Model 7002-HD-MTX1
Differential 6 × 32 Matrix Card

User's Manual

7002HDMTX1-900-01 Rev. A / November 2004

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Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, rechargeable batteries, diskettes, and documentation.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from product modification without Keithley's express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

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Manual Print History

The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.

Revision A (Document Number 7002HDMTX1-900-01) .....November 2004

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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting ca-

bles or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a  screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The  symbol indicates a connection terminal to the equipment frame.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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1 General Information

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Introduction

This section contains general information about the Model 7002-HD-MTX1 Differential 6 x 32 Matrix Card. The Model 7002-HD-MTX1 is equipped a 6 x 32 matrix.

Features

Key features include:

- Differential matrix switching configured with 6 rows by 32 columns.
- Card can be expanded for 6 x 64 matrix switching using a second card.
- 200V DC or 200V rms (283V peak AC) switching with 1A, 60W, 125VA maximum.

Warranty information

Warranty information is located on the inside front cover of this manual. Should your Model 7002-HD-MTX1 require warranty service, contact the Keithley representative or authorized repair facility in your area for more information. When returning the card for repair, be sure to fill out and include the service form at the back of this manual in order to provide the repair facility with the necessary information.

Manual addenda

Any improvements or changes concerning the manual will be explained in an addendum included with the card.

Safety symbols and terms

The following symbols and terms may be found on an instrument or used in this manual.

If a  screw is present, connect it to safety earth ground using the wire recommended in the documentation.

The  symbol on equipment indicates that you should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The  symbol indicates a connection terminal to the equipment frame.

Return to **Section 1 topics**

The **WARNING** heading used in this manual explains dangers that could result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading used in this manual explains hazards that could damage the multiplexer card. Such damage may invalidate the warranty.

Specifications

Model 7002-HD-MTX1 specifications are located in at the end of this manual.

Unpacking and inspection

Inspection for damage

The Model 7002-HD-MTX1 is packaged in a re-sealable, anti-static bag to protect it from damage due to static discharge and from contamination that could degrade its performance. Before removing the card from the bag, observe the following handling precautions.

Handling precautions

- Always grasp the card by the side edges and covers. Do not touch the board surfaces or components.
- After removing the card from its anti-static bag, inspect it for any obvious signs of physical damage. Report any damage to the shipping agent immediately.
- When the card is not installed in a switching mainframe, keep the card in its anti-static bag and store it in the original packing carton.

Shipment contents

The following items are included with every order:

- Model 7002-HD-MTX1 Differential 6 x 32 Matrix Card
- Model 7002-HD-MTX1 User's Manual (PDF on CD-ROM)
- Additional accessories as ordered

Instruction manual

If an additional Model 7002-HD-MTX1 User's Manual is required, order the manual package, Keithley part number 7002HDMTX1-900-00. The manual package includes an instruction manual and any pertinent addenda.

Return to **Section 1 topics**

Repacking for shipment

Should it become necessary to return the Model 7002-HD-MTX1 for repair, carefully pack the unit in its original packing carton or the equivalent, and include the following information:

- Call the Repair Department at 1-800-552-1115 for a Return Material Authorization (RMA) number.
- Advise as to the warranty status of the card.
- Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.
- Fill out and include the service form located at the back of this manual.

Mainframe compatibility

The Model 7002-HD-MTX1 Card is designed for use only in a Model 7002-HD mainframe. It cannot be used in either a Model 7001 or 7002 mainframe.

Recommended cables and connectors

The recommended cables and connectors are listed below. See Section 2 for connection details, and Section 3 for signal considerations.

- 6-pin removable screw terminal: Ria Part# 31007106.
- 14-pin female IDC socket: 3M Part# 89114-0101.
- 14-conductor jacketed ribbon cable: 3M Part# 3603/14.
- 64-pin female IDC socket: 3M Part# 7964-6500EC.
- 64-conductor jacketed ribbon cable: 3M Part# 3603/64.

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2 Connections and Installation

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Introduction

WARNING **The following information is intended for qualified service personnel. Do not make Model 7002-HD-MTX1 connections unless qualified to do so.**

To prevent electric shock that could result in serious injury or death, adhere to following safety precautions:

- **Before removing or installing a Model 7002-HD-MTX1 in the mainframe, make sure the mainframe is turned off and disconnected from line power.**
- **Before making or breaking connections, make sure power is removed from all external circuitry.**
- **Do not connect signals that may exceed the maximum specifications of the Model 7002-HD-MTX1 or external wiring. Specifications for the Model 7002-HD-MTX1 are provided at the end of this manual.**

This section includes information on making connections to the Model 7002-HD-MTX1 and installing the card in the Model 7002-HD Switch System.

Handling precautions

To maintain high-impedance isolation between channels, care should be taken when handling the card to avoid contamination from such foreign materials as body oils. Such contamination can reduce isolation resistance. To avoid possible contamination, always grasp the card by the side edges or covers. Do not touch board surfaces, components, or connector insulators.

Dirt build-up over a period of time is another possible source of contamination. To avoid this problem, operate the card in a clean environment. If the card becomes contaminated, it should be thoroughly cleaned as explained in Section 4.

Matrix

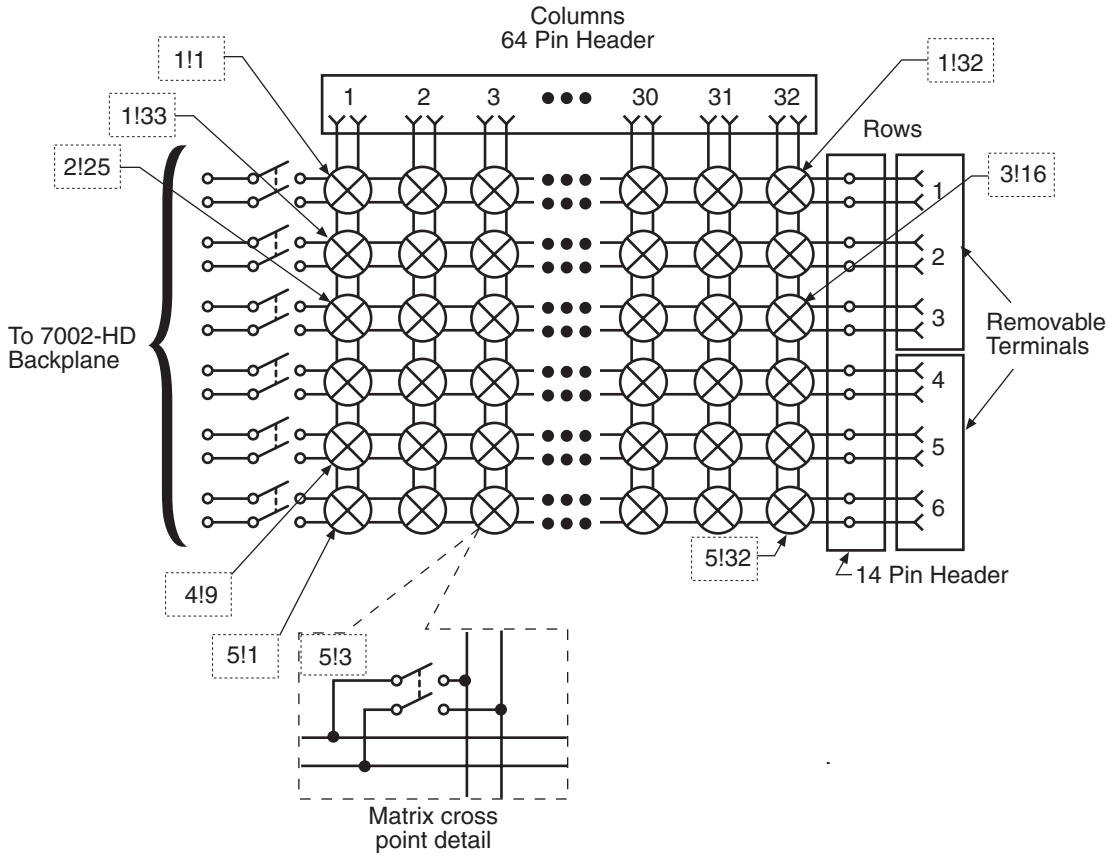
Figure 2-1 shows a simplified diagram of the Model 7002-HD-MTX1 6 x 32 matrix. The matrix consists of 192 crosspoints. Each crosspoint channel is a double pole switch that, when closed, connects a row to a column. As shown in Figure 2-1, closing channel 5!3 connects Row 6 to Column 3.

Return to **Section 2 topics**

The Model 7002-HD (mainframe) has an internal card expansion backplane. The Model 7002-HD-MTX1 has six switches (channels 5!33 through 5!38) used to connect Rows 1 through 6 to the backplane of the Model 7002-HD. When these switches (channels 5!33 through 5!38) are closed, Rows 1 through 6 are connected to the backplane.

Devices Under Test (DUTs) are typically connected to the matrix columns. Using 2-wire connections, up to 32 DUTs can be tested. For 4-wire connections, up to 16 DUTs can be tested.

Figure 2-1
Simplified schematic—Model 7002-HD-MTX1 matrix switching



Return to **Section 2 topics**

WARNING **Multiple channel operation should only be performed by experienced test engineers who recognize the dangers associated with multiple channel closures.**

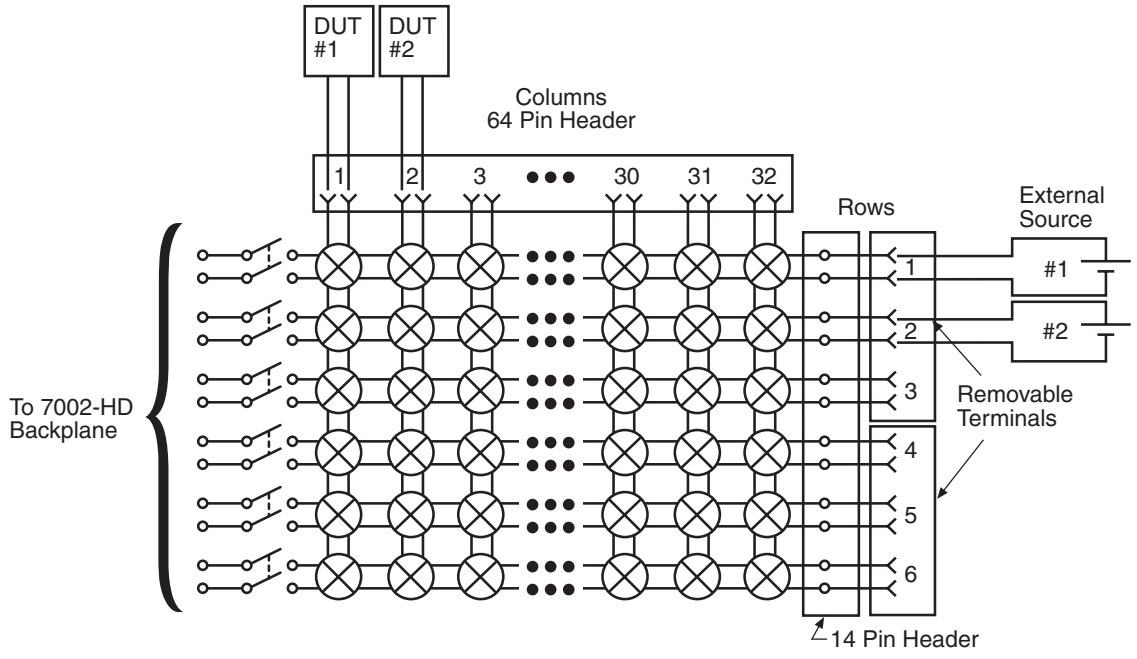
WARNING **When closing multiple channels, it is possible to connect incompatible test equipment and/or DUTs causing high currents to flow. This can cause serious damage to test equipment and DUTs.**

Rows 1 through 6 are typically used to connect one or more external sources to the test system. An external source is typically used to power the DUT. An example of this setup is shown in Figure 2-2. The external source is connected to Row 1. The power cables for the two DUTs are connected to Columns 1 for DUT 1 and Columns 2 for DUT 2.

As shown in Figure 2-2, DUT 1 is tested with external source #1 by closing channel 1!1. To test DUT 2 with external source #2, the following sequence would be used:

1. Open channel 1!1 to remove power from DUT 1.
2. Close channels 1!34 to apply power to DUT 2.

Figure 2-2
Adding external sources to the matrix test system



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Matrix expansion

Column expansion (6 x 64)

Increase the number of columns in a matrix test system by installing another Model 7002-HD-MTX1 in the mainframe and connecting the **rows** from each card through the backplane. Adding a second Model 7002-HD-MTX1 increases the total number of columns to 64.

Figure 2-3 on page 2-6 shows a two matrix system that can test 64 DUTs. As shown, channels 1!2, 5!33, and 10!33 are closed to connect External Source #1 to DUT #2.

Column expansion (6 x 128)

Figure 2-4 on page 2-7 shows a two mainframe / two matrix system that can test 128 DUTs. The matrix diagram would be similar to Figure 2-3. Channels 1!2, 5!33, and 10!33 are closed to connect External Source #1 to DUT #2. This matrix has been expanded through a 14-pin female IDC socket matrix expansion cable.

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Figure 2-3
Two matrix test system for 64 column expansion

