KEITHLEY

Model 7074 General Purpose Multiplexer Card

Instruction Manual

A GREATER MEASURE OF CONFIDENCE

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9/00

Model 7074 General Purpose Multiplexer Card
Instruction Manual

Cleveland, Ohio, U.S.A.
Document Number: 7074-901-01 Rev. B

Manual Print History

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

Revision A (Document Number 7074-901-01)..... January 1989
Addendum A (Document Number 7074-901-02)..... February 1996
Revision B (Document Number 7074-901-01)..... March 2001

Safety Precautions

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

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

The types of product users are:

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

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

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

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

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

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

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

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

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

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

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

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

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

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

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

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

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

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

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

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

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

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

Instrumentation and accessories shall not be connected to humans.

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

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

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

7074-D General Purpose Eight 1×12 Multiplexer Card (Dry Reed)

MULTIPLEX CONFIGURATION: Eight 1×12 banks. Adjacent banks can be connected together. Jumpers can be removed to isolate any bank from the backplane.

CONTACT CONFIGURATION: 3 pole Form A (HI, LO, GUARD).

CONNECTOR TYPE: Four 75 pin connectors for bank connections, one 38 pin connector for row connections.

MAXIMUM SIGNAL LEVEL: 200V, 1A carry/0.5A switched, 10VA peak (resistive load).

COMMON MODE VOLTAGE: 200V maximum between any 2 pins or chassis.

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

CHANNEL RESISTANCE (per conductor): <0.6Ω initial, <1.6Ω at end of contact life.

CONTACT POTENTIAL: <5μV per contact pair (HI to LO, <1 minute after actuation).

OFFSET CURRENT: <100pA.

ISOLATION:
Bank: $>10^{10}\Omega$, <10pF.
Channel: $>10^{10}\Omega$, <10pF.
Differential: $>10^9\Omega$, 55pF nominal.
Common Mode: $>10^9\Omega$, 300pF nominal.

CROSSTALK:
Bank: <–55dB at 1MHz, 50Ω load.
Channel: <–55dB at 1MHz, 50Ω load.

INSERTION LOSS (1MHz, 50Ω source, 50Ω load): 0.1dB typical.

3dB BANDWIDTH (50Ω load): 10MHz typical.

RELAY DRIVE CURRENT(per relay): 15mA.

RELAY SETTLING TIME: <3msec.

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

ACCESSORIES SUPPLIED: Instruction manual, 8 spare backplane jumpers.

ACCESSORIES AVAILABLE:

Bank Connector Accessories:

Model 7074-CIT:	Contact Extraction Tool
Model 7074-HCT:	Hand Crimping Tool
Model 7074-KIT:	Mass Terminated Plug with Contacts
Model 7074-MTC-20:	Mass Terminated Cable Assembly, 6m(20 ft.)
Model 7074-MTR:	Mass Terminated Receptacle with Contacts
Model 7074-RTC:	Relay Test Shorting Connector

Row Connector Accessories:

Model 7078-CIT:	Contact Insertion and Extraction Tools
Model 7078-HCT:	Hand Crimping Tool
Model 7078-KIT:	Mass Terminated Plug with Contacts
Model 7078-MTC-5:	Mass Terminated Cable Assembly, 1.5m (5 ft.)
Model 7078-MTC-20:	Mass Terminated Cable Assembly, 6m (20 ft.)
Model 7078-MTR:	Mass Terminated Receptacle with Contacts

Specifications subject to change without notice.

All specifications applicable to eight 1×12 configuration only.

7074-M General Purpose Eight 1×12 Multiplexer Card (Mercury Wetted Reed)

MULTIPLEX CONFIGURATION: Eight 1×12 banks. Adjacent banks can be connected together. Jumpers can be removed to isolate any bank from the backplane.

CONTACT CONFIGURATION: 3 pole Form A (HI, LO, GUARD).

CONNECTOR TYPE: Four 75 pin connectors for bank connections, one 38 pin connector for row connections.

MAXIMUM SIGNAL LEVEL: 200V, 3A carry/2A switched, 50VA peak (resistive load).

COMMON MODE VOLTAGE: 200V maximum between any 2 pins or chassis.

CONTACT LIFE:

Cold Switching: 10^9 closures.

At Maximum Signal Level: 10^8 closures.

CHANNEL RESISTANCE (per conductor): <0.6Ω initial, <0.7Ω at end of contact life.

CONTACT POTENTIAL: <10μV per contact pair (HI to LO, <1 minute after actuation).

OFFSET CURRENT: <100pA.

ISOLATION:

Bank: $>10^{10}$Ω, <10pF.

Channel: $>10^{10}$Ω, <10pF.

Differential: $>10^9$Ω, 55pF nominal.

Common Mode: $>10^9$Ω, 300pF nominal.

CROSSTALK:

Bank: <–55dB at 1MHz, 50Ω load.

Channel: <–55dB at 1MHz, 50Ω load.

INSERTION LOSS (1MHz, 50Ω source, 50Ω load): 0.1dB typical.

3dB BANDWIDTH (50Ω load): 10MHz typical.

RELAY DRIVE CURRENT(per relay): 50mA.

RELAY SETTLING TIME: <3msec.

ENVIRONMENT:

Operating: 0° to 50°C, up to 35°C @ 70% R.H.

Storage: –25 to 65°C.

ACCESSORIES SUPPLIED: Instruction manual, 8 spare backplane jumpers.

ACCESSORIES AVAILABLE:

Bank Connector Accessories:

Model 7074-CIT:	Contact Extraction Tool
Model 7074-HCT:	Hand Crimping Tool
Model 7074-KIT:	Mass Terminated Plug with Contacts
Model 7074-MTC-20:	Mass Terminated Cable Assembly, 6m (20 ft.)
Model 7074-MTR:	Mass Terminated Receptacle with Contacts
Model 7074-RTC:	Relay Test Shorting Connector

Row Connector Accessories:

Model 7078-CIT:	Contact Insertion and Extraction Tools
Model 7078-HCT:	Hand Crimping Tool
Model 7078-KIT:	Mass Terminated Plug with Contacts
Model 7078-MTC-5:	Mass Terminated Cable Assembly, 1.5m (5 ft.)
Model 7078-MTC-20:	Mass Terminated Cable Assembly, 6m (20 ft.)
Model 7078-MTR:	Mass Terminated Receptacle with Contacts

Specifications subject to change without notice.

All specifications applicable to eight 1×12 configuration only.

HOW TO USE THIS MANUAL

Contains information on Model 7074 features, specifications, and accessories.

SECTION 1
General Information

Details installation of the Model 7074 General Purpose Multiplexer Card within the Model 707 Switching Matrix, covers card signal paths, and describes connections.

SECTION 2
Operation

Gives typical applications for the Model 7074.

SECTION 3
Applications

Contains performance verification procedures, troubleshooting information, and principles of operation for the multiplexer card.

SECTION 4
Service Information

Lists replacement parts, and also includes component layout and schematic drawings for the Model 7074.

SECTION 5
Replaceable Parts

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SECTION 1
General Information

1.1 INTRODUCTION

This section contains general information about the Model 7074.

Section 1 is arranged in the following manner:

1.2 Features

1.3 Warranty Information

1.4 Manual Addenda

1.5 Safety Symbols and Terms

1.6 Specifications

1.7 Unpacking and Inspection

1.8 Repacking for Shipment

1.9 Optional Accessories

1.2 FEATURES

The Model 7074 General Purpose Multiplexer Card consists of eight banks of 1 × 12 multiplexers that can be configured in various combinations. Three-pole switching (HI, LO, guard) is provided for any of the 96 inputs.

The Model 7074 is available with either dry or mercury-wetted reed relays. The dry-reed version (Model 7074-D) has lower thermal offset performance, while the mercury-wetted version (Model 7074-M) offers minimal contact bounce for and constant contact resistance overlife. Throughout this manual, Model 7074 is used to refer to both versions unless otherwise indicated.

Key features of the Model 7074 include:

- Easy jumper configuration of single, dual, quad, or octal multiplexer banks.
- Each of the eight multiplexer banks can be connected to the 3-pole general-purpose backplane pathways with user-installed jumpers, allowing simple internal connections to the rows of those matrix cards.
- Five mass-termination receptacles located on the rear panel for quick-disconnect input and output connections.

1.3 WARRANTY INFORMATION

Warranty information is located on the inside front cover of this instruction manual. Should your Model 7074 require warranty service, contact the Keithley representative or authorized repair facility in your area for further information. When returning the card for repair, be sure to fill out and include the service form at the back of this manual in order to provide the repair facility with the necessary information.

1.4 MANUAL ADDENDA

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

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 1kV or greater 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 which could damage the multiplexer card. Such damage may invalidate the warranty.

1.6 SPECIFICATIONS

Model 7074-D and Model 7074-M specifications may be found at the front of this manual. Note that some specifications, such as contact life, path resistance, and contact potential, differ between the two versions of the card. These specifications are exclusive of the matrix mainframe specifications, which are located in the Model 707 Instruction Manual.

1.7 UNPACKING AND INSPECTION

1.7.1 Inspection for Damage

Upon receiving the Model 7074, carefully unpack it from its shipping carton and inspect the card for any obvious signs of physical damage. Report any such damage to the shipping agent immediately. Save the original packing carton for possible future reshipment.

1.7.2 Shipment Contents

The following items are included with every Model 7074 order:

- Model 7074-D or 7074-M Multiplexer Card
- Model 7074 Instruction Manual
- Eight spare configuration jumpers
- Additional accessories as ordered

1.7.3 Instruction Manual

The Model 7074 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 multiplexer card instruction manual.

If an additional instruction manual is required, order the manual package, Keithley part number 7074-901-00. The manual package includes an instruction manual and any pertinent addenda.

1.8 REPACKING FOR SHIPMENT

Should it become necessary to return the Model 7074 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 multiplexer 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 paragraphs discuss optional cables, connecting kits, and special tools that are available for use with the Model 7074.

1.9.1 BANK Receptacle Accessories

The following accessories are designed for use with the four BANK receptacles.

Model 7074-CIT Contact Extraction Tool — The Model 7074-CIT includes a tool that is used to remove wire crimp tail contacts from 75-pin "rack and panel" plugs and receptacles.

Model 7074-HCT Hand Crimping Tool — The Model 7074-HCT is used to attach wire crimp tail contacts (for 75-pin connectors) to #18 to #26 AWG stranded wire. However, provided contacts should only be used with #20 to #24 AWG wire.

