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KEITHLEY

Model 7076 General Purpose Matrix Card Dual 4 × 12

Instruction Manual

Contains Operating and Servicing Information

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Keithley Instruments, Inc. • 28775 Aurora Road • Cleveland, OH 44139 • 216-248-0400 • Fax: 216-248-6168 • http://www.keithley.com

CHINA:	**Keithley Instruments China** • Yuan Chen Xin Building, Room 705 • No. 12 Yumin Road, Dewai, Madian • Beijing, China 100029 • 8610-2022886 • Fax: 8610-2022892
FRANCE:	**Keithley Instruments SARL** • BP 60 • 3 allée des Garays • 91122 Palaiseau Cédex • 31-6-0115155 • Fax: 31-6-0117726
GERMANY:	**Keithley Instruments GmbH** • Landsberger Straße 65 • 82110 Germering • 49-89-849307-0 • Fax: 49-89-84930759
GREAT BRITAIN:	**Keithley Instruments, Ltd.** • The Minster • 58 Portman Road • Reading, Berkshire RG30 1EA • 44-01734-575666 • Fax: 44-01734-596469
ITALY:	**Keithley Instruments SRL** • Viale S. Gimignano 38 • 20146 Milano • 39-2-48303008 • Fax: 39-2-48302274
JAPAN:	**Keithley KK** • Aibido Bldg. • 7-20-2 Nishishinjuku • Shinjuku-ku, Tokyo 160 • 81-3-5389-1964 • Fax: 81-3-5389-2068
NETHERLANDS:	**Keithley Instruments BV** • Avelingen West 49 • 4202 MS Gorinchem • 31-(0)183-635333 • Fax: 31-(0)183-630821
SWITZERLAND:	**Keithley Instruments SA** • Kriesbachstrasse 4 • 8600 Dübendorf • 41-1-8219444 • Fax: 41-1-8203081
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Model 7076
Instruction Manual

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SAFETY PRECAUTIONS

The following safety precautions should be observed before using the Model 7076 and the associated instruments.

This matrix card is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read over this manual carefully before using the matrix card.

ALWAYS remove power from the entire system (Model 707, test instruments, DUT, etc.) and discharge any capacitors before doing any of the following:

1. Installing or removing the matrix card from the mainframe.
2. Connecting or disconnecting cables from the matrix card. The pins of cable connectors are easily accessible making them extremely hazardous to handle while power is applied.
3. Making internal changes to the card (such as removing or installing jumpers).

Exercise extreme caution when a shock hazard is present at the test fixture. User-supplied lethal voltages may be present on the fixture or the connector jacks. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS or 42.4V peak are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Do not connect the card or any other instrumentation to humans.

Inspect the connecting cables and test leads for possible wear, cracks, or breaks before each use.

For maximum safety, do not touch the test fixture, test cables or any instruments while power is applied to the circuit under test.

Do not touch any object which could provide a current path to the common side of the circuit under test or power line (earth) ground.

Do not exceed the maximum signal levels of the test fixture, as defined in the specifications and operation section of this manual.

Do not connect the matrix card directly to unlimited power circuits. This product is intended to be used with impedance limited sources. NEVER connect the matrix card directly to ac mains.

When connecting sources, install protective devices to limit fault current and voltage to the card.

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

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Model 7076 Dual 4×12 Two-Pole Matrix Card

MATRIX CONFIGURATION: Dual 4 rows by 12 columns. Also configurable as 8 rows by 12 columns. Jumpers can be removed to isolate any row from the backplane.

CROSSPOINT CONFIGURATION: 2 pole Form A (HI, GUARD).

CONNECTOR TYPE: 25-pin subminiature D connector, two for column connection, one for row connection.

MAXIMUM SIGNAL LEVEL:
DC Signals: 110V DC, 1A switched, 30VA (resistive load).
AC Signals: 175V AC peak, 1A switched, 62.5VA (resistive load).

COMMON MODE VOLTAGE: 110V DC, 175V AC peak pin to pin or pin to chassis.

CONTACT LIFE:
Cold Switching: 10^8 closures.
At Maximum Signal Level: 10^5 closures.

PATH RESISTANCE (per conductor): <0.50Ω initial, <1.5Ω at end of contact life.

CONTACT POTENTIAL: <5μV per crosspoint (HI to GUARD).

OFFSET CURRENT: <100pA.

ISOLATION:
Path: $>10^{10}\Omega$, <7pF.
Differential: $>10^9\Omega$, 120pF nominal.
Common Mode: $>10^9\Omega$, 200pF nominal.

CROSSTALK (1MHz, 50Ω load): <–50dB.

INSERTION LOSS (1MHz, 50Ω source, 50Ω load): 0.05dB typical.

3dB BANDWIDTH (50Ω load): 15MHz typical.

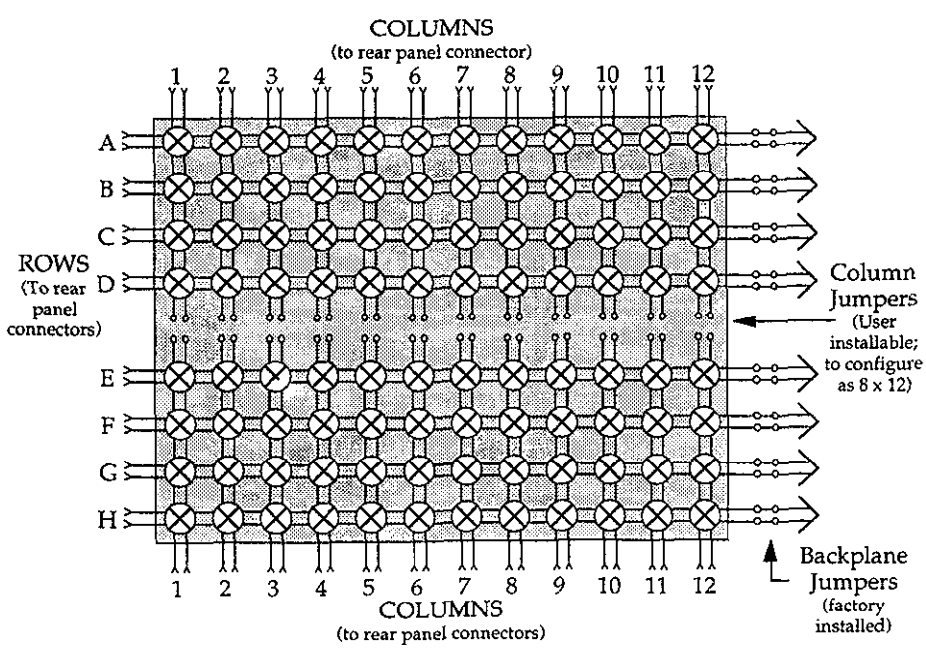
RELAY DRIVE CURRENT (per crosspoint): 28mA.

RELAY SETTLING TIME: <3ms.

ENVIRONMENT:
Operating: 0° to 50°C, up to 35°C at 70% R.H.
Storage: –25° to 65°C.

ACCESSORY SUPPLIED: Instruction manual, jumpers for 8 × 12 expansion.

Specifications subject to change without notice.



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SECTION 1
General Information

1.1 INTRODUCTION

This section contains general information about the Model 7076 General Purpose Matrix Card Dual 4 × 12.

1.2 FEATURES

The Model 7076 is a general purpose, two-pole, dual 4 × 12 (four row by 12 column) matrix card. Some of the key features include:

- Guard capability. Each HI path on the PC board is surrounded by a second path that can be used for guarding.
- Low contact potential and offset current for minimal effects on low-level signals.
- Quick disconnects using 25-pin D-Sub connectors on the rear panel.
- Row backplane jumpers. Cutting jumpers disconnects rows from the Model 707 backplane.
- Column jumpers. Installing jumpers configures card as an 8 × 12 matrix.

1.3 WARRANTY INFORMATION

Warranty information is located on the inside front cover of this instruction manual. Should your Model 7076 require warranty service, contact the Keithley representative or authorized repair facility in your area for further information. When returning the matrix 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.

1.4 MANUAL ADDENDA

Any improvements or changes concerning the matrix card or manual will be explained in an addendum included with the unit. Be sure to note these changes and incorporate them into the manual.

1.5 SAFETY SYMBOLS AND TERMS

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

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

The  symbol on an instrument shows that high voltage may be present on the terminal(s). Use standard safety precautions to avoid personal contact with these voltages.

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

The terms COLUMN, COLUMNS, ROW and ROWS are used in this manual as a reference to the rear panel receptacles of the matrix card.

1.6 SPECIFICATIONS

Model 7076 specifications may be found at the front of this manual. These specifications are exclusive of the matrix mainframe specifications.

1.7 UNPACKING AND INSPECTION

1.7.1 Inspection for Damage

The Model 7076 is packaged in a re-sealable, anti-static bag to protect it from damage due to static discharge and

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from contamination that could degrade its performance. Before removing the card from the bag, observe the following precautions on handling.

Handling Precautions:

1. Always grasp the card by the handle and side edges. Do not touch the edge connectors and do not touch board surfaces or components.
2. When not installed in a Model 707 mainframe, keep the card in the anti-static bag and store in the original packing carton.

After removing the card from its anti-static bag, inspect it for any obvious signs of physical damage. Report any such damage to the shipping agent immediately.

If you are going to install the card in the Model 707 mainframe at this time, be sure to follow the additional handling precautions explained in paragraph 2.2.

1.7.2 Shipping Contents

The following items are included with every Model 7076 order:

- Model 7076 Dual 4 × 12 Two-pole Matrix Card.
- Column jumper sets.
- Model 7076 Instruction Manual.
- Additional accessories as ordered. Note that the cables may be shipped in a separate packing carton.

1.7.3 Instruction Manual

The Model 7076 Instruction Manual is three-hole drilled so that it can be added to the three-ring binder of the Model 707 Switching Matrix Instruction Manual. After removing the plastic wrapping, place the manual in the binder after the mainframe instruction manual. Note that a manual identification tab is included and should precede the matrix card instruction manual.

If an additional instruction manual is required, order the manual package, Keithley part number 7076-901-00. The manual package includes an instruction manual and any applicable addenda.

1.8 REPACKING FOR SHIPMENT

Should it become necessary to return the Model 7076 for repair, carefully pack the unit in its original packing carton or the equivalent, and include the following information:

- Advise as to the warranty status of the matrix card.
- Write ATTENTION REPAIR DEPARTMENT on the shipping label.
- Fill out and include the service form located at the back of this manual.

1.9 OPTIONAL ACCESSORIES

The following accessories are available for use with the Model 7076:

Model 7075-MTC Standard Row/Column Cable Assembly

The Model 7075-MTC is a three-meter (10-feet), 24 conductor cable terminated with a 25-pin D-subminiature (D-sub) connector on both ends. This cable connects to either the ROWS or COLUMN receptacles on the rear panel of the card. This cable assembly is constructed using a general purpose flat cable that is fitted into a shielded round jacket.

This cable is commonly cut at a convenient length to provide two separate cables. The cables can then be used to connect to both the ROW and COLUMN receptacles. The unterminated ends of the cables can then be connected to instrumentation and DUTs.

Model 7076-RMTC High Isolation Row Cable Assembly

The Model 7076-RMTC is a three meter (10-feet), 28-conductor cable terminated with a 25-pin D-sub connectors on both ends and is configured to mate to the ROW receptacle of the Model 7076. Each conductor pair (signal and drain) of the shielded cable is wrapped with insulated foil to minimize crosstalk between conductor pairs.

This cable is commonly cut at a convenient length to provide two separate cables. The cables can then be used to connect to both COLUMN receptacles. The unterminated ends of the cables can then be connected to instrumentation and DUTs.

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Model 7076-CMTC High Isolation Column Cable Assembly

The Model 7076-CMTC is a 3-meter (10-feet), 28-conductor cable terminated with a 25-pin D-sub connector on both ends. This cable connects to either one of the two COLUMN receptacles on the Model 7076. Each conductor pair (signal and drain) of the shielded cable is wrapped with insulated foil to minimize crosstalk between conductor pairs.

This cable is commonly cut at a convenient length to provide two separate cables. The cables can then be used to connect to both COLUMN receptacles. The unterminated ends of the cables can then be connected to instrumentation and DUTs.

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SECTION 2
Operation

2.1 INTRODUCTION

WARNING

The matrix configuration procedures in this section should only be performed by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Review the safety precautions found at the front of this manual.

This section contains information on aspects of matrix card operation and is arranged as follows:

2.2 Handling Precautions: Details precautions that should be observed when handling the matrix card to ensure that its performance is not degraded due to contamination.

2.3 Card Installation and Removal: Covers the basic procedure for installing and removing the card from the Model 707 Switching Matrix.

2.4 Basic Matrix Configurations: Covers the basic matrix configurations that the card can be configured for; dual 4 × 12 matrices, a single 4 × 24 matrix or a single 8 × 12 matrix.

2.5 Typical Matrix Switching Schemes: Explains some of the basic ways that a matrix can be used to source or measure. Covers single-ended switching, differential (floating) switching, sensing, shielding, and guarding.

2.6 Connections: Discusses the various methods and techniques that can be used to connect DUTs and instrumentation to the matrix card.

2.7 Matrix Expansion: Discusses the various matrix configurations that are possible by using multiple cards. The significance of backplane row jumpers on matrix configurations is also covered here.

2.8 Typical Connection Schemes: Provides examples of external connections for single card, multiple card and multiple mainframe systems.

2.2 HANDLING PRECAUTIONS

To maintain high impedance isolation, care should be taken when handling the matrix card to avoid contamination from such foreign materials as body oils. Such contamination can substantially lower leakage resistances, degrading performance.

To avoid possible contamination, always grasp the card by the handle and side edges. Do not touch the edge connectors of the card and do not touch board surfaces or components. On D-subminiature (D-sub) connectors, do not touch areas adjacent to the electrical contacts.

CAUTION

Do not store the card by leaning it against an object (such as a wall) with its edge connectors in contact with a contaminated surface (such as the floor). The edge connectors will become contaminated, and tapes and solder connections on the PC board may break as the card bends. ALWAYS store the card (in its anti-static bag) in the original shipping carton.

Dirt build-up over a period of time is another possible source of contamination. To avoid this problem, operate the mainframe and matrix card in a clean environment.

If the card becomes contaminated, it should be thoroughly cleaned as explained in paragraph 4.2.

2.3 CARD INSTALLATION AND REMOVAL

WARNING

To avoid electrical shock that could result in injury or death, ALWAYS remove power from the entire system (Model 707, test instruments, DUT, etc.) and discharge any capacitors before doing any of the following:

1. Installing or removing the matrix card from the mainframe.

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2. Connecting or disconnecting cables from the matrix card. The pins of the cable connectors are easily accessible making them extremely hazardous to handle while power is applied.
3. Making internal changes to the card (such as removing or installing jumpers).

Cable connections to the matrix card make it difficult to install or remove the card from the mainframe. Thus, it is advisable to install the card and then make cable connections to it. Conversely, cables should be disconnected before removing the card from the mainframe.

Referring to Figure 2-1, perform the following procedure to install the Model 7076 matrix card in the Model 707:

CAUTION

Contamination will degrade the performance of the matrix card. To avoid contamination, always grasp the card by the handle and side edges. Do not touch the edge connectors of the card, and do not touch the board surfaces or components. On connectors, do not touch areas adjacent to the electrical contacts.

1. Turn the Model 707 off.
2. Select a slot in the mainframe and remove the cover-plate. The cover-plate is fastened to the mainframe chassis with two screws. Retain the cover-plate and screws for future use.
3. With the relay side of the matrix card facing towards the fan, feed the card into the slot such that the top and bottom card edges seat into the card edge guides of the mainframe. Slide the matrix card all the way into the mainframe and tighten the two spring loaded panel fasteners.

WARNING

The mounting screws must be secured to ensure a proper chassis ground connection between the card and the mainframe. Failure to properly secure this ground connection may result in personal injury or death due to electric shock.

4. To remove the card from the mainframe make sure the Model 707 is off, power is removed from external circuitry, and then reverse the above procedure.

2.4 BASIC MATRIX CONFIGURATIONS

A simplified schematic of the Model 7076 matrix card is shown in Figure 2-2A. As shipped from the factory, the matrix card is configured as two separate 4 × 12 matrices. Each of the 96 crosspoints is made up of a two-pole switch. By closing the appropriate crosspoint switch, any matrix row can be connected to any column in the same matrix. In this manual, the columns of every Model 7076 matrix card are referred to as columns 1 through 12 and 1′ through 12′. Columns 1 through 12 correspond to the columns receptacle (on the connection panel) labeled "TO ROWS A – D", while references to columns 1′ through 12′ correspond to the columns receptacle labeled "TO ROWS E – H".

Note that even though there are 24 unique columns in this configuration, the Model 707 recognizes only 12 columns for programming purposes. The crosspoint assignments for the matrix card are provided in Figure 2-2B. For example, to connect row A to column 10, the Model 707 would have to be programmed to close crosspoint A10 (row A, column 10); and to connect row E to column 10′ (22nd column), crosspoint E10 would have to be closed. These crosspoint closures assume that the matrix card is installed in slot 1 of the mainframe. The crosspoint assignments in Figure 2-2B are valid regardless of how the card is configured.

The column number assignments for programming the Model 707 are determined by the mainframe slot that the matrix card is installed in. For example, the column number assignments of a matrix card installed in slot 4 of the mainframe are numbered 37 through 48. Column number assignments for all six mainframe slots are listed in Table 2-1.

Notice in Figure 2-2A that there are backplane jumpers located on the matrix card. With the jumpers installed, the matrix card is connected to the backplane of the Model 707 allowing matrix expansion (see paragraph 2.7). With the jumpers removed, the matrix card is isolated from any other cards installed in the mainframe. The physical location of these jumpers on the board is shown in Figure 2-3.

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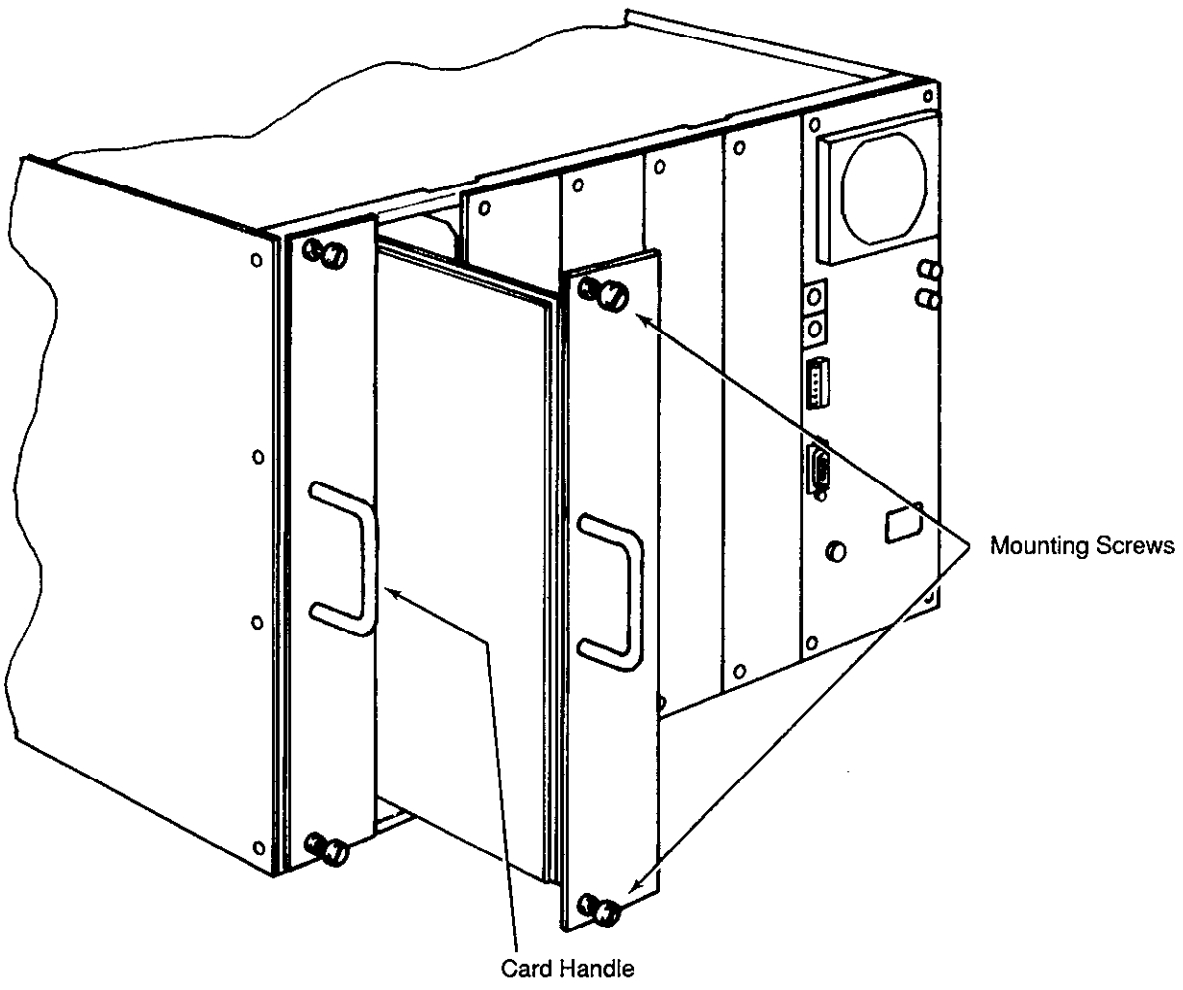
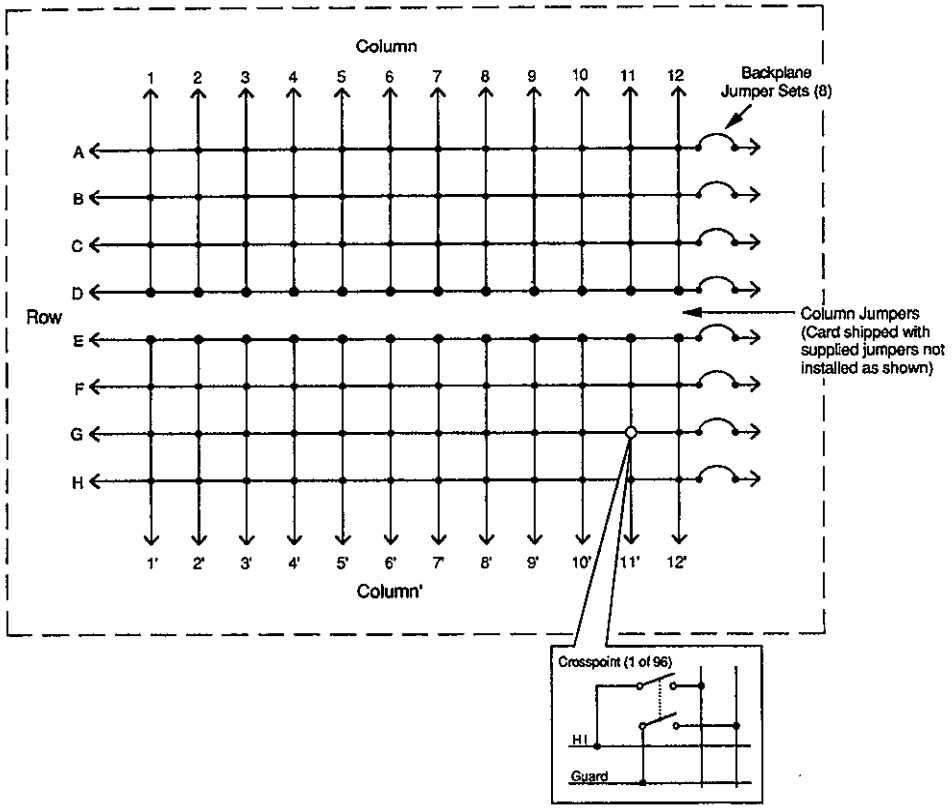


Figure 2-1. Matrix Card Installation

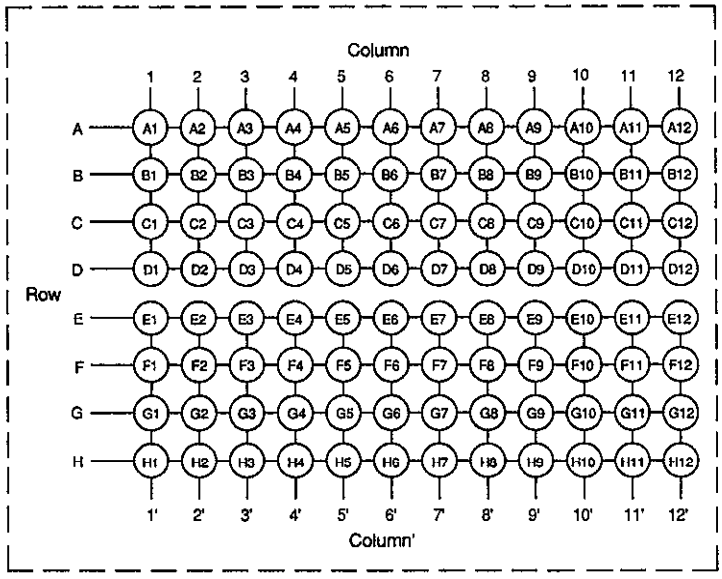
Table 2-1. Column Number Assignments

7076 Card Location	Matrix Column Numbers
Slot 1	1 through 12
Slot 2	13 through 24
Slot 3	25 through 36
Slot 4	37 through 48
Slot 5	49 through 60
Slot 6	61 through 72

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A. Simplified Schematic



Note : 7076 Installed in slot one of Model 707 Mainframe

B. Crosspoint Assignments

Figure 2-2. Model 7076

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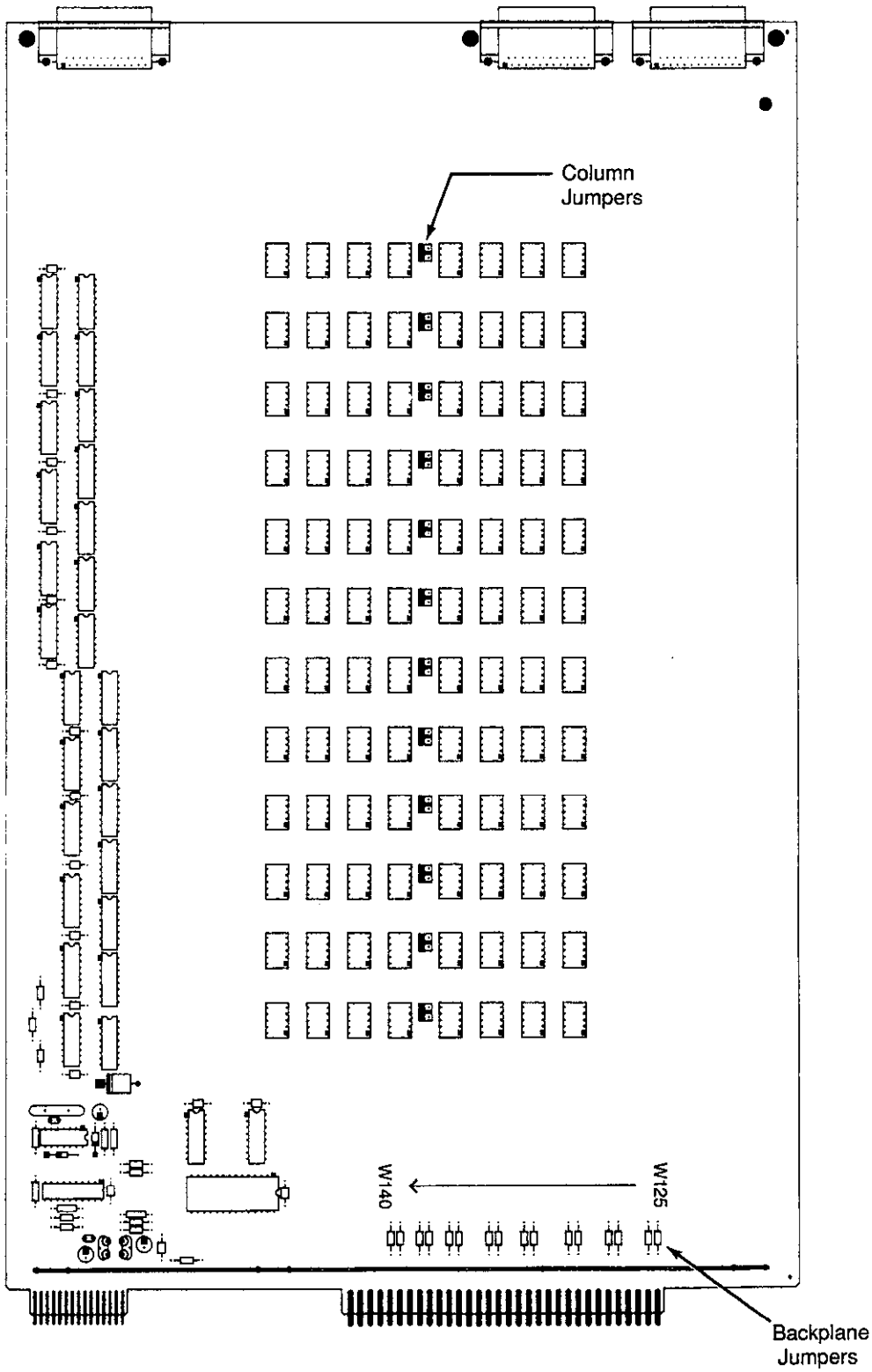


Figure 2-3. Simplified Component Layout

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2.4.1 4 × 24 Matrix

Figure 2-4 shows how the Model 7076 can be configured as a single 4 × 24 matrix. Row jumper wires are used to connect rows A, B, C and D to rows E, F, G and H respectively. These connections can be made wherever it is most convenient, such as at the connector of a customized cable assembly, or at the instrumentation (see Figure 2-15) or DUT test fixture.

