.2	K201 Chan1.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 5-8 (W) Base + 7_h

This register controls the power selection relays for channels 5 through 8 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K216 Chan8.4	K215 Chan8.3	K214 Chan7.2	K213 Chan7.1	K212 Chan6.2	K211 Chan6.1	K210 Chan5.2	K209 Chan5.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 9-12 (W) Base + 8_h

This register controls the power selection relays for channels 9 through 12 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K308 Chan12.2	K307 Chan12.1	K306 Chan11.2	K305 Chan11.1	K304 Chan10.2	K303 Chan10.1	K302 Chan9.2	K301 Chan9.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 13-16 (W) Base + 9_h

This register controls the power selection relays for channels 13 through 16 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K316 Chan16.2	K315 Chan16.1	K314 Chan15.2	K313 Chan15.1	K312 Chan14.2	K311 Chan14.1	K310 Chan13.2	K309 Chan13.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 17-20 (W) Base + A_h

This register controls the power selection relays for channels 17 through 20 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K408 Chan21.2	K407 Chan20.1	K406 Chan19.2	K405 Chan19.1	K404 Chan18.2	K403 Chan18.1	K402 Chan17.2	K401 Chan17.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 21-24 (W) Base + B_h

This register controls the power selection relays for channels 21 through 24 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K416 Chan24.2	K415 Chan24.1	K414 Chan23.2	K413 Chan23.1	K412 Chan22.2	K411 Chan22.1	K410 Chan21.2	K409 Chan21.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 25-28 (W) Base + C_h

This register controls the power selection relays for channels 25 through 28 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K508 Chan28.2	K507 Chan28.1	K506 Chan27.2	K505 Chan27.1	K504 Chan26.2	K503 Chan26.1	K502 Chan25.2	K501 Chan25.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 29-32 (W) Base + D_h

This register controls the power selection relays for channels 29 through 32 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K516 Chan32.2	K515 Chan32.1	K514 Chan31.2	K513 Chan31.1	K512 Chan30.2	K511 Chan30.1	K510 Chan29.2	K509 Chan29.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 33-36 (W) Base + E_h

This register controls the power selection relays for channels 33 through 36 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K608 Chan36.2	K607 Chan36.1	K606 Chan35.2	K605 Chan35.1	K604 Chan34.2	K603 Chan34.1	K602 Chan33.2	K601 Chan33.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 37-40 (W) Base + F_h

This register controls the power selection relays for channels 37 through 40 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K616 Chan40.2	K615 Chan40.1	K614 Chan39.2	K613 Chan39.1	K612 Chan38.2	K611 Chan38.1	K610 Chan37.2	K609 Chan37.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 41-44 (W) Base + 10_h

This register controls the power selection relays for channels 41 through 44 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K708 Chan44.2	K707 Chan44.1	K706 Chan43.2	K705 Chan43.1	K704 Chan42.2	K703 Chan42.1	K702 Chan41.2	K701 Chan41.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Load Select 44-48 (W) Base + 11_h

This register controls the power selection relays for channels 45 through 48 with two possible loads on each channel.

Bit	7	6	5	4	3	2	1	0
Purpose	K716 Chan48.2	K715 Chan48.1	K714 Chan47.2	K713 Chan47.1	K712 Chan46.2	K711 Chan46.1	K710 Chan45.2	K709 Chan45.1
Setting	state	state	state	state	state	state	state	state

- Write Only
- State:

  1 = closed

  0 = open
- Power On/Reset State = 0

Power Select 1-16 (W) Base + 12_h

This register controls the Pull Up/Down Power Select armature relays for channels 1-16. Each bit controls power shared by two channels. 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	K808 Pwr15-16	K807 Pwr13-14	K806 Pwr11-12	K805 Pwr9-10	K804 Pwr7-8	K803 Pwr5-6	K802 Pwr3-4	K801 Pwr1-2
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Power Select 17-32 (W) Base + 13_h

This register controls the Pull Up/Down Power Select armature relays for channels 17-32. Each bit controls power shared by two channels. 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	K816 Pwr31-32	K815 Pwr29-30	K814 Pwr27-28	K813 Pwr25-26	K812 Pwr23-24	K811 Pwr21-22	K810 Pwr19-20	K809 Pwr17-18
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Power Select 33-48 (W) Base + 14_h