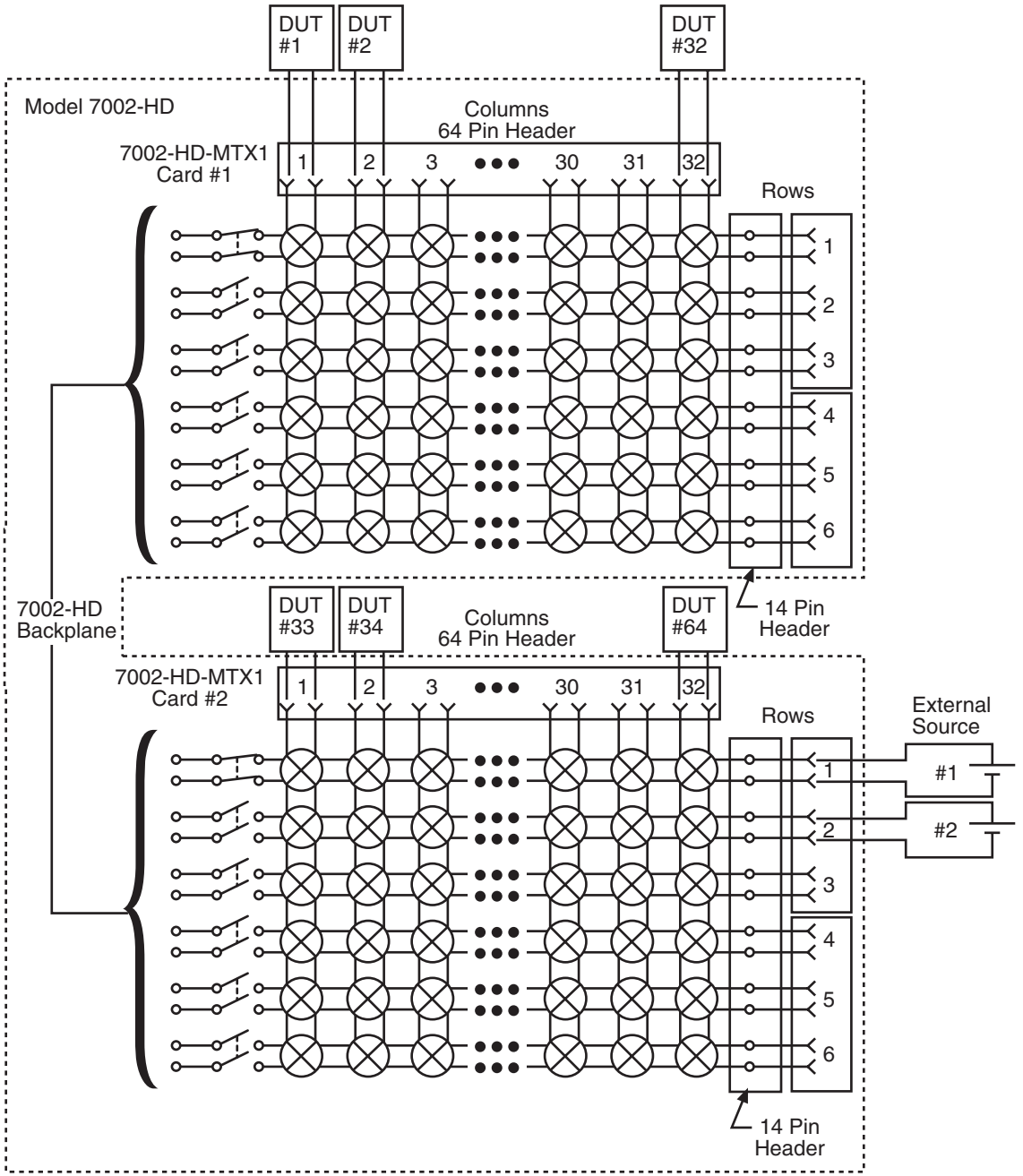

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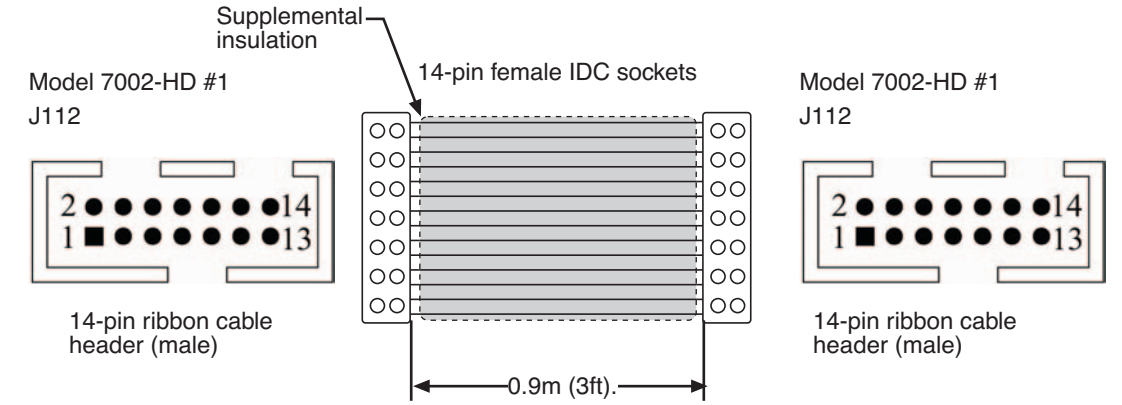
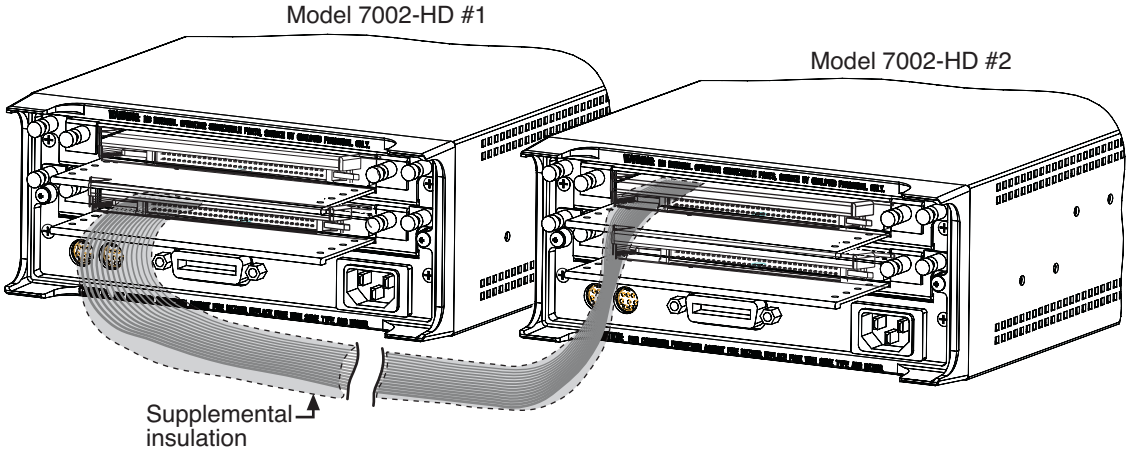
Figure 2-4
Two matrix test system for 128 column expansion





NOTE 7002-HD-MTX1 in Model 7002-HD #1, Card 1, is connected to 7002-HD-MTX1 in Card 2 internally through the backplane. Similarily, 7002-HD-MTX1s in Model 7002-HD #2 are also connected.

Return to **Section 2 topics**

Connections and wiring

WARNING **The following information is intended for qualified service personnel. Do not make Model 7002-HD-MTX1 connections unless qualified to do so.**

To prevent electric shock that could result in serious injury or death, adhere to the following safety precautions:

- **Before removing or installing a Model 7002-HD-MTX1 in the mainframe, make sure the mainframe is turned off and disconnected from line power.**
- **Before making or breaking connections, make sure power is removed from all external circuitry.**
- **Do not connect signals that may exceed the maximum specifications of the Model 7002-HD-MTX1 or external wiring. Specifications for the Model 7002-HD-MTX1 are provided at the end of this document.**

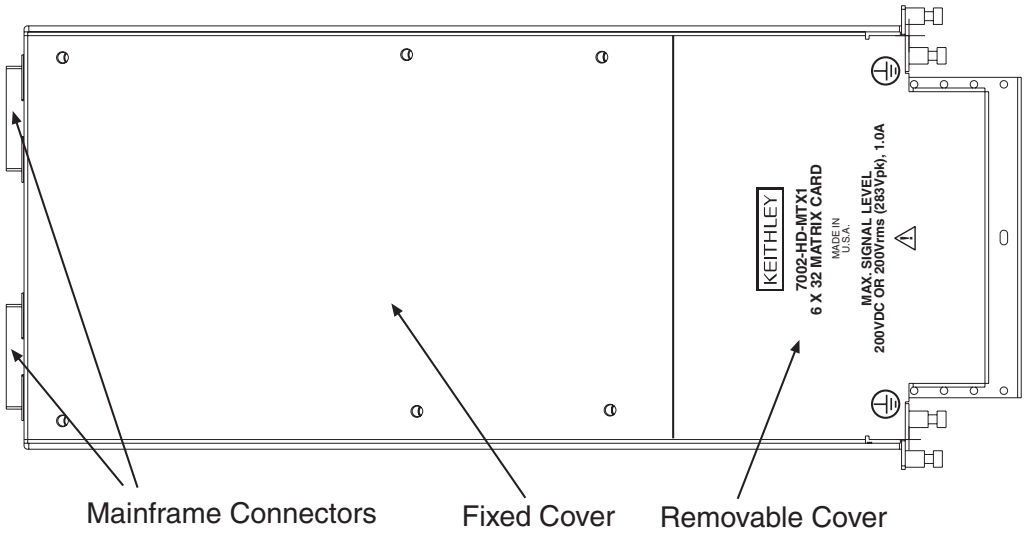
Card configuration

The general layout of the Model 7002-HD-MTX1 is shown in Figure 2-5. Note that the top cover must be removed to access some connectors to make signal connections.

Return to **Section 2 topics**

WARNING Replace and secure the top cover before installing and operating the Model 7002-HD-MTX1 card.

Figure 2-5
Model 7002-HD-MTX1 configuration



Recommended cables and connectors

The recommended cables and connectors are as listed in Table 2-1.

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Table 2-1
Recommended cables and connectors

Description	Part no.	7002-MTX-1 connector
6-pin removable screw terminal	Ria Part# 31007106	J110, J111
14-pin female IDC socket	3M Part# 89114-0101	J112
14-conductor jacketed ribbon cable	3M Part# 3603/14	
64-pin female IDC socket	3M Part# 7964-6500EC	J113
64-conductor jacketed ribbon cable	3M Part# 3603/64	

Connector access

Two captive screws per card provide a method of securing the card to the Model 7002-HD (see Card Access Screw in Figure 2-6). The columns connectors can be accessed from the rear as shown, while the card must be removed from the mainframe to access the rows (Figure 2-7).

Figure 2-6
Connector access

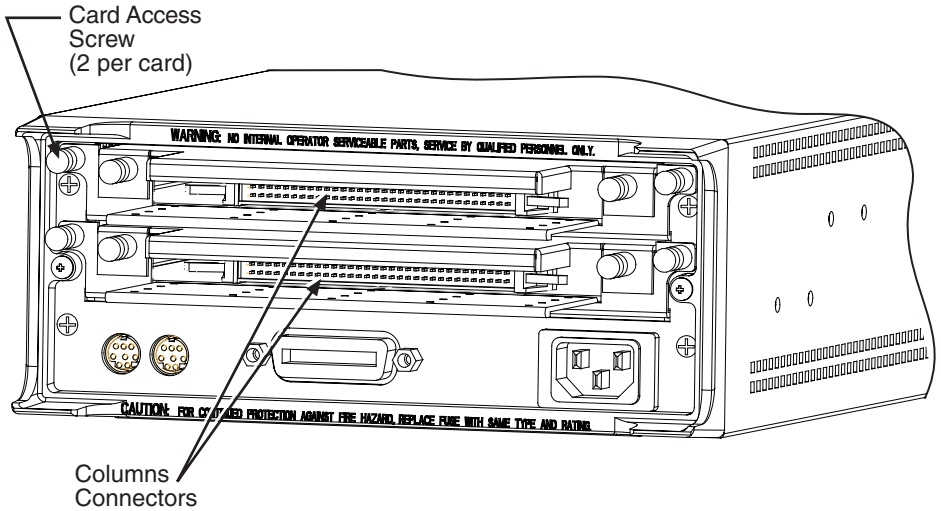

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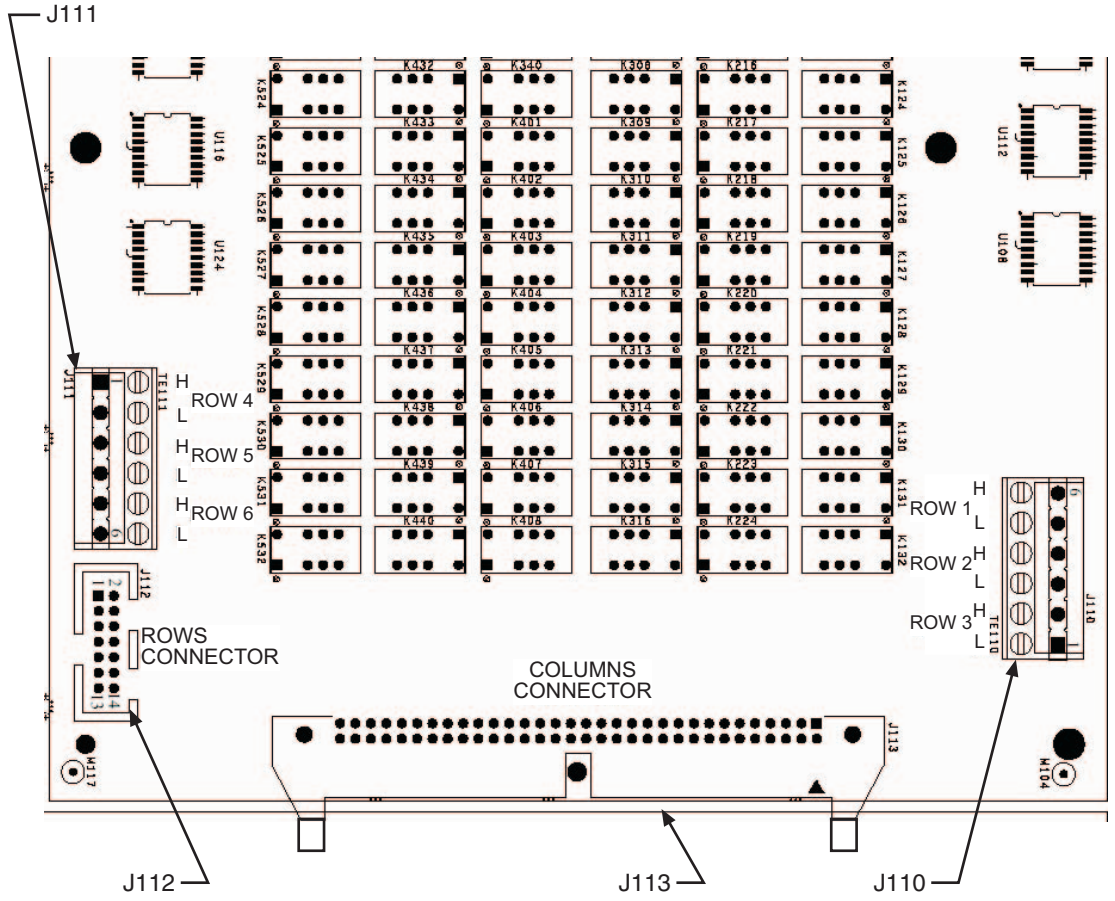
Figure 2-7
Top view - Model 7002-HD-MTX1 connections

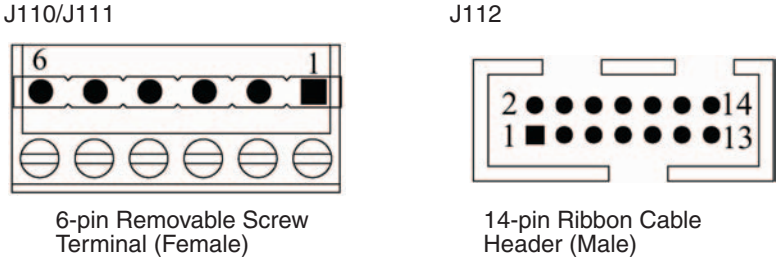


Matrix connectors

Figure 2-7 shows the general location of the connectors. Figure 2-8 details the connectors used for the Model 7002-HD-MTX1 matrix row connections. Both the 14-pin ribbon cable header and the two 6-pin removable screw terminals are used for rows connections. Figure 2-9 shows the 64-pin ribbon cable header that is used for matrix columns connections. Terminal identification for the male and female connector pins are located in Table 2-2 on page 2-13.