Model 7074-KIT Connector Kit — The Model 7074-KIT contains the parts to assemble one 75-pin "rack and

panel" plug. This plug will mate to the BANK receptacle on the rear panel of the card. Parts contained in the kit include the plug, 80 wire crimp tail contacts (for use with #20 to #24 AWG wire), four corner pins, one turnable male jackscrew, one turnable female jackscrew, and one shield.

Model 7074-MTC-20 Mass Terminated Cable Assembly — The Model 7074-MTC-20 is a 20-foot (6-meters), 72-conductor cable terminated with a "rack and panel" plug on both ends. This cable connects to the the BANK receptacles on the rear panel of the card. This cable can be cut in half to provide two separate cables, each of which can be connected to one of the BANK receptacles. The unterminated ends of the cables are then connected to instrumentation and DUTs.

Model 7074-MTR Mass Terminated Receptacle with Contacts — The Model 7074-MTR includes a 75-pin connector, 80 crimp tail contacts, (for #20 to #24 AWG wire), one fixed female jackscrew, one fixed male jackscrew, and four corner pins. The Model 7074-MTR mates with the Model 7074-MTC cables and the Model 7074-KIT plug kit.

Model 7074-RTC Relay Test Shorting Plug — The Model 7074-RTC is intended for use with the relay test software, as described in paragraph 4.2. The Model 7074-RTC consists of a 75-pin plug with pins and jumper wires.

1.9.2 ROW Receptacle Accessories

The following accessories are intended for use with the ROW A-H receptacle.

Model 7078-CIT Contact Insertion and Extraction Tools — The Model 7078-CIT includes an insertion tool that is used to insert wire crimp tail contacts into 38-pin "rack and panel" plugs and receptacles. Conversely, the extraction tool is required for the removal of the contacts.

Model 7078-HCT Hand Crimping Tool — The Model 7078-HCT is used to attach wire crimp tail contacts to #18 to #26 AWG stranded wire.

Model 7078-KIT Connector Kit — The Model 7078-KIT contains the parts to assemble one 38-pin "rack and panel" plug. This plug will mate to the ROW A-H receptacle on the rear panel of the card. Parts contained in the kit include the plug, plug housing and 40 wire crimp tail contacts.

Model 7078-MTC-5 Mass Terminated Cable Assembly — The Model 7078-MTC is a 5-foot (1.5-meters), 36-conductor cable terminated with a "rack and panel" plug on both ends. This cable connects to ROW A-H receptacle on the rear panel of the card. This cable can be cut in half to provide two separate cables when using two or more Model 7074 cards. The unterminated ends of the cables are then connected to instrumentation and DUTs.

Model 7078-MTC-20 Mass Terminated Cable Assembly — This cable is the same as the Model 7078-MTC-5, except that it is 20-feet (6-meters) in length.

Model 7078-MTR Mass Terminated Receptacle with Contacts — The Model 7078-MTR includes a 38-pin connector and 40 crimp tail contacts. The Model 7078-MTR mates with the Model 7078-MTC cables and the Model 7078-KIT plug kit.

SECTION 2
Operation

2.1 INTRODUCTION

This section contains information on multiplexer configuration, card connections, installation, and programming, and is arranged as follows:

2.2 Handling Precautions: Discusses precautions that should be taken when handling the card to avoid contamination that could degrade performance.

2.3 Environmental Considerations: Outlines environmental aspects of using the Model 7074.

2.4 Multiplexer Card Configuration: Discusses the multiplexer rear panel as well as multiplexer configuration, and expansion by jumpering two or more multiplexer sections together.

2.5 Card Installation and Removal: Details installation in and removal from the Model 707 Switching Matrix mainframe.

2.6 Connection Methods: Discusses card connectors, cables, and ways to connect the card to other instruments and test fixtures.

2.7 Typical Connection Schemes: Gives typical connections to other cards, mainframes, and test instrumentation.

2.8 Multiplexer Programming: Summarizes programming steps to control the multiplexer card from the Model 707 Switching Matrix.

2.9 Measurement Considerations: Reviews a number of considerations when making measurements using the Model 7074.

WARNING

The information in this section is intended for qualified personnel who have experience with potentially hazardous voltages. Do not attempt to perform these procedures unless you are qualified to do so. Carefully read the safety precautions located at the front of this manual before using the multiplexer card.

2.2 HANDLING PRECAUTIONS

To maintain high impedance isolation, care should be taken when handling the multiplexer card to avoid contamination from such foreign materials as body oils. Such contamination can substantially lower leakage resistances, degrading performance. To avoid any possible contamination, always grasp the card by the handle or the card edges. Do not touch board surfaces, components, or edge connectors.

Dirt build-up over a period of time is another possible source of contamination. To avoid this problem, operate the mainframe and matrix card only in a clean environment. If contamination is suspected, clean the card as discussed in Section 4. Also, the performance verification procedures in Section 4 can be used to test the card for low leakage resistances that could indicate contamination.

2.3 ENVIRONMENTAL CONSIDERATIONS

For rated performance, the card should be operated within the temperature and humidity limits given in the specifications at the front of this manual.

2.4 MULTIPLEXER CARD CONFIGURATION

The following paragraphs discuss the rear panel of the card, the eight 1 × 12 multiplexers of the Model 7074, as well as how to connect two or more multiplexer banks together to make multiplexers as large as 1 × 96.

2.4.1 Rear Panel

The rear panel of the Model 7074 is shown in Figure 2-1. The rear panel has a total of five receptacles for input/

output connections. The four BANK connectors (J48, J49, J51, and J52) would normally be used for multiplexer inputs and are labeled with multiplexer bank letters (BANKS A and B appear on J48, BANKS C and D are on J49, BANKS E and F are on J51, and BANKS G and H appear on J52). The eight multiplexer bank outputs are located on the ROW A-H connector (J50). Detailed connection information can be found in paragraphs 2.6 and 2.7.

2.4.2 1 × 12 Multiplexer Banks

As shown in Figure 2-2, the Model 7074 is organized as eight 1 × 12 multiplexer banks. These multiplexer banks are labeled rows A through H in order to conform to Model 707 Switching Matrix commands. Throughout this manual, the terms "banks" and "rows" are used interchangeably.

The inputs for each row are labeled 1 through 12 inclusive, and these numbers correspond to mainframe columns. Note that 3-pole switching is provided for each multiplexer input, with HI, LO, and guard switched. Two or more banks can be jumpered together to expand multiplexer inputs, as discussed below. Note that inputs are also referred to as channels in this manual.

2.4.3 Multiplexer Bank Jumpers

Jumpers can be installed on the card in order to connect multiplexer banks together to form multiplexers as large as 1 × 96. To connect adjacent multiplexer banks, simply install the jumpers between the adjacent bank jumper pins, which are shown in Figure 2-3. These jumpers are included with the Model 7074, but they are not installed at the factory. Note that you should install the jumpers for all three signal paths (HI, LO, and guard).

By installing the jumpers in the appropriate places, you can configure the multiplexer card in a variety of ways. Typical examples include:

- Eight 1 × 12 multiplexers: no jumpers installed (Figure 2-4).
- Four 1 × 24 multiplexers: jumper A to B, C to D, E to F, G to H (Figure 2-5).
- Two 1 × 48 multiplexers: jumper all except D to E (Figure 2-6).
- One 1 × 96 multiplexer: install all bank jumpers (Figure 2-7).

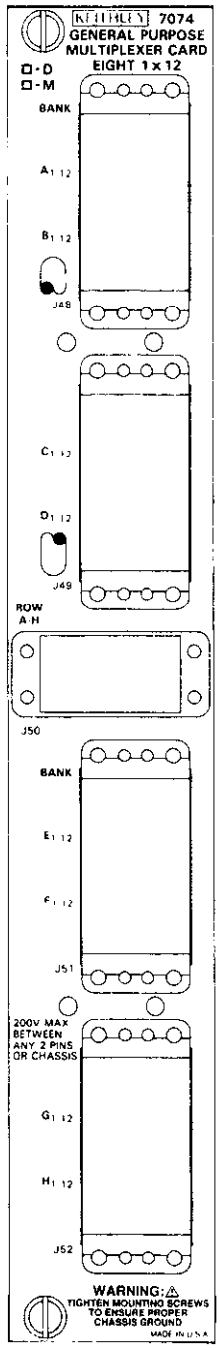


Figure 2-1. Model 7074 Rear Panel

Many other combinations are possible, including multiplexers of various sizes (in multiples of 12 channels) by installing jumpers as required. For example, you could install jumpers to configure the card as two 1 × 24 multiplexers and one 1 × 48 multiplexer.