This register controls the Pull Up/Down Power Select armature relays for channels 33-48. Each bit controls power shared by two channels. 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	K824 Pwr47-48	K823 Pwr45-46	K822 Pwr43-44	K821 Pwr41-42	K820 Pwr39-40	K819 Pwr37-38	K818 Pwr35-36	K817 Pwr33-34
Setting	state	state	state	state	state	state	state	state

- Write Only
- State: 1 = NO, shorted to Pwr node
- State: 0 = NC, shorted to Pwr node
- Power On/Reset State = 0 (all channels connected to NC)

Pin Matrix Card Register Definition

Registers for the various load cards are defined in the following tables. Each register is designated a W (Write-only) or R (Read-only). The h subscript indicates a hexadecimal number.

Agilent 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:

- Agilent E8792A returns a card type of 10_{10}: (dddd = 1010).
- Agilent 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 Agilent 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 Agilent 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_1	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 Agilent 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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_1$	$Inst_{10}$	$Inst_9$

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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_1$	$Inst_{10}$	$Inst_9$

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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_1$	$Inst_{10}$	$Inst_9$

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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_1$	$Inst_{10}$	$Inst_9$

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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_1$	$Inst_{10}$	$Inst_9$

Agilent E8782A 24-Instrument, 40-Measurement Matrix Card

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 Instrument matrix card type:

Instrument matrix card without auxiliary returns a card type of 6610 :(ddddddd=1000010)

Instrument matrix card with auxiliary returns a card type of 6710 :(ddddddd=1000011)

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

Card Configuration (R) Base + 1_h

Instrument matrix card configuration and firmware revision (FWR) register. Initial firmware revision = 0h

Bits	7	6	5	4	3	2	1	0
Read	FWR3	FWR2	FWR1	0	0	0	0	0

Status and Control (R/W) Base + 2_h

This register reads back the card's status. It can set the state of DAC1Rly, DAC2Rly and GndRly relays. I can also be used to Reset and Open All Relays (OAR).

Bits	7	6	5	4	3	2	1	0
Read	Busy~	0	OAR	0	DA2Rly	DAC1Rly	GndRly	Reset
Write	X	X	OAE	X	DAC2Rly	DAC1Rly	GndRly	Reset

Read Only:

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

Write and Read Bits:

- **OAR**: 0 causes no change, 1 causes all relays to open
- **GndRly**: 0 opens relay from Inst2 to System Gnd (default), 1 closes relay from Inst2 to System Gnd
- **DAC1Rly**: 0 opens relay from Inst1 to DAC1 (default), 1 closes relay from Inst1 to DAC1
- **DAC2Rly**: 0 opens relay from Inst1 to DAC2 (default), 1 closes relay from Inst1 to DAC2
- **Reset**: 0 causes no change, 1 causes board reset and triggers the relay timer. Clears itself afterward.

Not Used Base + 3_h

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

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

Instrument matrix 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	AB4	AB3	AB2	AB1	PB4	PB3	PB2	PB1

- Writing to PB4-PB1 sets state of protection bypass relays.
- Writing to AB4-AB1 sets state of Abus disconnect relays.

Not Used Base + 5_h

Register offser 5_h used only for placeholder to make software addressing simpler.

UUT Common to Instrument Bus

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

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 + 7_h

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

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

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

Aux Relays

Not available for Instrument matrix card without auxiliary.

Auxilary Relay 1-8 (W)
Base + 9_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

Auxilary Relay 9-16 (W)
Base + A_h (10_{10})

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

Auxilary Relay 17-24 (W)
Base + B_h (11_{10})

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}

Auxilary Relay 25-32 (W)
Base + C_h (12_{10})

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}

Auxilary Relay 33-40 (W)
Base + D_h (13_{10})

Bits	7	6	5	4	3	2	1	0
Write	Aux_{40}	Aux_{39}	Aux_{38}	Aux_{37}	Aux_{36}	Aux_{35}	Aux_{34}	Aux_{33}

ABUS1 to Instrument Bus

Instrument Relay 1-8 (W)
Base + E_h (14_{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 + F_h (15_{10})