Return to **Section 2 topics**

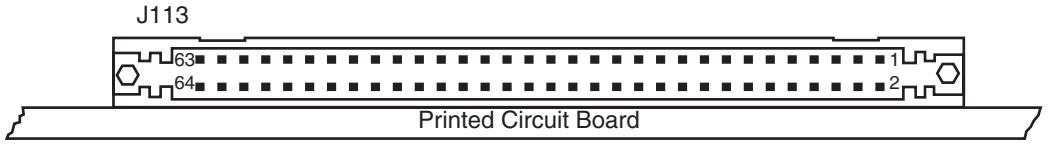
Figure 2-8
Top view - Model 7002-HD-MTX1 matrix rows connectors



6-pin Removable Screw Terminal (Female)

14-pin Ribbon Cable Header (Male)

Figure 2-9
Rear view - Model 7002-HD-MTX1 matrix columns connectors



64-pin Ribbon Cable Header (Male)

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Table 2-2
Matrix pin identification

Column connections 64-pin header (conn. J113)			
Pin	**Matrix terminal**	**Pin**	**Matrix terminal**
1	Col 1 HI	33	Col 17 HI
2	Col 1 LO	34	Col 17 LO
3	Col 2 HI	35	Col 18 HI
4	Col 2 LO	36	Col 18 LO
5	Col 3 HI	37	Col 19 HI
6	Col 3 LO	38	Col 19 LO
7	Col 4 HI	39	Col 20 HI
8	Col 4 LO	40	Col 20 LO
9	Col 5 HI	41	Col 21 HI
10	Col 5 LO	42	Col 21 LO
11	Col 6 HI	43	Col 22 HI
12	Col 6 LO	44	Col 22 LO
13	Col 7 HI	45	Col 23 HI
14	Col 7 LO	46	Col 23 LO
15	Col 8 HI	47	Col 24 HI
16	Col 8 LO	48	Col 24 LO
17	Col 9 HI	49	Col 25 HI
18	Col 9 LO	50	Col 25 LO
19	Col 10 HI	51	Col 26 HI
20	Col 10 LO	52	Col 26 LO
21	Col 11 HI	53	Col 27 HI
22	Col 11 LO	54	Col 27 LO
23	Col 12 HI	55	Col 28 HI
24	Col 12 LO	56	Col 28 LO
25	Col 13 HI	57	Col 29 HI
26	Col 13 LO	58	Col 29 LO
27	Col 14 HI	59	Col 30 HI
28	Col 14 LO	60	Col 30 LO
29	Col 15 HI	61	Col 31 HI
30	Col 15 LO	62	Col 31 LO
31	Col 16 HI	63	Col 32 HI
32	Col 16 LO	64	Col 32 LO

Row connections terminal block		
Pin	**Matrix terminal**	**Conn.**
1	Row 3 LO	J110
2	Row 3 HI	
3	Row 2 LO	
4	Row 2 HI	
5	Row 1 LO	
6	Row 1 HI	

Pin	**Matrix terminal**	**Conn.**
1	Row 4 HI	J111
2	Row 4 LO	
3	Row 5 HI	
4	Row 5 LO	
5	Row 6 HI	
6	Row 6 LO	

Row connections 14-pin header		
Pin	**Matrix terminal**	**Conn.**
1	Row 1 HI	J112
2	Row 1 LO	
3	Row 2 HI	
4	Row 2 LO	
5	Row 3 HI	
6	Row 3 LO	
7	Row 4 HI	
8	Row 4 LO	
9	Row 5 HI	
10	Row 5 LO	
11	Row 6 HI	
12	Row 6 LO	
13	--	
14	--	

Return to **Section 2 topics**

Wiring

WARNING When using IDC ribbon cable connections, DO NOT exceed 42V anywhere in the test system. For voltages above 42V peak, add supplementary insulation around the cable harness (shown on the 14-pin and 64-pin ribbon cable in Figure 2-10).

WARNING All wiring must be rated for the maximum voltage in the test system. For example, if 200V is applied to CARD 2 of the Model 7002-HD, the Model 7002-HD-MTX1 wiring must be rated for 200V.

WARNING Replace and secure the top cover before installing and operating the Model 7002-HD-MTX1 card.

Matrix wiring — rows input connections

Use Figure 2-10 and the following procedure to wire the Model 7002-HD-MTX1 matrix rows input. Make all connections using correct wire size (up to 18 AWG). Also, make sure to add supplementary insulation around the harness for voltages above 42V peak.

1. Make sure all power is discharged from the Model 7002-HD-MTX1.
2. Access the screw terminals (see "Connections and wiring" on page 2-8).
3. Using a small flat-blade screwdriver, loosen terminal screws and install wires as desired.
4. Route wire so that it exits around the right angle connector securing with cable tie as shown.
5. Fill in a copy of the connection log (Table 2-3 on page 2-16) and affix it to the Model 7002-HD-MTX1 cover.
6. Close and lock the cover.

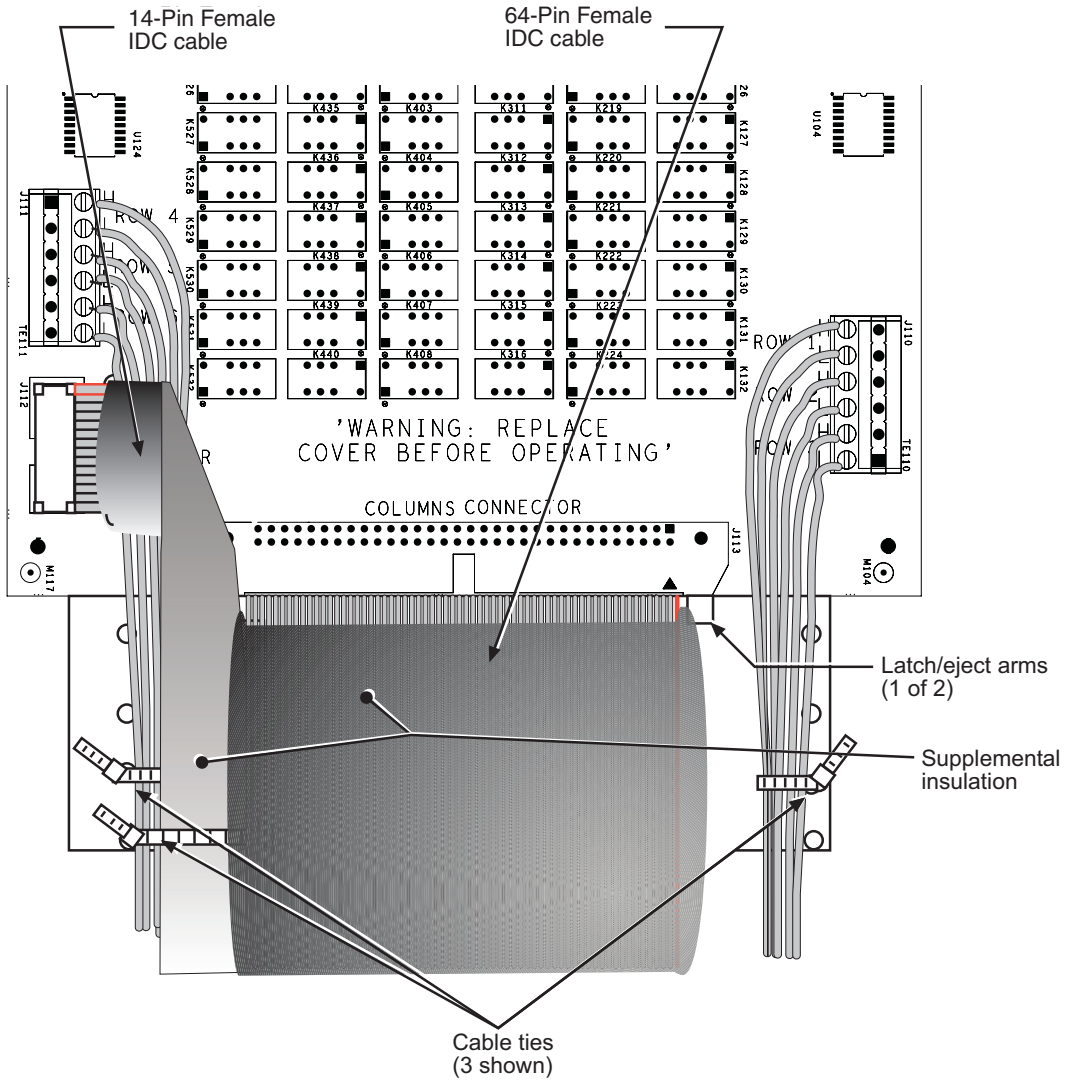
Matrix wiring — column output connections

Use Figure 2-10 and the following procedure to wire the Model 7002-HD-MTX1 column output.

1. Make sure all power is discharged from the Model 7002-HD-MTX1.
2. Access the ribbon cable headers (see "Connections and wiring" on page 2-8).
3. Connect 64-conductor ribbon cable to the columns output header.
4. Route and secure the cable with cable ties or using the lock arms on the J113 header (64-pin ribbon cable) as shown.

5. Fill in a copy of the connection log (Table 2-3 on page 2-16) and affix it to the Model 7002-HD-MTX1 cover.
6. Close and lock the cover.

Figure 2-10
Wire dressing



Return to **Section 2 topics**

Connection colors

Table 2-3 contains the color codes for the 64-pin ribbon cables (J113), and Table 2-4 on page 2-17 includes color codes for 14-pin cables (J112).

Table 2-3
Connection log for 64-pin header (J113)

Color coded 3M - 3302/64 flat ribbon cable					
64-pin header (J113)	**Color**	**Matrix columns connections**	**64-pin header (J113)**	**Color**	**Matrix columns connections**
1	Brown	Col 1 HI	33	Orange	Col 17 HI
2	Red	LO	34	Yellow	LO
3	Orange	Col 2 HI	35	Green	Col 18 HI
4	Yellow	LO	36	Blue	LO
5	Green	Col 3 HI	37	Violet	Col 19 HI
6	Blue	LO	38	Grey	LO
7	Violet	Col 4 HI	39	White	Col 20 HI
8	Grey	LO	40	Black	LO
9	White	Col 5 HI	41	Brown	Col 21 HI
10	Black	LO	42	Red	LO
11	Brown	Col 6 HI	43	Orange	Col 22 HI
12	Red	LO	44	Yellow	LO
13	Orange	Col 7 HI	45	Green	Col 23 HI
14	Yellow	LO	46	Blue	LO
15	Green	Col 8 HI	47	Violet	Col 24 HI
16	Blue	LO	48	Grey	LO
17	Violet	Col 9 HI	49	White	Col 25 HI
18	Grey	LO	50	Black	LO
19	White	Col 10 HI	51	Brown	Col 26 HI
20	Black	LO	52	Red	LO
21	Brown	Col 11 HI	53	Orange	Col 27 HI
22	Red	LO	54	Yellow	LO
23	Orange	Col 12 HI	55	Green	Col 28 HI
24	Yellow	LO	56	Blue	LO
25	Green	Col 13 HI	57	Violet	Col 29 HI
26	Blue	LO	58	Grey	LO
27	Violet	Col 14 HI	59	White	Col 30 HI
28	Grey	LO	60	Black	LO
29	White	Col 15 HI	61	Brown	Col 31 HI
30	Black	LO	62	Red	LO
31	Brown	Col 16 HI	63	Orange	Col 32 HI
32	Red	LO	64	Yellow	LO

Return to **Section 2 topics**

Table 2-4
Connection log for 14-pin head (J112)

Color coded 3M - 3302/14 flat ribbon		
14-pin header (J112)	**Matrix row color**	**Connections**
1	Brown	Row 1 HI
2	Red	LO
3	Orange	Row 2 HI
4	Yellow	LO
5	Green	Row 3 HI
6	Blue	LO
7	Violet	Row 4 HI
8	Grey	LO
9	White	Row 5 HI
10	Black	LO
11	Brown	Row 6 HI
12	Red	LO
13	Orange	--
14	Yellow	--

Return to **Section 2 topics**

Card installation and removal

The following paragraphs describe how to install and remove the Model 7002-HD-MTX1 card assembly from the Model 7002-HD mainframe.

WARNING **Installation or removal of the Model 7002-HD-MTX1 should be performed by qualified service personnel only. Failure to recognize and observe standard safety precautions could result in personal injury or death.**

To prevent performance degradation caused by contamination, handle the card only by the edges and covers.

Card installation

After connecting the input/output cables, perform the following steps, and refer to Figure 2-11 to install the card assembly in the Model 7002-HD mainframe in either the Card 1 or Card 2 location.

WARNING **Turn off power to all instrumentation (including the Model 7002-HD), and disconnect all line cords. Make sure all power is removed and any stored energy in external circuitry is discharged.**

1. Slide the card edges into the guide rails inside the mainframe.
2. Carefully push the card all the way forward to seat it fully in the connectors.
3. Make sure the captive screws are securely in place.

Card removal

Follow the steps below to remove the multiplexer card from the mainframe.

WARNING **Turn off power to all instrumentation (including the Model 7002-HD), and disconnect all line cords. Make sure all power is removed and any stored energy in external circuitry is discharged.**

1. Loosen the captive screws that secure the card.
2. Pull out on the card until it pulls free from the internal connector.
3. Carefully slide the card out of the switching mainframe.

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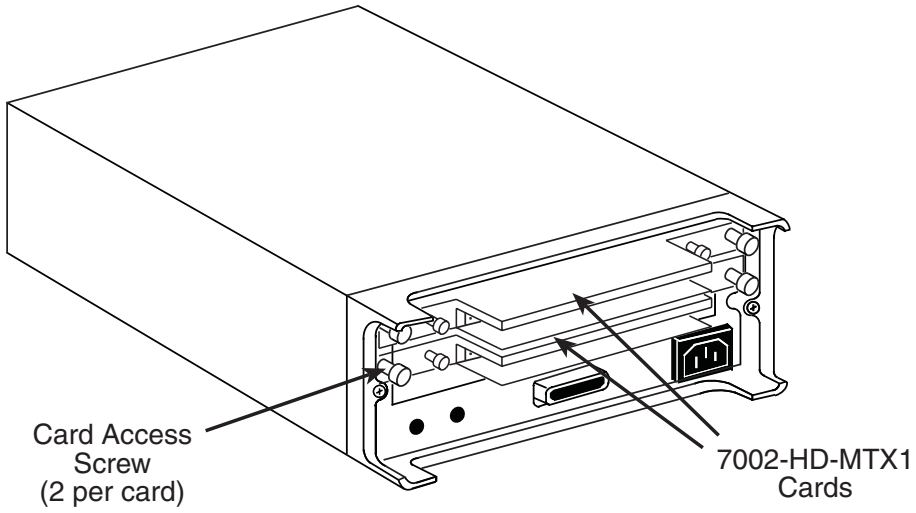
Figure 2-11
Card installation in Model 7002-HD mainframe



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3 Operation

Section 3 topics

Signal limitations, page 3-2

Channel mapping, page 3-2
- Channel assignments, page 3-2
- Channel map, page 3-3
- Backplane connections, page 3-4

Closing and opening channels, page 3-6
- Channel control considerations, page 3-6
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- IEEE-488 bus control, page 3-7
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Measurement considerations, page 3-8
- Connectors, page 3-8
- Cables, page 3-8
- Path isolation resistance, page 3-9
- Magnetic fields and RFI, page 3-9
- Ground loops, page 3-9

Introduction

This section contains information on using the Model 7002-HD-MTX1 including signal limitations, channel mapping, front panel and IEEE-488 bus operation, and measurement considerations.

Signal limitations

CAUTION **To prevent damage to the Model 7002-HD-MTX1, do not exceed the maximum signal level specifications of the card.**

To prevent overheating or damage to the relays, never exceed the following maximum signal levels when using the Model 7002-HD-MTX1:

- **Maximum voltage:** 200V DC or 200V rms (283V peak for AC waveforms)
- **Maximum current:** 1A switched per channel
- **Maximum power:** 60W, 125VA maximum

Channel mapping

Channel assignments

The Model 7002-HD-MTX1 uses five slot designations for control of all relays. To control the appropriate relay, the slot number must be included with the channel number when you specify a channel. The channel assignment is formatted as follows:

S!CH

where: S is the slot number
CH is the channel number

Examples:

1!1 = Slot 1, Channel 1

5!10 = Slot 5, Channel 10

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Channel map

Table 3-1 summarizes the complete channel map for the Model 7002-HD-MTX1. The backplane isolation map is contained in Table 3-2.

In these two tables, the Model 7002-HD-MTX1 is in the Card 1 position of the Model 7002-HD. When the Model 7002-HD-MTX1 is in the Card 2 position of the Model 7002-HD, add 5 to the slot number. The matrix will then occupy slots 6–10. See "Channel control considerations" on page 3-6.