In a multiple card system where backplane jumpers are left installed, row jumpers are only required at one card. Removing the backplane jumpers will isolate the 4 × 24 matrix from any other card installed in the mainframe.

Crosspoint assignments for programming the Model 707 do not change even though the matrix configuration of the card has changed (see Figure 2-2B). For example, to connect row A to the 24th (12') column of the 4 × 24 matrix (see the equivalent circuit in Figure 2-4), the Model 707 would have to be programmed to close crosspoint E12 (assuming the card is installed in slot 1 of the mainframe). Table 2-2 provides the crosspoint assignments for a Model 7076 configured as a 4 × 24 matrix installed in slot 1 of the mainframe. Table 2-1 provides the column number assignments for the other mainframe slots.

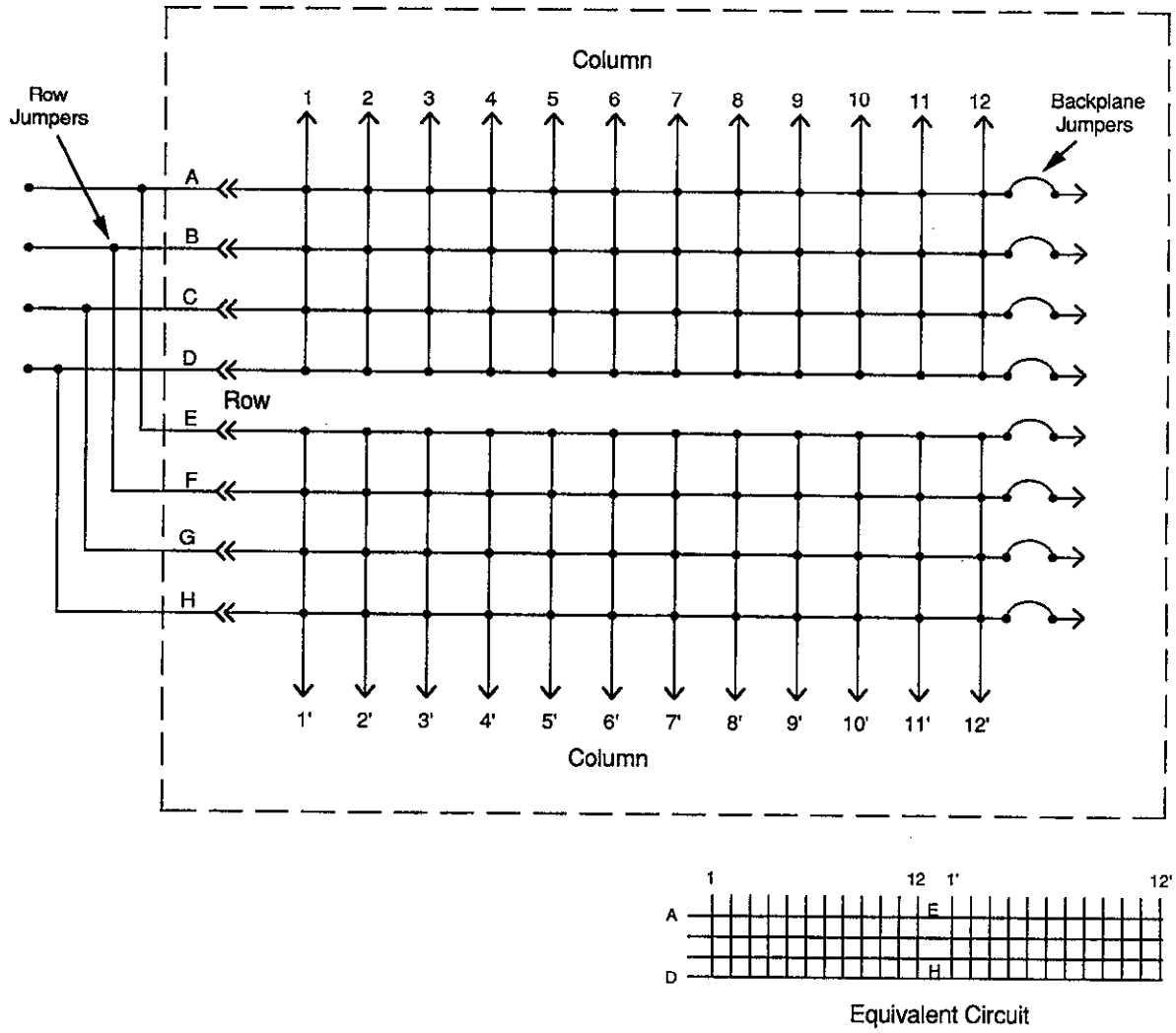


Figure 2-4. Model 7076 Configured as 4 × 24 Matrix

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Table 2-2. 4 × 24 Matrix Crosspoint Assignments

Matrix Row*	Matrix Column									
	1	2	3	...	12	1′	2′	3′	...	12′
A (E)	A1	A2	A3	...	A12	E1	E2	E3	...	E12
B (F)	B1	B2	B3	...	B12	F1	F2	F3	...	F12
C (G)	C1	C2	C3	...	C12	G1	G2	G3	...	G12
D (H)	D1	D2	D3	...	D12	H1	H2	H3	...	H12

*In the 4 × 24 matrix configuration, Row A is connected to Row E, Row B is connected to Row F, Row C to Row G and Row D to Row H

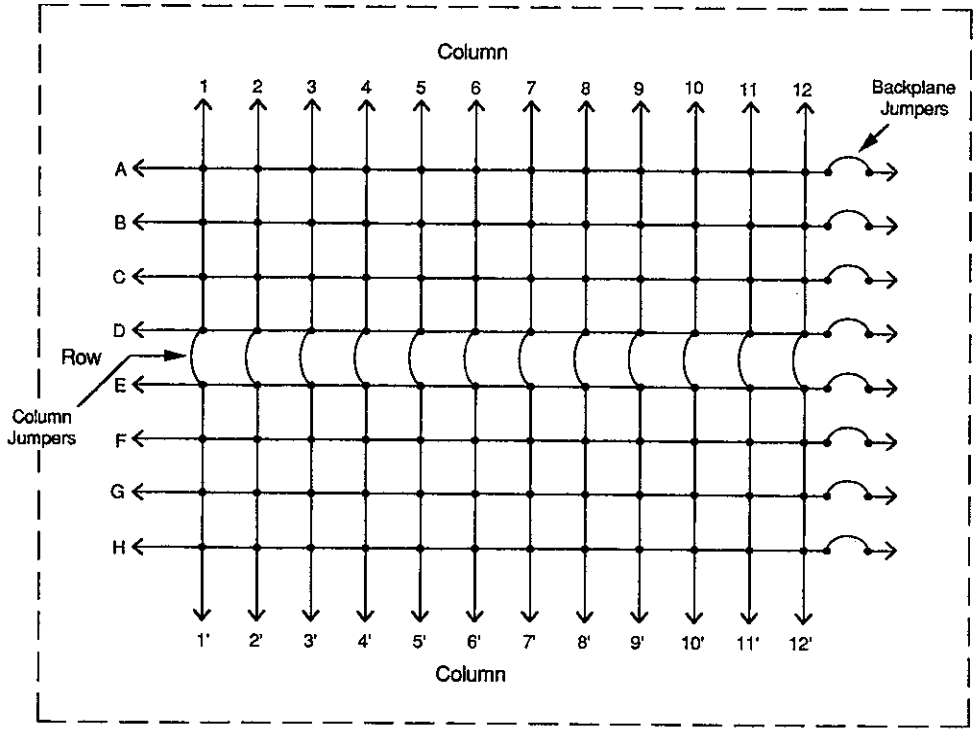


Figure 2-5. Model 7076 Configured as 8 × 12 Matrix

2.4.2 8 × 12 Matrix

Figure 2-5 shows that the Model 7076 can be configured as a standard 8 × 12 matrix by installing the column jumpers. The location of the column jumpers on the PC-board is shown in Figure 2-3. As shipped from the factory, the 12 column jumpers sets are not installed. Installing the 12 jumpers sets, as shown in Figure 2-6, configures the Model 7076 as an 8 × 12 matrix.

With the Model 7076 backplane jumpers installed, the 8 × 12 matrix is connected to the backplane of the Model 707 allowing matrix expansion (see paragraph 2.7). With the backplane jumpers removed, the 8 × 12 matrix will be isolated from any other card installed in the mainframe.

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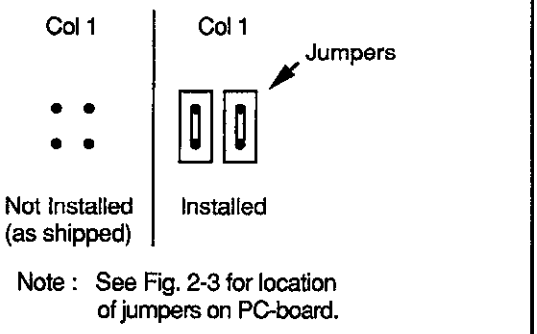


Figure 2-6. Column Jumper Installation

2.5 TYPICAL MATRIX SWITCHING SCHEMES

The following paragraphs describe some basic switching schemes that are possible with a two-pole switching matrix.

2.5.1 Single-ended Switching

In the single-ended switching configuration, the source or measure instrument is connected to the DUT through a single pathway as shown in Figure 2-7. Note that the shield of the Model 7075-MTC cable is connected to the shield around the DUT.

2.5.2 Differential Switching

The differential or floating switching configuration is shown in Figure 2-8. The advantage of using this configuration is that the terminals of the source or measure instrument are not confined to the same matrix crosspoint. Each terminal of the instrument can be connected to any matrix crosspoint. The guard terminals of the matrix card are used as a shield.

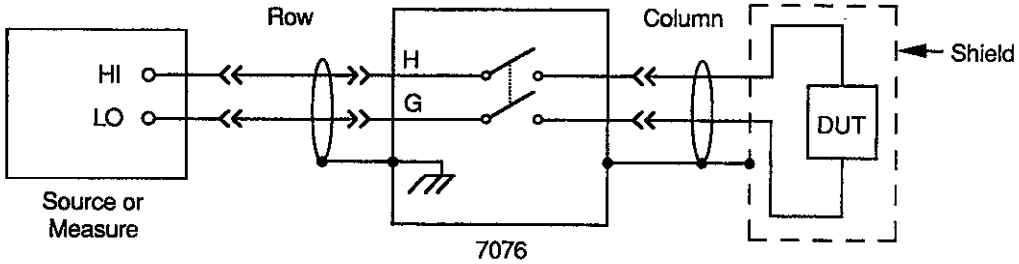


Figure 2-7. Single-ended Switching Example (Using 7075-MTC Cable)

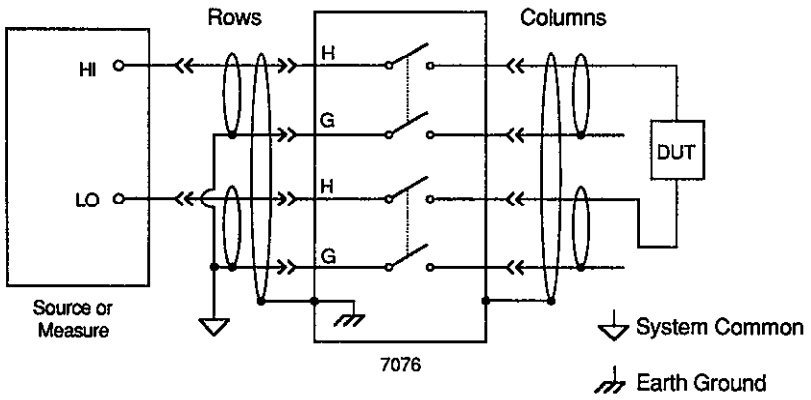


Figure 2-8. Differential Switching Example (Using High Isolation Cables)

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2.5.3 Guarding

Figure 2-9 shows how the matrix card can be used with a driven guard. Since the driven guard is at virtually the same potential as signal high, protection from possible hazardous voltages (up to 175V peak) must be provided. Many instruments have the capability of configuring their input or output such that a driven guard is placed on the inner shield of a triax connector. The outer shield, connected to system common, provides protection from the guard voltage. When making connections from the matrix card to the DUT, a safety shield may be required, depending on the type of connectors used.

2.5.4 Sensing

Figure 2-100 shows how the matrix card can be configured to use instruments that have sensing capability. The main advantage of using sensing is to cancel the effects of matrix card path resistance (<1.5) and the resistance of external cabling. Whenever path resistance is a consideration, sensing should be used.

The standard cable (Model 7075-MTC) can also be used, however the high (H) paths in the cable will not be surrounded by guard (G).

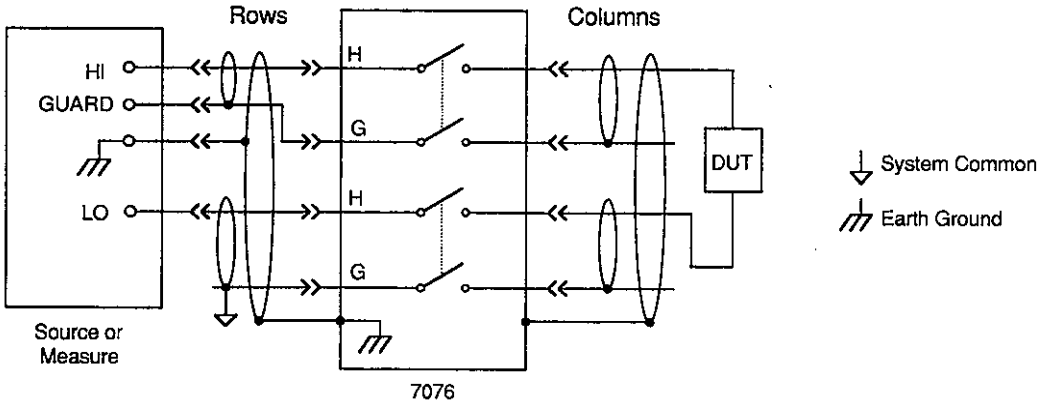


Figure 2-9. Driven Guard Example (Using High Isolation Cables)

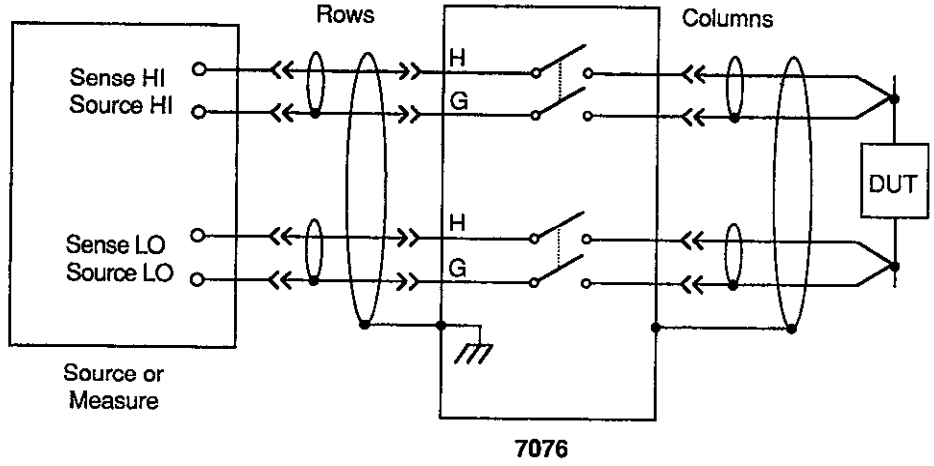


Figure 2-10. Sensing Example (Using High Isolation Cables)

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2.6 CONNECTIONS

CAUTION

To prevent damage (not covered by the warranty) and a possible safety hazard, do not exceed the maximum allowable limits of the Model 7076. Maximum signal levels are listed in the specifications located at the front of the manual.

As shipped, all rows and columns of the Model 7076 matrix card are connected to the three 25-pin D-sub receptacles mounted on the rear panel of the matrix card. One receptacle is provided for row connections and two receptacles are provided for column connections. The COLUMNS receptacle located near the top is for rows A through D, while the other COLUMNS receptacle is for rows E through H.

Pin identification for the D-sub receptacles is provided in Figure 2-11. Adjacent to the each contact designation of the D-sub receptacles is the corresponding row or column that it is internally connected to.

Cable Connections

There are two basic cable types available to make connections to the matrix card; the standard cable (Model 7075-MTC), and high isolation cables (Model 7076-RMTC and Model 7076-CMTC). Basically, the standard cable is a general purpose cable that will mate to either the ROWS or COLUMN receptacles. The high isolation cables provide better isolation between paths. The Model 7076-RMTC is used to connect to the ROWS receptacle, while the Model 7076-CMTC is used to connect to the COLUMN receptacles.

The available cables, as well as some miscellaneous connectors for customized user supplied terminations, are

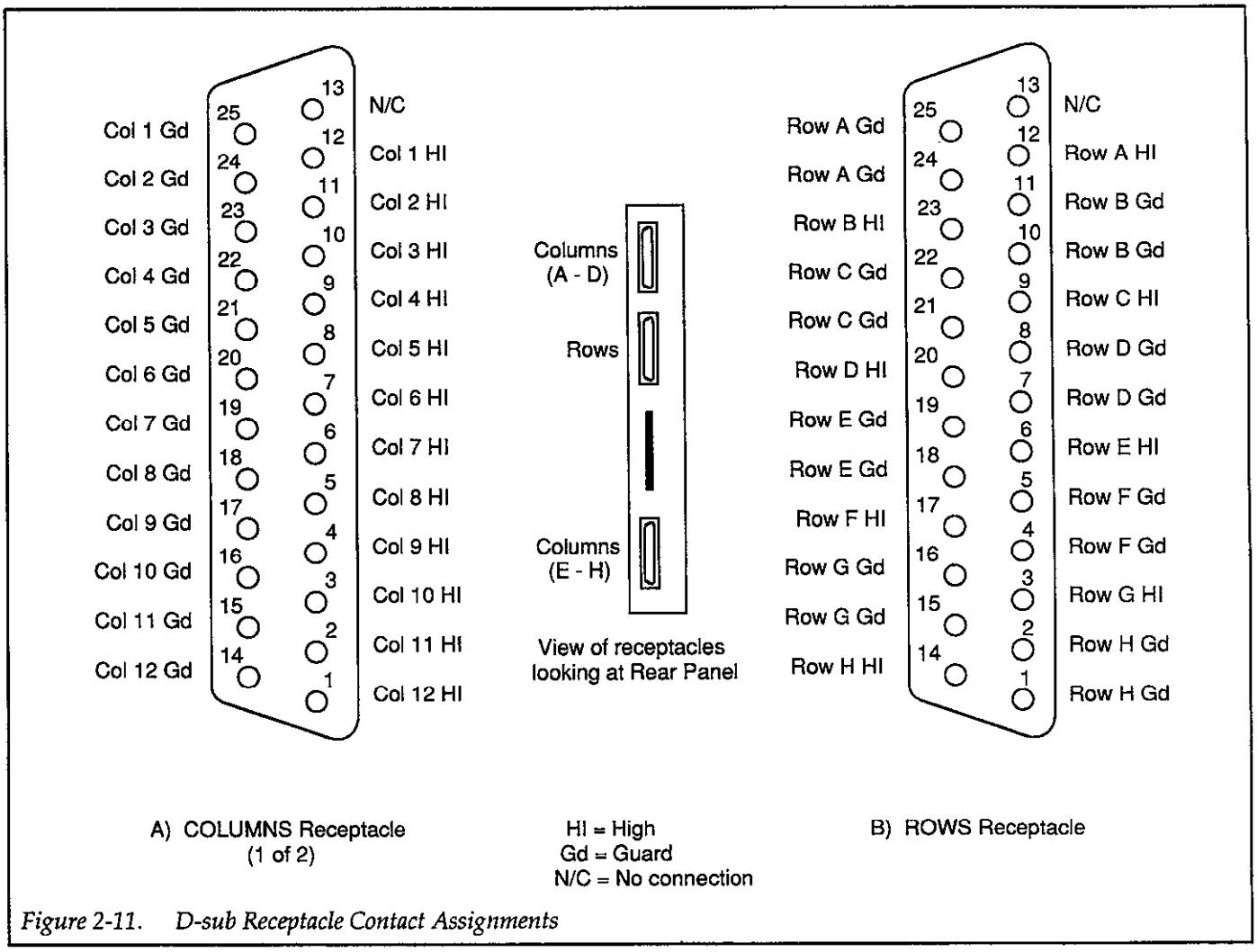


Figure 2-11. D-sub Receptacle Contact Assignments

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Table 2-3. Available Cables and Connectors

Manufacturer	Model or Part Number	Description
Keithley	Model 7075-MTC Standard Cable	Standard three-meter (10 feet) cable assembly terminated with 25-pin D-sub plugs on both ends. Mates to either the ROWS or COLUMN receptacles of the matrix card.
Keithley	Model 7076-CMTC High Isolation Columns Cable	Three-meter (10 feet), high isolation (for high isolation) cable assembly terminated with 25-pin D-sub plugs on both ends. Use to mate to either COLUMNS receptacle of the matrix card.
Keithley	Model 7076-RMTC High Isolation Rows Cable	Three-meter (10 feet), high isolation (for high isolation) cable assembly terminated with 25-pin D-sub plugs on both ends. Use to mate to the ROWS receptacle of the matrix card.
Keithley	CS-400	25-pin D-sub plug that will mate to the ROWS and COLUMN receptacles of the matrix card. Solder-cup connections simplify the building of custom cables.
Keithley	CS-401	25-contact D-sub receptacle that will mate to cables terminated with a 25-pin D-sub plug.
Keithley	CS-590	Plastic backshell housing for CS-400.
Belden	9868	High isolation cable. Same cable used for the Models 7076-RMTC and 7076-CMTC cable assemblies. See paragraph 2.6.2 for description.
3M	8225-7000	25-pin D-sub plug for customized ribbon cable assemblies.
3M	3357-9225	Junction shell for 3M 8225-7000 D-sub plug.

summarized in Table 2-3. The cables available from Keithley are described in more detail in paragraphs 2.6.1 and 2.6.2.

WARNING

To avoid electrical shock that could result in injury or death, ALWAYS remove power from the entire system (Model 707, test instruments, DUT, etc.) and discharge any capacitors before connecting or disconnecting cables from the matrix card. The pins of the cable connectors are easily accessible making them extremely hazardous to handle while power is applied.

Use the following procedure to connect a cable terminated with a 25-pin D-sub plug to the matrix card:

1. Install the matrix card in the Model 707 mainframe as explained in paragraph 2.3.
2. Push the plug of the cable onto the appropriate receptacle of the matrix card. The cable plug and matrix card receptacle will only mate one way.
3. Tighten the screws of the plug housing to secure it to the panel.

The same basic procedure applies for connecting the cable plug to a test fixture receptacle.

2.6.1 Standard Cable (Model 7075-MTC)

The standard cable (Model 7075-MTC) is a three-meter (10 feet), general purpose 24-conductor, shielded cable that is terminated with a 25-pin D-sub male plug on each end that will connect to either the ROWS or COLUMN receptacles on the matrix card.

The standard cable (shown in Figure 2-12) is comprised of a flat ribbon cable that is located inside a shielded, round cable casing. The braided shield of the cable surrounds the ribbon cable and is subsequently connected to chassis ground when the cable is connected to a Model 7076 that is installed in a Model 707 mainframe.

Pin designations on the D-sub plugs of the standard cable correspond to the contact designations on the D-sub receptacles of the matrix card. Thus, if connecting the standard cable to a COLUMNS receptacle, refer to Figure 2-11A for column identification. If connecting the standard cable to the ROWS receptacle, refer to Figure 2-11B for row identification.