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

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

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

ABUS1 to Row

Row Relay 1-8 (W)
Base + 11_h (17_{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 + 12_h (18_{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 + 13_h (19_{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 + 14_h (20_{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}

Row Relay 33-40 (W)
Base + 15_h (21_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

ABUS2 to Instrument Bus

Instrument Relay 1-8 (W)
Base + 16_h (22_{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 + 17_h (23_{10})

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

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

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

ABUS2 to Row

Row Relay 1-8 (W)
Base + 19_h (25_{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 + $1A_h$ (26_{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 + $1B_h$ (27_{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 + $1C_h$ (28_{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}

Row Relay 33-40 (W)
Base + $1D_h$ (29_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

ABUS3 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	$Inst_{16}$	$Inst_{15}$	$Inst_{14}$	$Inst_{13}$	$Inst_{12}$	$Inst_{11}$	$Inst_{10}$	$Inst_{9}$

Instrument Relay 17-24 (W)
Base + 20_h (32_{10})

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

ABUS3 to Row

Row Relay 1-8 (W)
Base + 21_h (33_{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 + 22_h (34_{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 + 23_h (35_{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 + 24_h (36_{10})

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

Row Relay 33-40 (W)
Base + 25_h (37_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

ABUS4 to Instrument Bus

Instrument Relay 1-8 (W)
Base + 26_h (38_{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 + 27_h (39_{10})

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

Instrument Relay 17-24 (W)
Base + 28_h (40_{10})

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

ABUS4 to Row

Row Relay 1-8 (W)
Base + 29_h (41_{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 + $2A_h$ (42_{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 + $2B_h$ (43_{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 + $2C_h$ (44_{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}

Row Relay 33-40 (W) Base + $2D_h$ (45_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

Agilent E8783A 64-Pin Matrix Card

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 measurement matrix card type:

Measurement matrix card without auxiliary returns a card type of 7010 : (ddddddd=1000110)

Measurement matrix card with auxiliary returns a card type of 7110 : (ddddddd=1000111)

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

Card Configuration (R) Base + 1_h

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

Bits	7	6	5	4	3	2	1	0
Read	FWR3	FWR2	FWR1	0	0	0	0	0

Status and Control (R/W) Base + 2_h

This register reads back the card's status. It can also be used to Reset and Open All Relays (OAR).

Bits	7	6	5	4	3	2	1	0
Read	Busy~	0	OAR	0	X	X	X	Reset

Read Only:

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

Write and Read Bits:

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

Not Used Base + 3_h

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

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

Measurement matrix 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	AB4	AB3	AB2	AB1	PB4	PB3	PB2	PB1

- Writing to PB4-PB1 sets state of protection bypass relays.
- Writing to AB4-AB1, sets state of Abus disconnect relays.

Not Used Base + 5_h

Register offser 5h used only for placeholder to make software addressing simpler.

Aux Relays

Not available for Measurement matrix card without auxiliary

Auxilary 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

Auxilary 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

Auxilary 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}

Auxilary 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}

Auxilary Relay 33-40 (W) Base + A_h (10_{10})

Bits	7	6	5	4	3	2	1	0
Write	Aux_{40}	Aux_{39}	Aux_{38}	Aux_{37}	Aux_{36}	Aux_{35}	Aux_{34}	Aux_{33}

Auxilary Relay 41-48 (W)
Base + B_h (11_{10})

Bits	7	6	5	4	3	2	1	0
Write	Aux_{48}	Aux_{47}	Aux_{46}	Aux_{45}	Aux_{44}	Aux_{43}	Aux_{42}	Aux_{41}

Auxilary Relay 49-56 (W)
Base + C_h (12_{10})

Bits	7	6	5	4	3	2	1	0
Write	Aux_{56}	Aux_{55}	Aux_{54}	Aux_{53}	Aux_{52}	Aux_{51}	Aux_{50}	Aux_{49}

Auxilary Relay 57-64 (W)
Base + D_h (13_{10})

Bits	7	6	5	4	3	2	1	0
Write	Aux_{64}	Aux_{63}	Aux_{62}	Aux_{61}	Aux_{60}	Aux_{59}	Aux_{58}	Aux_{57}

ABUS1 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}

Row Relay 33-40 (W)
Base + 12_h (18_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