Table 3-1
Channel/relay map (programming for Card 1)

		Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15	Col
Row 1	Close Command	1!1	1!2	1!3	1!4	1!5	1!6	1!7	1!8	1!9	1!10	1!11	1!12	1!13	1!14	1!15	1!
	Relay	K101	K102	K103	K104	K105	K106	K107	K108	K109	K110	K111	K112	K113	K114	K115	K1
Row 2	Close Command	1!33	1!34	1!35	1!36	1!37	1!38	1!39	1!40	2!1	2!2	2!3	2!4	2!5	2!6	2!7	2!
	Relay	K133	K134	K135	K136	K137	K138	K139	K140	K201	K202	K203	K204	K205	K206	K207	K2
Row 3	Close Command	2!25	2!26	2!27	2!28	2!29	2!30	2!31	2!32	2!33	2!34	2!35	2!36	2!37	2!38	2!39	2!
	Relay	K225	K226	K227	K228	K229	K230	K231	K232	K233	K234	K235	K236	K237	K238	K239	K2
Row 4	Close Command	3!17	3!18	3!19	3!20	3!21	3!22	3!23	3!24	3!25	3!26	3!27	3!28	3!29	3!30	3!31	3!
	Relay	K317	K318	K319	K320	K321	K322	K323	K324	K325	K326	K327	K328	K329	K330	K331	K3
Row 5	Close Command	4!9	4!10	4!11	4!12	4!13	4!14	4!15	4!16	4!17	4!18	4!19	4!20	4!21	4!22	4!23	4!
	Relay	K409	K410	K411	K412	K413	K414	K415	K416	K417	K418	K419	K420	K421	K422	K423	K4
Row 6	Close Command	5!1	5!2	5!3	5!4	5!5	5!6	5!7	5!8	5!9	5!10	5!11	5!12	5!13	5!14	5!15	5!
	Relay	K501	K502	K503	K504	K505	K506	K507	K508	K509	K510	K511	K512	K513	K514	K515	K5

		Col 17	Col 18	Col 19	Col 20	Col 21	Col 22	Col 23	Col 24	Col 25	Col 26	Col 27	Col 28	Col 29	Col 30	Col 31	Col
Row 1	Close Command	1!17	1!18	1!19	1!20	1!21	1!22	1!23	1!24	1!25	1!26	1!27	1!28	1!29	1!30	1!31	1!
	Relay	K117	K118	K119	K120	K121	K122	K123	K124	K125	K126	K127	K128	K129	K130	K131	K1
Row 2	Close Command	2!9	2!10	2!11	2!12	2!13	2!14	2!15	2!16	2!17	2!18	2!19	2!20	2!21	2!22	2!23	2!
	Relay	K209	K210	K211	K212	K213	K214	K215	K216	K217	K218	K219	K220	K221	K222	K223	K2
Row 3	Close Command	3!1	3!2	3!3	3!4	3!5	3!6	3!7	3!8	3!9	3!10	3!11	3!12	3!13	3!14	3!15	3!
	Relay	K301	K302	K303	K304	K305	K306	K307	K308	K309	K310	K311	K312	K313	K314	K315	K3
Row 4	Close Command	3!33	3!34	3!35	3!36	3!37	3!38	3!39	3!40	4!1	4!2	4!3	4!4	4!5	4!6	4!7	4!
	Relay	K333	K334	K335	K336	K337	K338	K339	K340	K401	K402	K403	K404	K405	K406	K407	K4
Row 5	Close Command	4!25	4!26	4!27	4!28	4!29	4!30	4!31	4!32	4!33	4!34	4!35	4!36	4!37	4!38	4!39	4!
	Relay	K425	K426	K427	K428	K429	K430	K431	K432	K433	K434	K435	K436	K437	K438	K439	K4
Row 6	Close Command	5!17	5!18	5!19	5!20	5!21	5!22	5!23	5!24	5!25	5!26	5!27	5!28	5!29	5!30	5!31	5!
	Relay	K517	K518	K519	K520	K521	K522	K523	K524	K525	K526	K527	K528	K529	K530	K531	K5

Table 3-2
Backplane isolation channel map (programming for Card 1)

		Backplane isolation
Row 1	Close Command	5!33
	Relay	K533
Row 2	Close Command	5!34
	Relay	K534
Row 3	Close Command	5!35
	Relay	K535
Row 4	Close Command	5!36
	Relay	K536
Row 5	Close Command	5!37
	Relay	K537
Row 6	Close Command	5!38
	Relay	K538

Backplane connections

The Model 7002-HD mainframe backplane connects signals from the Card 1 and Card 2 positions inserted in the mainframe in a one-to-one fashion. Therefore, pin 1 on J107 on the Card 1 card is connected to pin 1 on J107 on the Card 2 card through the backplane. The other J107 pins are connected similarly in this one-to-one manner. When both cards are of the same type, the connections through the backplane from one card to the other connect the same signals due to the symmetry of the cards. Table 3-3 can be used to interconnect two different card types through the 7002-HD backplane by closing the appropriate backplane relays on each card. (In this case, a Model 7002-HD-MUX1 Quad 1 x 40 Multiplexer Card is used with a Model 7002-HD-MTX1.) The backplane signals are not externally accessible to the end user. All pins not specified are unused.

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Table 3-3
Backplane connections between 7002-HD-MUX1 and 7002-HD-MTX1 cards

J107 pin number	7002-HD-MUX1 card use		7002-HD-MTX1 card use	
	Signal	Polarity	Signal	Polarity
11	None	N/A	Row 6	HI
12	None	N/A	Row 5	HI
13	Mux 4 Out	HI	Row 4	HI
14	Mux 3 Out	HI	Row 3	HI
15	Mux 2 Out	HI	Row 2	HI
16	Mux 1 Out	HI	Row 1	HI
43	None	N/A	Row 6	LO
44	None	N/A	Row 5	LO
45	Mux 4 Out	LO	Row 4	LO
46	Mux 3 Out	LO	Row 3	LO
47	Mux 2 Out	LO	Row 2	LO
48	Mux 1 Out	LO	Row 1	LO

Return to **Section 3 topics**

Closing and opening channels

Channel control considerations

Refer to Table 3-1 on page 3-3 and Table 3-2 on page 3-4 for a detailed channel map of the Model 7002-HD-MTX1. The Model 7002-HD contains a total of 10 slots for relay control. Card 1 position of the Model 7002-HD contains slots 1 through 5, and Card 2 contains slots 6 through 10.

Card 1

When a Model 7002-HD-MTX1 is used in the Card 1 position of the Model 7002-HD, the matrix will be controlled using slots 1 through 5.

Card 2

When a Model 7002-HD-MTX1 is used in the Card 2 position of the Model 7002-HD, the matrix will be controlled using slots 6 through 10. When using the tables, add five to the slot number programming. For example: Row 1 / Column 1 would be addressed as 6!1.

Front panel control

To close a Model 7002-HD-MTX1 channel, key in the CHANNEL assignment from the tables on the preceding pages, and then press the Model 7002-HD CLOSE key. For example, to close Row 1, Column10 of Card 1, key in the following channel list, and press CLOSE:

```
SELECT CHANNELS 1!10
```

To open a closed channel, press OPEN or OPEN ALL.

You can also simultaneously close more than one channel at a time by including the desired channels in the channel list. For example, to close Card 1, Row 1, Column 1 and Card 1, Row 3, Column 25, enter the following channel list:

```
SELECT CHANNELS 1!1,3!9
```

Channels are separated by a comma, which can be inserted by pressing either the ENTER or right cursor key. Again, you can open closed channels with the OPEN or OPEN ALL key. OPEN opens only channels in the channel list, and OPEN ALL opens all channels.

Return to **Section 3 topics**

WARNING **Multiple channel operation should only be performed by experienced test engineers who recognize the dangers associated with multiple channel closures.**

CAUTION **When closing multiple channels, it is possible to connect incompatible test equipment and/or DUTs causing high currents to flow. This situation can cause serious damage to test equipment and DUTs.**

IEEE-488 bus control

Use the following SCPI commands to close and open channels:

```
:CLOS <list>
:OPEN <list> | ALL
```

For example, the following command will close Row 2, Column 29 and Row 4, Column 16 of Card 1:

```
:CLOS (@ 2!21,3!32)
```

Conversely, either of the commands below will open previously closed Row 2, Column 29 and Row 4, Column 16 of Card 1:

```
:OPEN (@ 2!21,3!32)
:OPEN ALL
```

Programming examples

Programming example #1: Adding an external source to the matrix test system

Table 3-4 shows an example that connects an external source using Row 1 to a DUT connected to Column 1 of the matrix as shown in Figure 2-2 on page 2-4.

Table 3-4
Adding an external source to the matrix test system

	Description	Command sequence
1	Reset Model 7002-HD mainframe	`:*RST`
2	Open all channels	`:open all`
3	Close Row 1/Col 1	`:clos (@1!1)`
4	Query list of closed channels	`:clos:stat?`
5	Open previously closed channels	`:open (@1!1)`

Return to **Section 3 topics**

Programming example #2:
Adding an external source to a 6 x 64 matrix (2 matrix card test system)

The following example connects an external source using Row 1 of the matrix of a Model 7002-HD-MTX1 in the Card 2 position of the Model 7002-HD to DUT 2 connected to Column 2 of the matrix of a Model 7002-HD-MTX1 in the Card 1 position as shown in Figure 2-3 on page 2-6. The command sequence is summarized in Table 3-5.

Table 3-5
Adding an external source to a 64 column system

	Description	Command sequence
1	Reset Model 7002-HD mainframe	`:*RST`
2	Open all channels	`:open all`
3	Close relays and backplane row isolation relays for Row 1 and Column 2 of Card 1	`:clos (@1!2, 5!33,10!33)`
4	Query list of closed channels	`:clos:stat?`
5	Open previously closed channels	`:open all`

Measurement considerations

Signals passing through the Model 7002-HD-MTX1 Matrix Card are subject to various effects that can influence their characteristics. The following paragraphs discuss some of these effects and ways to minimize them.

Connectors

Connector housing materials will affect the performance of the Model 7002-HD-MTX1. In order to achieve the Model 7002-HD-MTX1 specifications, follow the list of recommended connectors.

Cables

Cable leakage and capacitance affect Model 7002-HD-MTX1 performance. In order to achieve the Model 7002-HD-MTX1 specifications, follow the list of recommended cables.

Return to **Section 3 topics**

Path isolation resistance

The path isolation resistance is the equivalent resistance between two given connecting points on the card and is of importance primarily for DC and low-frequency AC signals switched by the card. The effects of this characteristic depend on the particular isolation specification. Channel-to-channel isolation resistance may result in leakage currents generated in one channel caused by a voltage source connected to another channel.

To maintain maximum path isolation resistance, operate the Model 7002-HD-MTX1 in a clean environment to avoid contamination. Also be careful not to touch connectors and board surfaces during wiring and installation. If the board becomes contaminated, it should be cleaned using the procedure described in "Handling and cleaning precautions" on page 4-2.

Magnetic fields and RFI

Magnetic fields and RFI (Radio Frequency Interference) can induce small currents or other noise signals in connecting cables and wiring. To reduce the effects of these unwanted signals in a test system: (1) keep cable lengths to a minimum, and (2) minimized the exposed circuit area. Magnetic or RFI shielding may be necessary for satisfactory results. Measurement instrument offset nulling or filtering may be also be needed to minimize these negative effects on measurement integrity.

Ground loops

Ground loops that induce a noise signal at the power line frequency or its harmonics can result when two or more measurement instruments are connected to power line or earth ground simultaneously. To eliminate ground loop noise, connect only one instrument in the test system to power line or earth ground.

WARNING When making instrument connections, be careful to observe all necessary safety ground precautions for operator safety.

4 Servicing

Section 4 topics

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Introduction

This section contains information necessary to service the Model 7002-HD-MTX1 and includes information on handling and cleaning, performance verification, as well as principles of operation and troubleshooting.

WARNING **The information in this section is intended only for qualified service personnel. Some of the procedures may expose you to hazardous voltages that could result in personal injury or death. Do not attempt to perform these procedures unless you are qualified to do so.**

Handling and cleaning precautions

Because of the high-impedance areas on the Model 7002-HD-MTX1, care should be taken when handling or servicing the card to prevent possible contamination. The following precautions should be observed when servicing the card.

Handling precautions

Observe the following precautions when handling the multiplexer card:

- Handle the card only by the edges and shields
- Do not touch connector insulators
- Do not touch any board surfaces or components not associated with the repair
- Do not touch areas adjacent to electrical contacts
- When servicing the card, wear clean cotton gloves
- Do not store or operate the card in an environment where dust could settle on the circuit board
- Use dry nitrogen gas to clean dust off of the board if necessary

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Soldering considerations

Should it become necessary to use solder on the circuit board, observe the following precautions:

- Use an OA-based (organic activated) flux, and take care not to spread the flux to other areas of the circuit board.
- Remove the flux from the work areas when the repair has been completed. Use pure water along with clean cotton swabs or a clean soft brush to remove the flux.
- Once the flux has been removed, swab only the repaired area with methanol, and then blow-dry the board with dry nitrogen gas.
- After cleaning, allow the card to dry in a 50°C low humidity environment for several hours before use.

Special handling of static-sensitive devices

CMOS and other high-impedance devices are subject to possible static discharge damage because of the high-impedance levels involved. When handling such devices, observe the following precautions:

- To prevent damage, assume all parts are static-sensitive.
- Such devices should be transported and handled only in containers specially designed to prevent or dissipate static build-up. Typically, these devices will be received in anti-static containers made of plastic or foam.
- Keep these parts in their original containers until ready for installation or use.
- Remove the devices from their protective containers only at a properly grounded workstation. Also, ground yourself with an appropriate wrist strap while working with these devices.
- Handle the devices only by the body; do not touch the pins or terminals.
- Any printed circuit board into which the device is to be inserted must first be grounded to the bench or table.
- Use only anti-static type de-soldering tools and grounded-tip soldering irons.

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Performance verification

The following paragraphs discuss performance verification procedures for the Model 7002-HD-MTX1, including path resistance, offset current, contact potential, and path isolation.

WARNING **The following information is intended for qualified service personnel. Do not perform these tests unless you are qualified to do so.**

To prevent electric shock that could result in serious injury or death, adhere to following safety precautions:

- **Before removing or installing a Model 7002-HD-MTX1 in the mainframe, make sure the mainframe is turned off and disconnected from line power.**
- **Before making or breaking connections, make sure power is removed from all external circuitry.**
- **Do not connect signals that may exceed the maximum specifications of the Model 7002-HD-MTX1 or external wiring. Specifications for the Model 7002-HD-MTX1 are provided at the end of this manual.**

CAUTION **The maximum signal level, any channel to any channel, is: 200V DC or 200V rms (283V peak for AC waveforms), 1A switched, 60W, 125VA maximum. Exceeding these signal levels may result in card damage, possibly voiding the warranty.**

NOTE Failure of any performance verification test may indicate that the Model 7002-HD-MTX1 is contaminated. See "Handling and cleaning precautions" on page 4-2 to clean the Model 7002-HD-MTX1.

The verification procedures are located on the following pages:

"Channel resistance tests" on page 4-6

"Offset current tests" on page 4-11

"Contact potential tests" on page 4-15

"Isolation tests" on page 4-17

The performance verification procedures must be performed with only one Model 7002-HD-MTX1 (the one being checked) installed in the Model 7002-HD. These conditions do not apply if there are signals present in the backplane of the Model 7002-HD.

Environmental conditions

All verification measurements should be made at an ambient temperature between 18°C and 28°C, and at a relative humidity of less than 50%.