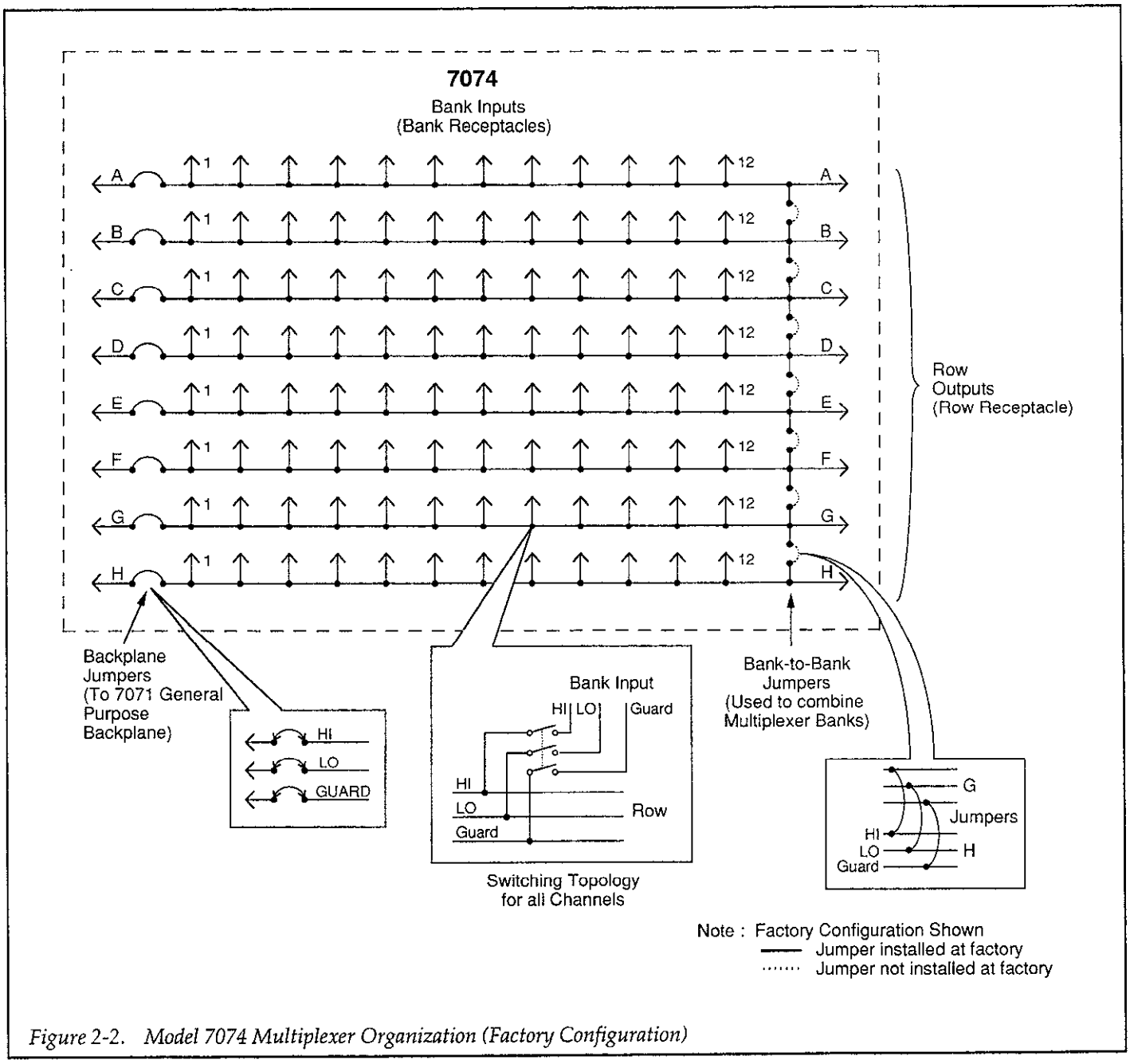


Figure 2-2. Model 7074 Multiplexer Organization (Factory Configuration)

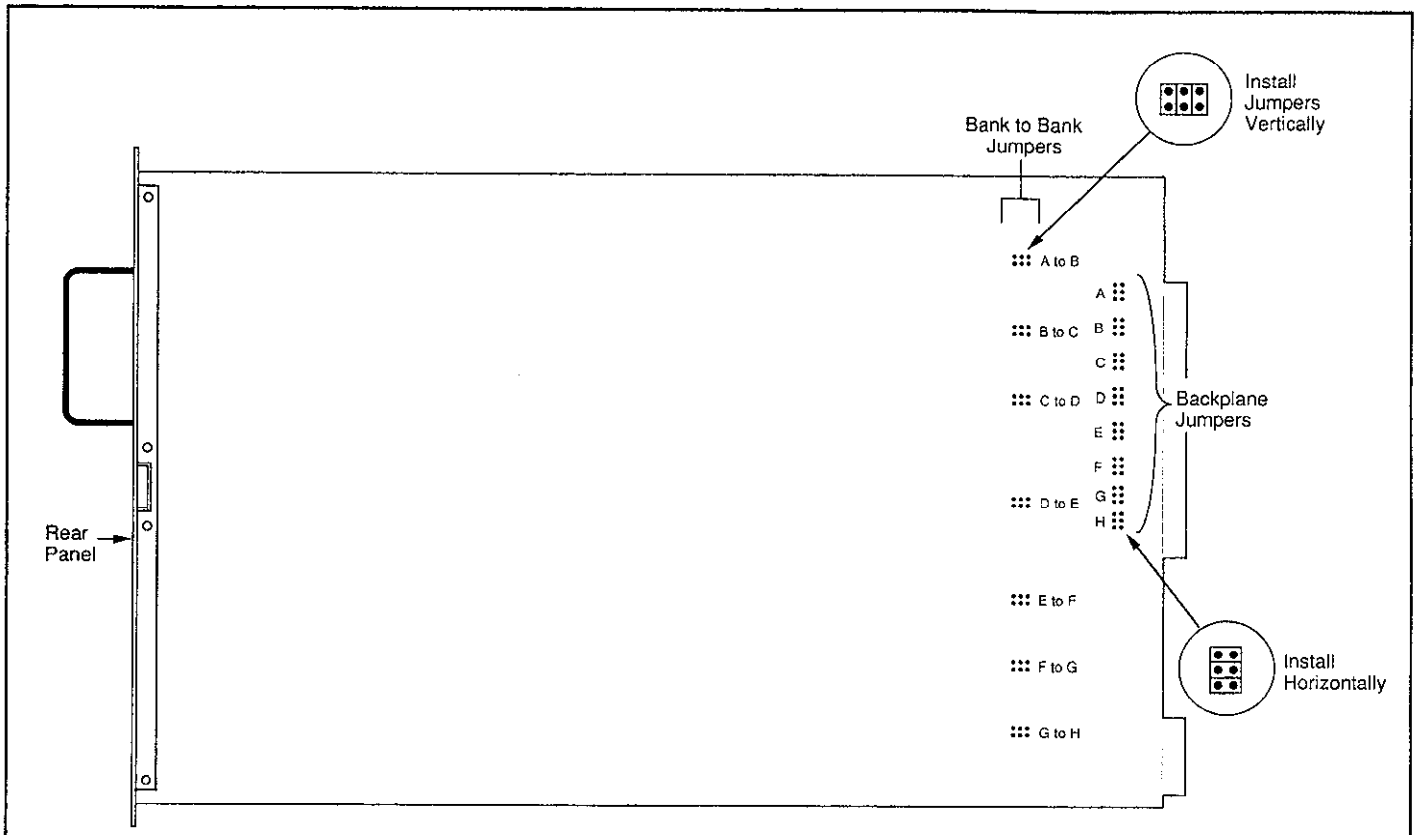


Figure 2-3. Model 7074 Card Showing Jumper Locations

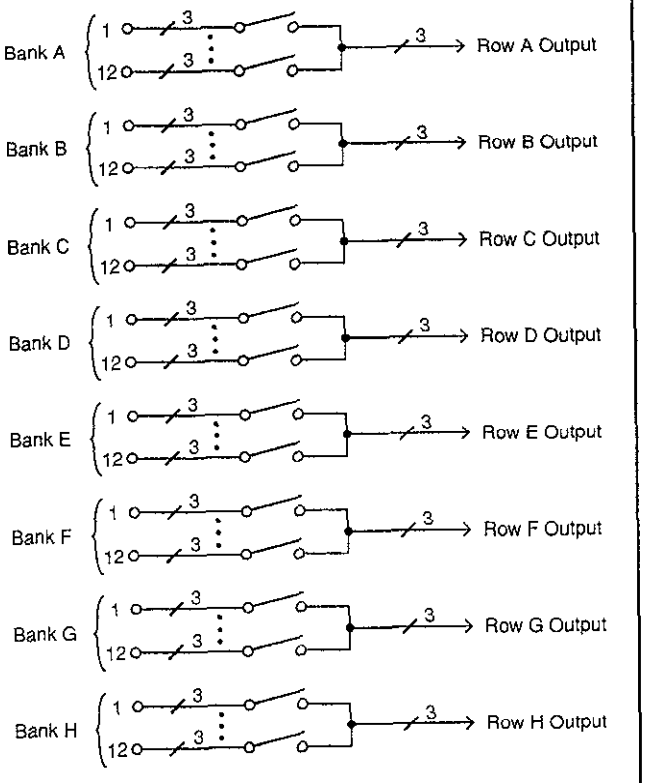


Figure 2-4. Eight 1 × 12 Multiplexer Configured (No jumpers installed)