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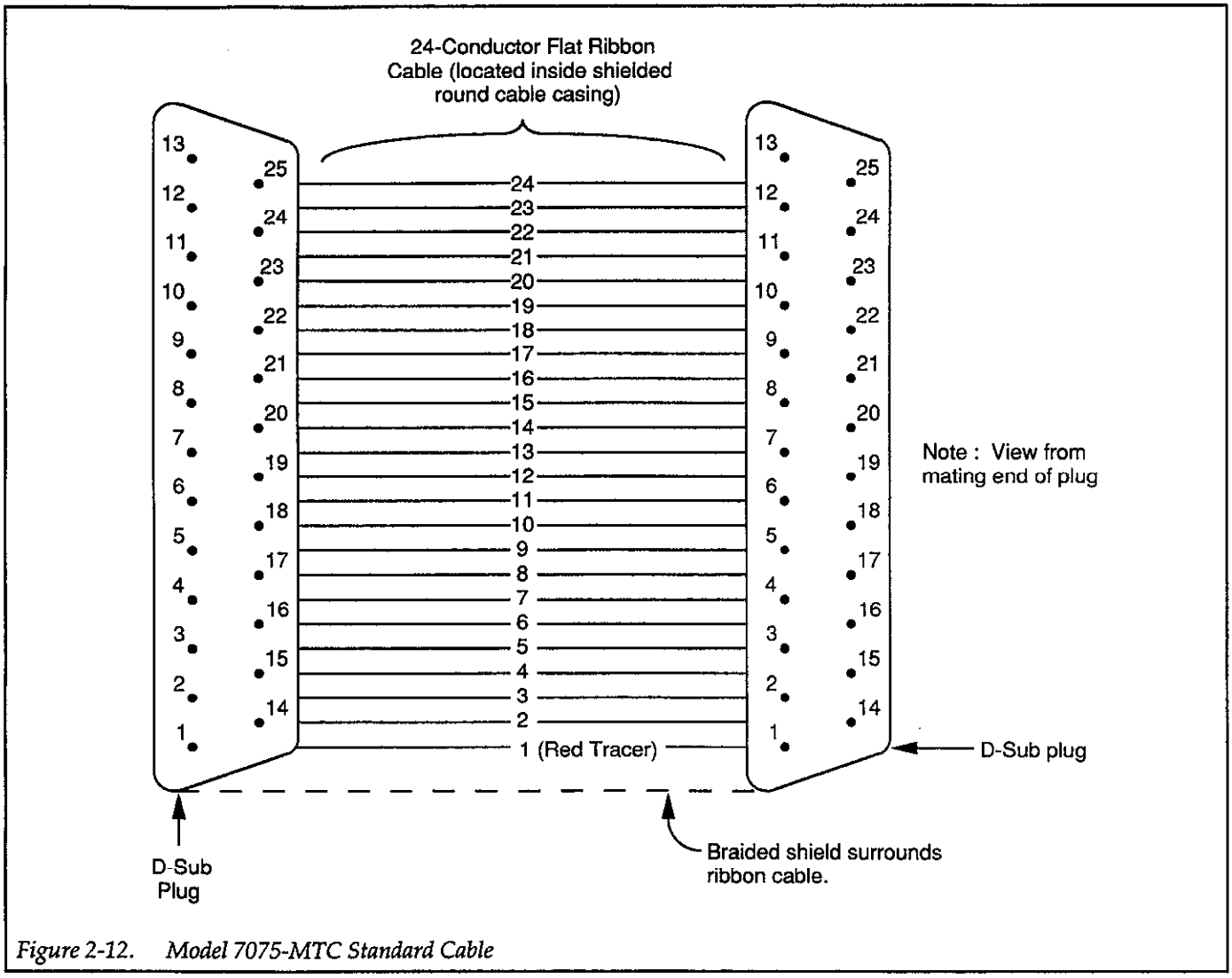


Figure 2-12. Model 7075-MTC Standard Cable

To connect the matrix to instrumentation and DUT, a test fixture using a D-sub receptacle can be used to mate to the D-sub plug of the cable. The Keithley part number for the D-sub receptacle is listed in Table 2-3.

Modifying the Standard Cable

A common way to use the standard cable is to cut it at a convenient length. The result is two cables that are unterminated at one end. The flat ribbon cables at the unterminated ends of the cables can then be connected to instrumentation and DUT, while the other ends will mate to the ROWS and COLUMN receptacles of the matrix card. The conductor designations of the ribbon cable are shown in Figure 2-12. The red tracer identifies conductor #1 of the ribbon cable. Table 2-4 is provided to correspond the ribbon cable conductors to the matrix card row or column terminal. For example, if the standard cable is connected to the ROWS receptacle, ribbon cable conductor #24 will correspond to Row A Guard of the matrix card. If the cable was instead connected to the COLUMNS receptacle, ribbon cable conductor #24 will correspond to Column 1 Guard of the matrix card.

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Table 2-4. Cable Conductor Identification (Model 7075-MTC)

Ribbon Cable Conductor	Matrix Row/Column Terminal	
	Connected to ROWS Receptacle	Connected to COLUMNS Receptacle
1*	ROW H, Guard	COLUMN 12, HI
2	ROW H, HI	COLUMN 12, Guard
3	ROW H, Guard	COLUMN 11, HI
4	ROW G, Guard	COLUMN 11, Guard
5	ROW G, HI	COLUMN 10, HI
6	ROW G, Guard	COLUMN 10, Guard
7	ROW F, Guard	COLUMN 9, HI
8	ROW F, HI	COLUMN 9, Guard
9	ROW F, Guard	COLUMN 8, HI
10	ROW E, Guard	COLUMN 8, Guard
11	ROW E, HI	COLUMN 7, HI
12	ROW E, Guard	COLUMN 7, Guard
13	ROW D, Guard	COLUMN 6, HI
14	ROW D, HI	COLUMN 6, Guard
15	ROW D, Guard	COLUMN 5, HI
16	ROW C, Guard	COLUMN 5, Guard
17	ROW C, HI	COLUMN 4, HI
18	ROW C, Guard	COLUMN 4, Guard
19	ROW B, Guard	COLUMN 3, HI
20	ROW B, HI	COLUMN 3, Guard
21	ROW B, Guard	COLUMN 2, HI
22	ROW A, Guard	COLUMN 2, Guard
23	ROW A, HI	COLUMN 1, HI
24	ROW A, Guard	COLUMN 1, Guard

*Conductor #1 of the ribbon cable is identified by the red tracer.

2.6.2 High Isolation Cables (Model 7076-RMTC and Model 7076-CMTC)

Shielded high isolation cables (Model 7076-RMTC and Model 7076-CMTC) are available to optimize performance by minimizing crosstalk between signal paths. Each HI signal path in the cable is completely surrounded by Guard (insulated foil) to maximize the effects of guarding. The outer foil shield of the cable is connected to the housings of the D-sub plugs. This shield is connected to chassis ground when the cable is connected to a Model 7076 that is properly installed in the Model 707 mainframe.

The Model 7076-RMTC is a 3-meter (10 feet) 28-conductor cable terminated with a D-sub plug on each end. The plug pin assignment for this cable is configured to mate with the ROWS receptacle of the matrix card. Pin identification for this cable is shown in Figure 2-13A.

The Model 7076-CMTC is a 3-meter (10 feet) 28-conductor cable terminated with a D-Sub plug on each end. The plug pin assignment for this cable is configured to mate with either of the two COLUMN receptacles of the matrix card. Pin identification for this cable is shown in Figure 2-13B.

For connections to instrumentation and DUT, a test fixture using a D-sub receptacles can be used to mate to the D-sub plugs of the cables. The Keithley part number for the D-sub receptacle is listed in Table 2-3.

Modifying the High Isolation Cable

Another way to use the Model 7076-RMTC or Model 7076-CMTC is to cut the cable at a suitable length and add appropriate user termination. Each cable can then be mated to the matrix card while the unterminated ends can be wired to another connector or directly to instrumentation and DUT.

Each cable contains 12 conductor pairs each of which corresponds to a row or column. Each pair contains a color-coded insulated wire (HI), and a bare drain wire (Guard). Each pair is wrapped in an insulated, color-coded foil which is also connected to Guard. The color combination of the HI conductor insulator and the surrounding foil is used for identification. Table 2-5 identifies the conductors of the Model 7076-RMTC cable, while Table 2-6 provides identification for the Model 7076-CMTC cable. Note that for both cables, the black with red foil and white with blue foil pairs (as well as the main outer shield) are connected to chassis ground at the housing of the D-Sub plugs.

CAUTION

When terminating a cable that has been cut, make sure that all exposed conductors are properly insulated using Teflon® or PVC tubing and/or heat shrink material. The conductive side of the foil and drain wire of each wire pair must be electrically isolated from the other wire pairs.

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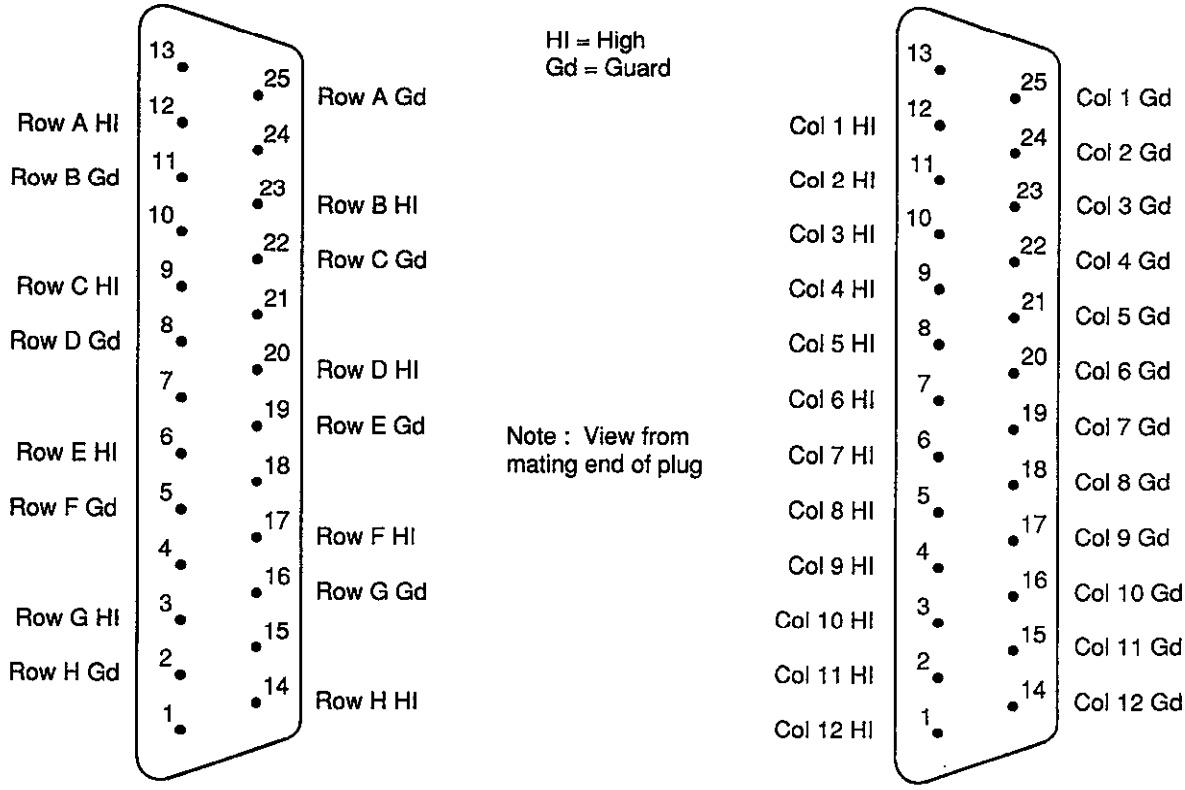


Figure 2-13. D-sub Plug Pin Assignments for High Isolation Cables

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Table 2-5. Model 7076-RMTC Conductor Identification

Matrix Row	Cable Wire Color Combination
Row A	Brown (HI), Red Foil w/Drain (Guard)
Row B	Red (HI), Red Foil w/Drain (Guard)
Row C	Orange (HI), Red Foil w/Drain (Guard)
Row D	Yellow (HI), Red Foil w/Drain (Guard)
Row E	Blue (HI), Red Foil w/Drain (Guard)
Row F	White (HI), Red Foil w/Drain (Guard)
Row G	Brown (HI), Blue Foil w/Drain (Guard)
Row H	Red (HI), Blue Foil w/Drain (Guard)
Chassis	Black (Chassis), Red Foil w/Drain (Chassis)
Chassis	White (Chassis), Blue Foil w/Drain (Chassis)
Chassis	Main outer shield w/Drain (Chassis)

Table 2-6. Model 7076-CMTC Conductor Identification

Matrix Column	Cable Wire Color Combination
Column 1	Brown (HI), Red Foil w/Drain (Guard)
Column 2	Red (HI), Red Foil w/Drain (Guard)
Column 3	Orange (HI), Red Foil w/Drain (Guard)
Column 4	Yellow (HI,) Red Foil w/Drain (Guard)
Column 5	Blue (HI), Red Foil w/Drain (Guard)
Column 6	White (HI), Red Foil w/Drain (Guard)
Column 7	Brown (HI), Blue Foil w/Drain (Guard)
Column 8	Red (HI), Blue Foil w/Drain (Guard)
Column 9	Orange (HI), Blue Foil w/Drain (Guard)
Column 10	Yellow (HI), Blue Foil w/Drain (Guard)
Column 11	Blue (HI), Blue Foil w/Drain (Guard)
Column 12	Black (HI), Blue Foil w/Drain (Guard)
Chassis	Black (Chassis), Red Foil w/Drain (Chassis)
Chassis	White (Chassis), Blue Foil w/Drain (Chassis)
Chassis	Main outer shield w/Drain (Chassis)

2.7 MATRIX EXPANSION

With the use of additional matrix cards, larger matrices can be configured through the backplane of the Model 707. Thus, unless otherwise noted, the examples provided in the following paragraphs assume that the Model 7076 backplane jumpers are installed.

2.7.1 Backplane Row Jumpers

The easiest way to to accomplish matrix row expansion is through the backplane of the Model 707 mainframe. It is through this mainframe backplane where row connections to other cards are made. As previously explained in paragraph 2.4, the Model 7076 has eight sets of backplane jumpers that connect the rows of the matrix card to the mainframe backplane.

There is another set of backplane jumpers that must be considered when building larger matrices through rows. This set of backplane jumpers is located in the Model 707 mainframe. With these mainframe backplane jumpers installed, the rows of all mainframe slots are connected together. With these jumpers removed, the rows of mainframe slots 1, 2 and 3 are isolated from the rows of mainframe slots 4, 5 and 6.

NOTE
The Model 707 is shipped with its backplane row jumpers installed. Some configurations require that these backplane row jumpers be removed. The procedure to remove these jumpers can be found in the Model 707 Instruction Manual.

Backplane Compatibility Considerations

The Model 7076 may be incompatible with other card types when expansion is done through the backplane. For example, in a particular test system it may be necessary to connect Guard of the Model 7076 (which is a two-pole card) to Low of a three-pole card. As shipped, the Model 7076 backplane row jumpers connect the Guard signal paths to the Guard terminals of the three-pole general purpose backplane of the Model 707 mainframe. The Low signal paths of the other card are connected to the Low backplane terminals of the Model 707. With this configuration, Guard of the Model 7076 cannot be routed to Low of the other card.

The Model 7076 provides some flexibility in altering the backplane route of the guard signal paths. The backplane row jumpers are shown in Figure 2-3 and Figure 2-14. They have circuit designations W125 through W140. The odd circuit designations (W125, W127, W129, W131, W133, W135, W137 and W139) identify the guard jumpers of the card. These jumpers connect the Guard signal paths of the card to the guard backplane terminals of the Model 707. Adjacent to each HI jumper (identified by the even circuit designations) are holes in the pc-board to ac-

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commodate a jumper. By moving the guard jumpers to these locations, the matrix card guard paths will connect to the low backplane terminals of the Model 707.

WARNING
Internal modifications to the matrix card should only be performed by qualified service personnel who are familiar with standard safety precautions.

CAUTION
Solder operations require that the pc-board be cleaned as explained in paragraph 4.2.

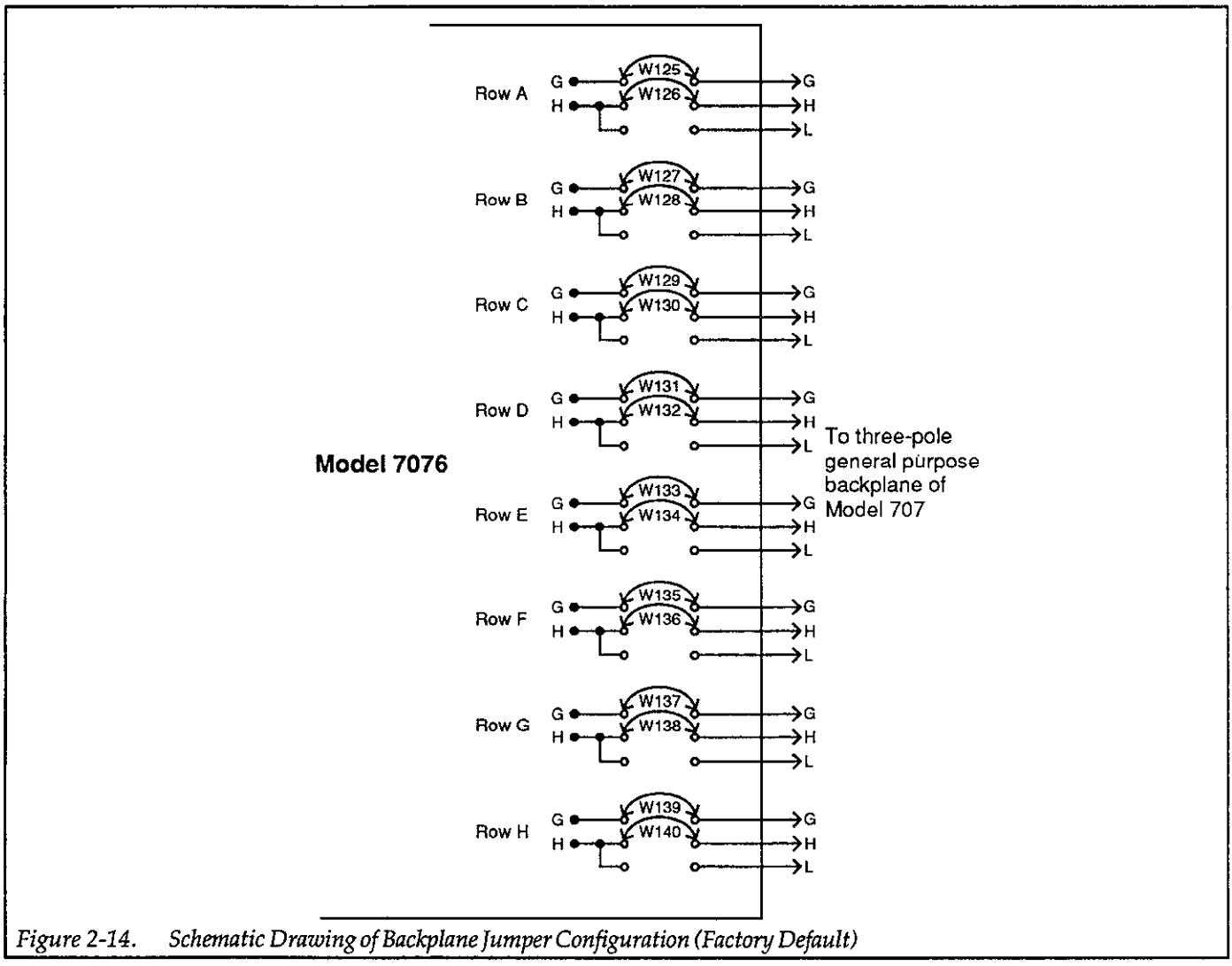


Figure 2-14. Schematic Drawing of Backplane Jumper Configuration (Factory Default)

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2.7.2 Narrow Matrix Expansion

An example of a narrow matrix is shown in Figure 2-15. This 4×72 matrix is configured by simply installing three "as shipped" Model 7076s in the Model 707 mainframe. Rows A, B, C and D are connected to rows E, F, G and H externally. These connections can be made at the instrumentation as shown in the illustration, or with custom built cable that shorts rows A to E, B to F, C to G, and D to H. This example assumes that the mainframe backplane jumpers are installed. Every additional Model 7076 installed in the mainframe would add 24 columns to the matrix. For example, four Model 7076s installed in the mainframe would result in a 4×96 matrix. Table 2-7 summarizes the narrow (four rows) matrix possibilities for a single Model 707 mainframe.

Model 7076 matrix cards installed in slots 1, 2 and 3 of the Model 707 can be electrically isolated from slots 4, 5 and 6 by removing the mainframe backplane row jumpers. With the jumpers removed, the Model 707 can accommodate two complete, separate matrices using Model 7076 matrix cards (see Figure 2-16).

Table 2-7. Narrow Matrix Expansion*

Installed Matrix Card	Resulting Matrix
1 Card	4×24
2 Cards	4×48
3 Cards	4×72
4 Cards	4×96
5 Cards	4×120
6 Cards	4×144

*Mainframe backplane row jumpers between slots 3 and 4 of mainframe must be installed for a matrix larger than 72 columns.

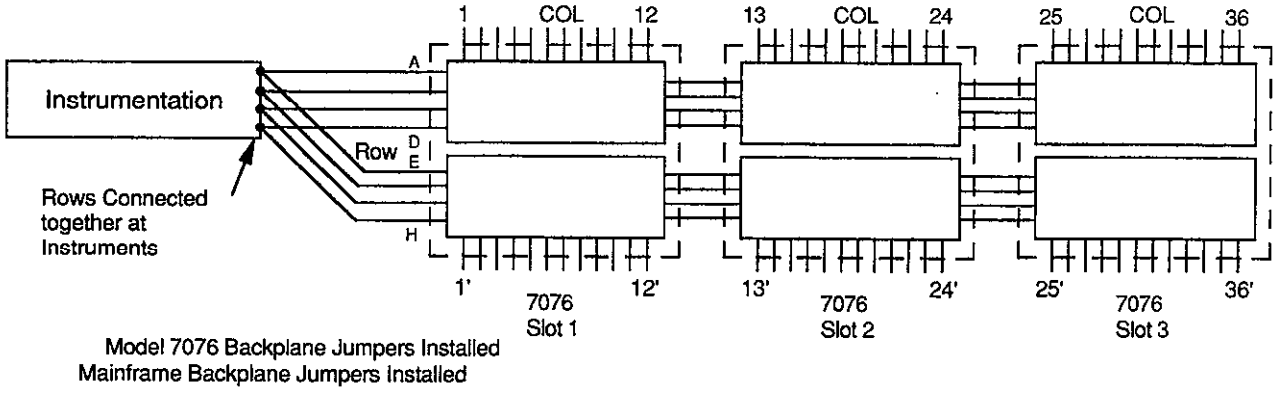


Figure 2-15. Narrow Matrix Example (4×72)

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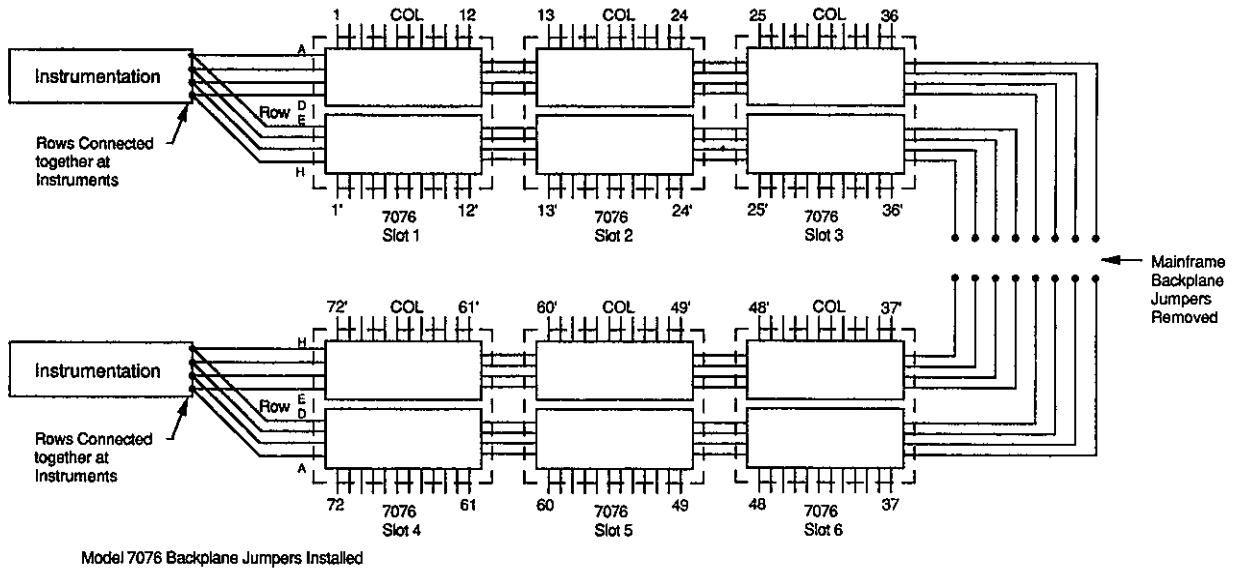


Figure 2-16. Dual 4 × 72 Matrices

2.7.3 Wide Matrix Expansion

By installing the column jumpers of the Model 7076, the card becomes configured as an 8 × 12 matrix (see paragraph 2.4.2). Assuming that the backplane jumpers of the Model 707 and 7076s are installed, each 8 × 12 matrix card installed in the mainframe extends the matrix by 12 columns. For example, three Model 7076s (configured as 8 × 12 matrices) installed in the Model 707 will result in an 8 × 36 matrix. An example of an 8 × 36 matrix is shown in Figure 2-17. Table 2-8 summarizes the wide (eight rows) matrix possibilities for a single Model 707 mainframe.

With the column jumpers installed, column 1 is connected to column 1', column 2 is connected to column 2' and so on. Thus, when connecting DUT or instrumentation to the columns of the matrix, it is recommended that only one column's receptacle be used.

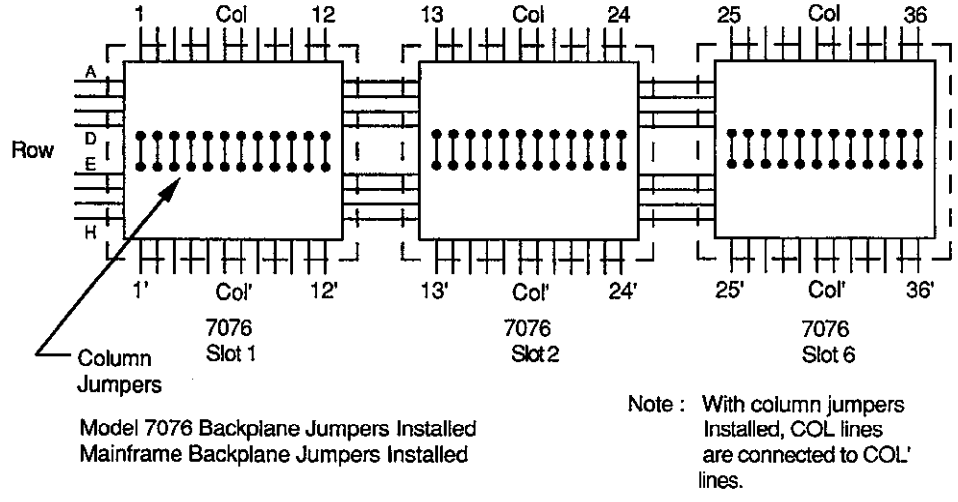


Figure 2-17. Wide Matrix Example (8 × 36)

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Table 2-8. Wide Matrix Expansion*

Installed Matrix Card	Resulting Matrix
1 Card	8 × 12
2 Cards	8 × 24
3 Cards	8 × 36
4 Cards	8 × 48
5 Cards	8 × 60
6 Cards	8 × 72

*Mainframe backplane row jumpers between slots 3 and 4 of mainframe must be installed for a matrix larger than 36 columns.