Row Relay 41-48 (W)
Base + 13_h (19_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{48}	Row_{47}	Row_{46}	Row_{45}	Row_{44}	Row_{43}	Row_{42}	Row_{41}

Row Relay 49-56 (W)
Base + 14_h (20_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{56}	Row_{55}	Row_{54}	Row_{53}	Row_{52}	Row_{51}	Row_{50}	Row_{49}

Row Relay 57-64 (W)
Base + 15_h (21_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{64}	Row_{63}	Row_{62}	Row_{61}	Row_{60}	Row_{59}	Row_{58}	Row_{57}

ABUS2 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}

Row Relay 33-40 (W)
Base + $1A_h$ (26_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

Row Relay 41-48 (W)
Base + $1B_h$ (27_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{48}	Row_{47}	Row_{46}	Row_{45}	Row_{44}	Row_{43}	Row_{42}	Row_{41}

Row Relay 49-56 (W)
Base + $1C_h$ (28_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{56}	Row_{55}	Row_{54}	Row_{53}	Row_{52}	Row_{51}	Row_{50}	Row_{49}

Row Relay 57-64 (W)
Base + $1D_h$ (29_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{64}	Row_{63}	Row_{62}	Row_{61}	Row_{60}	Row_{59}	Row_{58}	Row_{57}

ABUS3 to Row

Row Relay 1-8 (W)
Base + $1E_h$ (30_{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 + $1F_h$ (31_{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 + 20_h (32_{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 + 21_h (33_{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}

Row Relay 33-40 (W)
Base + 22_h (34_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

Row Relay 41-48 (W)
Base + 23_h (35_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{48}	Row_{47}	Row_{46}	Row_{45}	Row_{44}	Row_{43}	Row_{42}	Row_{41}

Row Relay 49-56 (W)
Base + 24_h (36_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{56}	Row_{55}	Row_{54}	Row_{53}	Row_{52}	Row_{51}	Row_{50}	Row_{49}

Row Relay 57-64 (W)
Base + 25_h (37_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{64}	Row_{63}	Row_{62}	Row_{61}	Row_{60}	Row_{59}	Row_{58}	Row_{57}

ABUS4 to Row

Row Relay 1-8 (W)
Base + 26_h (38_{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 + 27_h (39_{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 + 28_h (40_{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 + 29_h (41_{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}

Row Relay 33-40 (W)
Base + $2A_h$ (42_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{40}	Row_{39}	Row_{38}	Row_{37}	Row_{36}	Row_{35}	Row_{34}	Row_{33}

Row Relay 41-48 (W)
Base + $2B_h$ (43_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{48}	Row_{47}	Row_{46}	Row_{45}	Row_{44}	Row_{43}	Row_{42}	Row_{41}

Row Relay 49-56 (W)
Base + $2C_h$ (44_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{56}	Row_{55}	Row_{54}	Row_{53}	Row_{52}	Row_{51}	Row_{50}	Row_{49}

Row Relay 57-64 (W)
Base + $2D_h$ (45_{10})

Bits	7	6	5	4	3	2	1	0
Write	Row_{64}	Row_{63}	Row_{62}	Row_{61}	Row_{60}	Row_{59}	Row_{58}	Row_{57}

Agilent 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.