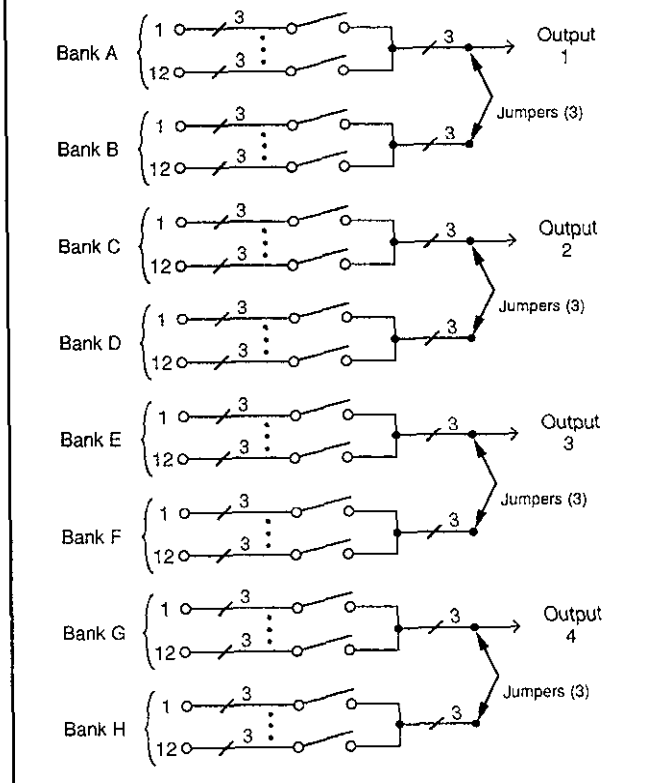


Figure 2-5. Four 1 × 24 Multiplexer Configuration

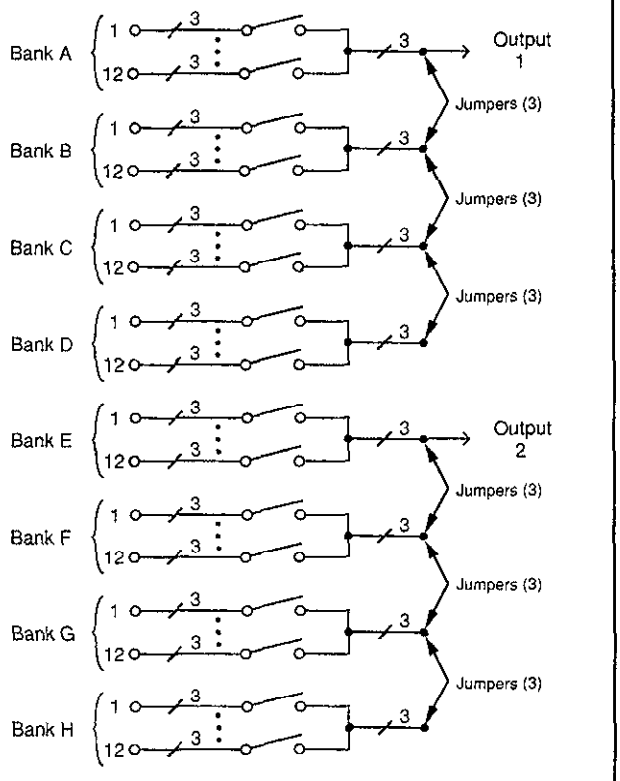


Figure 2-6. Two 1 × 48 Multiplexer Configuration

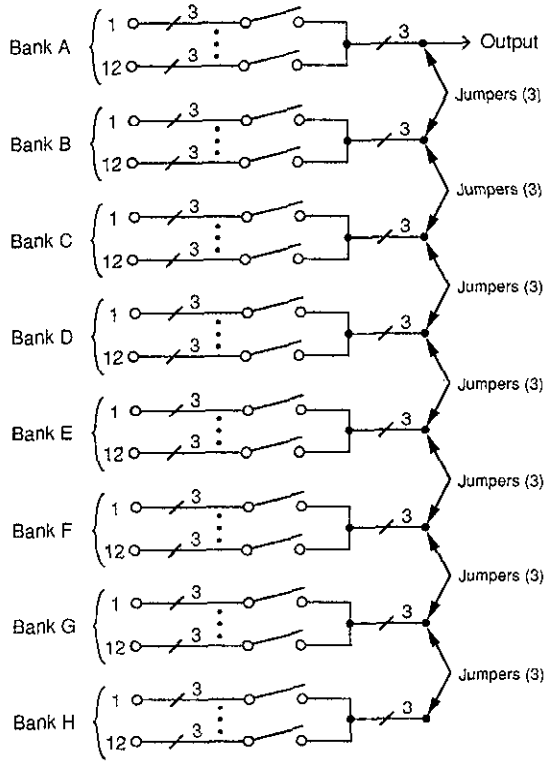


Figure 2-7. 1 × 96 Multiplexer Configuration

2.4.4 Backplane Connection Jumpers

The multiplexer banks on the Model 7074 can be connected to row A through H 3-pole, general-purpose backplane pathways of the matrix mainframe by installing the appropriate backplane jumpers. These pathways provide connection to rows A through H of any Model 7071 General Purpose or Model 7071-4 Dual 4 × 12 Matrix Cards installed in the mainframe. Figure 2-8 shows multiplexer bank rows A through H of the Model 7074 connected through the mainframe backplane to rows A through H of the matrix card. Appendix B provides additional card-backplane information.

The backplane jumpers can also be used to expand the multiplexer banks using other Model 7074 cards installed in the same mainframe. For example, three Model 7074 cards installed in a mainframe with the proper bank and backplane jumper configuration would result in a 1 × 288 or 2 × 144 multiplexer configuration.

The backplane jumpers are located on the right edge of the card (see Figure 2-3). Note that HI, LO, and guard for a particular bank would all normally be jumpered to the corresponding row of the 3-pole, general-purpose backplane.

2.4.5 Switching Configurations

Guarded Switching

Each multiplexer switch is a 3-pole relay that switches, HI, LO, and guard, allowing 3-pole switching, an example of which is shown in Figure 2-9. In this case, a driven guard is provided by the measuring/sourcing instrument (guarding helps to minimize the effects of leakage resistance and capacitance, especially where long pathways are involved; see paragraph 2.9).

WARNING
Hazardous voltages up to 200V may be present on GUARD. Install an earth-grounded safety shield around the DUT and make sure all cable shields are properly insulated.

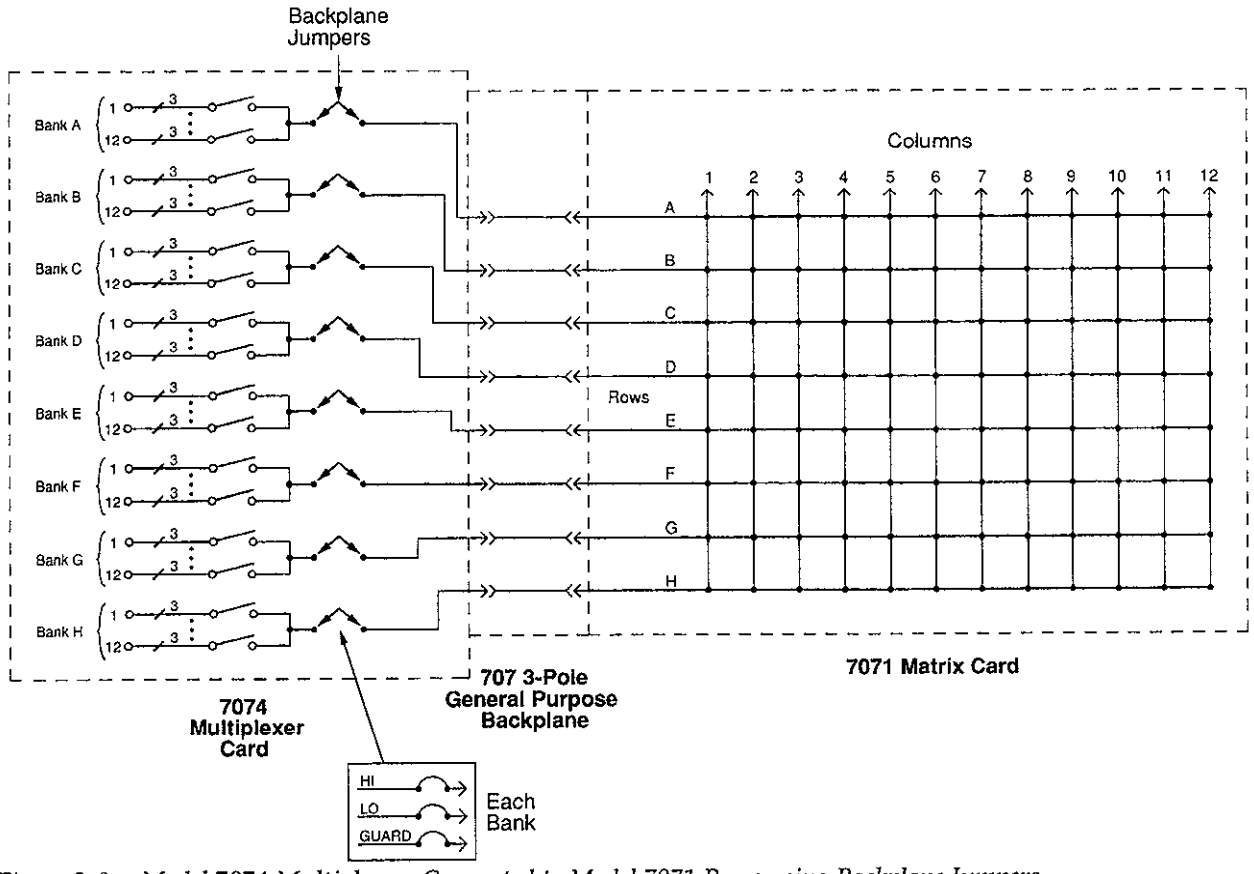


Figure 2-8. Model 7074 Multiplexers Connected to Model 7071 Rows using Backplane Jumpers

Unguarded Switching

In cases where no guard is required or available, the guard path, which is connect to the cable shield, should be connected to signal LO at the source/measurement instrument in order to shield the entire pathway. Such an arrangement is shown in Figure 2-10. An optional shield, surrounding the DUT, can also be added to ensure complete shielding. This shield should be connected to circuit LO rather than earth ground. An additional safety shield should also be included as shown.

Multiple-pole Switching

In some cases, it may be necessary to switch more than three poles for a given input or output channel. Two such cases are four-wire resistance measurements, or when using SMUs (source/measure units). Since the Model 7074 can be split up into several multiplexers, two or more multiplexer banks can be used together to add the desired number of poles.

Figure 2-11 shows an example for 4-wire resistance measurements using a DMM. Note that VOLTS/OHMS HI and SENSE HI are routed through one bank, while VOLTS/OHMS LO and SENSE LO are routed through a second bank.

Figure 2-12 demonstrates a typical configuration when using a Model 236 SMU. Here, source and sense are routed through separate banks. If a guard shield surrounding the DUT is to be used, a safety shield must also be incorporated.

WARNING
Hazardous voltages up to 200V may be present on GUARD. Install an earth-grounded safety shield around the DUT and make sure all cable shields are properly insulated.