2.7.4 Partial Matrix Implementation

A fully implemented matrix provides a relay at each potential crosspoint. For example, a fully implemented 8 × 36 matrix utilizing three 8 × 12 matrix cards contains 288 crosspoints. A partially implemented 8 × 36 matrix would contain fewer crosspoints. An example of a partially implemented 8 × 36 matrix is shown in Figure 2-18. The partial matrix is still 8 × 36, but contains only 192 crosspoints using two matrix cards. Model 7076 #1 is configured as a 4 × 24 matrix. Notice in Figure 2-18A that the Model 7076 backplane jumpers for rows E through H are cut. These jumpers must be cut in order to isolate Model 7076 #1 from rows E through H of the other matrix card in the mainframe (see Figure 2-18B).

An obvious advantage of a partial matrix is that fewer matrix cards are needed. Another reason to use a partial matrix is to keep certain devices from being connected directly to other certain devices. For example, a source in Figure 2-18B cannot be connected to a column of Model 7076 #1 with one "accidental" crosspoint closure. Three specific crosspoints must be closed in order to connect a source to a Model 7076 #1 column.

2.7.5 Mainframe Matrix Expansion

Matrices using up to 30 matrix cards are possible by daisy-chaining five Model 707 mainframes together. Using 30 Model 7076 matrix cards provides 2880 crosspoints.

In general, assuming all backplane jumpers are installed, connecting the rows of a card in one mainframe to the rows of a card in a second mainframe increases the column numbers of the matrix. For example, if the rows of a 4 × 120 matrix in one mainframe are connected to the rows of a 4 × 72 matrix in a second mainframe, the resulting matrix would be 4 × 192. See the Model 707 Instruction Manual for detailed information on daisy-chaining Model 707 mainframes.

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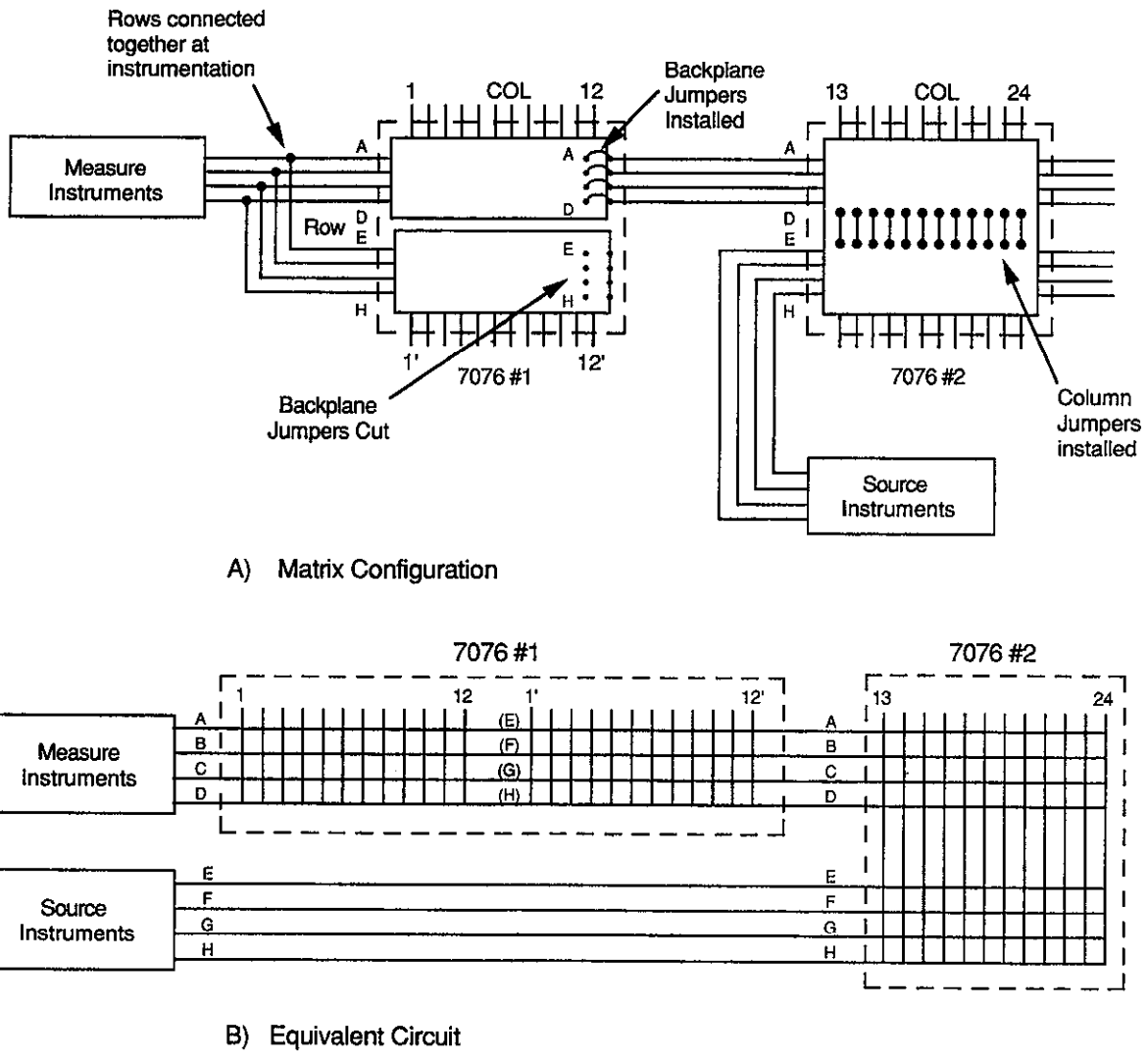


Figure 2-18. Partial Matrix Expansion (8 × 36)

2.8 TYPICAL CONNECTION SCHEMES

The following information provides some typical connection schemes for single card, multiple card and multiple mainframe system configurations. Also, a system using the matrix card with a multiplexer card (Keithley Model 7075) is shown to demonstrate versatility and compatibility. All of the examples use Model 7076s configured as 4 × 24 matrices.

Also, the examples show Model 7075 cables, or Model 7076-CMTC and Model 7076-RMTC cables. In many instances, these cables are best utilized by cutting them in half. Cutting them provides twice as many cables and allows direct connection to instrumentation and DUT. Cables could just as well be custom built to better suit a particular application.

2.8.1 Single Card System

Figure 2-19 shows how external connections for a single card system might by made. Instrumentation is connected to matrix card rows using a standard cable (Model 7075-MTC) for general purpose testing, or a high isolation cable (Model 7076-RMTC) for critical tests that require optimum isolation. In a similar manner, DUT is connected to the matrix card using a standard cables or the Model 7076-CMTC high isolation column cables. No-

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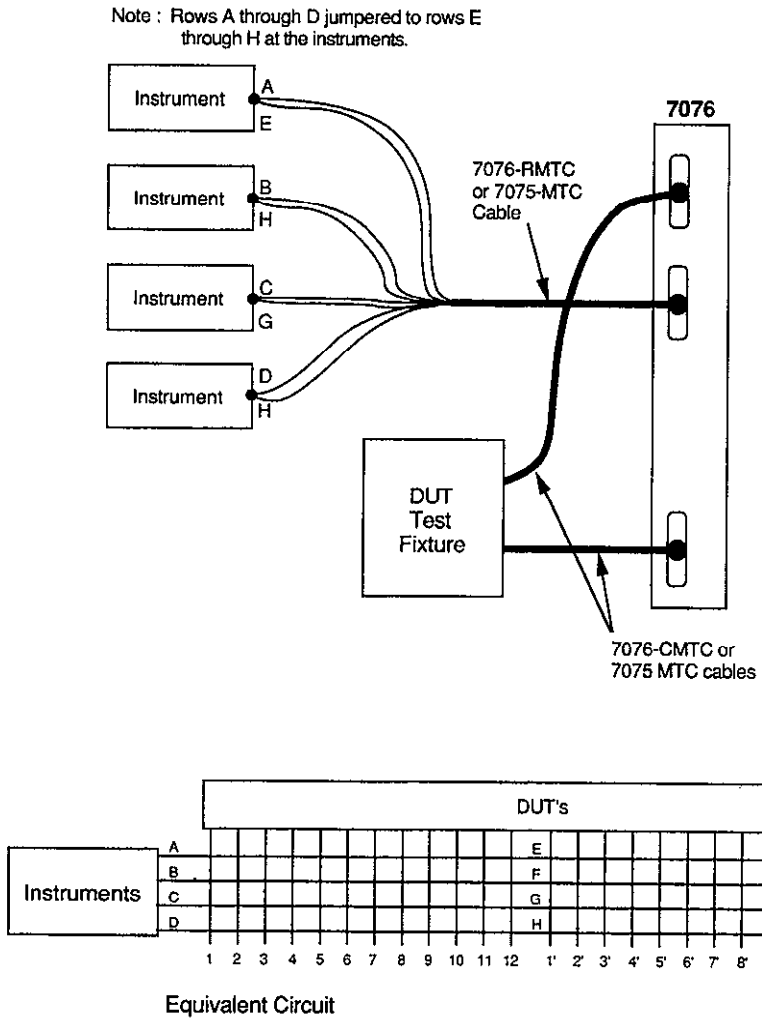


Figure 2-19. Single Card System Example

tice that cutting one of these cables in half will provide two column cables that will connect directly to DUT.

2.8.2 Multiple Card System

Figure 2-209 shows a system using two matrix cards. In this configuration, both instrumentation and DUT are connected to the columns of the matrix. In this example, the instruments are connected to the columns because they require six pathways. The matrix, as configured, has only four rows.

Notice that the row jumper connections required to configure the four row matrix are done at a 25-pin D-sub plug.

2.8.3 Multiple Mainframe System

Figure 2-21 shows a system using seven matrix cards, requiring two Model 707s daisy-chained together. In this configuration DUTs are connected to matrix card columns. A single cable is used to connect the rows of the master mainframe to the rows of the slave mainframe. Note that if path resistance is a critical factor, use a modified (or custom) cable that is as short as possible.

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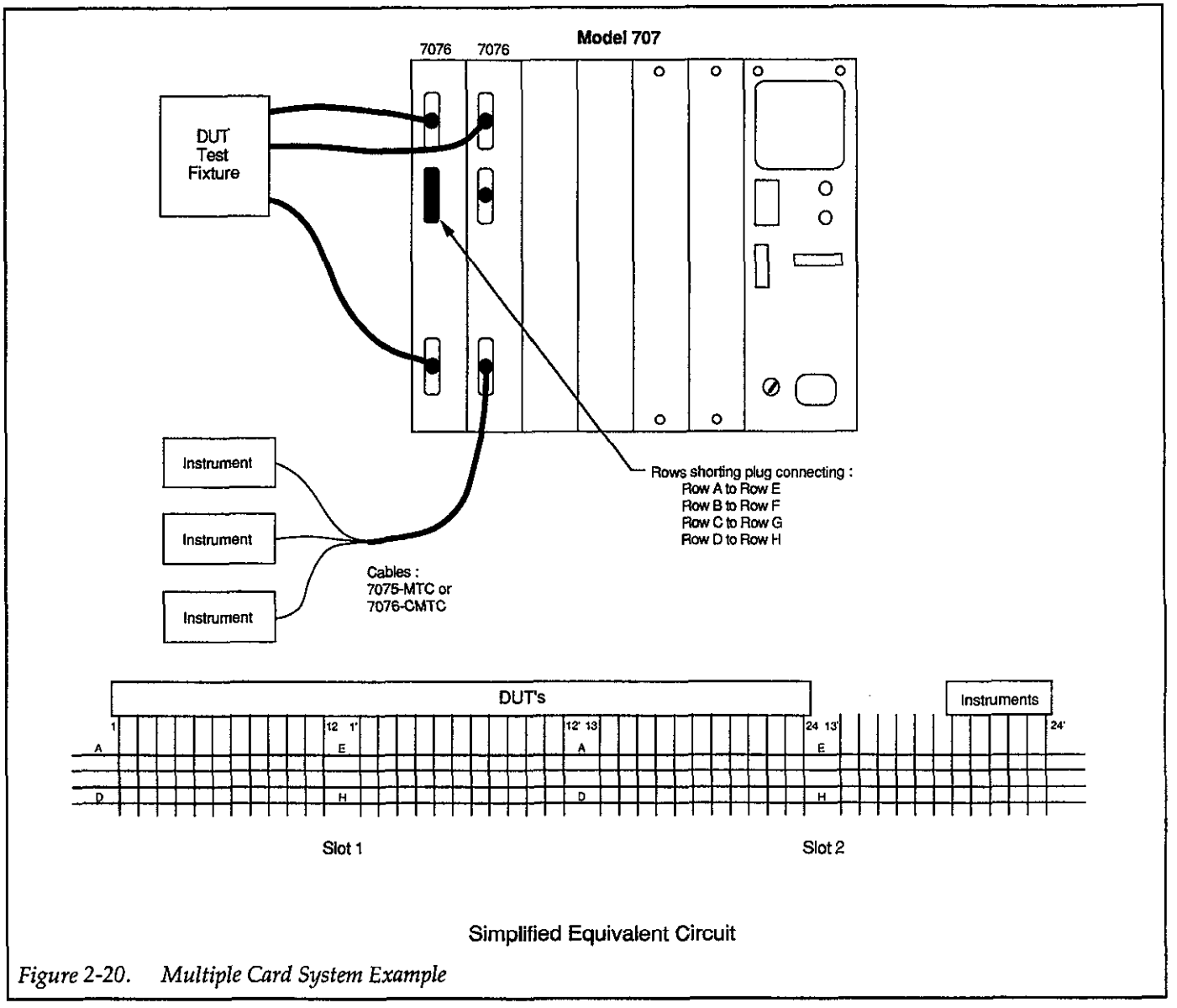


Figure 2-20. Multiple Card System Example

2.8.4 Matrix/Multiplexer System

Figure 2-22 shows an example of how the Model 7076 can be used along with a multiplexer card (Keithley Model 7075) in the same test system. In this example, the Model 7076 is configured as a 4×24 matrix and the Model 7075 is configured as a quad 1×24 multiplexer. In this test system, the matrix card provides 24 columns for DUT or additional instrumentation. By using the multiplexer card in the system, 96 additional test lines are made available.

Different bank jumper/backplane jumper combinations on the Model 7075 can provide different pin outs for the same quad 1×24 multiplexer configuration. Also, different multiplexer configurations are easily accomplished. For example (refer to Figure 2-22), removing backplane jumpers for rows C and F, and installing bank jumpers B to C and F to G will configure the card as a dual 1×48 multiplexer.

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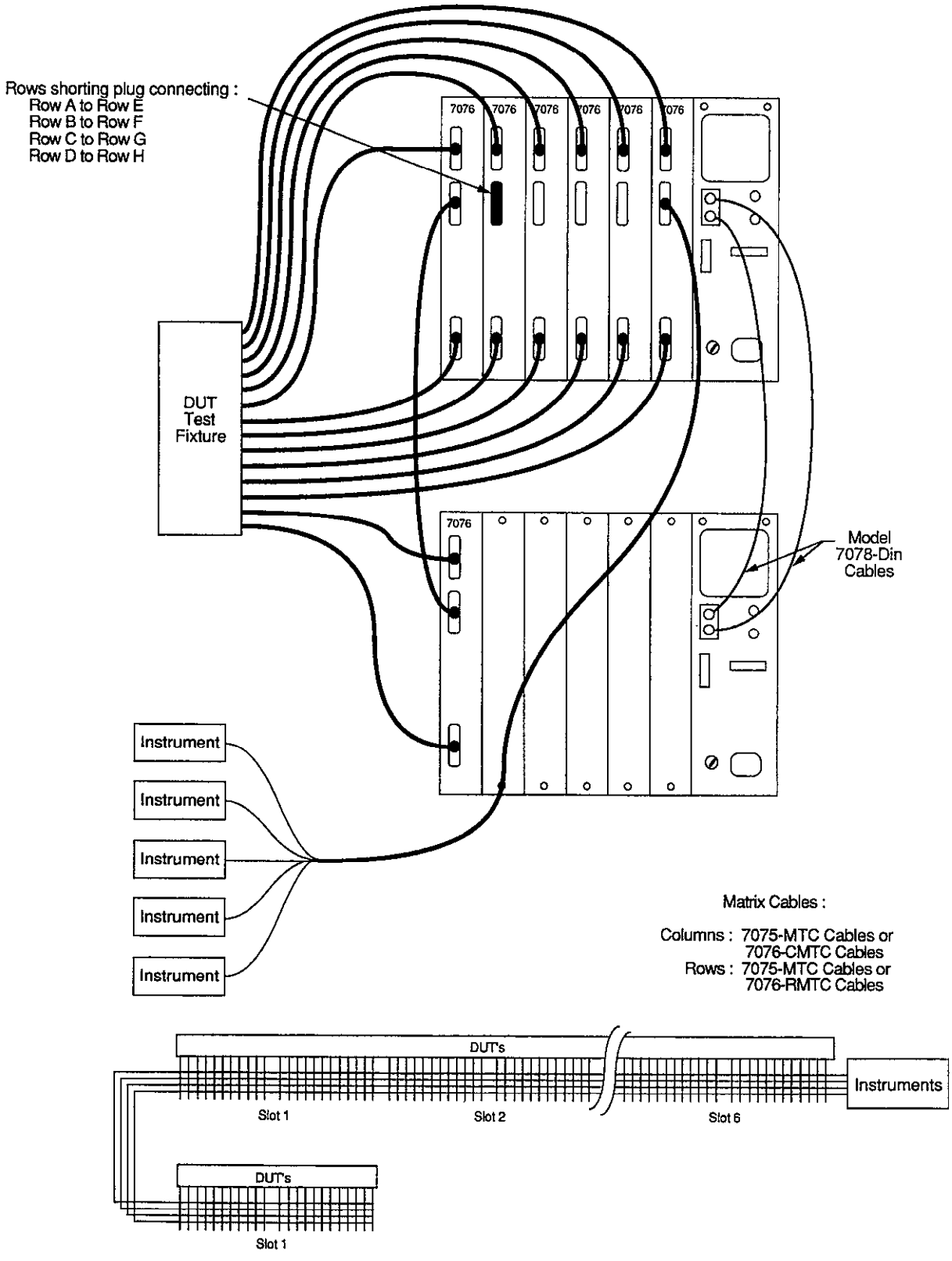


Figure 2-21. Multiple Mainframe Example

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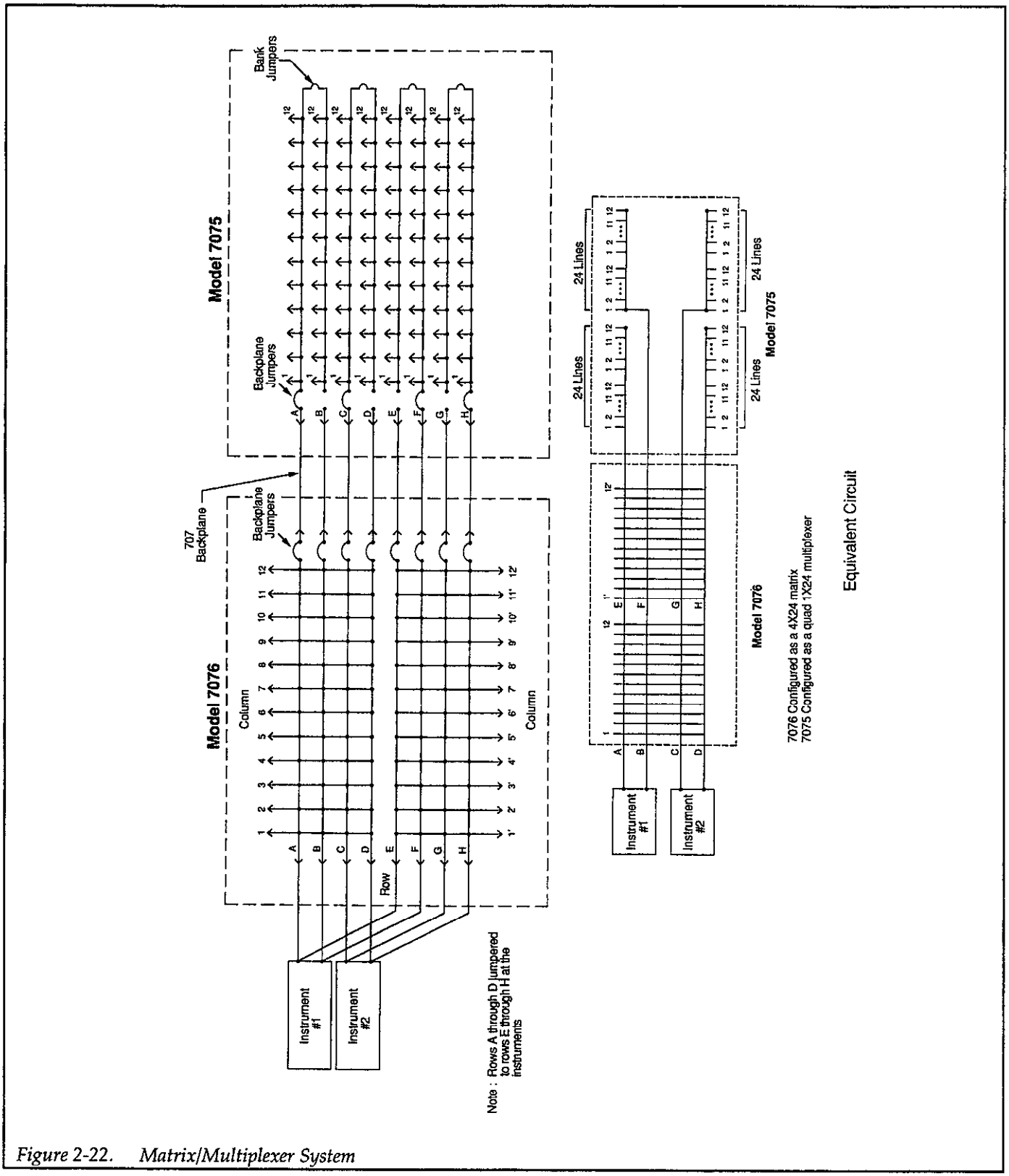


Figure 2-22. Matrix/Multiplexer System

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2.9 BANDWIDTH AND CROSSTALK

Figure 2-23 through Figure 2-26 show typical AC response curves for –3dB bandwidth and crosstalk. Measurements for the four plots were performed using the HP 8752A Network Analyzer under the following conditions:

1. The Model 7076 backplane jumpers are installed and configured per factory default.
2. The Model 7076 is configured as dual 4 × 12 matricies.
3. The Model 7076 is installed in slot #1 of the Model 707 mainframe. The other mainframe slots are empty.
4. 50Ω source (R_S) and a 50 load (R_L).

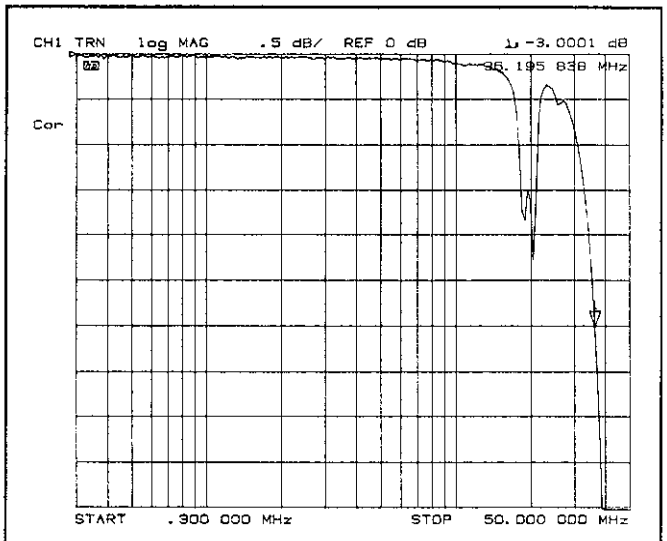


Figure 2-23. –3dB Bandwidth (Crosspoint A1 closed, $R_S = R_L = 50\Omega$)

Bandwidth

Figure 2-23 shows the –3dB bandwidth with matrix crosspoint A1 closed. The 50Ω source is connected to ROW A and the 50Ω load is connected to COLUMN 1. Figure 2-24 shows the –3dB bandwidth with crosspoint H12 closed. The 50Ω source is connected to ROW H and the 50Ω load is connected to COLUMN 12′.

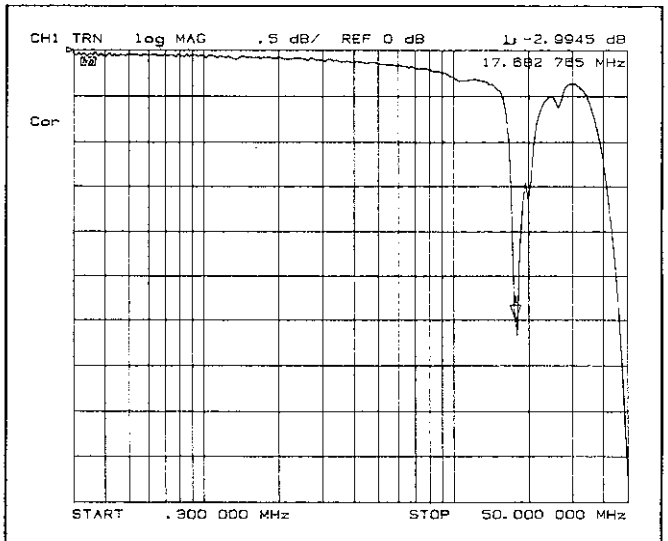


Figure 2-24. –3db Bandwidth (Crosspoint H12 closed, $R_S = R_{RL} = 50\Omega$)

Crosstalk

Figure 2-25 and Figure 2-26 show typical crosstalk for adjacent pathways. For Figure 2-25, crosspoints A11 and B12 are closed. The 50Ω source is connected to ROW A and the 50Ω load is connected to COLUMN 11. Measurements are made at ROW B. For Figure 2-26, crosspoints G1 and H2 are closed. The 50Ω source is connected to ROW G and the 50Ω load is connected to COLUMN 1′. Measurements are made at ROW H.