C
Repair Information

Support Strategy

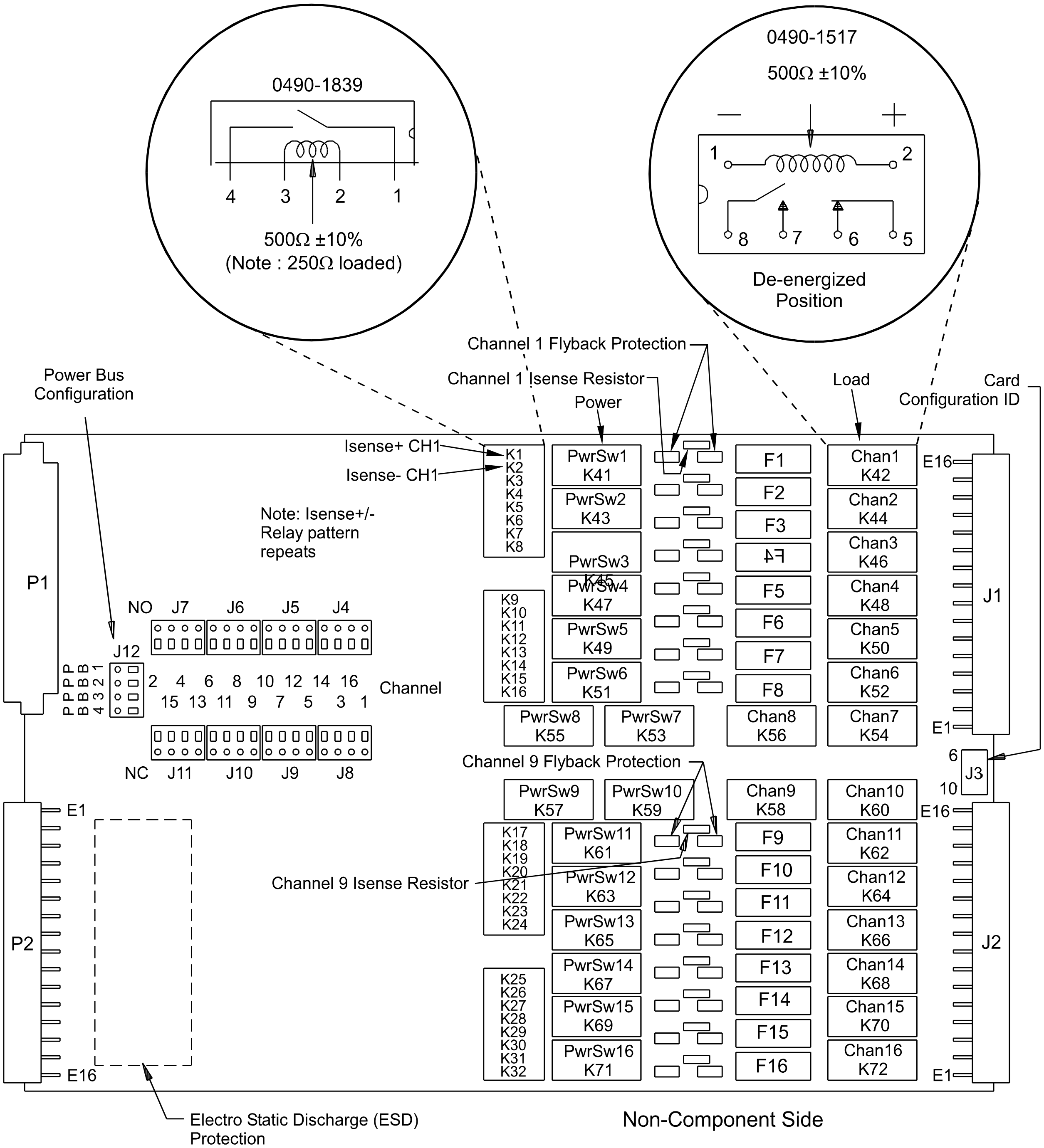
Rebuilt exchange assemblies are available for many Agilent VXI modules. However, there are no exchange assemblies available for the load cards. If a load card fails, you have two choices: purchase a new load card or troubleshoot the problem and repair it. If the problem is a relay and you can determine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

Locating Load Card Components

Agilent E6175A 8-Channel High-Current Card

See the block diagram in Figure 5-3 to locate the relays and fuses for the E6175A. The component locator diagram in shows the non-component side, back of the Agilent E3750-66503 through-hole PC board.This cards uses the 0490-1517 Form C relay, as shown in Figure C-1. Two Agilent 0490-1839 relays, switched in parallel, are used to connect the Isense+ and Isense- signals.