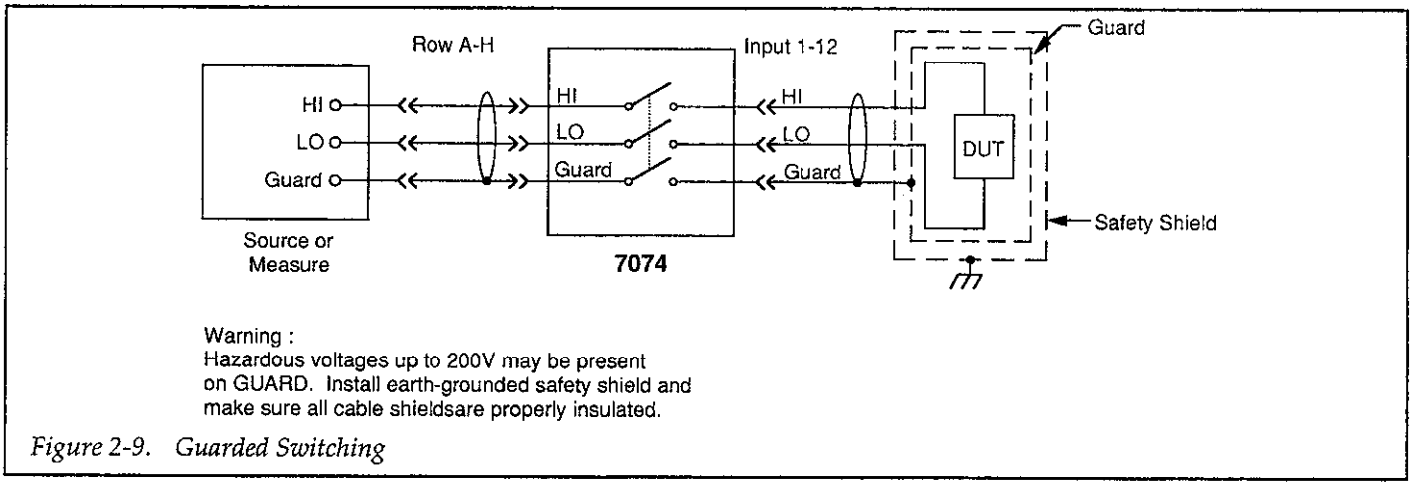


Figure 2-9. Guarded Switching

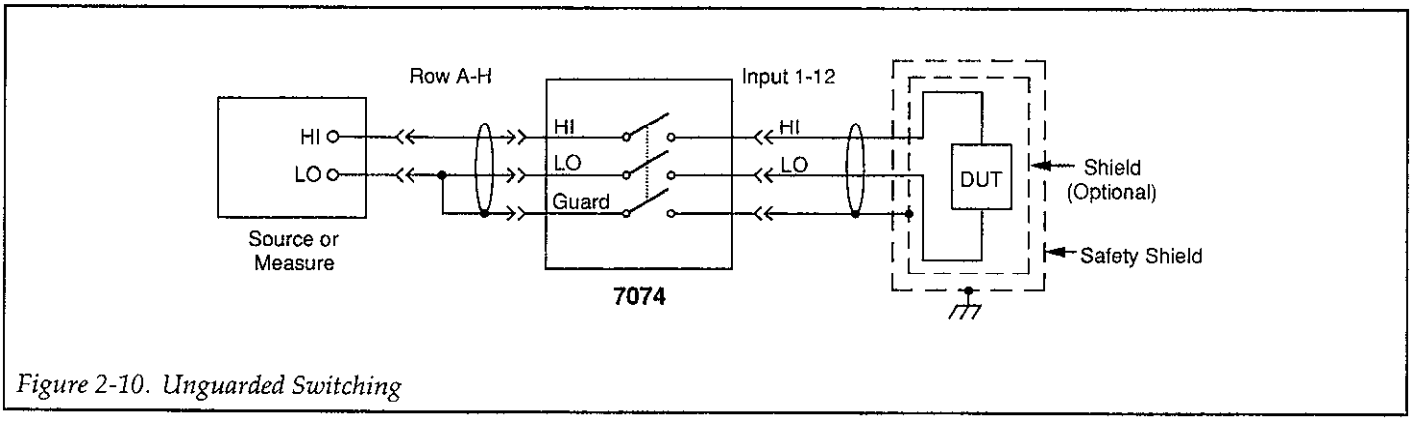


Figure 2-10. Unguarded Switching

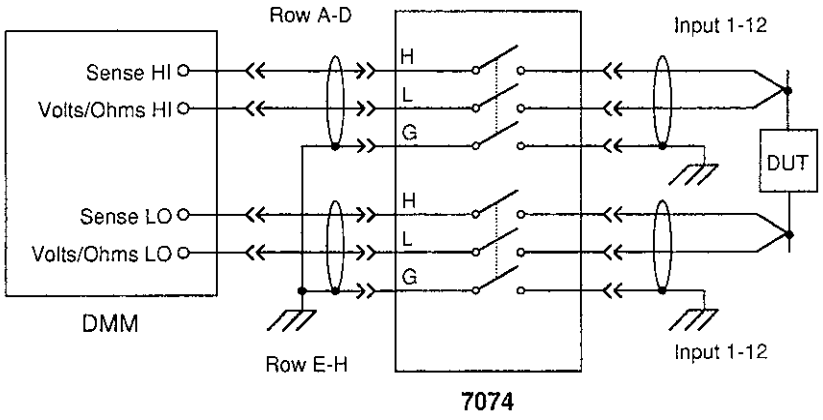
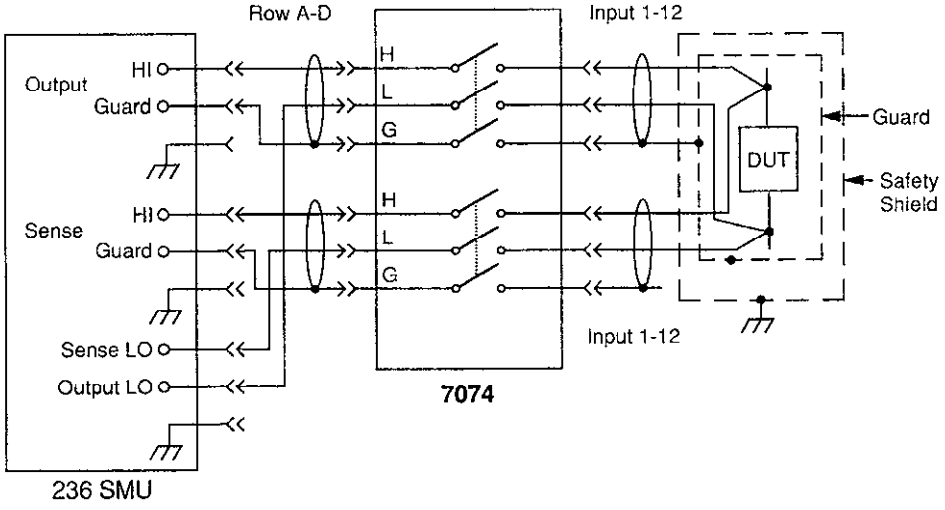


Figure 2-11. 4-Wire DMM Switching



Warning :
Hazardous voltages up to 110V may be present on GUARD. Install earth-grounded safety shield and make sure all cable shields are properly insulated.

Figure 2-12. SMU Connections

2.5 CARD INSTALLATION AND REMOVAL

After selecting the jumper configuration, the Model 7074 should be installed within the Model 707 Switching Matrix, as summarized below. Figure 2-13 shows the installation procedure.

WARNING

Turn off the mainframe power and disconnect the line cord before installing or removing cards.

CAUTION

Disconnect all connecting cables before installing or removing the multiplexer card.

1. Before installing the card, make sure the access door on top of the Model 707 is fully closed and secured. The access door contains tracks for the card slots and must be in place to properly install the card.
2. With one hand grasping the handle, and the other holding the back bottom edge of the card, line up the card with the tracks in the desired slot. Make certain that the component side of the card is facing the fan on the mainframe.

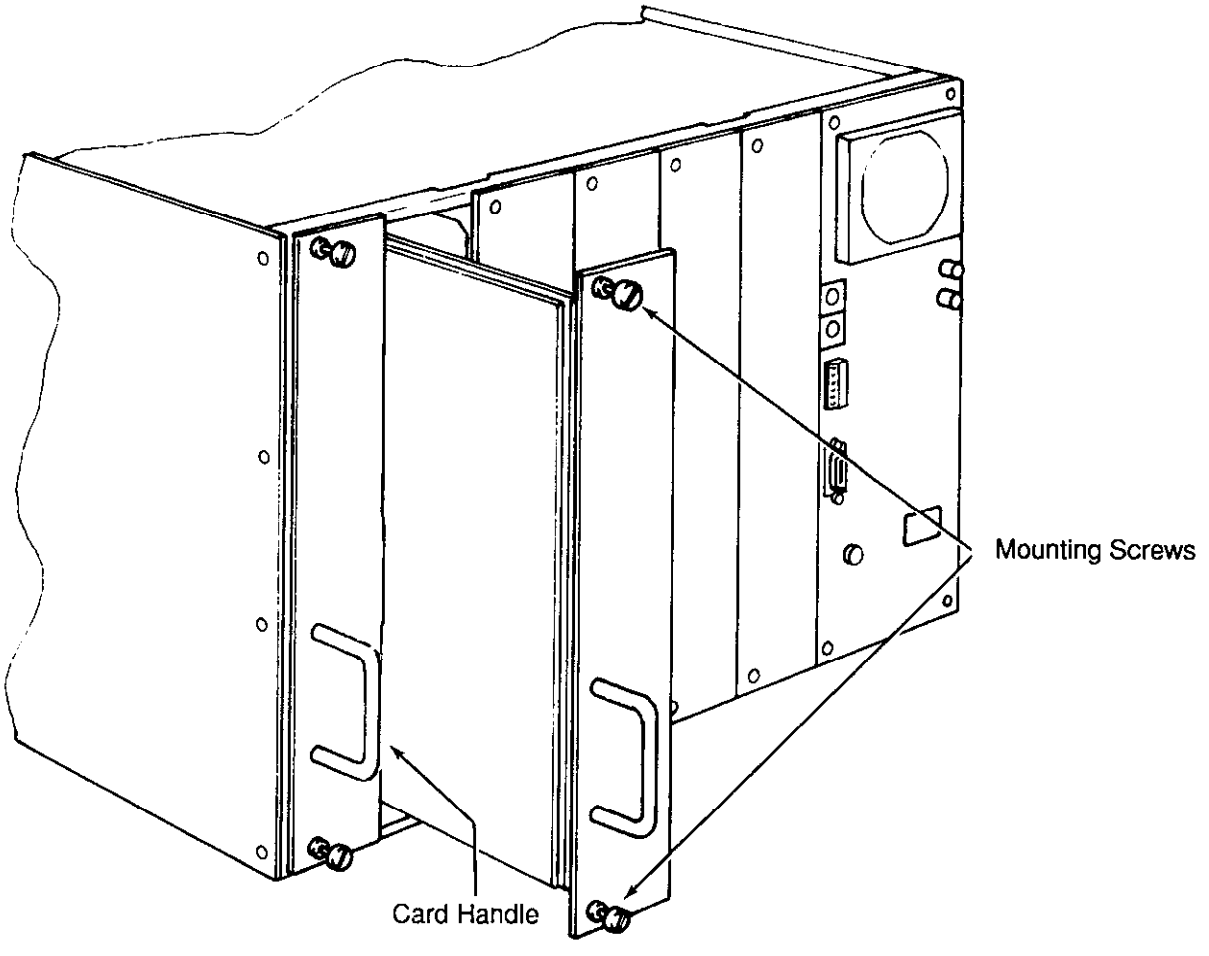


Figure 2-13. Model 7074 Installation

CAUTION

Do not touch the card surfaces or any components to avoid contamination that could degrade card performance.