Recommended equipment

Table 4-1 summarizes the equipment necessary for performance verification, along with an application for each unit.

Table 4-1
Verification equipment

Description	Keithley Model	Specifications	Applications
DMM	2750	100Ω; 0.01%	Path resistance
Electrometer with voltage source	6517A	20pA; 1% 20nA, 200nA; 0.2% 100V source; 0.15%	Offset current, isolation
Sensitive DMM	2182A	10mV; 0.006%	Contact potential
Triax cable	237	NA	Offset current, isolation
Low thermal cable	2107	NA	Contact potential

Matrix connections

The following information summarizes methods that can be used to connect test instrumentation to the matrix. Detailed connection information is provided in "Connections and wiring" on page 2-8.

CAUTION **Contamination will degrade the performance of the Model 7002-HD-MTX1. To avoid contamination, always grasp the Model 7002-HD-MTX1 by the side edges. Do not touch the connectors, and do not touch the board surfaces or components. On plugs and receptacles, do no touch areas adjacent to the electrical contacts.**

Rows input

Instrumentation can be hard-wired directly to the Rows Input screw terminals of the matrix. Keep jumper wires as short as possible.

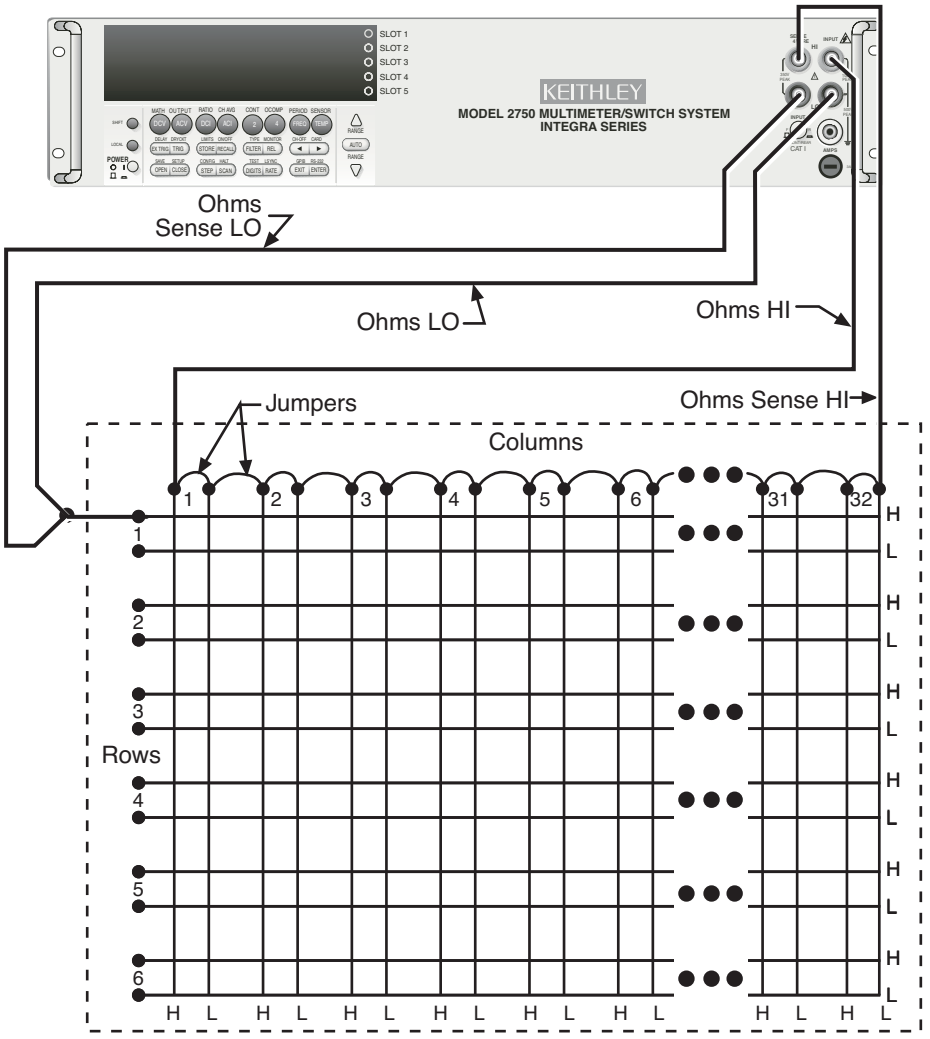
Column output

One method for making instrument connections to the matrix is by taking an IDC 64-pin ribbon cable socket connector and mating it to the column output connector of the matrix. Column shorting connections can also be done at the connector. Pin identification for the columns output connector of the matrix is provided in Table 2-2 on page 2-13.

Channel resistance tests

Referring to Figure 4-1, perform the following steps to verify that each contact of every relay is closing properly and that channel resistance is within specification.

Figure 4-1
Matrix path resistance testing



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1. Remove power from Model 7002-HD.
2. Set up for resistance tests:
   - As shown in Figure 4-1, connect all terminals of matrix Columns 1 through 32 together to form one common terminal.
   - Check that FRONT/REAR switch of the Model 2750 is set to FRONT.
   - Set the Model 2750 to the 4-Wire 100Ω range and connect four test leads to the INPUT and SENSE input.
   - Short the four test leads together and REL the Model 2750. Leave REL enabled for the entire test.
   - Connect INPUT HI and SENSE HI of the Model 2750 to the common terminal. It is recommended that the physical connections be made at Columns 1 and 32 as shown in Figure 4-1.
3. Check resistance for Row 1 HI:
   - Connect INPUT LO and SENSE LO to the Rows Input terminal of Row 1 HI.
   - Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
   - Turn on the Model 7002-HD and program it to close channels 1!1 (Row 1/Column 1 HI). Verify that the resistance of this channel is <1Ω.
   - Open channel 1!1 and close 1!2. Verify that the resistance of this channel is <1Ω.
   - Open channel 1!2 and close 1!3. Verify that the resistance of this channel is <1Ω.
   - Repeat the basic procedure of opening and closing channels to check the resistance of Row 1 terminal paths for Columns 4 through 32 (channels 1!4 through 1!32).
4. Check resistance for Rows 2–6 HI:
   - Turn off the Model 7002-HD and connect the INPUT LO and SENSE LO test leads of the Model 2750 to the terminal of Row 2.
   - Repeat step 3 to check channel paths of Rows 2–6. Refer to 7002-HD-MTX1 Channel Relay Map (Table 3-1 on page 3-3).
5. Check resistance for Row 1 LO:
   - Turn off the Model 7002-HD and connect the INPUT LO and SENSE LO test leads of the Model 2750 to the LO Row 1 terminal.
   - Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
   - Turn on the Model 7002-HD and program it to close channels 1!1 (Row 1/Column 1 LO). Verify that the resistance of this channel is <1Ω.
   - Turn off the Model 7002-HD and connect the INPUT LO and SENSE LO test leads of the Model 2750 to the input test terminal of Row 2 LO.
   - Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
   - Turn on the Model 7002-HD and program it to close channels 1!33 (Row 2/Column 1 LO). Verify that the resistance of this channel is <1Ω.

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6. Check resistance for rows 2–6 LO:
   - Repeat the basic procedure in step 5 for Rows 3 through 6.
   - Turn off the Model 7002-HD and remove the jumpers of Columns 1 through 32 on the Model 7002-HD-MTX1.
7. Check rows input to columns output terminal resistance:
   - Connect the INPUT LO and SENSE LO test leads of the Model 2750 to the rows input terminal of Row 1 HI of the Model 7002-HD-MTX1 #1 as shown in Figure 4-2.
   - Connect INPUT HI and SENSE HI to the columns output terminal of Column 1 HI of the Model 7002-HD-MTX1 #2.
   - Install the Model 7002-HD-MTX1 #1 in Card 1 and the Model 7002-HD-MTX1 #2 in Card 2 of the Model 7002-HD.
   - Turn on the Model 7002-HD and program it to close channels 5!33, 10!33, and 6!1. (This connects Row 1 backplane channels for the Model 7002-HD-MTX1 #1 and Row 1/ Column 1 and backplane channels for the 7002-HD-MTX1 #2.) Verify that the resistance of this channel is <2Ω.
   - Turn off the Model 7002-HD, remove the card, and connect the INPUT LO and SENSE LO test leads of the Model 2750 to the rows input t erminal of Row 1 LO of the Model 7002-HD-MTX1 #1.
   - Install the Model 7002-HD-MTX1 #1 in Card 1.
   - Turn on the Model 7002-HD and program it to close channels 5!33, 10!33, and 6!1. (This connects Row 1 backplane channels for the Model 7002-HD-MTX1 #1 and Row 1/ Column 1 and backplane channels for the 7002-HD-MTX1 #2). Verify that the resistance of this channel is <2Ω.
8. Repeat the basic procedure in Step 7 for rows 2 through 6.

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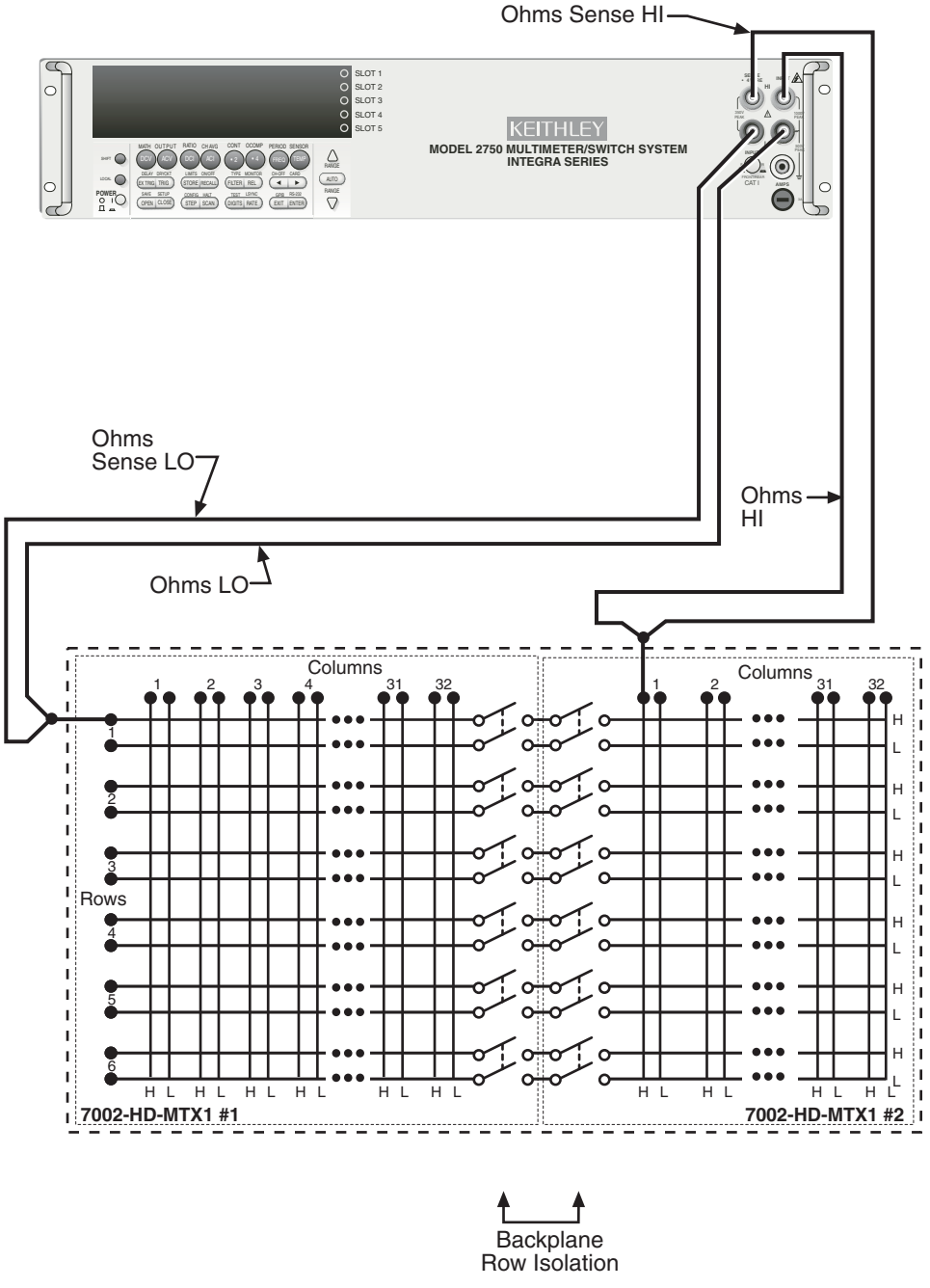
Figure 4-2
Matrix backplane rows path resistance testing



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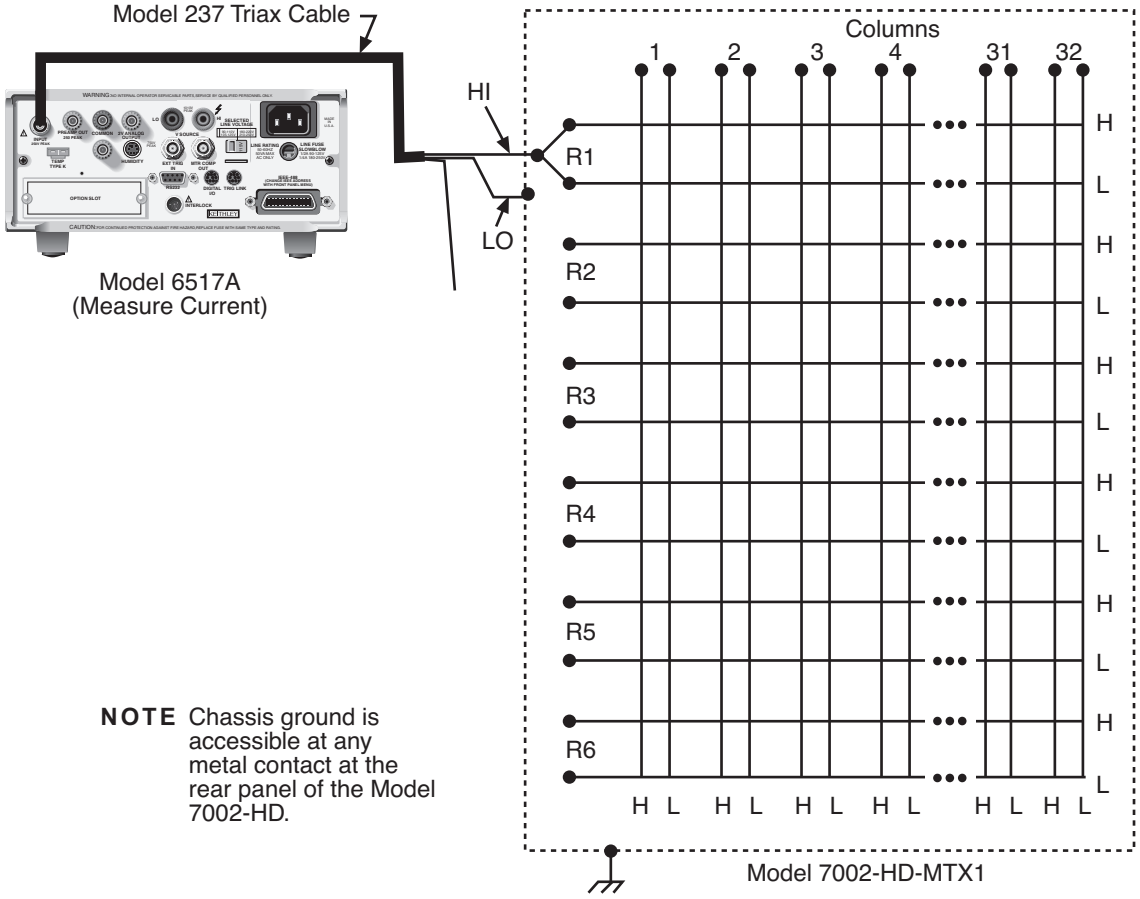
Offset current tests

These tests check leakage current from channel-to-channel and from channel-to-chassis for each pathway. In general, these tests are performed by measuring the leakage current with an electrometer. In the following procedure, the Model 6517A is used to measure leakage current.