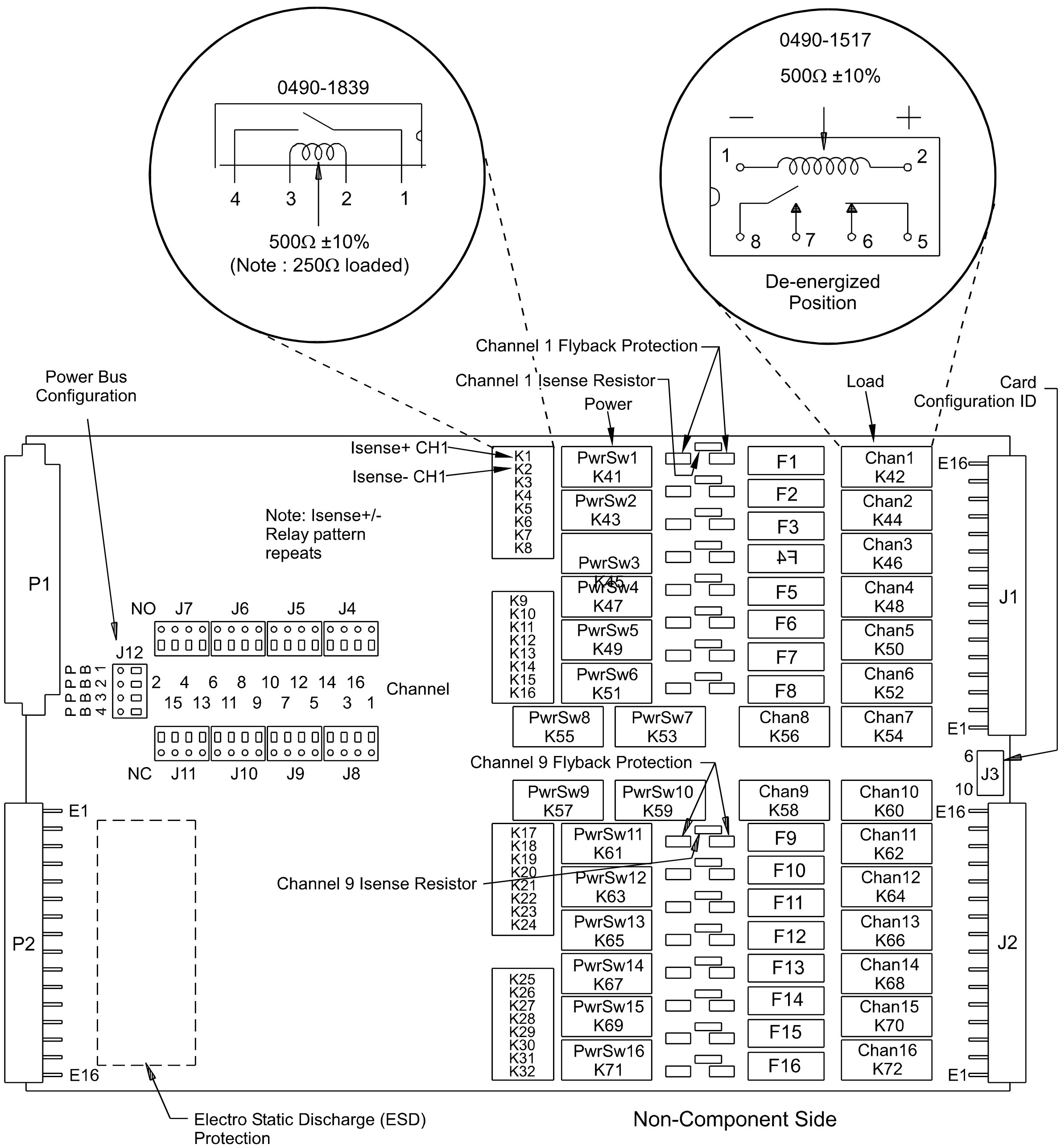
Figure C-1 Agilent E6175A Component Locator (Rear View)



Agilent E6176A 16-Channel High-Current Card

See Figure 5-17 to locate the relays and fuses for the E6176A. The component locator diagram (Figure C-1) shows the solder-side or back of the Agilent E3750-66504 through-hole PC board. This load card uses the 0490-1517 Form C relay. Two Agilent 0490-1839 relays, switched in parallel, are used to connect the Isense+ and Isense- signals.