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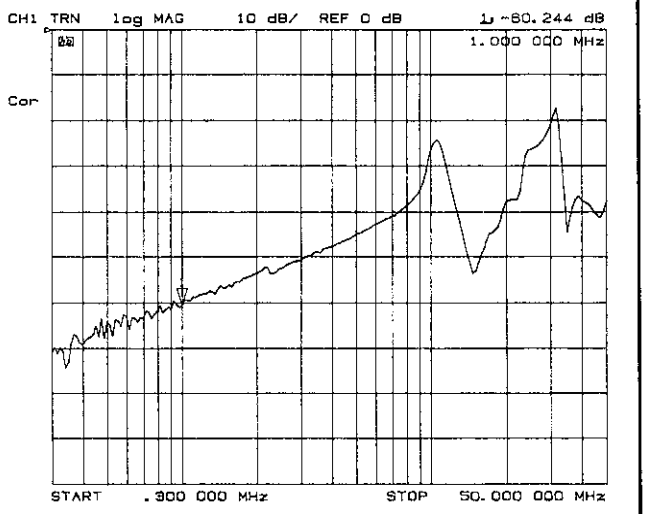


Figure 2-25. Crosstalk (Crosspoints G1 and H2 closed, 50Ω source on ROW G, 50Ω load on COLUMN 1', Measurements at ROW H)

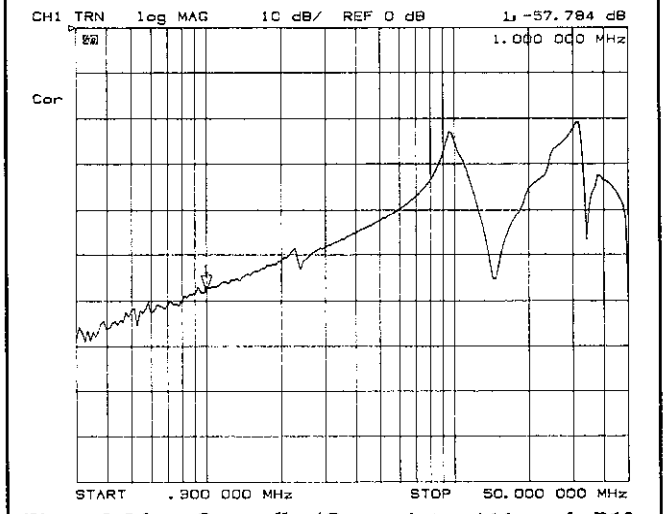


Figure 2-26. Crosstalk (Crosspoints A11 and B12 closed, 50Ω source on ROW A, 50Ω load on COLUMN 11, Measurements at ROW B)

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SECTION 3
Applications

3.1 INTRODUCTION

General applications to test thick film resistor networks and transistors are provided in this section. These applications are intended to demonstrate the versatility of using the matrix card in test systems.

The first application (Thick Film Testing) uses the Model 7076 as a 4 × 24 matrix and the second application (Transistor Testing) uses the card as an 8 × 12 matrix.

3.2 THICK FILM RESISTOR NETWORK TESTING

A dedicated matrix system for testing thick film resistor networks is shown in Figure 3-1. This particular system provides two different methods to check thick films; four-wire resistance measurements, and voltage measurements using an applied voltage. The Model 7076 used in this system is configured as a 4 × 24 matrix.

The system shown in Figure 3-11 tests six 3-element thick films, but can be expanded to test more by simply using additional Model 7076 matrix cards. The Model 707 will accommodate six matrix cards. Daisy-chaining five Model 707s expands the system to 30 matrix cards allowing 180 three-element thick films to be tested.

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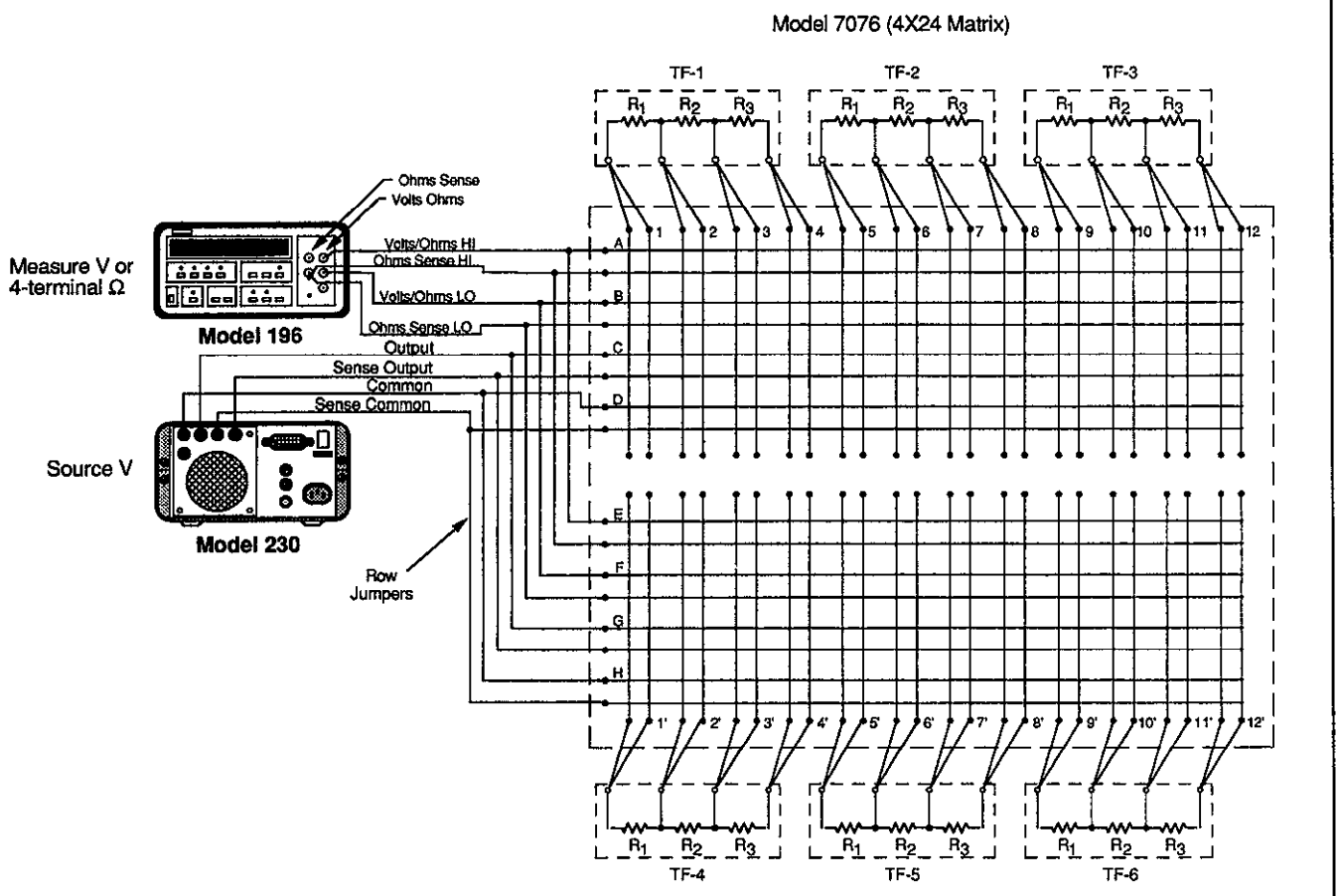


Figure 3-1. Thick Film Resistor Network Testing

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3.2.1 Four-terminal Ohms Measurements

For general purpose testing, the Keithley Model 196 can be used to make four-terminal resistance measurements of each thick film. As shown in Figure 3-2, OHMS HI and OHMS SENSE HI are connected to one matrix row, and OHMS LO and OHMS SENSE LO are connected to another matrix row. With this configuration, the resistance of each resistor element and/or combined elements can be measured by closing the appropriate crosspoints. In Figure 3-2, crosspoints A1 (row A, column 1) and B3 are closed to measure the combined resistance of R1 and R2.

The effects of thermal EMFs generated by relay contacts and connections can be canceled by using the offset compensated ohms feature of the Model 196. To compensate for thermal EMFs, close two crosspoints (such as A1 and B1) that will short the input of the Model 196, enable zero to cancel internal offset, and then enable offset compensated ohms.

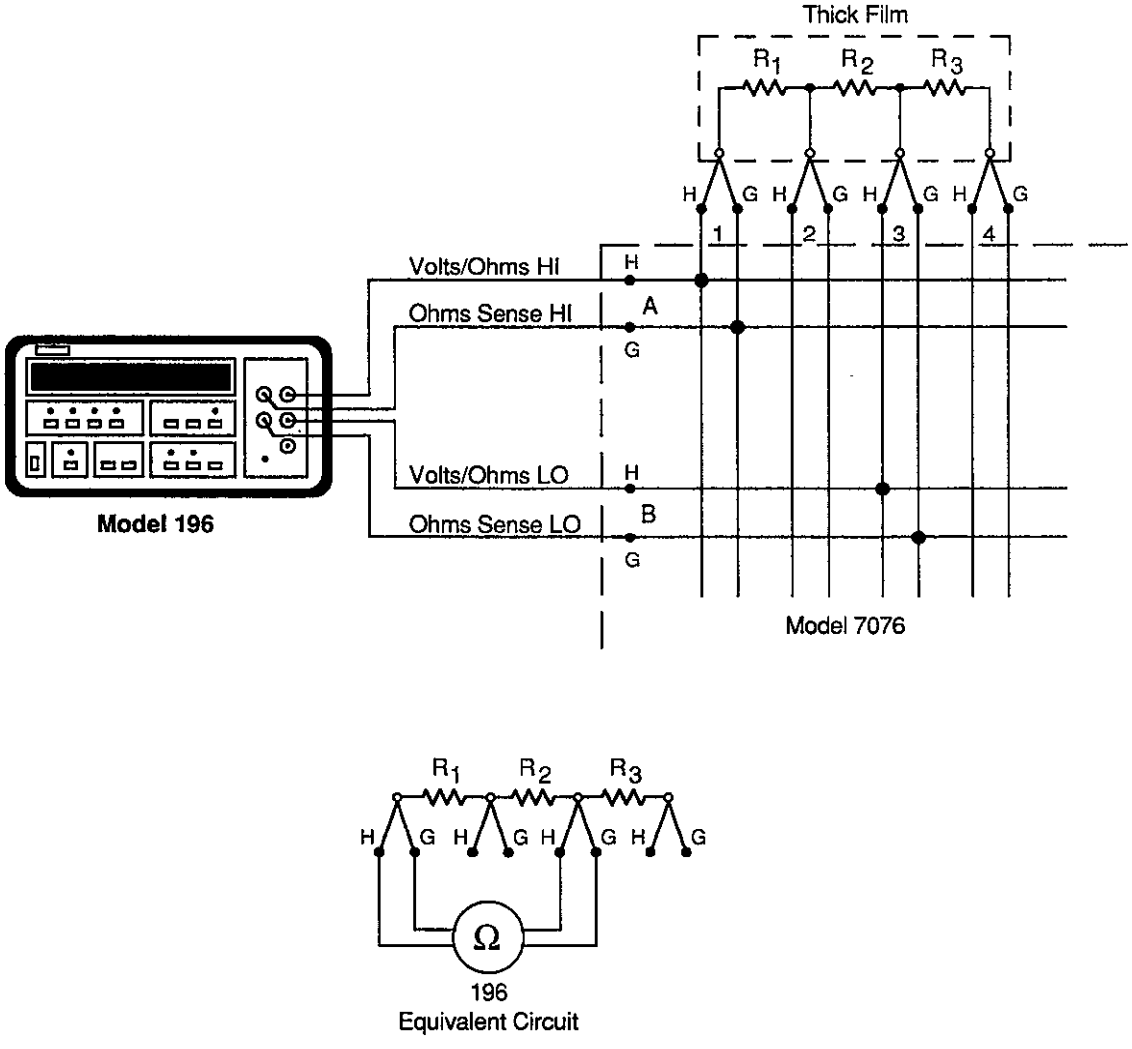


Figure 3-2. 4-Terminal Ohms Measurements

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3.2.2 Voltage Divider Checks

For thick film resistor networks that are going to be used as voltage dividers, it may be desirable to test them using voltages that simulate actual operating conditions. This is a particularly useful test for resistor networks that have a voltage coefficient specification. The test system in Figure 3-1 uses a Keithley Model 230 to source voltage and the Model 196 to measure voltage.

A consideration in these checks is the affect of the Model 196 input impedance on voltage measurements. The input impedance is shunted across the resistor being measured. The resultant divider resistance is the parallel combination of the resistor under test and the input impedance. As long as the input impedance is much larger than the resistor being tested, the error introduced into the measurement will be minimal. Minimum input impedance requirements are, of course, determined by the accuracy needed in the measurement. The input impedances of the Model 196 are as follows: 300mV and 3V ranges, 1GΩ; 30V range, 11MΩ; 300V range, 10.1MΩ. For better input impedance requirements, the Keithley Model 617 Electrometer can be incorporated into the test system to measure voltage.

Another factor to be considered when checking low voltage dividers is thermal EMFs generated by the matrix card. A matrix card crosspoint can generate up to +5μV of thermal EMF. Thus, when making low voltage measurements be sure to account for this additional error.

Even though four-terminal connections are made at the Model 196 and the resistor networks, the sense leads are internally disconnected from the input of the DMM when the volts function is selected. The simplified test system is shown in Figure 3-3.

The thick film is tested by applying a voltage across the resistor network and measuring the voltage across each resistor element and/or across combined elements. In Figure 3-3, crosspoints C1 and D4 are closed to apply voltage across the network, and crosspoints A3 and B4 are closed to measure the voltage drop across R3.

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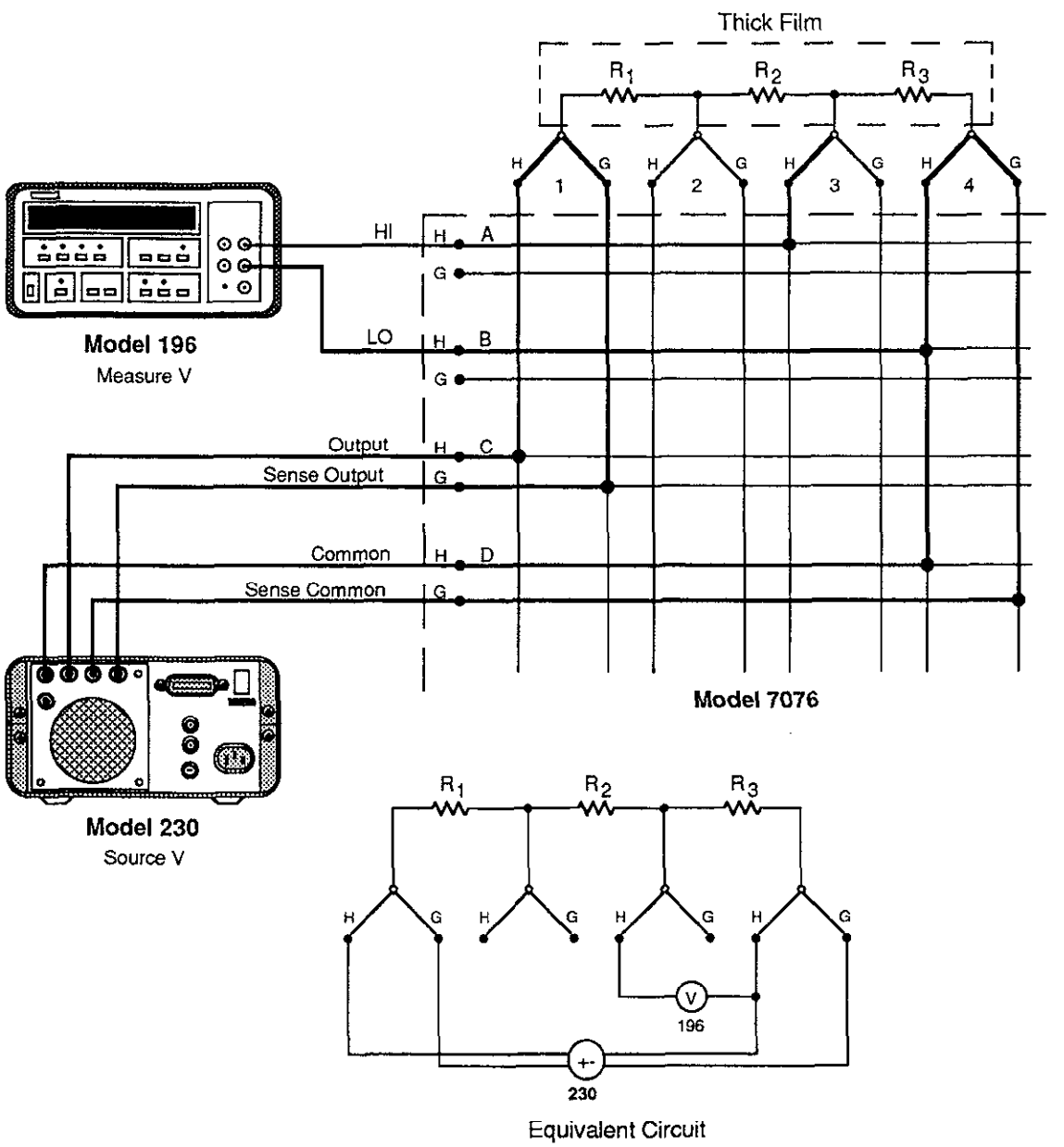


Figure 3-3. Voltage Divider Checks

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3.3 TRANSISTOR TESTING

A matrix system for testing dc parameters of transistors is shown in Figure 3-4. The Model 7076 is configured as an 8 × 12 matrix. This system uses a current source (Keithley Model 224), a voltage source (Keithley Model 230) and a DMM (Keithley Model 196) to measure current and/or voltage. This system tests three transistors, but can be expanded to test more by simply using additional Model 7076 matrix cards. The Model 707 will accommodate six matrix cards. Daisy-chaining five Model 707s expands the system to 30 matrix cards allowing 90 transistors to be tested.

NOTE
To check FETs or transistors that have high gain or low power, equipment that has lower offset current and higher impedance must be used. To check these devices, the Keithley Model 7072 Semiconductor Matrix Card and the Keithley Model 617 Electrometer can be used.

3.3.1 Current Gain Checks

The dc current gain of a general purpose transistor can be checked by configuring the transistor as a common-emitter amplifier. Figure 3-5 shows which crosspoints to close to configure the amplifier circuit. In this circuit, gain is calculated by dividing collector current (measured by the Model 196) by base current (sourced by the Model 224). A profile of the transistor operating characteristics can be obtained by measuring the collector current over a specified voltage range (V) for different base bias currents. For example, Figure 3-6 shows the characteristics of a typical NPN silicon transistor at base bias currents (I) of 20mA, 40mA, 60mA and 80mA.

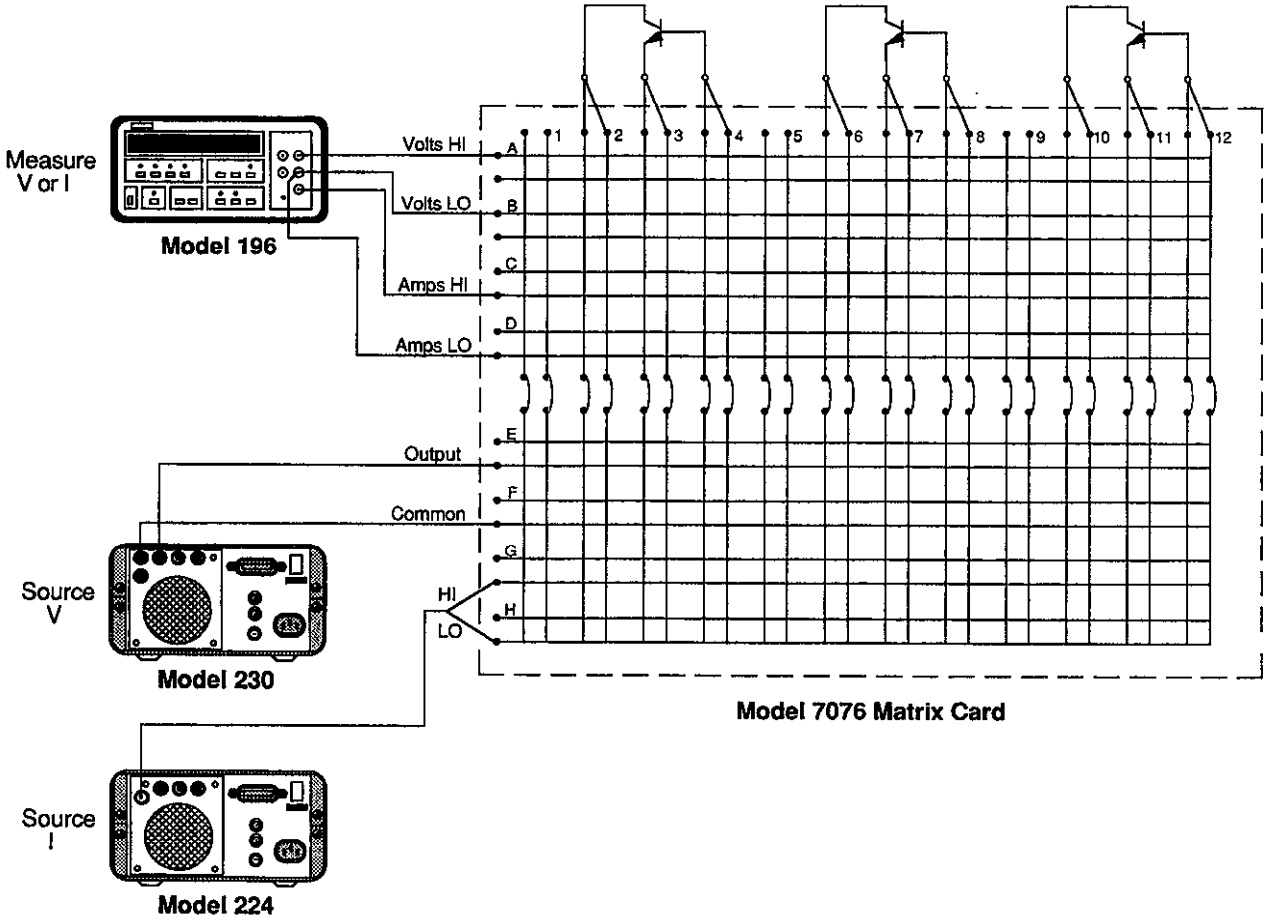


Figure 3-4. Transistor Testing

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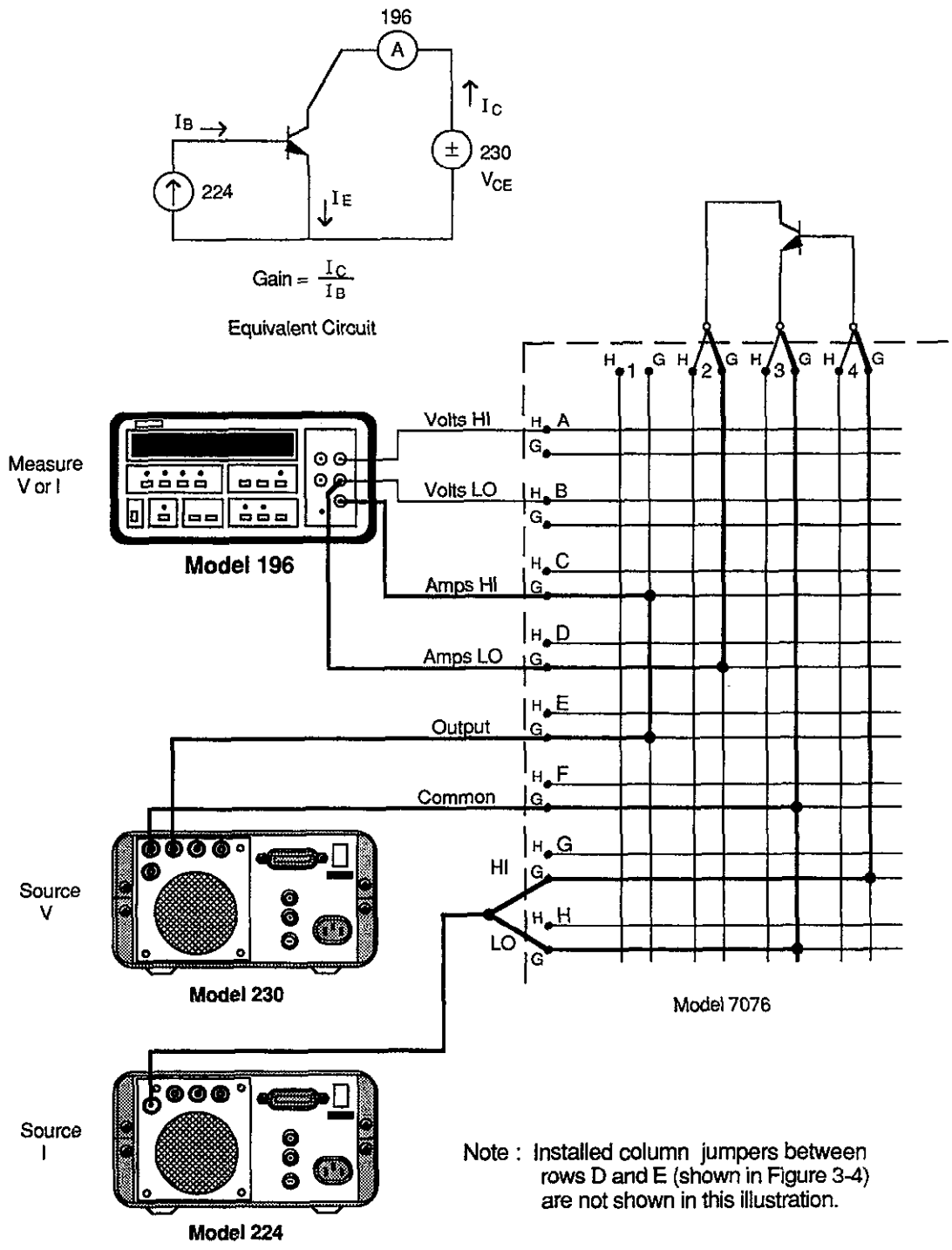


Figure 3-5. Transistor Current Gain Checks

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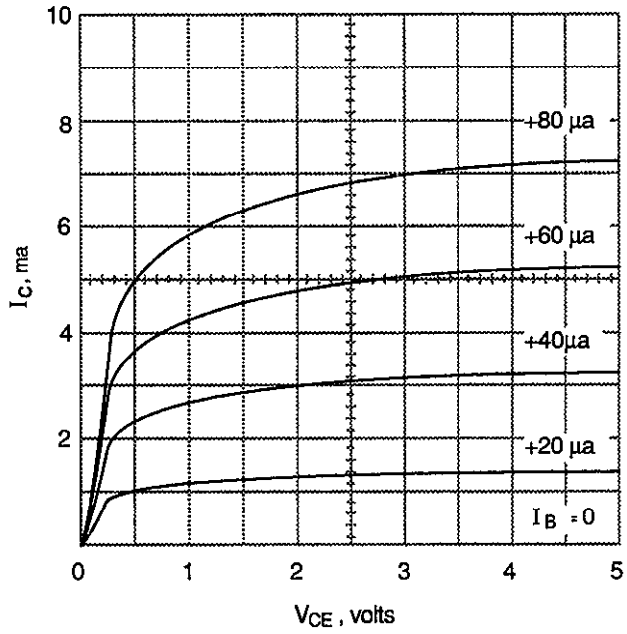


Figure 3-6. Common Emitter Characteristics of an NPN Silicon Transistor

3.3.2 I_E and V_{BE} Measurements

The versatility of using a matrix is demonstrated in Figure 3-7 and Figure 3-8. The transistor is still configured as a common-emitter amplifier, but the Model 196 is removed from the collector circuit and used to measure emitter current and base-to-emitter voltage. Notice that external connection changes are not required. All connection changes are accomplished by control of matrix crosspoints. In this situation, care must be taken to prevent crosspoints of rows B and D from being closed at the same time.