Referring to Figure 4-3 and Figure 4-4, perform the following procedure to check channel-to-chassis offset current in the matrix.

Figure 4-3
Matrix channel-to-chassis offset current testing



NOTE Chassis ground is accessible at any metal contact at the rear panel of the Model 7002-HD.

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Configuration 1: Channel-to-chassis (common mode) offset current test

1. Remove power from Model 7002-HD.
2. Setup for offset current tests:
   - Connect the Model 6517A to the rows input terminal of Row 1 as shown in Figure 4-3. Note that HI is connected to Row 1 HI and LO. LO is connected to chassis ground, which is accessible at any metal contact at the rear panel of the 7002-HD.
   - Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
   - On the Model 6517A, select the 200pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
   - Turn on the Model 7002-HD.
3. Check row pathway leakage current:
   - Program the Model 7002-HD to close channel 1!1. (This step closes Row 1/Column 1.)
   - On the Model 6517A, disable zero check and verify that it is <100pA. This measurement is the leakage current of the pathway.
   - On the Model 6517A, enable zero check and on the Model 7002-HD-MTX1, open channel 1!1.
4. Repeat the basic procedure in Configuration 1, Step 3 to check the rest of the pathways (Channels 1!2 through 1!32) of the row.
5. Check remaining channels:
   - Turn off the Model 7002-HD-MTX1 and connect the Model 6517A to Row 2.
   - Repeat the basic procedure in Configuration 1, Steps 3 and 4 to check row 2, columns 1–32.
   - Repeat Configuration 1, Steps 3 and 4 for rows 3–6.
   - Turn off the Model 7002-HD.
   - Disable zero correct on the Model 6517A.

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Configuration 2: Differential offset current test

1. Setup for differential offset current check:
   - Connect the Model 6517A HI to Row 1 HI, and Model 6517A LO to Row 1 LO as shown in Figure 4-4.
   - Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
   - On the Model 6517A, select the 200pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
   - Turn on the Model 7002-HD.
2. Check differential offset current for channel 1:
   - Program the Model 7002-HD to close channel 1!1. (This step closes Row 1/Column 1).
   - On the Model 6517A, disable zero check and verify that it is <100pA. This measurement is the leakage current of the pathway.
   - On the Model 6517A, enable zero check and on the Model 7002-HD-MTX1, open channel 1!1.
3. Check differential offset current for remaining channels:
   - Program the Model 7002-HD to close channel 1!2.
   - On the Model 6517A, disable zero check and verify that it is <100pA. On the Model 6517A, enable zero check and on the Model 7002-HD-MTX1, open channel 1!2.
   - Repeat the basic procedure in this step to check the rest of the channels (channels 1!2 through 1!32).
4. Turn off the Model 7002-HD and connect the Model 6517A HI to Row 2 HI and LO. Repeat the basic procedure in Steps 2 through 3 to check the rest of the channel offsets.
5. Repeat the basic procedure in Step 4 to check leakage of Row 3–6.

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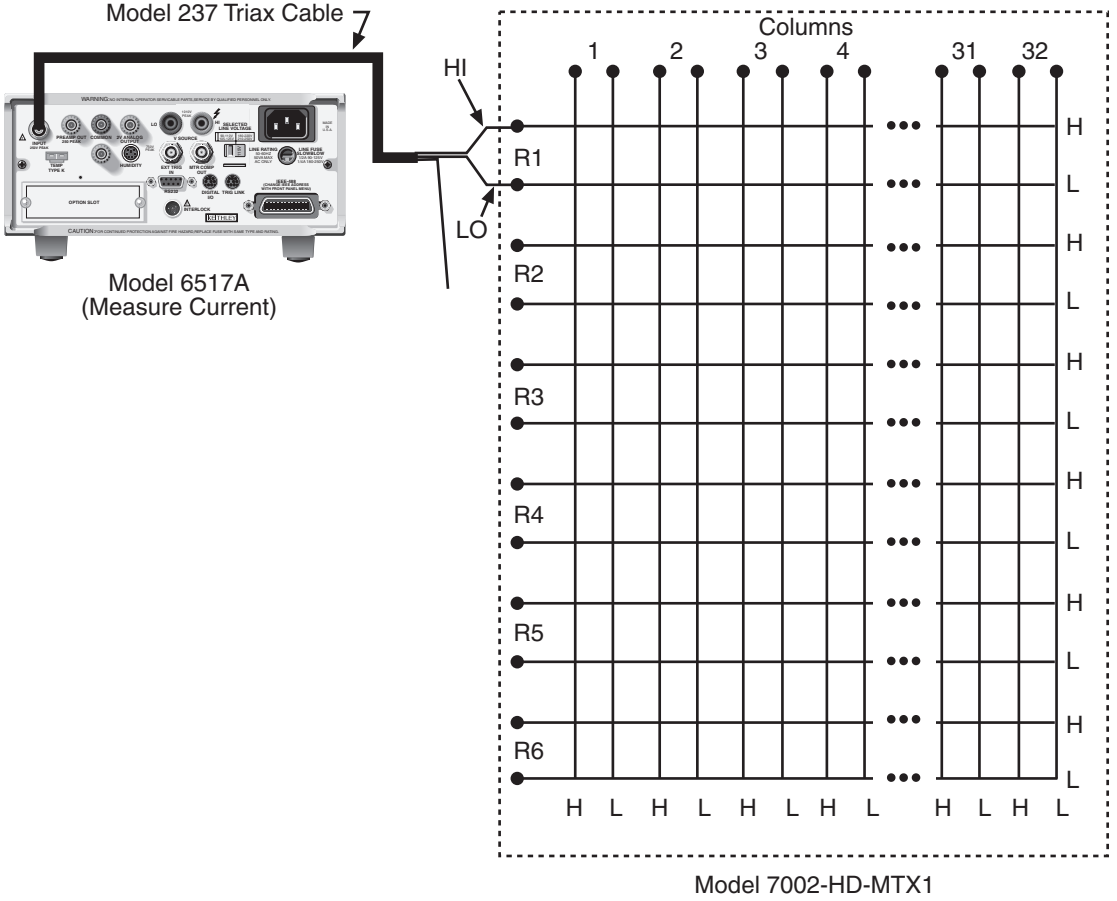
Figure 4-4
Differential offset current testing



Configuration 3: 6 x 64 offset current tests

1. To check channel-to-chassis and channel-to-channel offset current in a 6 x 64 matrix configuration, install a second Model 7002-HD-MTX1 in Card 2 of Model 7002-HD.
2. Follow the procedures for Configuration 1: Channel-to-chassis and Configuration 2: Differential offset current testing. Connect the 6517A to row 1–6 HI and LO Card 1, closing channels 6!1 through 10!32 on Card 2. Make sure to close the appropriate backplane row isolation and rows input channels in Model 7002-HD-MTX1.
3. Verify that the offset leakage current is <200pA.

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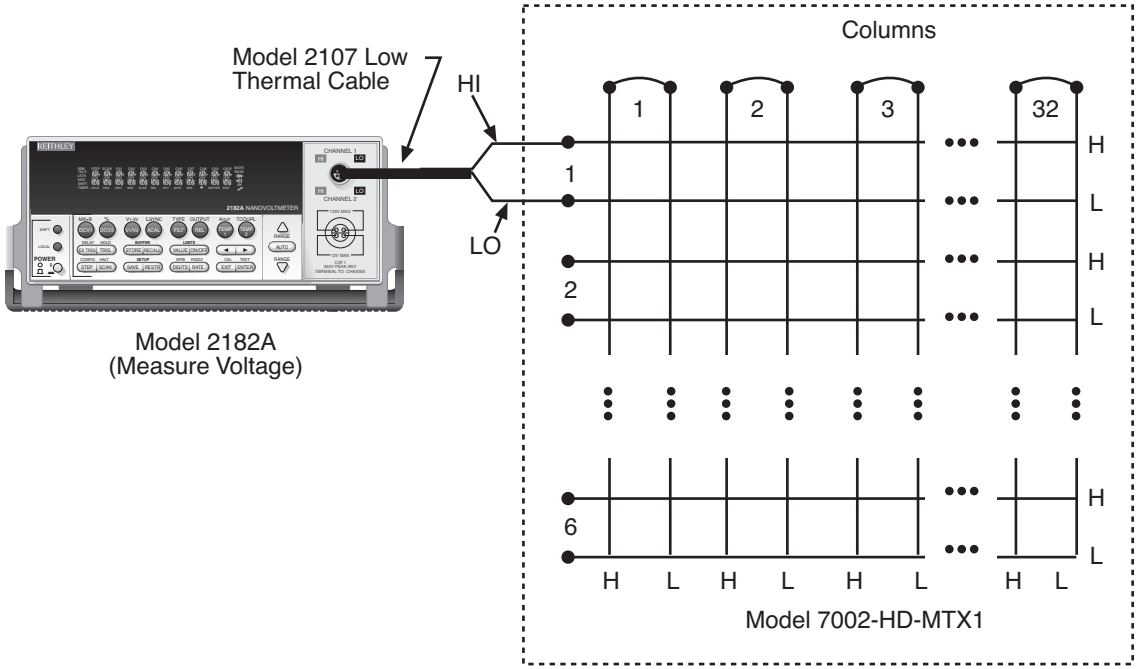
Contact potential tests

These tests check the EMF generated by each relay contact for each pathway. The tests consist of using a sensitive digital voltmeter (Model 2182A) to measure the contact potential.

Perform the following procedure to check the contact potential of each path.

Figure 4-5
Matrix contact potential testing



Configuration 1: 6 x 32 matrix

1. Remove power from Model 7002-HD.
2. Connect to a low thermal short between HI and LO of each row input.
3. Connect a low thermal short between HI and LO of each column output.
4. Connect the Model 2182A HI and LO input test leads to the rows input terminal of Row 1 respectively as shown in Figure 4-5.
5. Install the Model 7002-HD-MTX1 in Card 1 opening of the Model 7002-HD and turn the Model 7002-HD on.
6. Allow the Model 2182A, 7002-HD, and 7002-HD-MTX1 to warm up for two hours.
7. Select the 10mV range on the Model 2182A.

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8. Press REL on the Model 2182A to null out internal offsets. Leave REL enabled for the entire procedure.
9. Turn off the Model 7002-HD.
10. Remove the 7002-HD-MTX1 from the card 1 opening.
11. Cut the low thermal short between ROW 1 HI and LO.
12. Install the 7002-HD-MTX1 into the CARD 1 opening.
13. Turn on the Model 7002-HD.
14. Program the Model 7002-HD to close channels 1!1 (This steps closes Row 1/Column 1.)
15. After settling (< 5 minutes), verify that the reading on the Model 2182A is <4.5µV. This measurement represents the contact potential of the pathway.
16. From the Model 7002-HD, open channel 1!1.
17. Close channel 1!2 through 1!32 for each column (2–32), verifying the Model 2182A reads < 4.5µV for each column.
18. Repeat steps 4–17 for each row input (skipping step 6).

NOTE Step 6 is skipped because it is not necessary to wait the additional 2 hours other than the first time the configuration is set up.

Configuration 2: 6 x 64 matrix

1. Turn off the Model 7002-HD.
2. Disable REL on the Model 2182A.
3. Add a second Model 7002-HD-MTX1 to the test system.
4. Connect to a low thermal short between HI and LO of each row input for Model 7002-HD-MTX1 #1.
5. Connect a low thermal short between HI and LO of each column output for Model 7002-HD-MTX1 #2.
6. Turn Model 7002-HD on.
7. Allow 2 hours for warm-up.
8. Follow Configuration 1, steps 4–17 (skipping Step 6) for each row input to check Card 2's 192 crosspoints. Make sure to close appropriate backplane rows isolation relay for every row when testing. Verify that the contact potential is <9µV.
9. Turn off the Model 7002-HD.
10. Disable REL on the Model 2182A.

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Isolation tests

WARNING The following steps use high voltage (100V). Be sure to remove power from the circuit before making connection changes.

The isolation tests check the channel-to channel leakage resistance (isolation) between adjacent paths and the channel-to-chassis isolation. A path is defined as the contact from a row to a column that results by closing a particular crosspoint in the matrix or the contact from an input to an output by closing a particular independent channel. In general, the test is performed by applying a voltage (+100V) across two adjacent paths and then measuring the leakage current across the paths. The isolation resistance is then calculated as R = V / I. In the following procedure, the Model 6517A functions as both a voltage source and an ammeter. In the R function, the Model 6517A internally calculates the resistance from the known voltage and current levels, and displays the resistance value.

6 x 32 channel-to-channel isolation test

1. Remove power from Model 7002-HD.
2. Connect HI and LO of each row.
3. Connect the Model 6517A to the terminals for Rows 1 and 2 as shown in Figure 4-6 on page 4-19. Make sure the voltage source OPERATE is disabled. Also, make sure there are no other connections to the Model 7002-HD-MTX1.
4. Install the Model 7002-HD-MTX1 in Card 1 of the Model 7002-HD.
5. On the Model 6517A, enable the V-source LO and ammeter input LO internal connection METER-CONNECT in the CONFIGURE V-SOURCE menu.
6. On the Model 6517A, select the 2pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
7. On the Model 6517A, select the 20pA range and release zero check.
8. On the Model 6517A, press REL to cancel offset current and then enable zero check.
9. On the Model 6517A, set the voltage source for +100V and select the 200nA current range. Make sure the voltage source OPERATE is not enabled.
10. Place the Model 6517A in the R measurement function.
11. Turn on the Model 7002-HD and program it to close channels 1!1 and 1!34 (refer to path isolation test in Table 4-2 on page 4-20.)
12. On the Model 6517A, disable zero check and press OPERATE to source +100V.

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13. After allowing the reading on the Model 6517A to settle, verify that it is >1GΩ. This measurement is the leakage resistance (isolation) between Row 1/ Column 1 and Row 2/Column 2.
14. Turn the Model 6517A +100V source off and enable zero check.
15. Program the Model 7002-HD to open channels 1!1 and 1!34.
16. Program the Model 7002-HD to close channels in test number 2. (Refer to path isolation test in Table 4-2 on page 4-20.)
17. On the Model 6517A, disable zero check and press OPERATE to source +100V.
18. After allowing the reading on the Model 6517A to settle, verify that it is >1GΩ.
19. Turn the Model 6517A +100V source off and enable zero check.
20. Program the Model 7002-HD to open channels in test number 2.
21. Continue to verify >1GΩ isolation for each test number.

Figure 4-6
Channel-to-channel isolation testing

Notes: Setup shown is configured to test isolation between row 1 column 1 and row 2 columnn 2.

Ground link is removed.

V-source LO and Ammeter LO connected internally.