Figure C-2 Agilent E6176A 16-Channel Load Card Component Locator (Rear View)



Other Load Cards

Consult the relevant section for each load card in Chapter 5 for diagrams and components on other load cards. For more information see:

- “Using the Agilent E6177A 24-Channel Load Card"
- “Using the Agilent U7177A 24-Channel Load Card"
- “Using the Agilent N9377A 16-Channel Dual-Load Load Card"
- “Using the Agilent N9377A 16-Channel Dual-Load Load Card"
- “Using the Agilent N9378A 24-Channel Low Resistance Load Card"
- “Using the Agilent N9379A 48-Channel High-Density Load Card"

32-Pin Matrix Modules

Figure 6-2 shows the relay groupings for the Agilent E8792A. (The Agilent E8793A is identical but does not have the instrumentation relays.) Individual relays can be replaced on the Agilent E8792A and E8793A 32-pin matrix modules. All relays are 5V, 1A reed relays. The Agilent part number for an 8-pack of relays is 0490-1838.

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 C-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.

Table C-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

Table C-1 Measurement Matrix Relays (continued)

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
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 C-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 C-3 Bypass and Disconnect Relays

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

Table C-4 Miscellaneous Relays

Inst2 to System Ground Relay	K502
DAC1 to Inst1	K503
DAC2 to Inst1	K504

64-Pin Matrix Modules

Figure 6-11 shows the relay groupings for the Agilent E8782A. (The Agilent E8783A is identical but does not have the instrumentation relays.) Individual relays can be replaced on the Agilent E8782A and E8783A 32-pin matrix modules. All relays are 5V, 1A reed relays. The Agilent part number for an 8-pack of relays is 0490-2063. 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 C-6, 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.

Note that E8782A with ID 66_{10} and E8783A with ID 70_{10} do not have Row to Aux relays.

Table C-5 Measurement Matrix Relays for E8782A

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Inst1	K101	K201	K301	K401	K901
Inst2	K102	K202	K302	K402	K902
Inst3	K103	K203	K303	K403	K903
Inst4	K104	K204	K304	K404	K904
Inst5	K105	K205	K305	K405	K905
Inst6	K106	K206	K306	K406	K906
Inst7	K107	K207	K307	K407	K907
Inst8	K108	K208	K308	K408	K908
Inst9	K109	K209	K309	K409	K909
Inst10	K110	K210	K310	K410	K910
Inst11	K111	K211	K311	K411	K911
Inst12	K112	K212	K312	K412	K912
Inst13	K113	K213	K313	K413	K913
Inst14	K114	K214	K314	K414	K914
Inst15	K115	K215	K315	K415	K915
Inst16	K116	K216	K316	K416	K916
Inst17	K117	K217	K317	K417	K917
Inst18	K118	K218	K318	K418	K918

Table C-5 Measurement Matrix Relays for E8782A (continued)

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Inst19	K119	K219	K319	K419	K919
Inst20	K120	K220	K320	K420	K920
Inst21	K121	K221	K321	K421	K921
Inst22	K122	K222	K322	K422	K922
Ins23	K123	K223	K323	K423	K923
Inst24	K124	K224	K324	K424	K924
Row1	K125	K225	K325	K425	K925
Row2	K126	K226	K326	K426	K926
Row3	K127	K227	K327	K427	K927
Row4	K128	K228	K328	K428	K928
Row5	K129	K229	K329	K429	K929
Row6	K130	K230	K330	K430	K930
Row7	K131	K231	K331	K431	K931
Row8	K132	K232	K332	K432	K932
Row9	K133	K233	K333	K433	K933
Row10	K134	K234	K334	K434	K934
Row11	K135	K235	K335	K435	K935
Row12	K136	K236	K336	K436	K936
Row13	K137	K237	K337	K437	K937
Row14	K138	K238	K338	K438	K938
Row15	K139	K239	K339	K439	K939
Row16	K140	K240	K340	K40	K940
Row17	K141	K241	K341	K441	K941
Row18	K142	K242	K342	K442	K942
Row19	K143	K243	K343	K443	K943
Row20	K144	K244	K344	K544	K944
Row21	K145	K245	K345	K445	K945
Row22	K146	K246	K346	K446	K946
Row23	K147	K247	K347	K447	K947
Row24	K148	K248	K348	K448	K948
Row25	K149	K249	K349	K449	K949

Table C-5 Measurement Matrix Relays for E8782A (continued)