3. Slide the card into the mainframe until it is properly seated in the edge connectors at the back of the slot. Once the card is properly seated, secure it to the mainframe by finger tightening the spring-loaded screws.

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 a card, first turn off the power and disconnect the line cord from the mainframe. Disconnect all cables from the multiplexer card. Loosen the mounting screws, then pull the card out of the mainframe by the handle. When the back of the card clears the mainframe, support it by grasping the bottom edge near the rear of the card.

2.6 CONNECTION METHODS

The Model 7074 has two types of "rack and panel" receptacles mounted on the rear panel. The four BANK (input) receptacles are 75-pin receptacles that will mate with either the optional mass terminated cables (Models 7074-MTC-5 or 7074-MTC-20) or the plug provided with the optional connector kit (Model 7074-KIT). The ROW A-H (output) receptacle is a 38-pin connector that will mate with either the optional mass terminated cables (Models 7078-MTC-5 or 7078-MTC-20) or the plug provided with the optional connector kit (Model 7078-KIT).

The following paragraphs discuss how to make connections using the two connector types. Since the procedures for the two connector types are virtually identical, only one procedure for each type is given. Where applicable, differences between the two connector types are called out separately.

Model numbers for the two groups of cables, plugs, receptacles, and special tools are similar and are called out together. Table 2-1 summarizes the cables, receptacles, and special tools that can be obtained directly from Keithley Instruments. To avoid confusion, remember that all 7074 numbers pertain to the four BANK receptacles, and all 7078 numbers are associated with the ROW A-H receptacle.

NOTE

The term receptacle refers to a connector mounted on the rear panel of the multiplexer card (and the connector supplied with the Model 7074-MTR and 7078-MTR kits). The term plug refers to a connector that attaches to a cable such as the Model 7074-MTC and 7078-MTC cables, and the plugs supplied with the Model 7074-KIT and 7078-KIT kits.

2.6.1 Connection Methods

There are several ways to make connections to the Model 7074. These include:

Unmodified Mass Terminated Cable Method (Models 7074-MTC and 7078-MTC) — This method is probably the most convenient method to make connections to the multiplexer card. *Using the whole cable (both plugs intact)* makes it most convenient to connect the multiplexer card to a test fixture that uses the same "rack and panel" receptacles as the multiplexer card. Additional receptacles that mate with these cables can be ordered from Keithley Instruments; order Model 7074-MTR for the BANK receptacles, or Model 7078-MTR for the ROW A-H receptacle. Detailed information on wiring these receptacles is located in paragraph 2.6.4.

Modified Mass Terminated Cable Method — By cutting each MTC cable in half (or wherever appropriate), two separate cables, unterminated at one end, will result. These cables can then be hard-wired to DUTs or to your test fixture. The plug on each Model 7074-MTC cable will then connect to one of the BANK (input) receptacles, and the plug on one end of a Model 7078-MTC cable will connect to the ROW A-H receptacle on the card.

Connector Kit Method (Models 7074-KIT and 7078-KIT) — These kits contain plugs that mate to the "rack and panel" receptacles, and they are designed for custom-built mass terminated cables. An alternative to building a complete cable from scratch is to cut the Model

Table 2-1. Cables, Receptacles, and Special Tools

Model or Part	Description
Model 7074-CIT: Extraction Tool	Used to remove wire crimp tails in 75-pin "rack and panel" plugs and receptacle
Model 7074-HCT: Hand Crimping Tool	Used to connect wire crimp tails to #18 to #26 gauge wire.
Model 7074-KIT: Connection Kit	Contains one "rack and panel" plug, housing and 80 wire crimp tail pins. Note: These pins are intended for use with #20 to #24 AWG wires.
Model 7074-MTC: Mass Terminated Cable	6-meter (20 ft.) 72 conductor cable terminated with 75-pin "rack and panel" plugs. Mates to "rack and panel" receptacles.
Model 7074-MTR: Mass Terminated Receptacle	Contains one 75-pin "rack and panel" receptacle and contact sockets. Note: These sockets are intended for use with #20 to #24 AWG wire.
Model 7078-CIT: Insertion and Extraction Tools	Used to install/remove wire crimp tails into/from 38-pin "rack and panel" plugs and receptacles.
Model 7078-HCT: Hand Crimping Tool	Used to connect wire crimp tails to #18 to #26 gauge wire.
Model 7078-KIT: Connection Kit	Contains one 38-pin "rack and panel" plug, housing, and 40 wire crimp tails.
Model 7078-MTC: Mass Terminated Cable	6-meter (20 ft.), 36 conductor cable terminated with "rack and panel" plugs. Mates to 38-pin "rack and panel" receptacles.
Model 7078-MTR: Mass Terminated Receptacle	38-pin "rack and panel" receptacle and contact pins.

NOTE: All Model 7074 numbers pertain to BANK receptacles/plugs. All Model 7078 numbers pertain to ROW receptacle/plug.

7074-MTC or 7078-MTC cable at a length that is suitable and then attach the plug to it.

WARNING

To avoid electrical shock, which could result in injury or death, make sure all power is off and stored energy in external circuitry is discharged before making any connections to the multiplexer card. Do not exceed the voltage and current ratings for the card or connecting cables as stated in the specifications and safety precautions at the front of this manual. Do not connect this card to unlimited power circuits or directly to ac mains. Install appropriate protection devices to limit fault currents from any supply connected to this card.

CAUTION

Contamination will degrade the performance of the multiplexer 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 "rack and panel" receptacles and plugs, do not touch areas adjacent to the electrical contacts.

2.6.2 Connection Methods Using Mass Terminated Cables

The Model 7074-MTC-20 is a 6-meter (20-foot), 75-conductor cable terminated with a 75-pin "rack and panel" plug on each end. This cable is used to connect the BANK (input) receptacles on the rear panel of the card to external equipment.

Similarly, the Model 7078-MTC-5 is a 1.5 meter (5-foot), 36-conductor cable terminated with a 38-pin "rack and panel" plug on each end. The Model 7078-MTC-20 is the same except that it is 6 meters (20 feet) in length. These cables are used to connect the ROW A-H receptacle on the rear panel of the card to external instrumentation and test circuits.

Direct Connections

Figure 2-14 shows how these cables can be used to connect inputs and outputs of the multiplexer card to external "rack and panel" receptacles. The external receptacles can then be hard wired to other connectors or wired directly to instrumentation and DUTs. See paragraph 2.6.4 for receptacle wiring information.

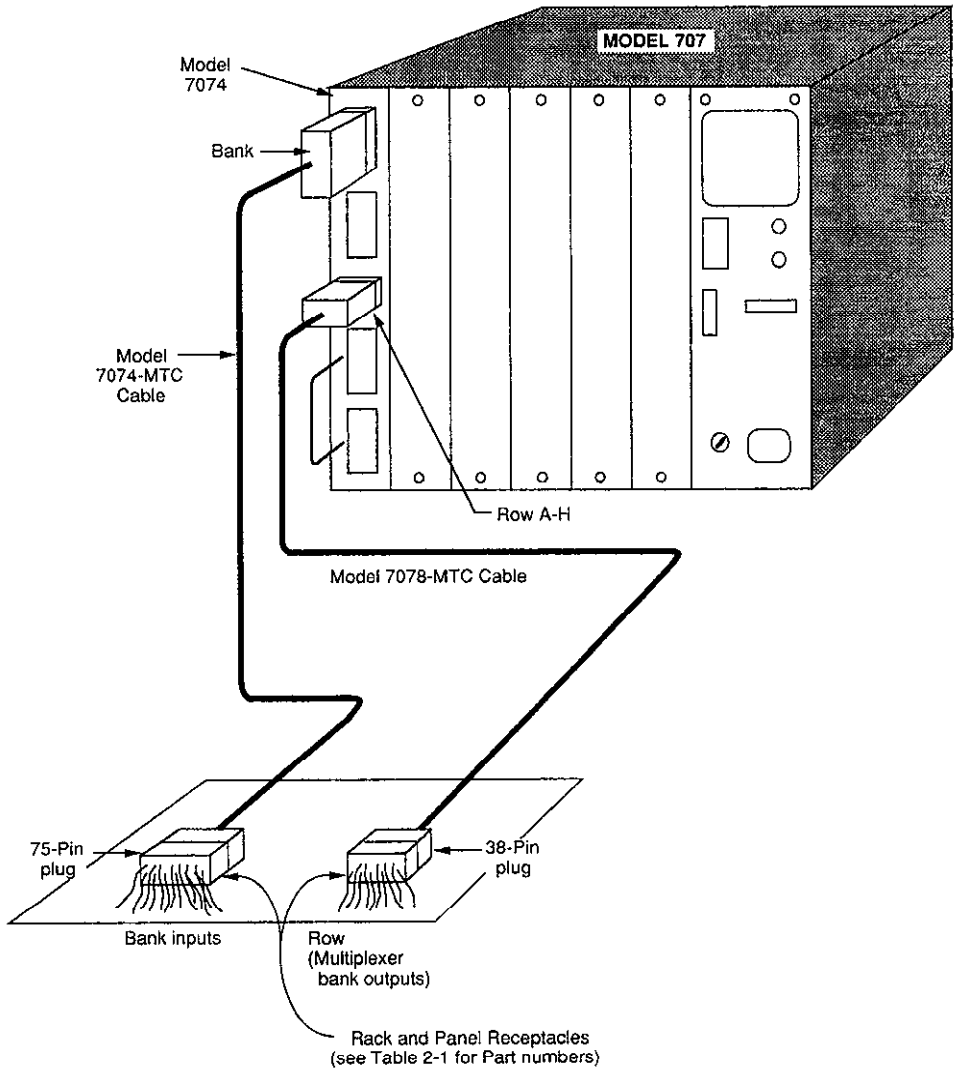


Figure 2-14. Connections Using Mass Terminated Cables

Connecting MTC Cables to the Multiplexer Card

Use the following procedure to connect the Model 7074-MTC and 7078-MTC cables to the multiplexer card:

1. Install the multiplexer card in the Model 707 mainframe as explained in paragraph 2.5.

WARNING
Turn off power to all instruments and discharge all capacitors before making connections. Do not connect the Model 7074 to unlimited power circuits or directly to ac mains. Install appropriate protection devices to limit fault currents from any supply connected to the multiplexer card.

CAUTION
Be careful not to bend the plug pins when making connections.