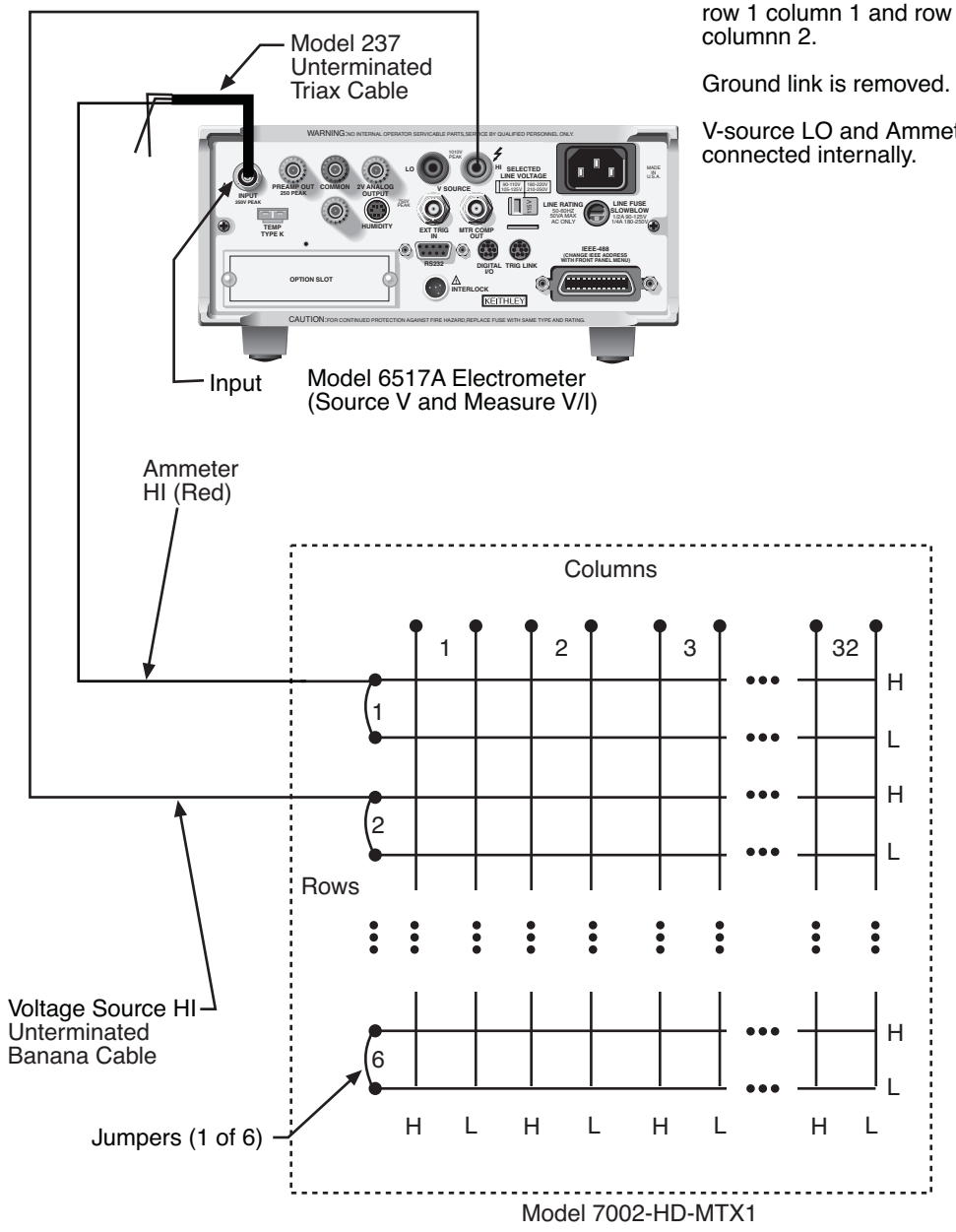

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Table 4-2
6 x 32 channel-to-channel isolation configuration

Test no.	Row	Col	Row	Col	Test equip. location	Channels closed
1	1	1	2	2	R1, R2	1!1, 1!34
2	2	2	3	3	R2, R3	1!34, 2!27
3	3	3	4	4	R3, R4	2!27, 3!20
4	4	4	5	5	R4, R5	3!20,4!13
5	5	5	6	6	R5, R6	4!13, 5!6
6	5	6	6	7	R5, R6	4!14, 5!7
7	5	7	6	8	R5, R6	4!15, 5!8
8	5	8	6	9	R5, R6	4!16, 5!9
9	5	9	6	10	R5, R6	4!17, 5!10
10	5	10	6	11	R5, R6	4!18, 5!11
11	5	11	6	12	R5, R6	4!19, 5!12
12	5	12	6	13	R5, R6	4!20, 5!13
13	5	13	6	14	R5, R6	4!21, 5!14
14	5	14	6	15	R5, R6	4!22, 5!15
15	5	15	6	16	R5, R6	4!23, 5!16
16	5	16	6	17	R5, R6	4!24, 5!17
17	5	17	6	18	R5, R6	4!25, 5!18
18	5	18	6	19	R5, R6	4!26, 5!19
19	5	19	6	20	R5, R6	4!27, 5!20
20	5	20	6	21	R5, R6	4!28, 5!21
21	5	21	6	22	R5, R6	4!29, 5!22
22	5	22	6	23	R5, R6	4!30, 5!23
23	5	23	6	24	R5, R6	4!31, 5!24
24	5	24	6	25	R5, R6	4!32, 5!25
25	5	25	6	26	R5, R6	4!33, 5!26
26	5	26	6	27	R5, R6	4!34, 5!27
27	5	27	6	28	R5, R6	4!35, 5!28
28	5	28	6	29	R5, R6	4!36, 5!29
29	5	29	6	30	R5, R6	4!37, 5!30
30	5	30	6	31	R5, R6	4!38, 5!31
31	5	31	6	32	R5, R6	4!39, 5!32

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6 x 64 channel-to-channel isolation test

1. To check channel-to-channel isolation in a 6 x 64 matrix configuration, add a second Model 7002-HD-MTX1 to the test system.
2. Install Model 7002-HD-MTX1 #1 in Card 1 of Model 7002-HD and Model 7002-HD-MTX1 #2 in Card 2.
3. Turn Model 7002-HD on.
4. Follow Steps 7 through 19 in the "6 x 32 channel-to-channel isolation test" on page 4-17 to check all adjacent channels. Refer to Table 4-3 for appropriate channel closures.
5. Turn off the Model 7002-HD.
6. Turn the Model 6517A +100V source off, disable REL, and enable zero check.

Table 4-3
6 x 64 channel-to-channel isolation configuration

Test no.	Row	Col	Row	Col	Test equip. location	Card 1 closed channels	Card 2 closed channels
1	1	1	2	2	R1, R2	1!1, 1!34, 5!33, 5!34	10!33, 10!34
2	2	2	3	3	R2, R3	1!34, 2!27, 5!33, 5!34	10!34, 10!35
3	3	3	4	4	R3, R4	2!27, 3!20, 5!33, 5!34	10!35, 10!36
4	4	4	5	5	R4, R5	3!20, 4!13, 5!33, 5!34	10!36, 10!37
5	5	5	6	6	R5, R6	4!13, 5!6, 5!33, 5!34	10!37, 10!38
6	5	6	6	7	R5, R6	4!14, 5!7, 5!33, 5!34	10!37, 10!38
7	5	7	6	8	R5, R6	4!15, 5!8, 5!33, 5!34	10!37, 10!38
8	5	8	6	9	R5, R6	4!16, 5!9, 5!33, 5!34	10!37, 10!38
9	5	9	6	10	R5, R6	4!17, 5!10, 5!33, 5!34	10!37, 10!38
10	5	10	6	11	R5, R6	4!18, 5!11, 5!33, 5!34	10!37, 10!38
11	5	11	6	12	R5, R6	4!19, 5!12, 5!33, 5!34	10!37, 10!38
12	5	12	6	13	R5, R6	4!20, 5!13, 5!33, 5!34	10!37, 10!38
13	5	13	6	14	R5, R6	4!21, 5!14, 5!33, 5!34	10!37, 10!38
14	5	14	6	15	R5, R6	4!22, 5!15, 5!33, 5!34	10!37, 10!38
15	5	15	6	16	R5, R6	4!23, 5!16, 5!33, 5!34	10!37, 10!38
16	5	16	6	17	R5, R6	4!24, 5!17, 5!33, 5!34	10!37, 10!38
17	5	17	6	18	R5, R6	4!25, 5!18, 5!33, 5!34	10!37, 10!38
18	5	18	6	19	R5, R6	4!26, 5!19, 5!33, 5!34	10!37, 10!38
19	5	19	6	20	R5, R6	4!27, 5!20, 5!33, 5!34	10!37, 10!38
20	5	20	6	21	R5. R6	4!28, 5!21, 5!33, 5!34	10!37, 10!38
21	5	21	6	22	R5, R6	4!29, 5!22, 5!33, 5!34	10!37, 10!38
22	5	22	6	23	R5, R6	4!30, 5!23, 5!33, 5!34	10!37, 10!38
23	5	23	6	24	R5, R6	4!31, 5!24, 5!33, 5!34	10!37, 10!38
24	5	24	6	25	R5, R6	4!32, 5!25, 5!33, 5!34	10!37, 10!38
25	5	25	6	26	R5, R6	4!33, 5!26, 5!33, 5!34	10!37, 10!38
26	5	26	6	27	R5, R6	4!34, 5!27, 5!33, 5!34	10!37, 10!38
27	5	27	6	28	R5, R6	4!35, 5!28, 5!33, 5!34	10!37, 10!38
28	5	28	6	29	R5, R6	4!36, 5!29, 5!33, 5!34	10!37, 10!38
29	5	29	6	30	R5, R6	4!37, 5!30, 5!33, 5!34	10!37, 10!38
30	5	30	6	31	R5, R6	4!38, 5!31, 5!33, 5!34	10!37, 10!38
31	5	31	6	32	R5, R6	4!39, 5!32, 5!33, 5!34	10!37, 10!38

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Differential / common mode isolation test

To verify channel-to-chassis (common mode) and differential isolation, repeat the basic procedure for channel-to-chassis testing. Refer to Figure 4-7 and Figure 4-8 for connections. See Table 4-4 on page 4-26 and Table 4-5 on page 4-27 for Model 6517A test, closed channel, and card 1 and 2 expansion requirements. For channel-to-channel (common mode), keep the Model 6517A input HI connected to chassis ground (which is accessible at any metal contact at the rear panel of the Model 7002-HD) at all times and connect V-Source HI to the row under test.

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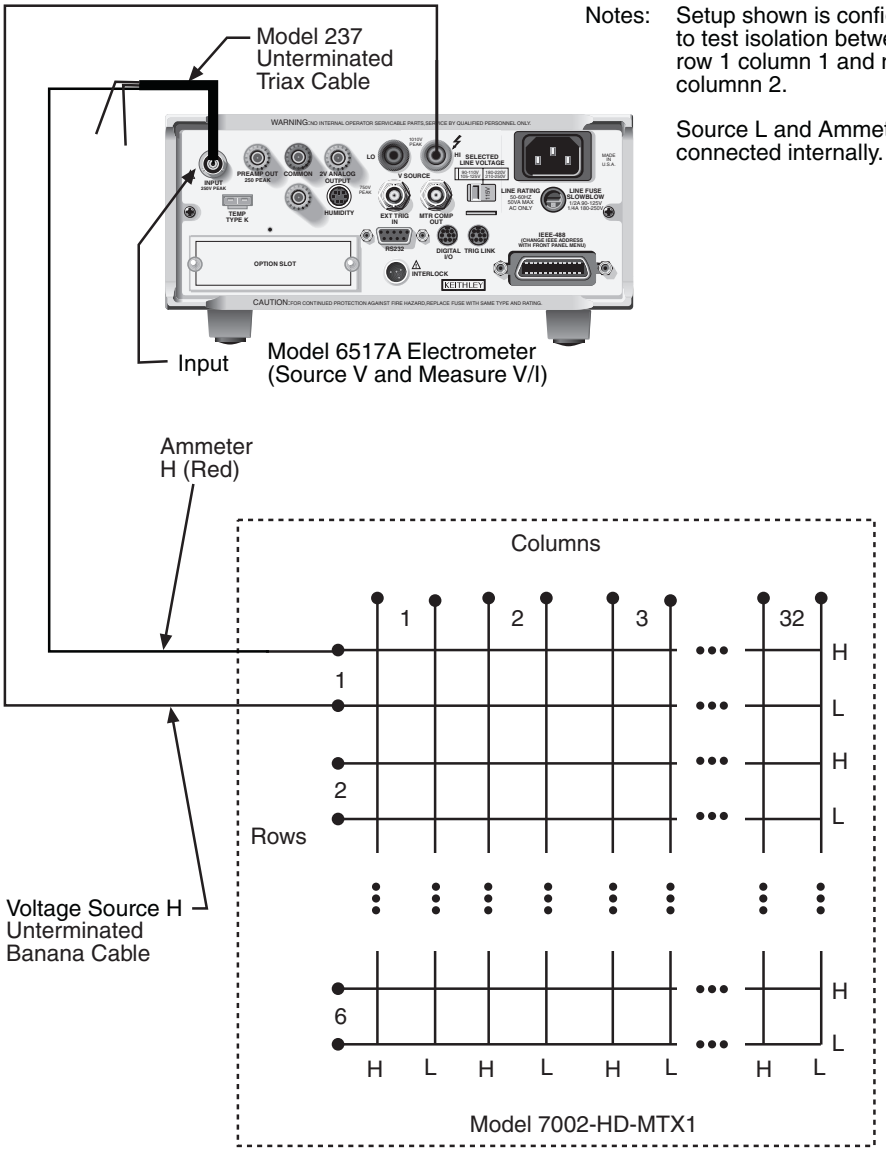
Figure 4-7
Differential isolation testing



Notes: Setup shown is configured to test isolation between row 1 column 1 and row 2 columnn 2.

Source L and Ammeter L connected internally.