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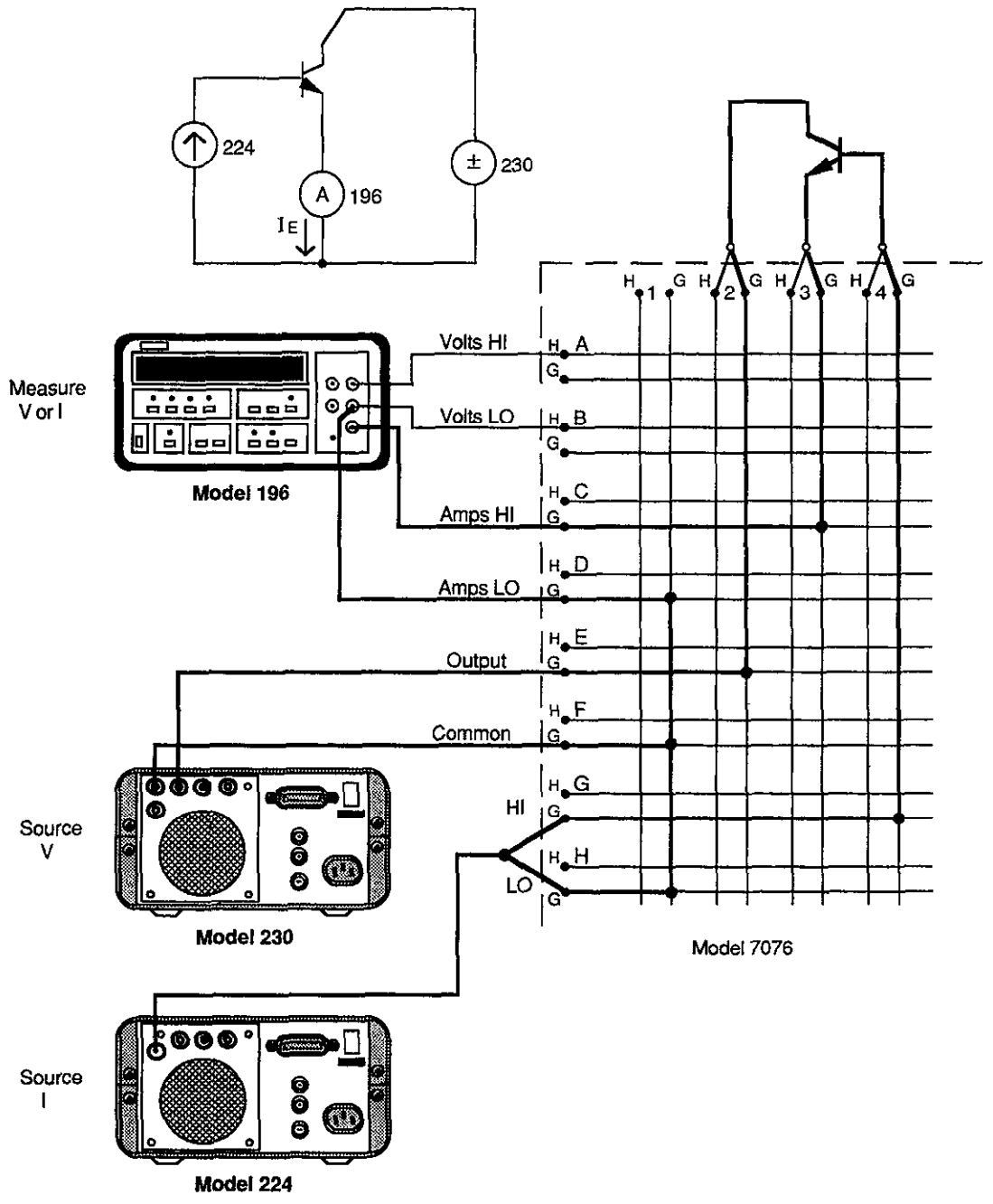


Figure 3-7. Transistor I_E Measurements

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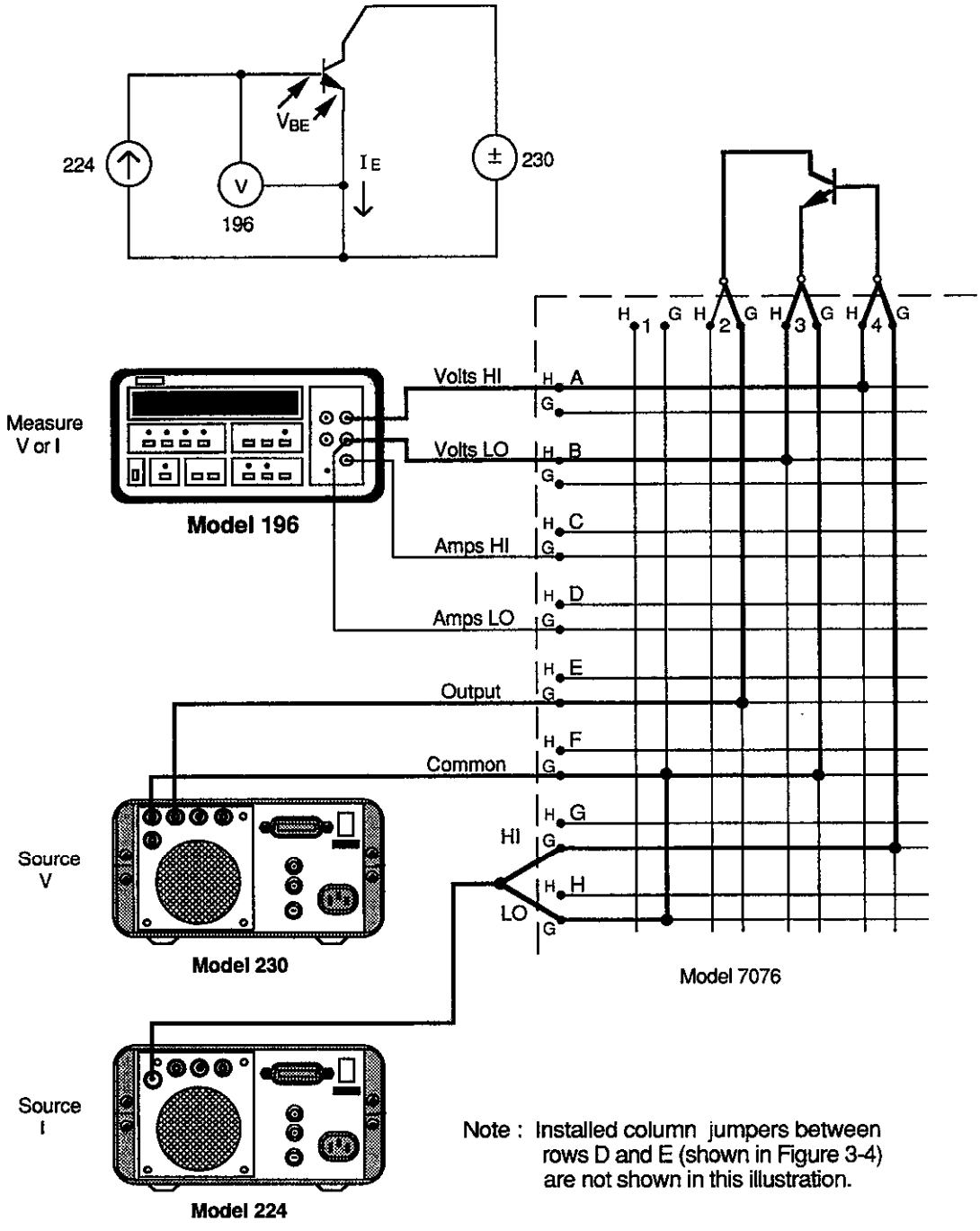


Figure 3-8. Transistor V_{BE} Measurements

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SECTION 4
Service Information

4.1 INTRODUCTION

This section contains information necessary to service the Model 7076 and is arranged as follows:

4.2 Handling and Cleaning Precautions: Discusses handling procedures and cleaning methods for the matrix card.

4.3 Relay Test Program: Explains how to connect the matrix card to the Model 707 mainframe for the relay test program.

4.4 Performance Verification: Covers the procedures necessary to determine if the card is operating properly.

4.5 Principles of Operation: Briefly discusses circuit operation.

4.6 Special Handling of Static-Sensitive Devices: Reviews precautions necessary when handling static-sensitive devices.

4.7 Troubleshooting: Presents some troubleshooting tips for the matrix card.

4.2 HANDLING AND CLEANING PRECAUTIONS

Because of the high impedance circuits on the Model 7076, care should be taken when handling or servicing the card to prevent possible contamination, which could degrade performance. The following precautions should be taken when handling the matrix card.

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 the card if necessary.

Handle the card only by the handle and side edges. Do not touch any board surfaces, components, or edge connectors. Do not touch areas adjacent to electrical contacts. When servicing the card, wear clean, cotton gloves.

If making solder repairs on the circuit board, use a flux that is rosin RMA based. Remove the flux from these areas when the repair is complete. Use Freon® TMS or TE, or the equivalent along with plenty of clean cotton swabs to remove the flux. Take care not to spread the flux to other areas of the circuit board. Once the flux has been removed, swab only the repaired area with methanol, then blow dry the board with dry nitrogen gas.

After cleaning, the card should be placed in a 50°C low humidity environment for several hours.

4.3 RELAY TEST PROGRAM SET-UP

The Model 707 comes equipped with a test program on disk that will test the relays of all Model 7076s installed in the mainframe. The test program will flag any relay that fails to close when energized or open when de-energized. Instructions for using the test program with an IBM PC or XT, or HP 200 or 300 series computer are contained in the Model 707 Instruction Manual.

Perform the following steps to configure the Model 7076 for relay testing:

1. Remove the relay test terminal block from the rear panel of the Model 707. This is a quick-disconnect terminal block and simply pulls off the rear panel terminal strip.
2. Connect the relay test terminal block to rows A and B of any Model 7076 card installed in the mainframe as shown in Figure 4-1. Note that terminals 5 and 6 of the relay test terminal block must be shorted together. Terminals H and G of row B of the Model 7076 must also be shorted together.

NOTE

A convenient method to make connections to the matrix card is by hard-wiring a 25-pin D-sub plug and then mating it to the ROWS receptacle of the card. Table 2-3 lists the Keithley part number for the D-sub plug. Pin identification for the plug is provided by Figure 2-13.

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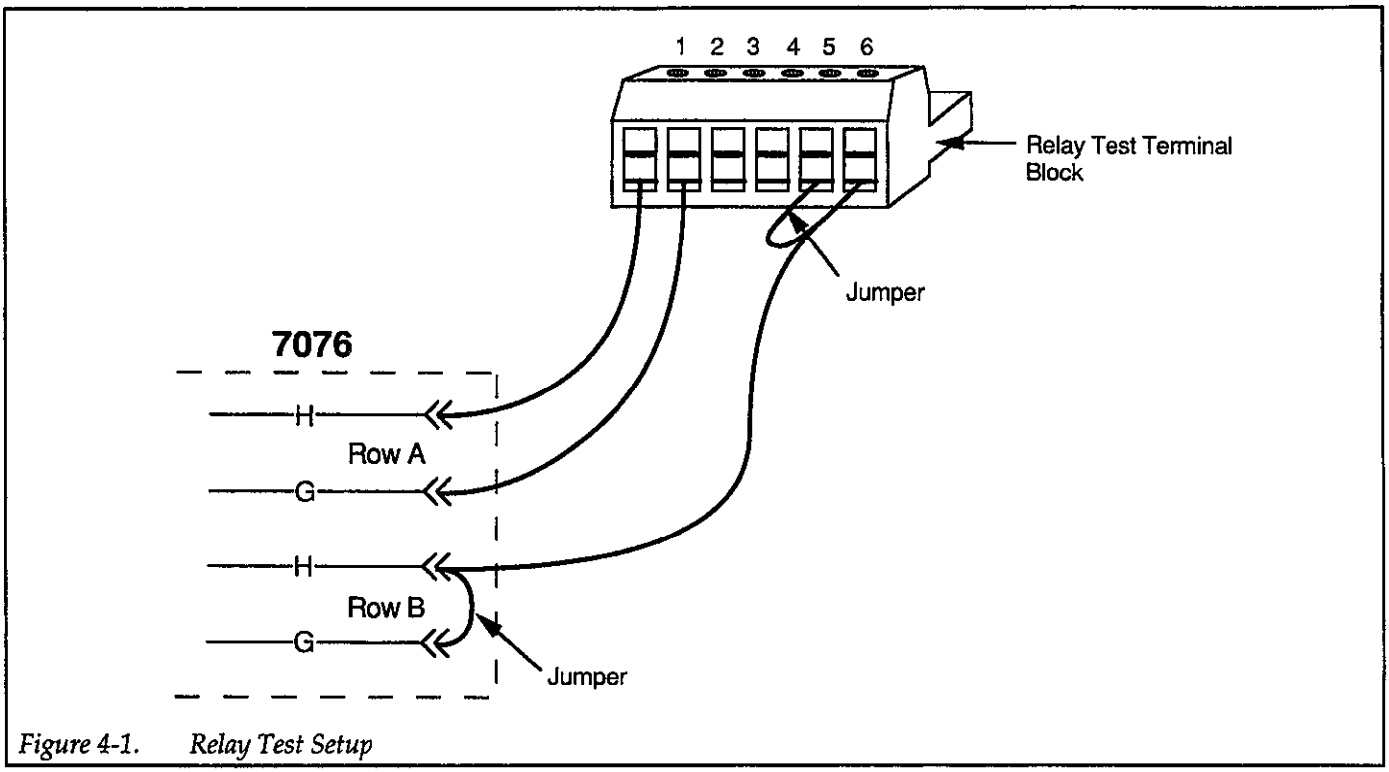


Figure 4-1. Relay Test Setup

3. Re-install the relay test terminal block into the rear panel of the Model 707 mainframe and refer to the Model 707 Instruction Manual to run the test program.

4.4 PERFORMANCE VERIFICATION

The following paragraphs discuss performance verification procedures for the Model 7076, including path resistance, offset current, contact potential, and isolation.

The procedures in this section are rather lengthy due to the large number of row and column combinations that are checked. As an alternative to this extensive testing, it may be desirable to check only those paths that are going to be used, or those that are suspected of being faulty.

With the Model 7076's backplane jumpers installed, the performance verification procedures must be performed with only one matrix card (the one being checked) installed in the Model 707 mainframe. Also, the Model 707 must not be daisy-chained to another Model 707. These conditions do not apply if the jumpers are already removed.

CAUTION

Contamination will degrade the performance of the matrix card. To avoid contamination, always grasp the card by the handle and side edges. Do not touch the edge connectors of the card, and do not touch the board surfaces or components. On plugs and receptacles, do not touch areas adjacent to the electrical contacts.

NOTE

Failure of any performance verification test may indicate that the matrix card is contaminated. See paragraph 4.2 to clean the card. If the test still fails after cleaning, then try cleaning the backplane (see the Model 707 Instruction Manual).

4.4.1 Environmental Conditions

All verification measurements should be made at an ambient temperature between 18° and 28°C, and at a relative humidity of less than 70%.

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4.4.2 Recommended Equipment

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

NOTE
Do not use the Model 7070 Universal Adapter Card as an extender card to verify performance of the Model 7076. The Model 7076 must be installed in the Model 707 mainframe.

4.4.3 Matrix Card Connections

A convenient method to make instrument and DUT connections to the matrix card is by hard-wiring 25-pin D-Sub plugs and then mating it to the appropriate receptacle of the card. Row and column shorting connections can also be done at D-sub plugs. Table 2-3 lists the Keithley part number for the D-sub plug. Pin identification for the plug is provided by Figure 2-13.

Before pre-wiring any D-sub plugs, study the following test procedures to fully understand the connection requirements.

4.4.4 Path Resistance Tests

Referring to Figure 4-2, perform the following steps to verify that each contact of every relay is closing properly and that the resistance is within specification.

1. Turn the Model 707 off if it is on.
2. Remove the matrix card column jumpers if they are installed.
3. Install the Model 7076 in slot 1 of the Model 707.
4. As shown in Figure 4-2, connect all terminals of matrix columns 1-12 together to form one common terminal.
5. Set the Model 196 to the 300mV range and connect four test leads to the OHMS and OHMS SENSE input.
6. Short the four test leads together and zero the Model 196. Leave zero enabled for the entire test.
7. Connect OHMS HI and OHMS SENSE HI of the Model 196 to the common terminal. It is recommended that the physical connections be made at columns 1 and 12 as shown in the illustration.
8. Connect OHMS LO and OHMS SENSE LO to the high (H) terminal of ROW A.
9. Turn on the Model 707 and program it to close crosspoint A1 (ROW A, COLUMN 1), and verify that the resistance of this path is <1.5Ω.
10. Open crosspoint A1, and close A2. Verify that the resistance of this path is <1.5Ω.
11. Open crosspoint A2, and close A3. Verify that the resistance of this path is <1.5Ω.
12. Repeat the basic procedure of opening and closing crosspoints to check the resistance of ROW A high (H) terminal paths for COLUMNS 4 through 12 (crosspoints A4 through A12).
13. Connect the OHMS LO and OHMS SENSE LO test leads of the Model 196 DMM to the guard (G) terminal of ROW A.
14. Repeat steps 9 through 12 to check the guard (G) terminal paths of ROW A.
15. Repeat the basic procedure in steps 8 through 14 for ROWS B, C and D.
16. Connect all terminals of matrix columns 1′–12′ together to form one common terminal.
17. Connect OHMS HI and OHMS SENSE HI of the Model 196 to the common terminal. It is recom-

Table 4-1. Verification Equipment

Description	Model or Part	Specifications	Applications
DMM	Keithley Model 196	300Ω; 0.01%	Path resistance
Electrometer w/voltage source	Keithley Model 617	10pA, 100pA; 1.6% 100V source; 0.2%	Offset current, path isolation
Nanovoltmeter	Keithley Model 181	2mV; 0.015%	Contact potential
Triax cable (unterminated)	Keithley Model 7025	—	Offset current
Low thermal cable (unterminated)	Keithey Model 1484	—	Contact potential

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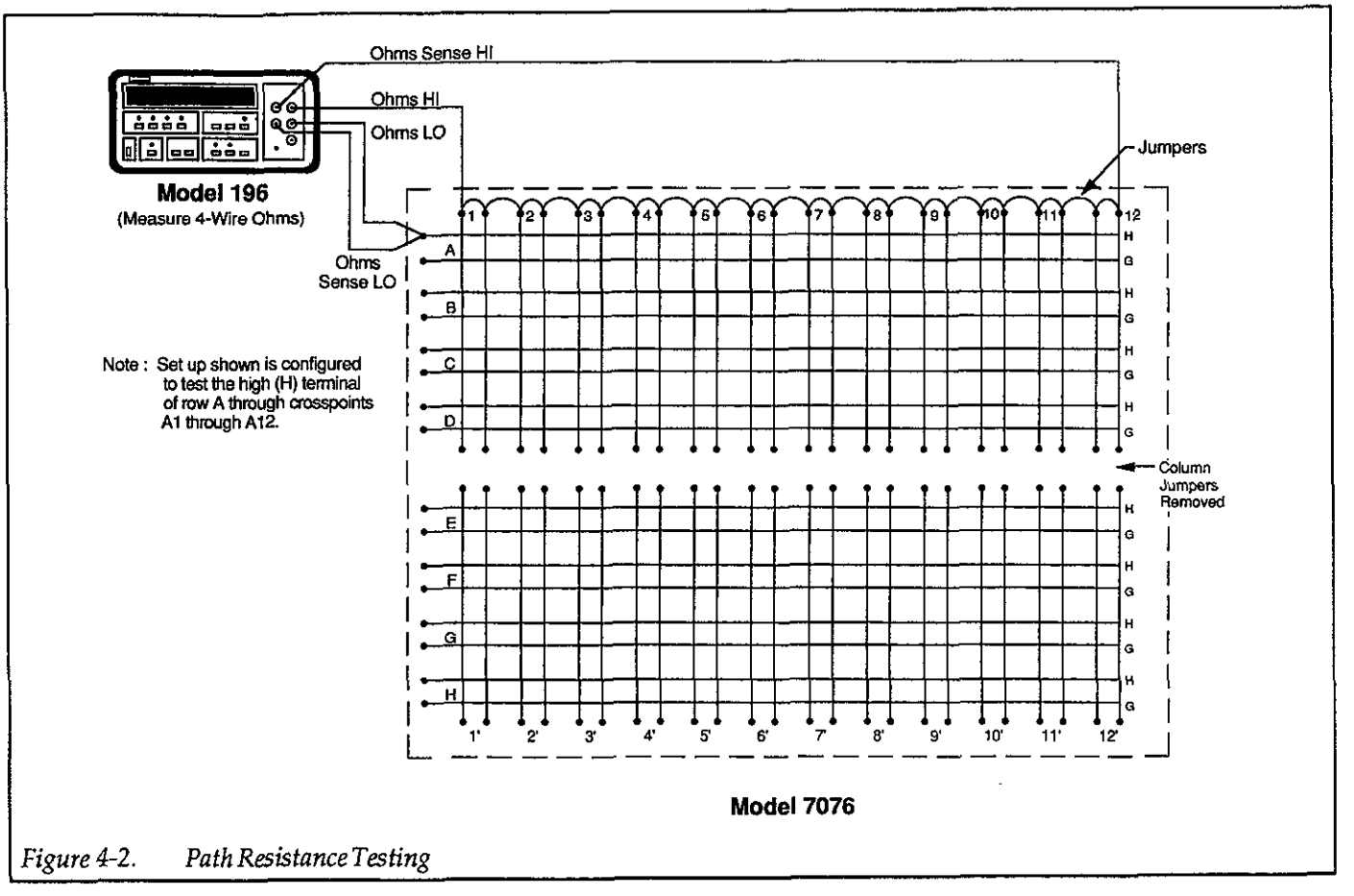


Figure 4-2. Path Resistance Testing

mended that the physical connections be made at columns 1′ and 12′.

18. Connect OHMS LO and OHMS SENSE LO to the high (H) terminal of ROW E.
19. Repeat the basic procedure of steps 9 through 15 to test the paths of rows E, F, G and H.

4.4.5 Offset Current Tests

These tests check leakage current from high (HI) to guard (G) (differential), and from high (HI) and guard (G) to chassis (common mode) for each pathway. In general, these tests are performed by simply measuring the leakage current with an electrometer. In the following procedure, the Model 617 is used to measure leakage current.

Referring to Figure 4-3, perform the following procedure to check offset current:

1. Turn the Model 707 off if it is on.
2. On the matrix card, remove the column jumpers if they are installed.
3. Install the matrix card in slot 1 of the Model 707.
4. Connect the Model 617 electrometer to ROW A of the matrix card as shown in Figure 4-3.
5. On the Model 617, select the 200pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
6. Turn on the Model 707
7. Program the Model 707 to close crosspoint A1.
8. On the Model 617, disable zero check and verify that it is <100pA.This measurement is the leakage current of the pathway.
9. On the Model 617, enable zero check and on the Model 707, open crosspoint A1.
10. Repeat the basic procedure in steps 7 through 9 to check the rest of the pathways (crosspoints A2 through A12) of the row.
11. Connect the Model 617 to ROW B and repeat the basic procedure in steps 7 through 10 to check crosspoints B1 through B12.
12. Repeat the basic procedure in step 11 to check ROWS C, D, E, F and G.
13. To check differential offset current, connect the Model 617 to ROW A as shown in Figure 4-4 and repeat steps 5 through 12.

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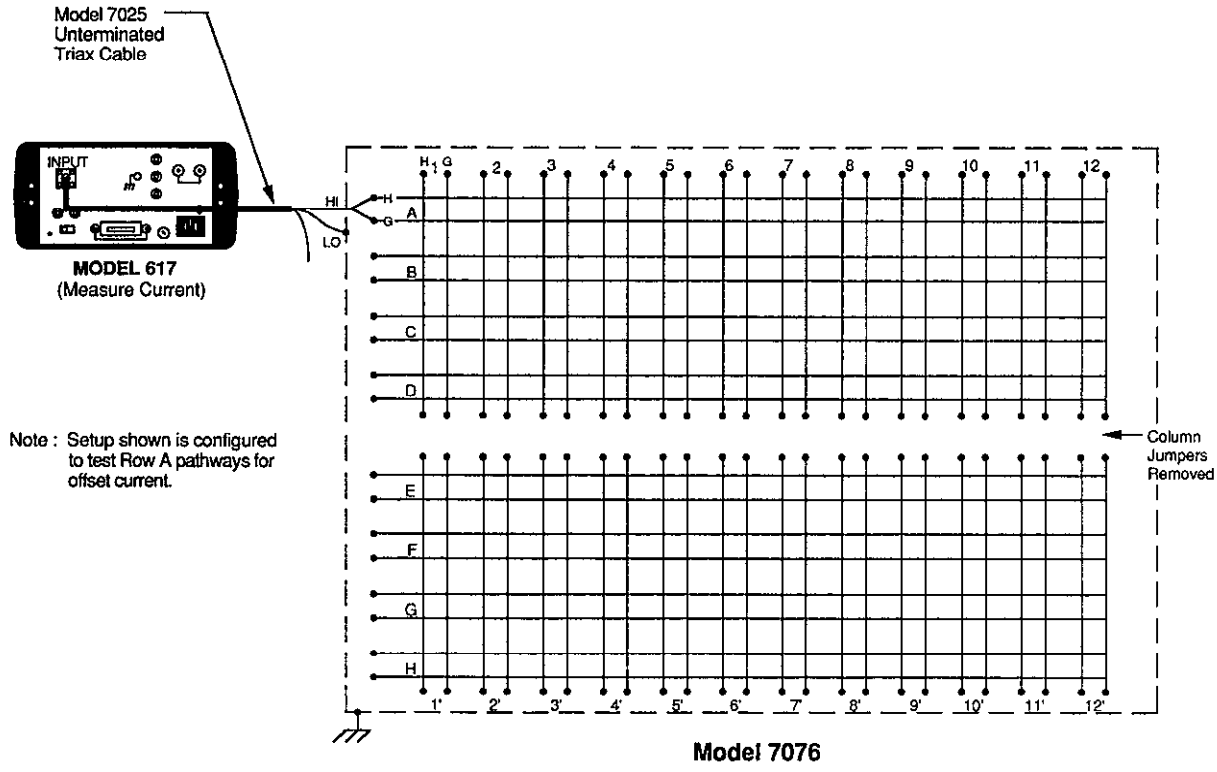


Figure 4-3. Common Mode Offset Current Testing

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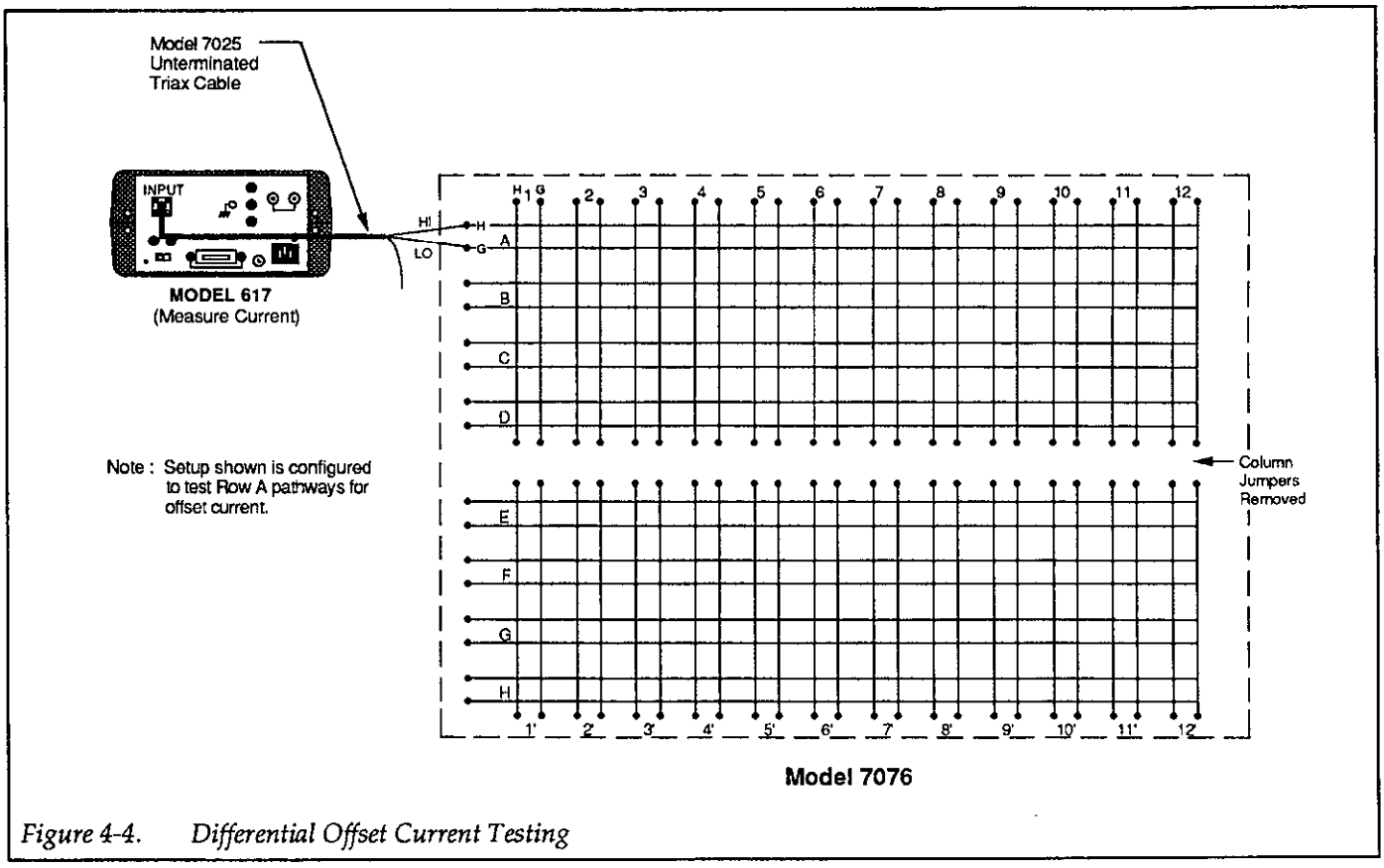


Figure 4-4. Differential Offset Current Testing

4.4.6 Contact Potential Tests

These tests check the EMF generated by each relay contact pair (H and G) for each pathway. The tests simply consist of using a nanovoltmeter (Model 181) to measure the contact potential.