2. Place the plug of the cable on the appropriate "rack and panel" receptacle as shown in Figure 2-15 (BANK) or Figure 2-16 (ROW A-H). For the BANK (input) receptacles, align the two locking screws of the plug with the screws in the receptacle (male to female and female to male). For the ROW A-H receptacle, align the plug such that the large diameter keying pin of the plug fits into the large keyway of the receptacle.

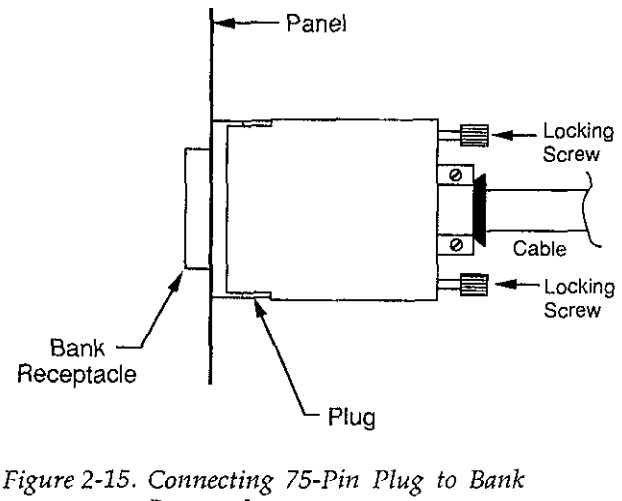


Figure 2-15. Connecting 75-Pin Plug to Bank Receptacle

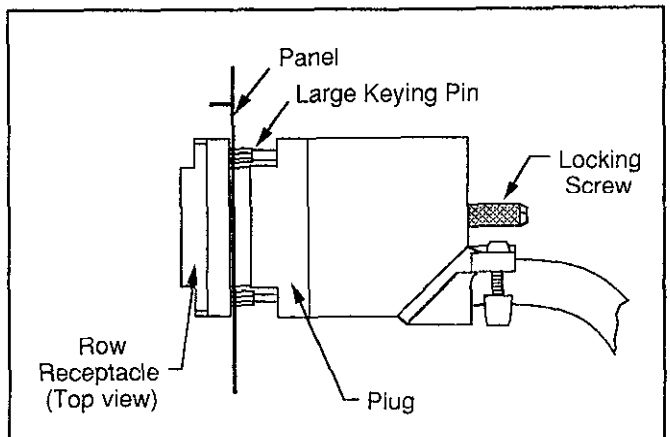


Figure 2-16. Connecting 38-Pin Plug to ROW Receptacle

3. Using a screwdriver, turn the locking screw(s) clockwise until the plug is fully mated to the receptacle (for the BANK plugs, both screws must be secured).

Disconnecting Cables

To disconnect a cable from the multiplexer card, first loosen the locking screw(s) completely using a screwdriver. Grasp the plug by its body, then wiggle it from side to side or with a slight rotary motion while pulling back on the plug.

CAUTION
Never pull on the cable itself. Always grasp the body of the plug to remove cables.

Cutting MTC Cables

Another way to use the Model 7074-MTC or 7078-MTC cables is to remove one of the plugs. Cutting the Model 7078-MTC-5 cable in half will provide two 2 1/2-foot cables. Cutting the Model 7074-MTC-20 or 7078-MTC-20 cable in half will provide two 10-foot cables. Each cable can then be mated to a BANK (input) or ROW receptacle, as shown in Figure 2-17.

The wire end of each cable can then be wired to another connector or wired directly to instrumentation or DUTs. Each cable contains bundles of wires each of which corresponds to a bank or channel. Each bundle contains three wires; a bare wire (guard) and two insulated wires that have a unique color combination for identification purposes, with one wire HI, and the other wire LO. Table 2-2 provides the color combinations for each bundle of the

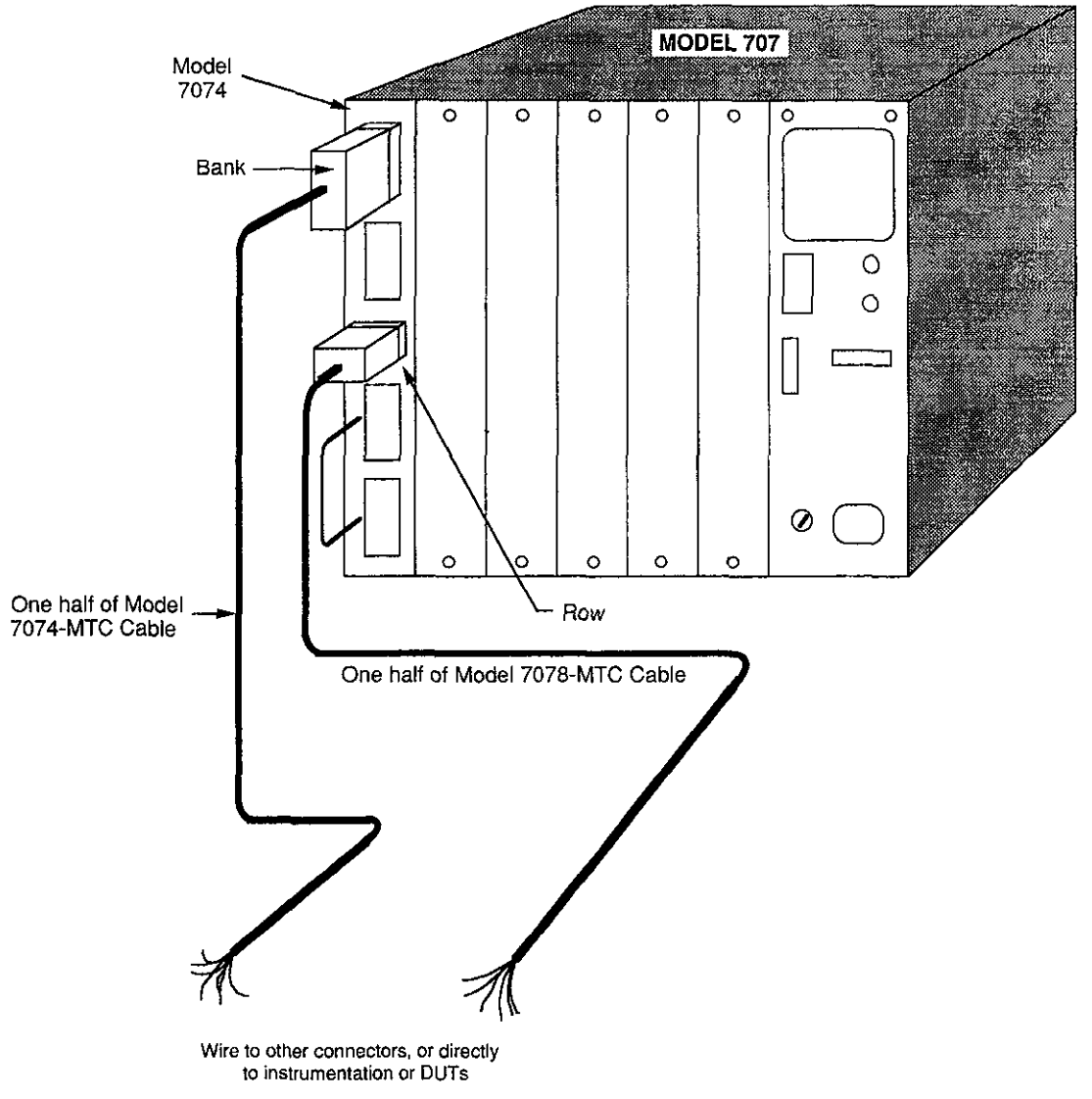


Figure 2-17. Connecting Method using MTC Cables Cut in Half

Model 7074-MTC (BANK) cables, and Table 2-3 summarizes the color coding for the Model 7078-MTC (ROW) cables.

WARNING

The three wires in the brown and white bundle should be collectively connected to common system ground of the test system to assure continued protection against a possible shock hazard. These wires are connected to Model 7074 chassis ground.

For example, with the cable connected to the ROW A-H receptacle of the multiplexer card, Bank E can be identified by locating the bundle that has a black insulated wire (H) and a brown insulated wire (L). The bare wire in the bundle is guard (G).

Insulating the Cable Wrappings

The outer wrapping of each bundle is insulated while the inner wrapping is conductive (guard). When the cable is cut, it is likely that the conductive side of the bundle wrapping will become exposed. Thus, each bundle, as well as each bare wire, should be insulated as outlined below.

Table 2-2. Model 7074-MTC Cable Color Codes

Input #*	Pin #	High	Pin #	Low	Pin #	Guard
A1	31	Green	37	Orange	25	Clear
A2	12	White	4	Blue	18	Clear
A3	28	Brown	34	Green	22	Clear
A4	8	Yellow	1	Green	15	Clear
A5	32	Orange	38	Black	26	Clear
A6	13	Blue	5	Black	20	Clear
A7	29	Red	35	Black	23	Clear
A8	10	Green	2	Black	16	Clear
A9	33	Green	39	White	27	Clear
A10	14	Green	7	Blue	21	Clear
A11	30	Red	36	Brown	24	Clear
A12	11	Red	3	Orange	17	Clear
B1	70	Yellow	76	White	62	Clear
B2	49	Black	43	Brown	55	Clear
B3	73	White	79	Orange	65	Clear
B4	52	Yellow	46	Black	58	Clear
B5	71	Yellow	77	Blue	63	Clear
B6	50	Red	44	White	56	Clear
B7	74	Blue	80	Brown	66	Clear
B8	53	Green	47	Red	59	Clear
B9	72	Blue	78	Red	64	Clear
B10	51	White	45	Black	57	Clear
B11	75	Orange	82	Blue	67	Clear
B12	54	Yellow	48	Red	60	Clear

*Designation refers to row and input number. A also applies to rows C, E, and G. B also applies to rows D, F, and H.

WARNING: Pins 40, 41, and 42 and brown/white cable bundle wires are earth ground and must be connected to plug shell.

Table 2-3. Model 7078-MTC Cable Color Codes

Wire Set	Terminal*	Insulation Color
ROW A	H	Black
	L	Blue
	G	Bare Wire
ROW B	H	Red
	L	Brown
	G	Bare Wire
ROW C	H	Black
	L	Red
	G	Bare Wire
ROW D	H	Red
	L	Yellow
	G	Bare Wire
ROW E	H	Black
	L	Brown
	G	Bare Wire
ROW F	H	Red
	L	Blue
	G	Bare Wire
ROW G	H	Black
	L	Orange
	G	Bare Wire
ROW H	H	Red
	L	Green
	G	Bare Wire

*H = High
L = Low
G = Guard

CAUTION

Each cable bundle must be insulated as covered below, or damage to instruments connected to the Model 7074 may result.