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Figure 4-8
Common-mode isolation testing

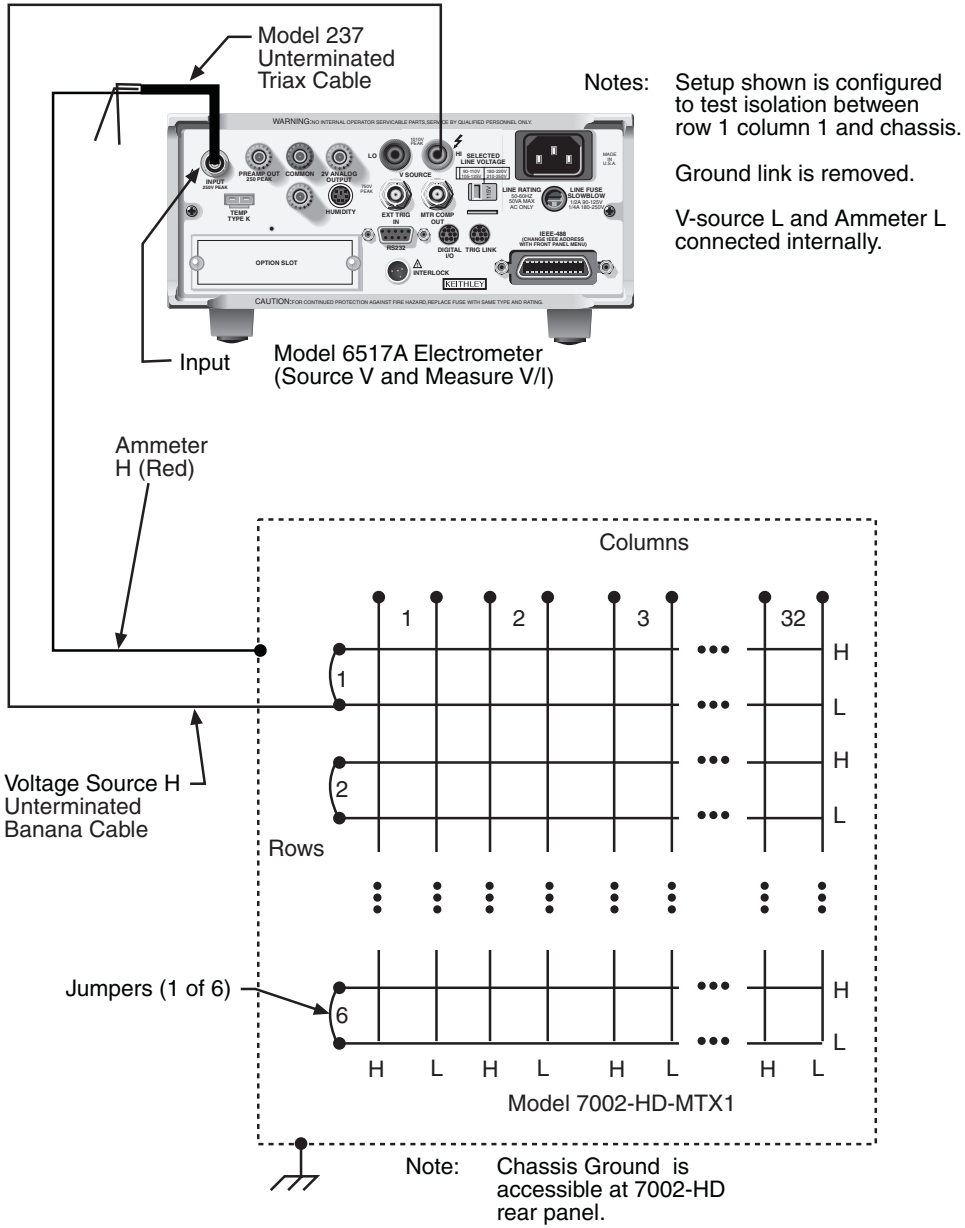

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Table 4-4
6 x 32 differential or common mode (terminal to earth) isolation

Test no.	Location	Card 1 closed channels	Card 2 closed channels
1	Row 1	none	none
2	Col 1	1!1	none
3	Col 2	1!2	none
4	Col 3	1!3	none
5	Col 4	1!4	none
6	Col 5	1!5	none
7	Col 6	1!6	none
8	Col 7	1!7	none
9	Col 8	1!8	none
10	Col 9	1!9	none
11	Col 10	1!10	none
12	Col 11	1!11	none
13	Col 12	1!12	none
14	Col 13	1!13	none
15	Col 14	1!14	none
16	Col 15	1!15	none
17	Col 16	1!16	none
18	Col 17	1!17	none
19	Col 18	1!18	none
20	Col 19	1!19	none
21	Col 20	1!20	none
22	Col 21	1!21	none
23	Col 22	1!22	none
24	Col 23	1!23	none
25	Col 24	1!24	none
26	Col 25	1!25	none
27	Col 26	1!26	none
28	Col 27	1!27	none
29	Col 28	1!28	none
30	Col 29	1!29	none
31	Col 30	1!30	none
32	Col 31	1!31	none
33	Col 32	1!32	none
34	Row 2	1!1, 1!33	none
35	Row 3	1!1, 2!25	none
36	Row 4	1!1, 3!17	none
37	Row 5	1!1, 4!9	none
38	Row 6	1!1, 5!1	none

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Table 4-5
6 x 64 differential or common mode (terminal to earth) isolation

Test no.	Location	Card 1 closed channels	Card 2 closed channels
1	Row 1	none	none
2	Col 33	5!33	6!1, 10!33
3	Col 34	5!33	6!2, 10!33
4	Col 35	5!33	6!3, 10!33
5	Col 36	5!33	6!4, 10!33
6	Col 37	5!33	6!5, 10!33
7	Col 38	5!33	6!6, 10!33
8	Col 39	5!33	6!7, 10!33
9	Col 40	5!33	6!8, 10!33
10	Col 41	5!33	6!9, 10!33
11	Col 42	5!33	6!10, 10!33
12	Col 43	5!33	6!11, 10!33
13	Col 44	5!33	6!12, 10!33
14	Col 45	5!33	6!13, 10!33
15	Col 46	5!33	6!14, 10!33
16	Col 47	5!33	6!15, 10!33
17	Col 48	5!33	6!16, 10!33
18	Col 49	5!33	6!17, 10!33
19	Col 50	5!33	6!18, 10!33
20	Col 51	5!33	6!19, 10!33
21	Col 52	5!33	6!20, 10!33
22	Col 53	5!33	6!21, 10!33
23	Col 54	5!33	6!22, 10!33
24	Col 55	5!33	6!23, 10!33
25	Col 56	5!33	6!24, 10!33
26	Col 57	5!33	6!25, 10!33
27	Col 58	5!33	6!26, 10!33
28	Col 59	5!33	6!27, 10!33
29	Co'l 60	5!33	6!28, 10!33
30	Col 61	5!33	6!29, 10!33
31	Col 62	5!33	6!30, 10!33
32	Col 63	5!33	6!31, 10!33
33	Col 64	5!33	6!32, 10!33
34	Row 2	5!33	6!1, 6!33, 10!33
35	Row 3	5!33	6!1, 7!25, 10!33
36	Row 4	5!33	6!1, 8!17, 10!33
37	Row 5	5!33	6!1, 9!9, 10!33
38	Row 6	5!33	6!1, 10!1, 10!33

Return to **Section 4 topics**

Replaceable parts

This section contains replacement parts information and the component layout drawing for the Model 7002-HD-MTX1 card.

Parts list

Replaceable parts for the Model 7002-HD-MTX1 are listed in Table 4-6 and Table 4-7.

Ordering information

To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the factory (see rear cover for addresses). When ordering parts, be sure to include the following information:

- Card model number (Model 7002-HD-MTX1)
- Card serial number
- Part description
- Component designation (if applicable)
- Keithley part number

Factory service

If the Model 7002-HD-MTX1 is to be returned to Keithley Instruments for repair, perform the following:

- Call the Repair Department at 1-888-KEITHLEY for a Return Material Authorization (RMA) number.
- Complete the service form at the back of this manual, and include it with the Model 7002-HD-MTX1.
- Carefully pack the Model 7002-HD-MTX1 in the original packing carton.
- Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.

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Table 4-6
Model 7002-HD-MTX1 electronic parts list

Circuit designation	Decription	Keithley part no.
C100,C102,C114-C120,C123-C140, C154,C173-C196,C203-C207,C212	CAP,.1U,20%,50V,CERAMIC	C-418-.1
C101	CAP,10U,20%,25V,TANTALUM	C-440-10
C199-C202,C208-C211	CAP,47P,10%,100V,CERAMIC	C-451-47P
C108,C110,C111,C113,C121,C141-C153,C155,C156,C158,C160,C162, C164,C165,C168,C170-C172	CAP,47P,5%,100V,CERAMIC	C-465-47P
C103,C213	CAP,470U,20%,25V,ALUM ELEC	C-622-470
CR101-CR140,CR201-CR240,CR301-CR340,CR401-CR440,CR501-CR538	SWITCHING DIODE	RF-112
J100	CONN,RT ANGLE,TRIPLE ROW,DIN	CS-1065-2
J107	CONN,RT ANGLE,DUAL ROW,DIN	CS-1065-1
J110,J111	6 PIN TERMINAL BLOCK	CS-521-5
J112	CONN,HEADER,14 PINS	CS-368-14
J113	CONN,RT ANGLE HEADER,64 PIN	CS-1201-2
K101-K140,K201-K240,K301-K340, K401-K440,K501-K538	EMR,NON-LATCHING RELAY	RL-243
R101-R140,R201-R240,R301-R340, R401-R440,R501-R538	RES,20,1%,.1W,THICK FILM	R-418-20
R150-R174	RES,1K,1%,1W,THICK FILM	R-418-1K
TP100-TP103,TP105	CONN, TEST POINT	CS-1026
U100,U126-U129	2 WIRE SERIAL EEPROM	IC-1462
U101-U125	8 BIT INPUT LATCH DRIVE	IC-857

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Table 4-7
Model 7002-HD-MTX1 mechanical parts list

Description	Keithley part no.
Brass Hex	ST-166-31
Phillips Flat HD Undercut	4-40X1/4PFHUC
Phillips Pan Head	4-40X1/4PPH
Phillips Head Pan Head	2-56X3/8PPH
Nut	2-56NUT
Tie Wrap	CC-38-2
Insulator	S40-SQ00-316
Top Cover	S40-SQ00-321A
Bottom Cover	S40-SQ00-320A
Strain Relief Cover	S40-SQ00-322A

Component layout

A component layout for the Model 7002-HD-MTX1 is provided in Figure 4-9.

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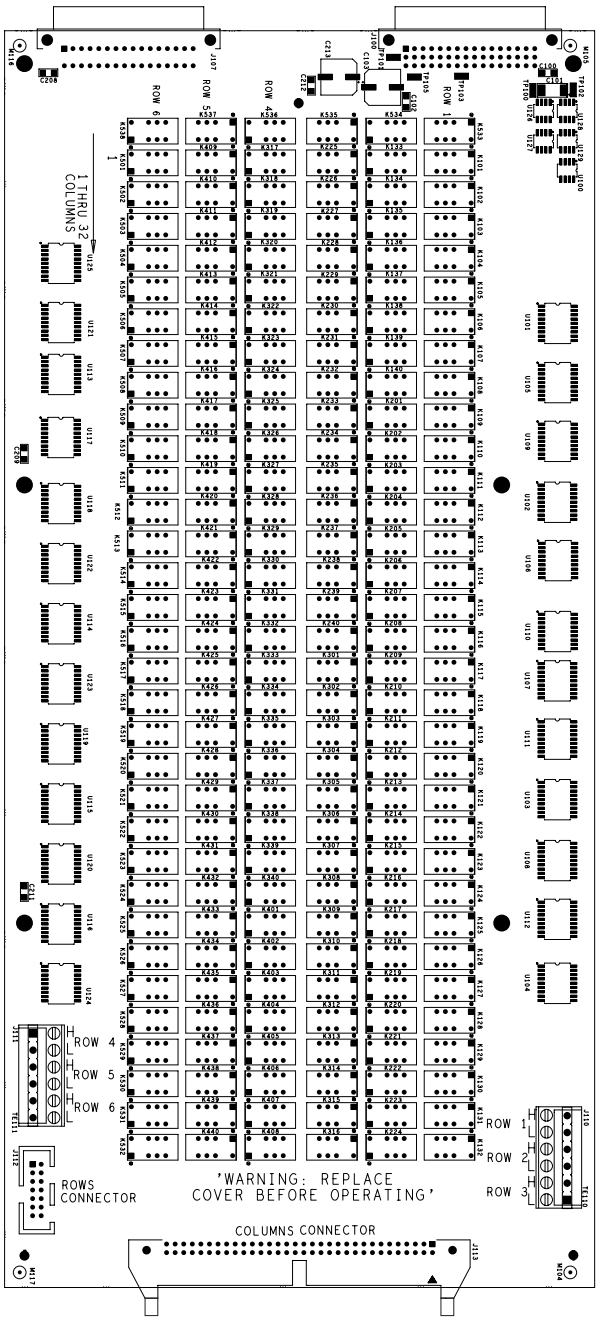
Figure 4-9
Model 7002-HD-MTX1 component layout (top side)



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A
Specifications

7002-HD-MTX1 Differential 6x32 Matrix Card

GENERAL

MATRIX CONFIGURATION: Differential 6 rows x 32 columns.

RELAY TYPE: Double pole form A (DPST) electromechanical relays.

RELAY DRIVE CURRENT: <35mA per channel.

RELAY ACTUATION TIME: <3ms.

FIRMWARE: Specified for Model 7002-HD.

EMC: Conforms to European Union Directive 89/336/EEC; EN61326-1.

SAFETY: Conforms to European Union Directive 73/23/EEC EN61010-1.

INPUTS

MAXIMUM SIGNAL LEVEL: 200VDC or 200Vrms (283V peak for AC waveforms), 1A switched, 60W, 125VA maximum.

COMMON MODE VOLTAGE: 200VDC or 200Vrms (283V peak for AC waveforms) between any terminal and chassis.

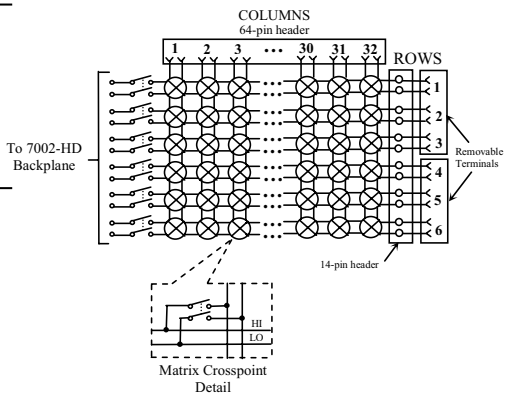
CONNECTOR TYPE:

Columns: 64-pin IDC compatible header with latch/eject arms.
Rows: 5mm removable screw terminals (supports 18-22AWG wire).
-Supplied with removable screw terminals.
14-pin IDC compatible header.

CONTACT LIFE:

$>10^8$ operations at no load.

$>10^5$ operations at rated load (resistive load).



MATRIX CONFIGURATION

	6 X 32	6 X 64[3]
CHANNEL RESISTANCE[4]	<1Ω	<2Ω
CONTACT POTENTIAL	<4.5µV per contact pair	<9µV per contact pair
OFFSET CURRENT	<100pA	<200pA
ISOLATION		
Between any two terminals	$>10^9$Ω <150pF	$>10^9$Ω <300pF
Between any terminal and earth	$>10^9$Ω <500pF	$>10^9$Ω <700pF
CROSSTALK (1MHz, 50Ω Load)[5]	<-35dB	<-35dB
INSERTION LOSS (50Ω Source, 50Ω Load)[5]	<0.35dB below 1MHz <3dB below 2MHz	<0.7dB below 1MHz <3dB below 1.5MHz

ENVIRONMENTAL[2]

OPERATING ENVIRONMENT:

Specified for 0°C to 50°C.
Specified to 50% RH at 35°C

STORAGE ENVIRONMENT: -25°C to 65°C.

WEIGHT: <2.1kg (4.6lb).

ALTITUDE: Maximum 2000m above sea level.

RECOMMENDED CONNECTOR/CABLE[1]

6-pin removable screw terminal:	RIA Part# 31007106.
14-pin female IDC socket:	3M Part# 89114-0101.
14-conductor jacketed ribbon cable:	3M Part# 3603/14.
64-pin female IDC socket:	3M Part# 7964-6500EC.
64-conductor jacketed ribbon cable:	3M Part# 3603/64.

7002-HD-MTX1 Notes:

[1] Refer to User's Guide for measurement considerations.
[2] For indoor use only.
[3] Two cards installed in mainframe using analog backplane for expansion.
[4] At end of life, add an additional 1Ω for a single card and 2Ω for two cards.
[5] Includes end of life.

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Service Form

Model No. _____ **Serial No.** _____ **Date**_____

Name and Telephone No. _____

Company _____

List all control settings, describe problem and check boxes that apply to problem. _____

_____

_____

❑ Intermittent ❑ Analog output follows display ❑ Particular range or function bad; specify

_____

❑ IEEE failure ❑ Obvious problem on power-up ❑ Batteries and fuses are OK

❑ Front panel operational ❑ All ranges or functions are bad ❑ Checked all cables

Display or output (check one)

❑ Drifts ❑ Unable to zero ❑ Unstable

❑ Overload ❑ Will not read applied input

❑ Calibration only ❑ Certificate of calibration required ❑ Data required

(attach any additional sheets as necessary)

Show a block diagram of your measurement including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)_____

_____

What power line voltage is used? _____ Ambient temperature? _____ °F

Relative humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe.)

_____

_____

Be sure to include your name and phone number on this service form.

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