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

1. Turn the Model 707 off if it is on.
2. On the matrix card, remove the column jumpers if they are installed.
3. Install the matrix card in slot 1 of the Model 707.
4. As shown in Figure 4-5, short high (H) to guard (G) of columns 1 through 12.
5. Set the Model 181 to the 2mV range, short the input leads and press ZERO to null out internal offset. Leave zero enabled for the entire procedure.
6. Connect the Model 181 to a ROW A as shown in the illustration.
7. Turn on the Model 707
8. Program the Model 707 to close crosspoint A1.
9. Verify that the reading on the Model 181 is <5μV. This measurement is the contact potential of the pathway.
10. From the Model 707, open crosspoint A1.
11. Repeat the basic procedure in steps 8 through 10 to check the rest of the pathways (crosspoints A2 through A12) of the row.
12. Connect the Model 181 to ROW B and repeat the basic procedure in steps 8 through 11 to check crosspoints B1 through B12.
13. Repeat the basic procedure in step 12 for the remaining rows (ROWS C and D).
14. Short high (HI) to guard (G) of columns 1′ through 12′.
15. Connect the Model 181 to Row E.
16. Repeat the basic procedure in steps 8 through 13 to test ROWS E through H.

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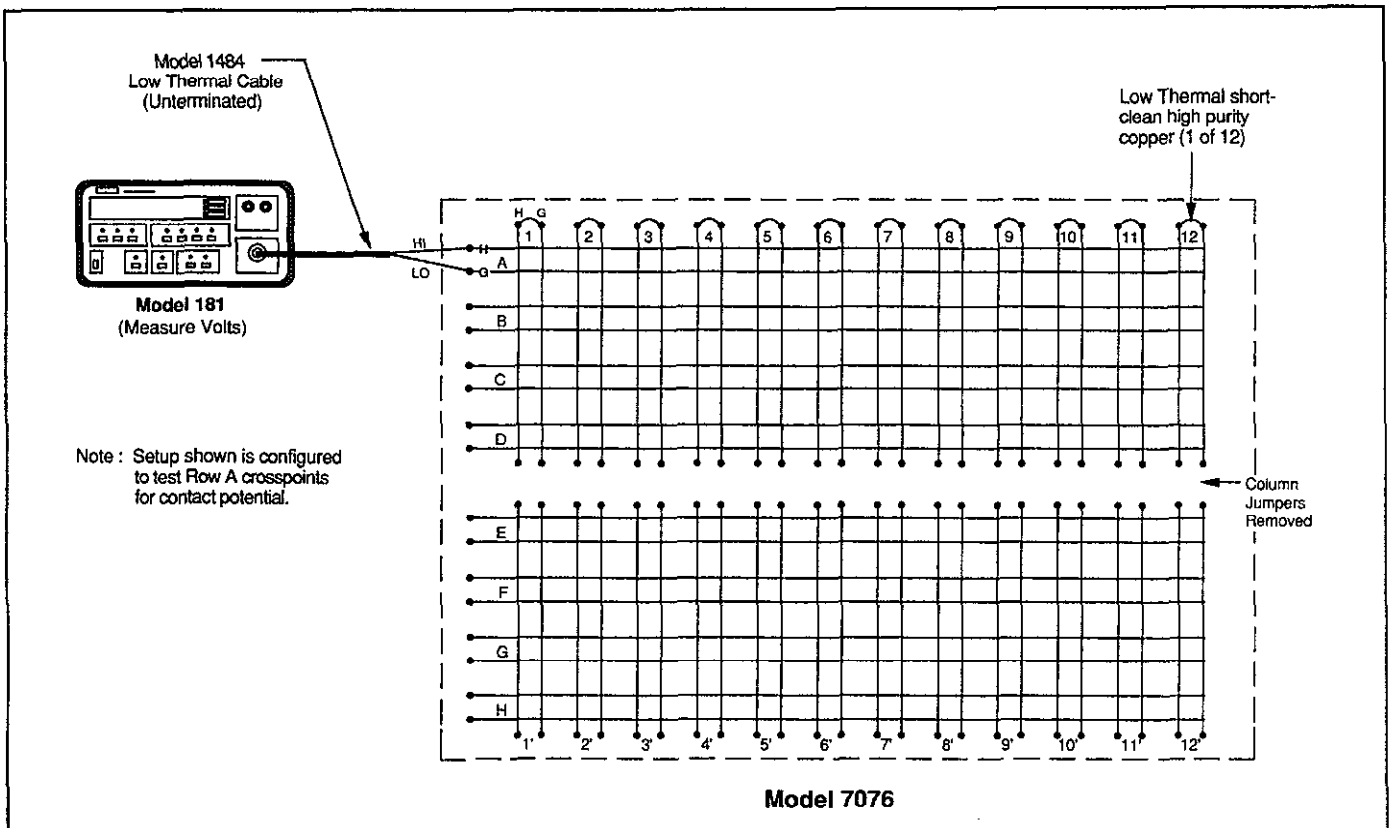


Figure 4-5. Contact Potential Testing

4.4.7 Path Isolation Tests

These tests check the leakage resistance (isolation) between adjacent paths. A path is defined as the high (H) and guard (G) circuit from a row to a column that results by closing a particular crosspoint. 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 617 functions as both a voltage source and an ammeter. In the V/I function, the Model 617 internally calculates the resistance from the known voltage and current levels and displays the resistance value.

NOTE
Refer to Figure 4-6 for the following procedure.

1. Turn the Model 707 off if it is on.
2. Remove the matrix card column jumpers if installed.
3. Install the Model 7076 in slot 1 of the Model 707.
4. Connect the Model 617 to ROWS A and B as shown in Figure 4-6. Make sure The voltage source is in standby. Also, make sure there are no other connections to the card.

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

5. On the Model 617, select the 2pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
6. On the Model 617, select the 20pA range and release zero check.
7. On the Model 617, press suppress to cancel offset current and then enable zero check.
8. On the Model 617, set the voltage source for +100V, and select the 20nA current range. Make sure the voltage source is in standby.
9. Place the Model 617 in the V/I measurement function by pressing SHIFT OHMS.
10. Turn on the Model 707, and program it to close crosspoints A1 (ROW A, COLUMN 1) and B2 (ROW B, COLUMN 2).

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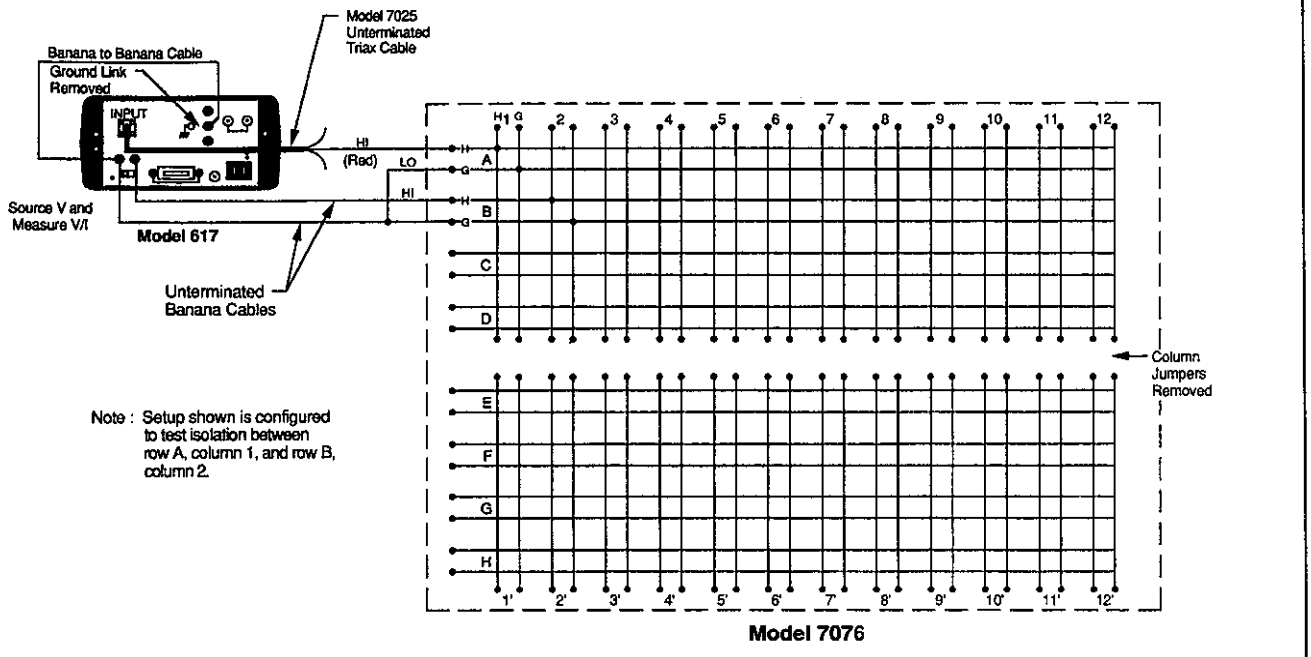


Figure 4-6. Path Isolation Testing (Guarded)

11. On the Model 617, disable zero check and press OPERATE to source +100V.
12. After allowing the reading on the Model 617 to settle, verify that it is >10GΩ. This measurement is the leakage resistance (isolation) between ROW A, COLUMN 1 and ROW B, COLUMN 2.
13. Place the Model 617 in standby and enable zero check.
14. Turn off the Model 707.
15. Disconnect the Model 617 from ROWS A and B, and, in a similar manner, reconnect it to ROWS B and C (picoammeter high and voltage source low to ROW B, and voltage source high and low to ROW C).
16. Turn on the Model 707 and program it to close crosspoints B2 and C3.
17. On the Model 617, disable zero check and press OPERATE to source +100V.
18. After allowing the reading on the Model 617 to settle, verify that it is >10GΩ.
19. Using Table 4-2 as a guide, repeat the basic procedure of steps 13 through 18 for the rest of the path pairs (starting with test #3).

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Table 4-2. Path Isolation Tests

Test No.	Path Isolation	Test Equipment Locations	Crosspoints Closed
1	Row A, Col 1 to Row B, Col 2	Row A and Row B	A1 and B2
2	Row B, Col 2 to Row C, Col 3	Row B and Row C	B2 and C3
3	Row C, Col 3 to Row D, Col 4	Row C and Row D	C3 and D4
4	Row C, Col 4 to Row D, Col 5	Row C and Row D	C4 and D5
5	Row C, Col 5 to Row D, Col 6	Row C and Row D	C5 and D6
6	Row C, Col 6 to Row D, Col 7	Row C and Row D	C6 and D7
7	Row C, Col 7 to Row D, Col 8	Row C and Row D	C7 and D8
8	Row C, Col 8 to Row D, Col 9	Row C and Row D	C8 and D9
9	Row C, Col 9 to Row D, Col 10	Row C and Row D	C9 and D10
10	Row C, Col 10 to Row D, Col 11	Row C and Row D	C10 and D11
11	Row C, Col 11 to Row D, Col 12	Row C and Row D	C11 and D12
12	Row D to Row E	Row D and Row E	None
13	Row E, Col 1′ to Row F, Col 2′	Row E and Row F	E1 and F2
14	Row F, Col 2′ to Row G, Col 3′	Row F and Row G	F2 and G3
15	Row G, Col 3′ to Row H, Col 4′	Row G and Row H	G3 and H4
16	Row G, Col 4′ to Row H, Col 5′	Row G and Row H	G4 and H5
17	Row G, Col '5 to Row H, Col 6′	Row G and Row H	G5 and H6
18	Row G, Col 6′ to Row H, Col 7′	Row G and Row H	G6 and H7
19	Row G, Col 7′ to Row H, Col 8′	Row G and Row H	G7 and H8
20	Row G, Col 8′ to Row H, Col 9′	Row G and Row H	G8 and H9
21	Row G, Col 9′ to Row H, Col 10′	Row G and Row H	G9 and H10
22	Row G, Col 10′ to Row H, Col 11′	Row G and Row H	G10 and H11
23	Row G, Col 11′ to Row H, Col 12′	Row G and Row H	G11 and H12

4.4.8 Differential and Common Mode Isolation Tests

These tests check the leakage resistance (isolation) between high (H) and guard (G) (differential), and from high and guard to chassis (common mode) of every row and column. In general, the test is performed by applying a voltage (100V) across the terminals and then measuring the leakage current. The isolation resistance is then calculated as R = V/I. In the following procedure, the Model 617 functions as a voltage source and an ammeter. In the V/I function, the Model 617 internally calculates the resistance from the known voltage and current levels and displays the resistance value.

1. Turn the Model 707 off if it is on.
2. Remove the matrix card column jumpers if installed.
3. Install the Model 7076 in slot 1 of the Model 707.
4. Connect the Model 617 to ROW A as shown in Figure 4-7 to measure differential isolation. Make sure The voltage source is in standby. Also, make sure there are no other connections to the card.

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

5. On the Model 617, select the 2pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
6. On the Model 617, set the voltage source for +100V, and select the 200nA current range. Make sure the voltage source is still in standby.
7. Place the Model 617 in the V/I measurement function by pressing SHIFT OHMS.
8. Turn on the Model 707, but do not program any crosspoints to close. All crosspoints must be open.
9. On the Model 617, disable zero check and press OPERATE to source 100V.
10. After allowing the reading on the Model 617 to settle, verify that it is >1GΩ. This measurement is the leakage resistance (isolation) of ROW A.
11. Place the Model 617 in standby and enable zero check.
12. Program the Model 707 to close crosspoint A1.
13. On the Model 617, disable zero check and press OPERATE to source +100V.

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14. After allowing the reading on the Model 617 to settle, verify that it is also >1GΩ. This measurement checks the isolation of COLUMN 1.
15. Using Table 4-3 as a guide, repeat the basic procedure of steps 11 through 14 for the rest of the columns and rows (test numbers 3 through 32 of the table). Note that starting with test #17, the Model 617 must be connected to ROW E.
16. Place the Model 617 in standby and turn the Model 707 off.
17. Connect the Model 617 to ROW A as shown in Figure 4-8. and repeat steps 8 through 16 to check common mode isolation.

Table 4-3. Differential and Common Mode Isolation Test

Test No.	Differential or Common Mode Test	Crosspoints Closed
1	ROW A	None
2	COLUMN 1	A1
3	COLUMN 2	A2
4	COLUMN 3	A3
5	COLUMN 4	A4
6	COLUMN 5	A5
7	COLUMN 6	A6
8	COLUMN 7	A7
9	COLUMN 8	A8
10	COLUMN 9	A9
11	COLUMN 10	A10
12	COLUMN 11	A11
13	COLUMN 12	A12
14	ROW B	A1 and B1
15	ROW C	A1 and C1
16	ROW D	A1 and D1
17	ROW E	None
18	COLUMN 1′	E1
19	COLUMN 2′	E2
20	COLUMN 3′	E3
21	COLUMN 4′	E4
22	COLUMN 5′	E5
23	COLUMN 6′	E6
24	COLUMN 7′	E7
25	COLUMN 8′	E8
26	COLUMN 9′	E9
27	COLUMN 10′	E10
28	COLUMN 11′	E11
29	COLUMN 12′	E12
30	ROW F	E1 and F1
31	ROW G	E1 and G1
32	ROW H	E1 and H1

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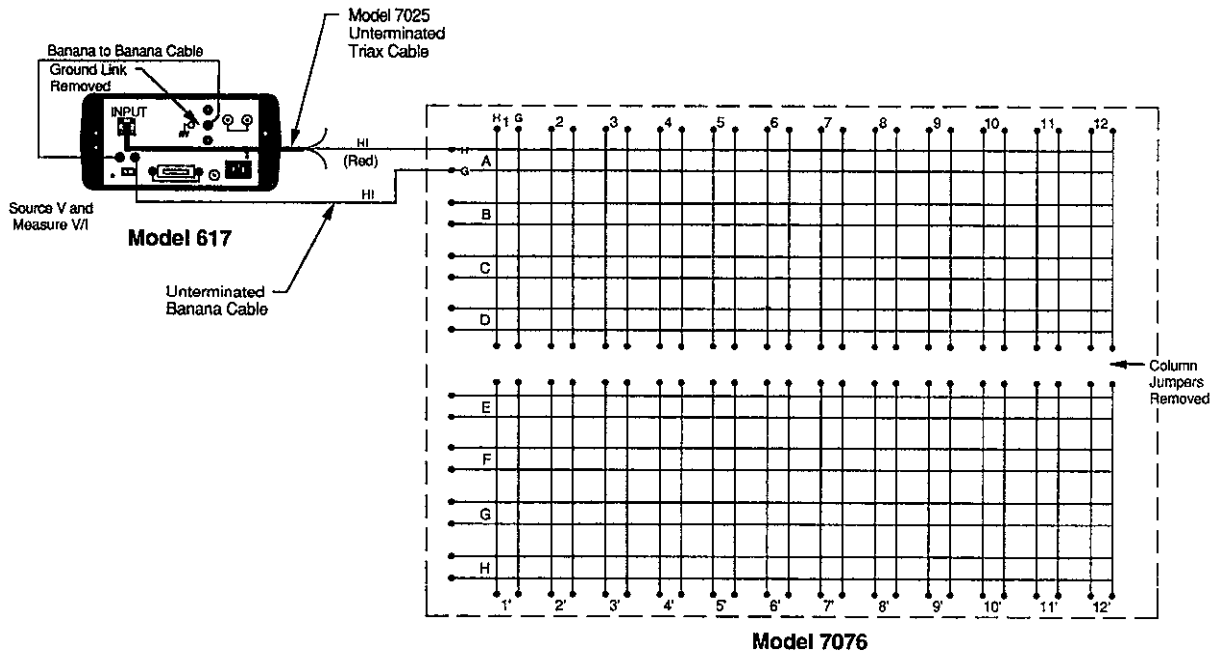


Figure 4-7. Differential Isolation Testing

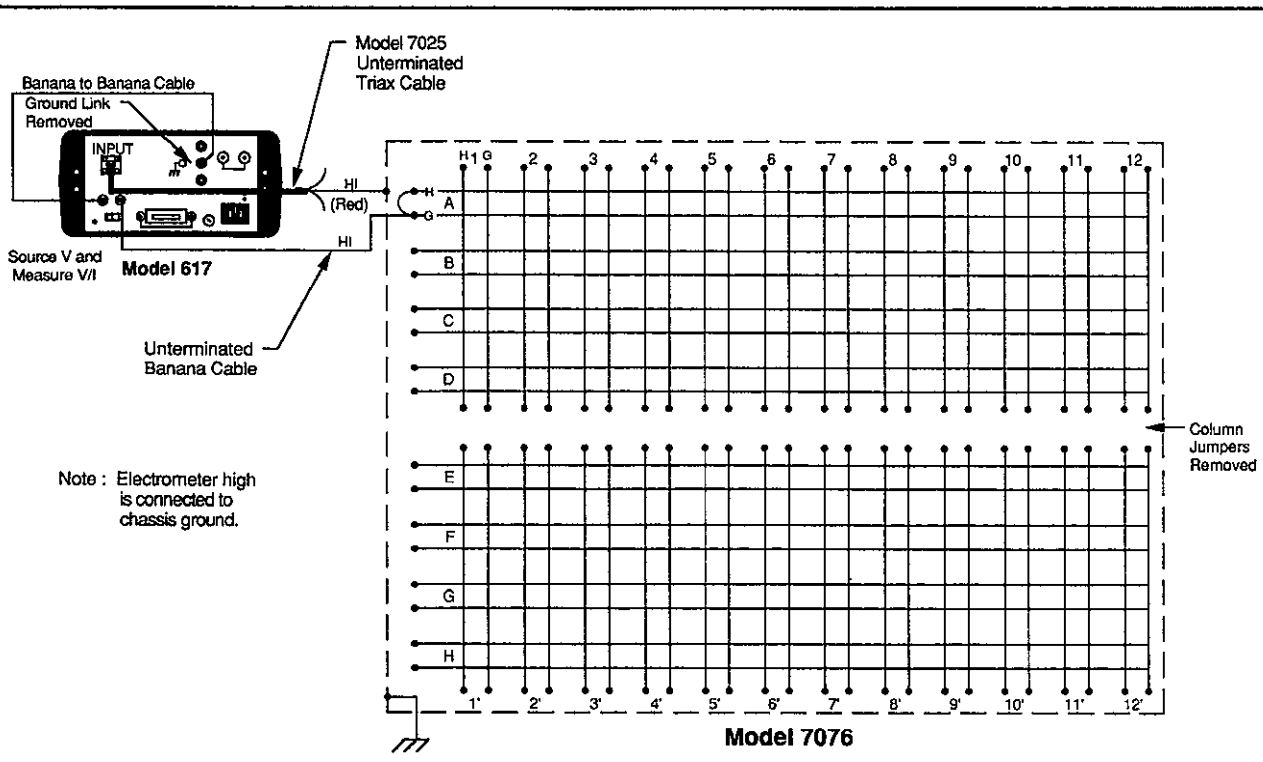


Figure 4-8. Common Mode Isolation Testing

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4.5 PRINCIPLES OF OPERATION

The paragraphs below discuss the basic operating principles for the Model 7076 and can be used as an aid in troubleshooting the matrix card. The schematic drawing of the matrix card is shown on drawing number 7076-106, located at the end of Section 5.

4.5.1 Card Identification

Identification coding and a matrix configuration table are stored in an erasable programmable read-only memory (EPROM). This information is sent to the Model 707 so that it "knows" which type of matrix card is installed in that particular mainframe slot. This enables the Model 707 to send valid configuration data to the matrix card.

On power up, control line CARDSEL goes low turning on the EPROM (U128). That control line, as well as the other control lines from the Model 707, are buffered by U130. Lines CLK, NEXT ADDR and CLR ADDR along with counter U126 control the task of loading data from the EPROM into the parallel to serial shift register (U127). Data sent from U130 to the Model 707 via the IDDATA line is strobed by the CLK control line. The timing diagram in Figure 4-9 shows the first byte of identification data during the transfer sequence. For subsequent bytes, the CLRADDR line stays low.

4.5.2 Switching Circuitry

Matrix configuration data is sent from the Model 707 via the RELAY DATA control line and is serially loaded into the 12 shift registers (U114 through U125). The matrix card relays configure accordingly when the registers receive the STROBE signal from the Model 707. A relay is energized when a relay driver output (U100 through U113) is low (connected to digital common). A driver output is low when a "high" data bit is clocked into it (i.e. inverting drivers).

4.5.3 Power Up Safeguard

To prevent relays from inadvertently energizing and causing possible damage during power up, a safeguard circuit has been incorporated into the design. The protection circuit is comprised of a dual NAND gate (U129) configured as a SET/RESET flip-flop and an RC network (R102, C122 and CR101). The time constant of the RC network keeps the output of the NAND gate low during the power up sequence. This low signal is applied to the OE input of the shift registers keeping the relays de-energized. After the capacitor of the RC network charges, a STROBE signal will then force the output of the NAND gate high allowing configured relays to energize.

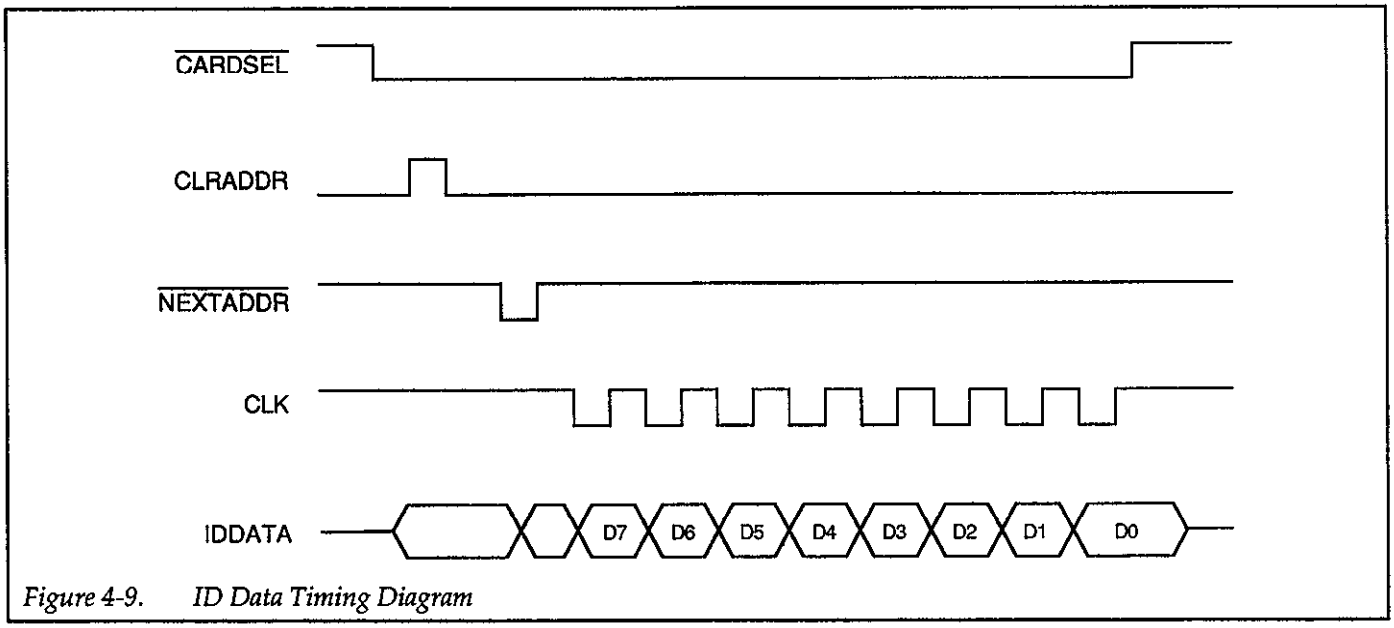


Figure 4-9. ID Data Timing Diagram

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4.6 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. The following precautions pertain specifically to static-sensitive devices. However, since many devices in the Model 7076 are static-sensitive, it is recommended that they all be treated as static-sensitive.