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Row26	K150	K250	K350	K450	K950
Row27	K151	K251	K351	K452	K951
Row28	K152	K252	K352	K442	K952
Row29	K153	K253	K353	K453	K953
Row30	K154	K254	K354	K454	K954
Row31	K155	K255	K355	K455	K955
Row32	K156	K256	K356	K456	K956
Row33	K157	K257	K357	K457	K957
Row34	K158	K258	K358	K458	K958
Row35	K159	K259	K359	K459	K959
Row36	K160	K260	K360	K460	K960
Row37	K161	K261	K361	K461	K961
Row38	K162	K262	K362	K462	K962
Row39	K163	K263	K363	K463	K963
Row40	K164	K264	K364	K464	K964

Table C-6 Measurement Matrix Relays for E8783A

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Row1	K101	K201	K301	K401	K901
Row2	K102	K202	K302	K402	K902
Row3	K103	K203	K303	K403	K903
Row4	K104	K204	K304	K404	K904
Row5	K105	K205	K305	K405	K905
Row6	K106	K206	K306	K406	K906
Row7	K107	K207	K307	K407	K907
Row8	K108	K208	K308	K408	K908
Row9	K109	K209	K309	K409	K909
Row10	K110	K210	K310	K410	K910
Row11	K111	K211	K311	K411	K911
Row12	K112	K212	K312	K412	K912
Row13	K113	K213	K313	K413	K913

Table C-6 Measurement Matrix Relays for E8783A (continued)

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Row14	K114	K214	K314	K414	K914
Row15	K115	K215	K315	K415	K915
Row16	K116	K216	K316	K416	K916
Row17	K117	K217	K317	K417	K917
Row18	K118	K218	K318	K418	K918
Row19	K119	K219	K319	K419	K919
Row20	K120	K220	K320	K420	K920
Row21	K121	K221	K321	K421	K921
Row22	K122	K222	K322	K422	K922
Row23	K123	K223	K323	K423	K923
Row24	K124	K224	K324	K424	K924
Row25	K125	K225	K325	K425	K925
Row26	K126	K226	K326	K426	K926
Row27	K127	K227	K327	K427	K927
Row28	K128	K228	K328	K428	K928
Row29	K129	K229	K329	K429	K929
Row30	K130	K230	K330	K430	K930
Row31	K131	K231	K331	K431	K931
Row32	K132	K232	K332	K432	K932
Row33	K133	K233	K333	K433	K933
Row34	K134	K234	K334	K434	K934
Row35	K135	K235	K335	K435	K935
Row36	K136	K236	K336	K436	K936
Row37	K137	K237	K337	K437	K937
Row38	K138	K238	K338	K438	K938
Row39	K139	K239	K339	K439	K939
Row40	K140	K240	K340	K40	K940
Row41	K141	K241	K341	K441	K941
Row42	K142	K242	K342	K442	K942
Row43	K143	K243	K343	K443	K943
Row44	K144	K244	K344	K544	K944

Table C-6 Measurement Matrix Relays for E8783A (continued)

	Column1 (Abus1)	Column2 (Abus2)	Column3 (Abus3)	Column4 (Abus4)	Row to Aux
Row45	K145	K245	K345	K445	K945
Row46	K146	K246	K346	K446	K946
Row47	K147	K247	K347	K447	K947
Row48	K148	K248	K348	K448	K948
Row49	K149	K249	K349	K449	K949
Row50	K150	K250	K350	K450	K950
Row51	K151	K251	K351	K452	K951
Row52	K152	K252	K352	K442	K952
Row53	K153	K253	K353	K453	K953
Row54	K154	K254	K354	K454	K954
Row55	K155	K255	K355	K455	K955
Row56	K156	K256	K356	K456	K956
Row57	K157	K257	K357	K457	K957
Row58	K158	K258	K358	K458	K958
Row59	K159	K259	K359	K459	K959
Row60	K160	K260	K360	K460	K960
Row61	K161	K261	K361	K461	K961
Row62	K162	K262	K362	K462	K962
Row63	K163	K263	K363	K463	K963
Row64	K164	K264	K364	K464	K964

Table C-7 Bypass and Disconnect Relays for E8782A and E8783A

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

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 Agilent 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 VXlbus-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.

- **SLU**

  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 GPIB communications features.

THIS PAGE IS INTENTIONALLY LEFT BLANK.