1. 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.
2. Remove the devices from their protective containers only at a properly grounded workstation. Also ground yourself with a suitable wrist strap while working with these devices.
3. Handle the devices only by the body; do not touch the pins.
4. Any printed circuit board into which the device is to be inserted must first be grounded to the bench or table.
5. Use only anti-static type de-soldering tools and grounded-tip soldering irons.

4.7 TROUBLESHOOTING

The Keithley Model 7070 Universal Adapter Card is an extender card that allows access to circuit components of the Model 7076 during troubleshooting. Also, Figure 4-9, which provides receptacle contact identification, is included as a troubleshooting aid.

4.7.1 Recommended Equipment

Table 4-4 summarizes the equipment necessary for general troubleshooting.

Table 4-4. Recommended Troubleshooting Equipment

Description	Application
DMM (Keithley 196)	Measure dc voltage
Dual-trace, triggered sweep oscilloscope, dc to 50MHz	Check clock and logic pulses
Extender card (Keithley 7070)	Allow circuit access

4.7.2 Troubleshooting Procedure

In order to service the matrix card, it may be necessary to remove the bottom shield. The bottom shield is secured to the matrix card by eight screws. Simply remove these screws and separate the shield from the pc-board. When reinstalling the shield make sure the shield is oriented such that the standoffs (staked onto the shield) are positioned between the pc-board and the shield.

Table 4-5 outlines troubleshooting procedure for the matrix card.

CAUTION

Contamination will degrade the performance of the matrix card. To avoid contamination, always grasp the card by the handle and side edges. Do not touch the edge connectors of the card, and do not touch the board surfaces or components. On connectors, do not touch areas adjacent to the electrical contacts.

CAUTION

If removing relays from the PC-board, care must be taken to prevent traces from being ripped off the board. Using a solder sucker, make sure all solder is removed. Each relay pin must move freely in the feed-through hole. Also, make sure there are no burrs on the ends of the relay pins.

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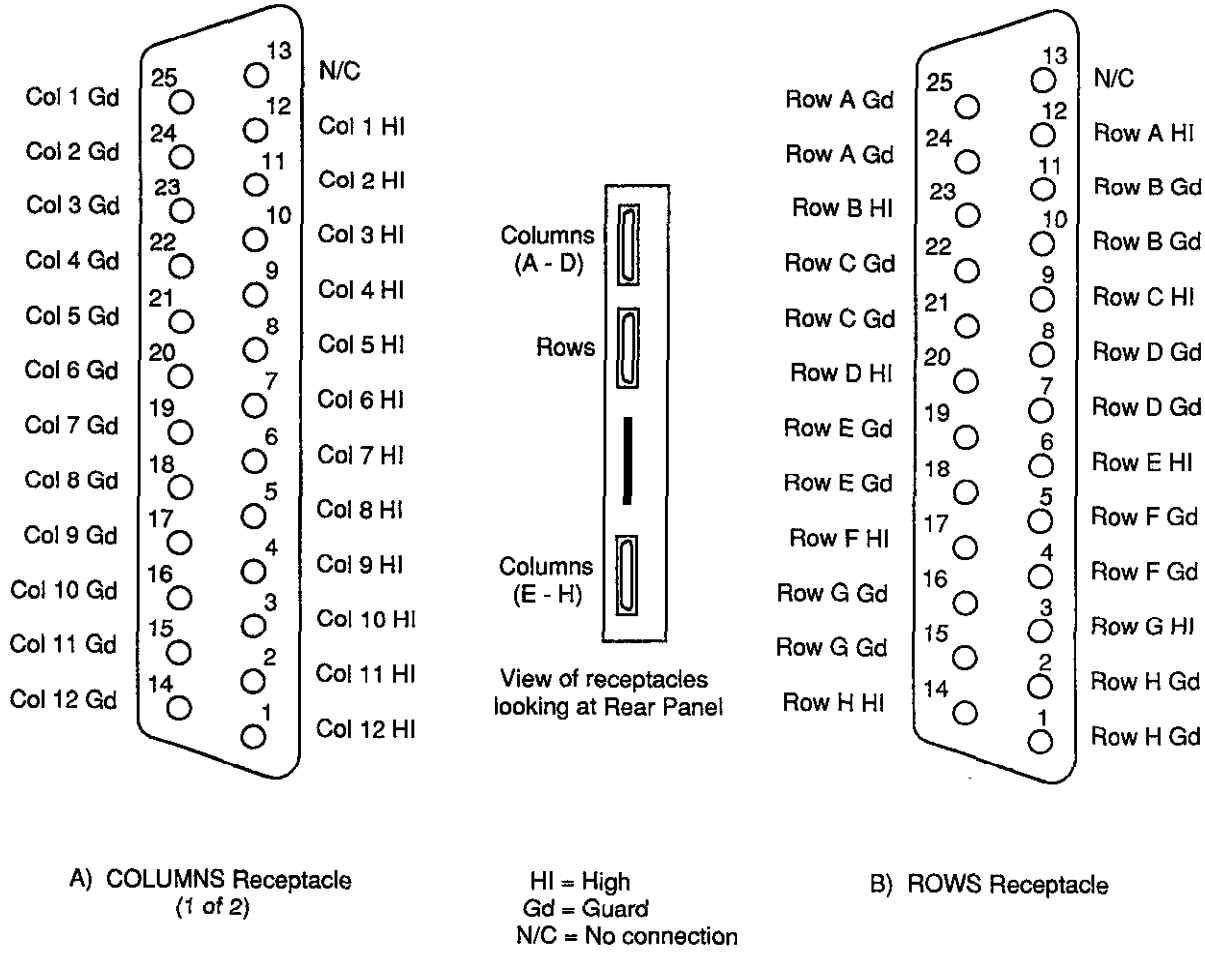


Figure 4-10. D-sub Receptacle Contact Assignments

Table 4-5. Troubleshooting Summary*

Step	Items/Component**	Comment	Required Condition
1	W152	+6V supply	+6V dc
2	W155	+5V supply	+5V dc
3	W150	CLR ADDR line***	High logic pulse at beginning of each card identification byte transfer sequence (upon power up).
4	W151	NEXT ADDR line ***	Low logic pulse before each byte transfer.
5	W149	Clk line	1.79MHz clock
6	W154	ID Data line***	Card identification logic pulse train (on power up).
7	W156	*Power up safeguard*	*Remains low during power up.*
8	W157	RELAY DATA line	Logic pulse train to load relay configuration registers.
9	W158	STROBE line	High logic pulse to strobe relay configuration registers.
10	U100 through U113 pins 10 through 16	Relay drivers	+6V for open crosspoints ≈ 0V for closed crosspoints. Note that pin 10 on U100 and U107 is not connected.

*All measurements referenced to digital common (W153)
**W149 through W158 are jumpers located on the pc-board. See Component Location drawing (at end of Section 5) for jumper locations.
***See Figure 4-8.

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SECTION 5
Replaceable Parts

5.1 INTRODUCTION

This section contains a list of replaceable parts for the Model 7076, as well as a component layout drawing and schematic diagram of the matrix card.

5.2 PARTS LIST

Replaceable parts are listed in the Model 7076, Parts List. Electrical parts are listed in order of circuit designation.

5.3 ORDERING INFORMATION

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

- Matrix card model number (7076)
- Card serial number
- Part description
- Circuit description, if applicable
- Keithley Part number

5.4 FACTORY SERVICE

If the matrix card is to be returned to Keithley Instrument for repair, perform the following:

1. Complete the service form at the back of this manual and include it with the card.
2. Carefully pack the card in the original packing carton.
3. Write ATTENTION REPAIR DEPARTMENT on the shipping label.

NOTE
It is not necessary to return the matrix mainframe with the card.

5.5 COMPONENT LAYOUT AND SCHEMATIC DIAGRAM

The component layout and schematic diagram of the Model 7076 follows the parts list.

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MODEL 7076, PARTS LIST

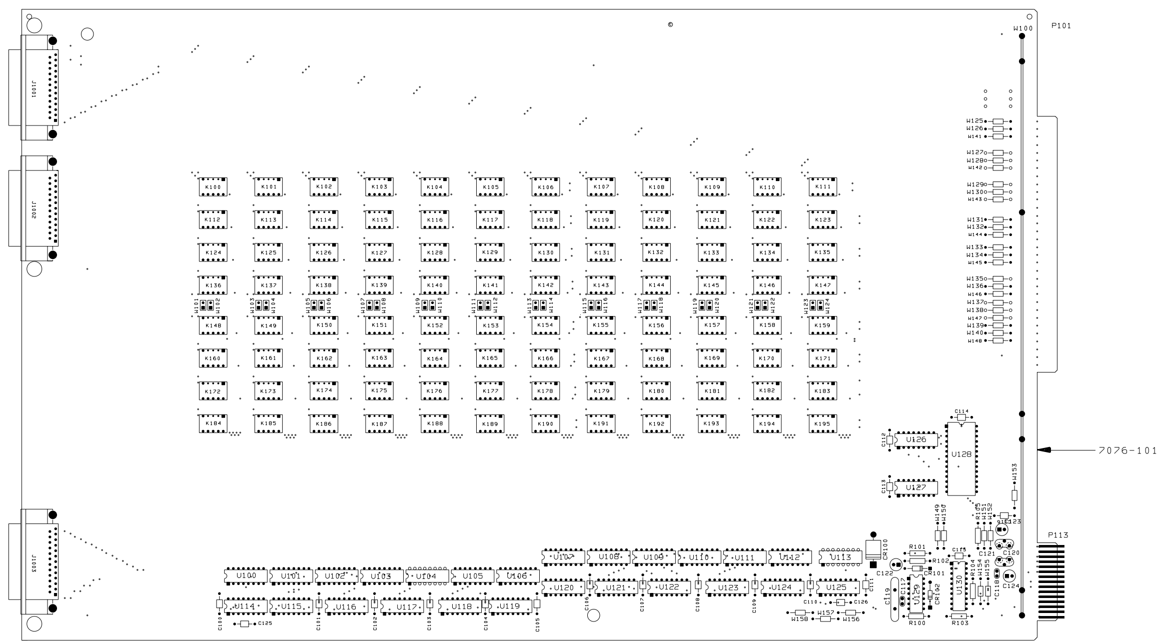
CIRCUIT DESIG.	DESCRIPTION	KEITHLEY PART NO.
	REAR PANEL ASSEMBLY	7076-303A
	CHASSIS ASSEMBLY	7076-MECH-2
	CHIPLOC BAG	PO-14-6
	LABEL, CAUTION	MC-487
	CONN,BERG	CS-339
	INSTRUCTION MANUAL	7076-901-01A
	PEM NUTS	FA-135
	HOLE SIZE	7076-102B
	SOCKET,I.C. 28 PIN	SO-69
	SHIELD, BOTTOM	7075-306A
	HANDLE	HH-33-1
C100..116	CAP,.1UF,20%,50V,CERAMIC	C-365-.1
C117,118	CAP,.01UF,20%,50V,CERAMIC	C-237-.01
C119	CAP,.01UF,10%,1000V,CERAMIC	C-64-.01
C120,121	CAP,270PF,20%,100V,CERAMIC/FERRITE	C-386-270P
C122	CAP, 47UF,10%,16V,ALUM ELEC	C-321-47
C123,124	CAP, 10UF,-20+100%,25V,ALUM ELEC	C-314-10
CR100	DIODE	RF-34
CR101	DIODE,SILICON,IN4148 (DO-35)	RF-28
CR102	DIODE,SCHOTTKY, IN5711	RF-69
	SCREWLOCK, FEMALE, CS-721-1 TO PANEL	CS-725
J1001..1003	CONNECTOR, RIGHT ANGLE D-SUB SOCKET	CS-721-1A
K100..195	RELAY, ULTRA-SMALL POLARIZED TQ2E-5V	RL-136
R100	RES,10K,5%,1/4W,COMPOSITION OR FILM	R-76-10K
R101	RES,200,5%,1/4W,COMPOSITION OR FILM	R-76-200
R102	RES,47K,5%,1/4W,COMPOSITION OR FILM	R-76-47K
R103	RES,11K,5%,1/4W,COMPOSITION OR FILM	R-76-11K
R104	RES,5.1K,5%,1/4W,COMPOSITION OR FILM	R-76-5.1K
R105	RES,120K,5%,1/4W,COMPOSITION OR FILM	R-76-120K
U100..113	IC,DARLINGTON ARRAY,2003	IC-206
U114..125	IC, 8 BIT SHIFT LAT REG,74HC4094	IC-713
U126	IC, 12 STAGE BINARY COUNTER,74HCT4040	IC-545
U127	IC,8-BIT PARALLEL TO SERIAL,74HCT165	IC-548
U128	PROGRAMMED EPROM	7076-800-*
U129	IC, QUAD 2 INPUT NAND, 74HCT00	IC-399
U130	IC, OCTAL BUFFER/LINE DRIVER, 74HC244	IC-489
W100	STIFFENER, BOARD	J-16
W101..124	CONN,BERG,2 PIN	CS-339-2
W125..140,149..158	JUMPER	J-15
	SUPPLIED ACCESSORY	
	CONNECTOR, JUMPER	CS-476
	POUCH	PO-1

*ORDER FIRMWARE REVISION LEVEL INDICATED ON IC PACKAGE.

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7076-100

LTR.	ECO NO.	REVISION	ENG.	DATE
B	900308	RELEASED	MS	3-8-90
C	15338	CHG'D ARTWORK FROM REV B TO C.	AS	11-23-92
D	18233	ADDED C125,C126. REV C TO D.	SZ	5-1-96



NOTE:

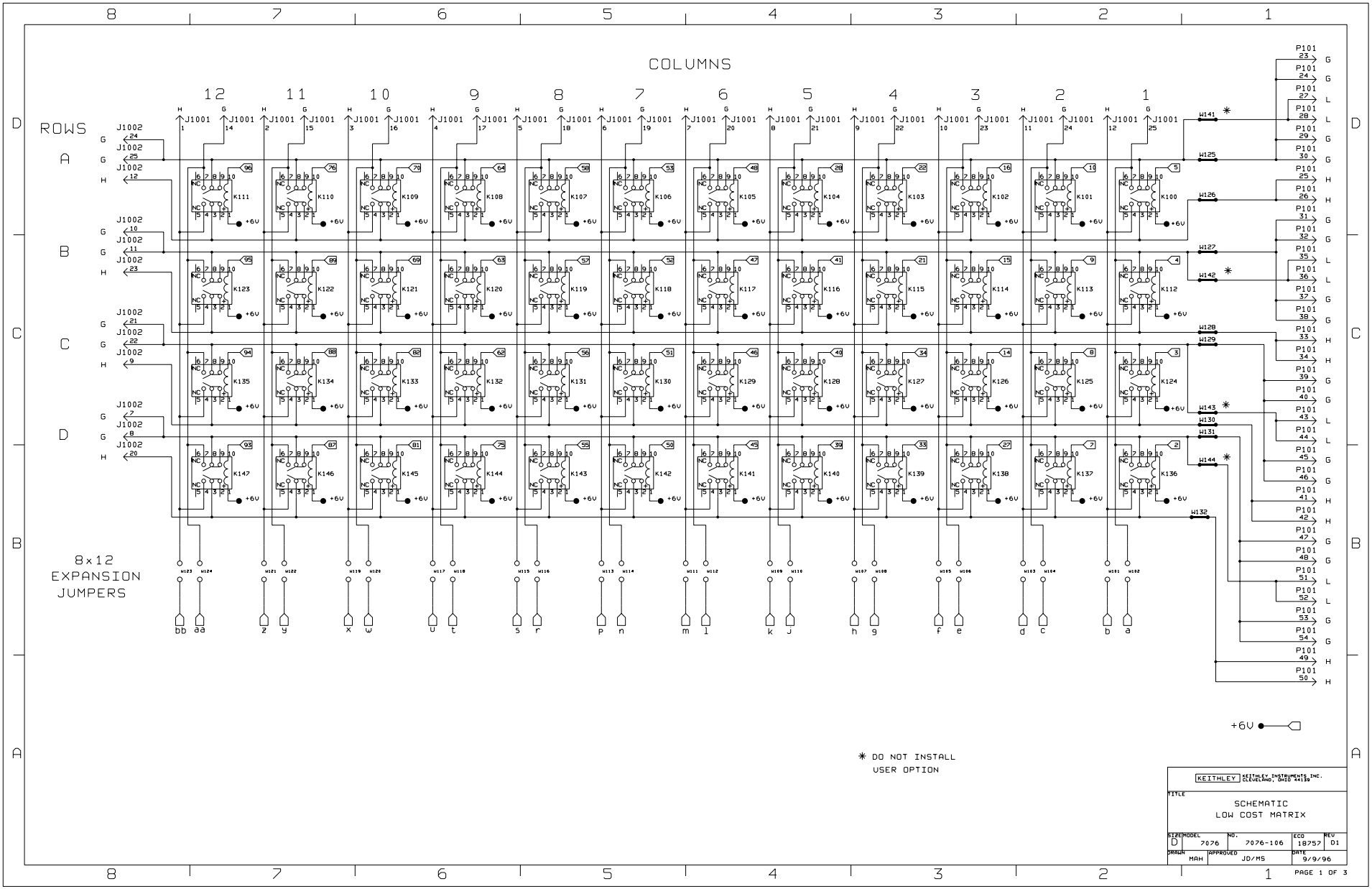
FOR COMPONENT INFORMATION
REFER TO PRODUCT STRUCTURE.

MODEL	NEXT ASSEMBLY	QTY.
USED ON		

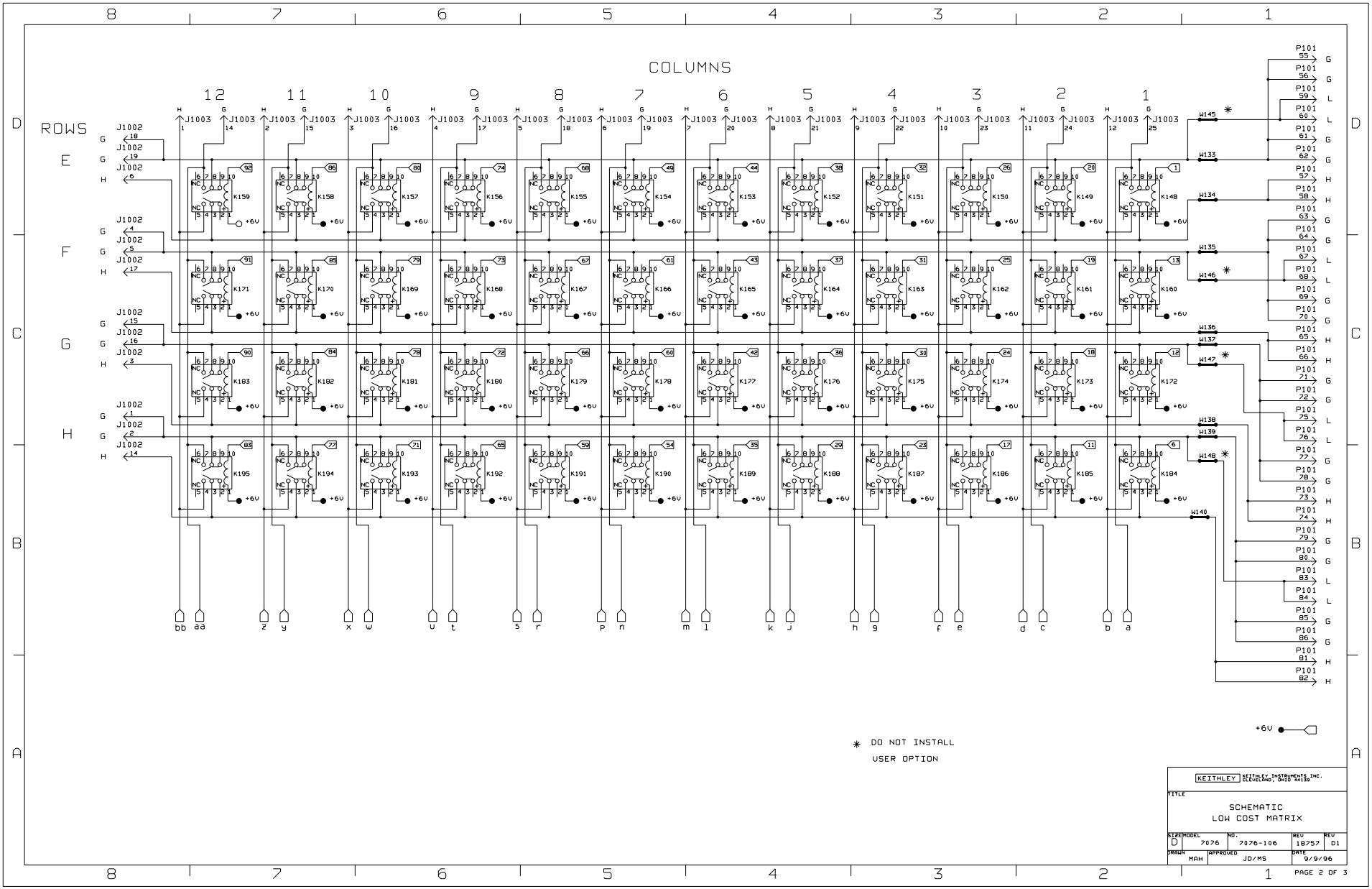
DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 1-16-90	SCALE 1:1	TITLE COMPONENT LAYOUT MATRIX CARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.015 ANG.=±1°	DRN. KEK	ENG. APPR. B/JD	
	XXX=±.005 FRAC.=±1/64	MATERIAL		D NO. 7076-100
	SURFACE MAX. 63	FINISH		

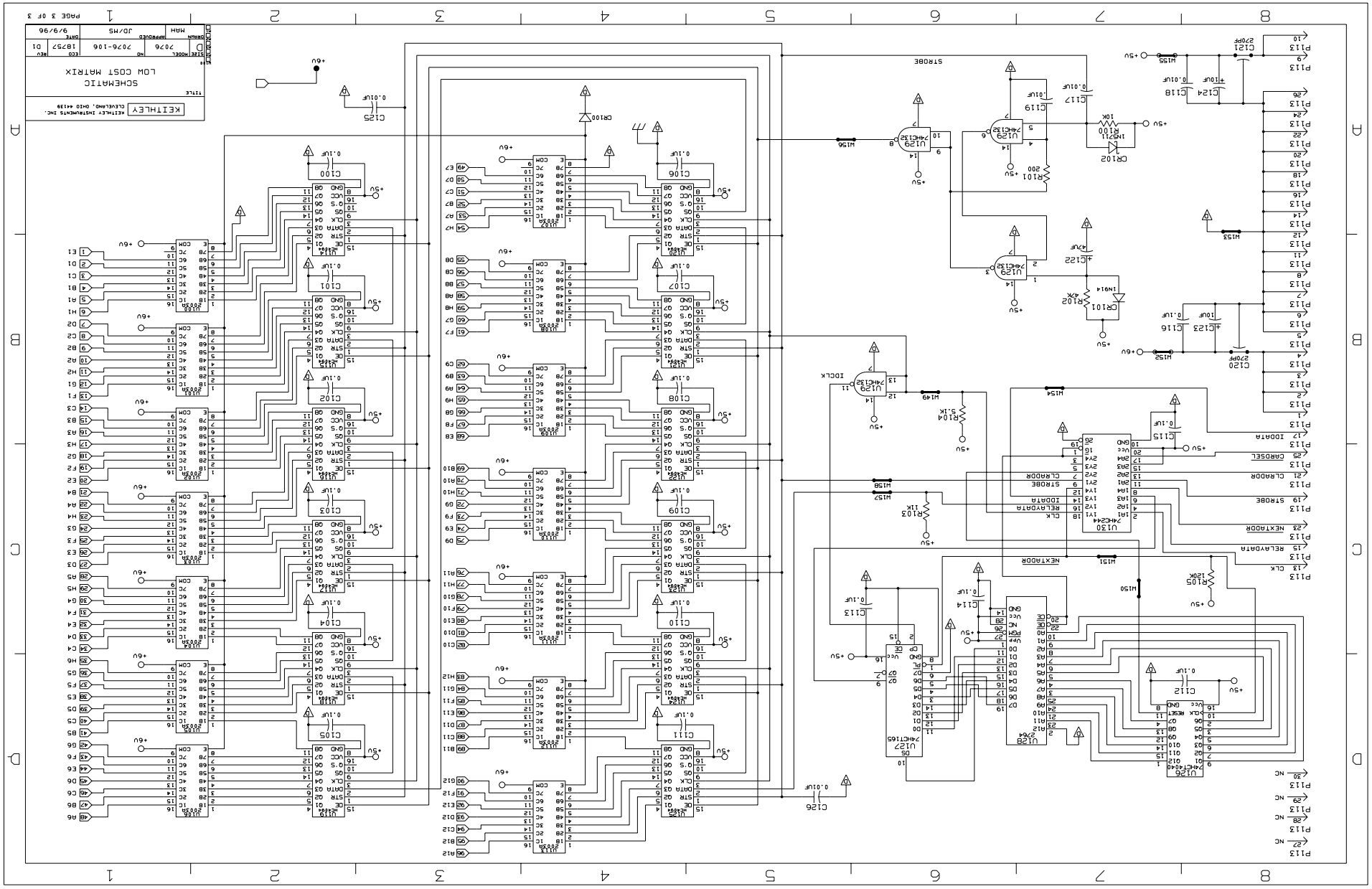
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Service Form

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

Name and Telephone No. _____

Company _____

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

_____

_____

- ❑ Intermittent
- ❑ IEEE failure
- ❑ Front panel operational
- ❑ Analog output follows display
- ❑ Obvious problem on power-up
- ❑ All ranges or functions are bad
- ❑ Particular range or function bad; specify _____
- ❑ Batteries and fuses are OK
- ❑ Checked all cables

Display or output (check one)

- ❑ Drifts
- ❑ Unstable
- ❑ Overload
- ❑ Unable to zero
- ❑ Will not read applied input

- ❑ Calibration only
- ❑ Data required
- ❑ Certificate of calibration required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system 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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