Procedure:

1. Place a length of Teflon® tubing over each bare wire.
2. Place a length of shrink tubing over the bundle such that the frayed end of the bundle wrapping is completely covered and part of the Teflon® tubing is covered.
3. Heat the shrink tubing.

2.6.3 Connection Method Using Connector Kits

The Models 7074-KIT and 7078-KIT each contain the parts of one "rack and panel" plug. The Model 7074-KIT contains a 75-pin plug and is intended to mate with one of the BANK (input) receptacles, while the Model 7078-KIT contains a 38-pin plug that mates with the ROW A-H receptacle. These kits will allow you to build your own custom cables that connect with the BANK (input) and ROW A-H receptacles on the Model 7074. For example, since a 1 × 96 configuration is not uncommon, it may be simpler to make your own cable because you would need only one paired cable instead of the eight provided by MTC cables.

The "rack and panel" plugs will mate to the receptacles on the multiplexer card in the same manner as the Model 7074-MTC and 7078-MTC cables. The other end of the cables can be wired directly to instrumentation or DUTs, or to other connectors.

Basically, there are two ways you can wire these cables: (1) use the same cables as those used with the MTC cables, and (2) wire up your own cables or groups of cables to the plugs. Each of these methods is discussed below.

ROW A-H Plug MTC Cable Wiring

NOTE

The following procedure shows how to properly connect a 36-conductor cable to a 38-pin plug. The cable used in the procedure is assumed to be the same one used in the Model 7078-MTC and is available from Belden (P/N 9734).

Perform the following steps to connect the 36-conductor Belden cable to the Model 7078-KIT plug:

1. Feed one end of the cable through the plug housing. Slide the housing far enough down the cable to set it out of the way.

NOTE

Refer to Figure 2-18 for the following cable preparation steps.

2. Using a sharp knife, remove 1-3/4" of insulation from the end of the cable. Be careful not to cut into

the insulated shield of any of the internal wire bundles.

3. Remove 1" of insulated shielding from each of the bundles of wires.
4. Insulate the bare guard wire of each bundle so that they do not short out to each other. The insulation must have a 200V UL rating.
5. Remove 1/8" of insulation from each of the insulated wires.
6. Using the Model 7078-HCT crimping tool, connect a wire crimp tail to each of the wires. The wires are #24 gauge so be sure to use the slot labeled "20-24" on the tool.
7. Insulate the locking screw of the plug with shrink tubing as shown in Figure 2-19.
8. Orient the cable to the plug as shown in Figure 2-19. Using Figure 2-20 as a guide, insert the wire crimp tails into the plug.

NOTE
Figure 2-20 shows where the wires of each bundle belong. The wires in each bundle have a unique color combination that is different from the color combination of any other bundle. The plug is shown from the cable side.

9. Slide the housing over the plug, and install the four screws that secure the housing to the plug.
10. Tighten the two cable clamp screws on the housing.

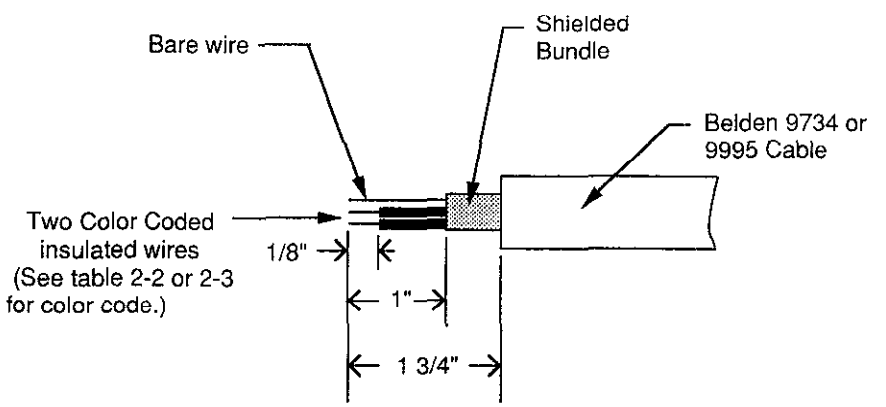


Figure 2-18. Cable Preparation

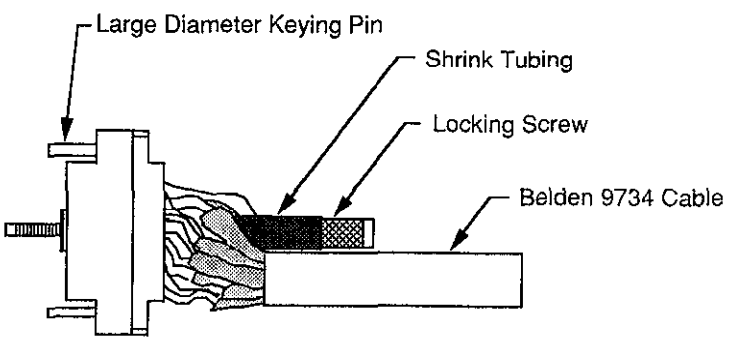


Figure 2-19. 38-Pin Plug Cable Position

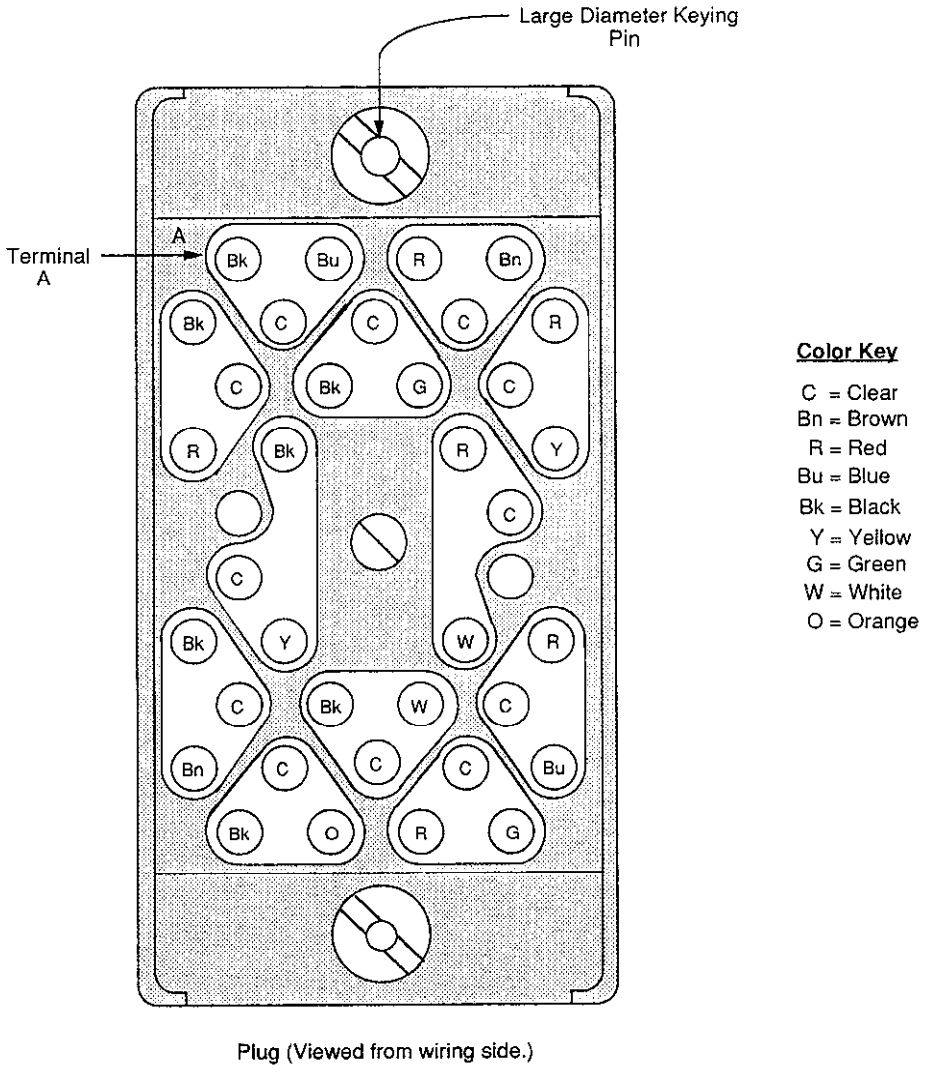


Figure 2-20. 38-Pin Plug (7078-KIT) Wire Color Coding

BANK Plug MTC Cable Wiring

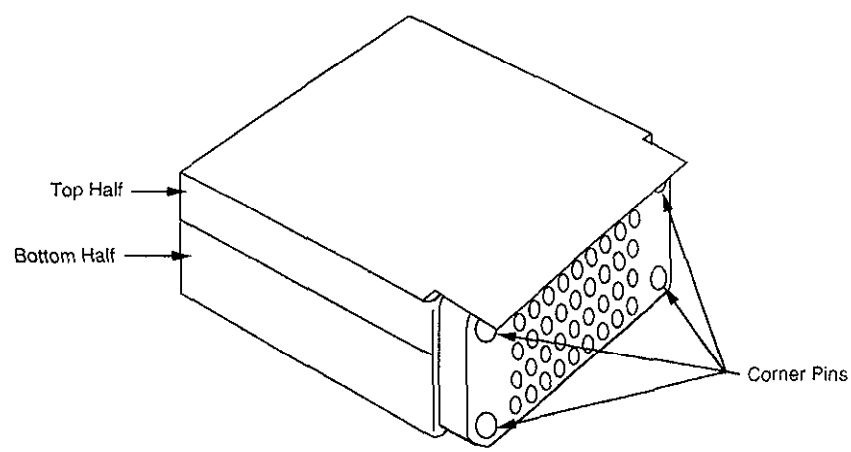
NOTE
The following procedure shows how to properly connect a 75-conductor cable to a 75-pin plug. The cable used in the procedure is assumed to be the same one used in the Model 7074-MTC and is available from Belden® (P/N 9995).

Perform the following steps to connect the 75-conductor Belden® cable to the Model 7074-KIT plug (see Figure 2-21):

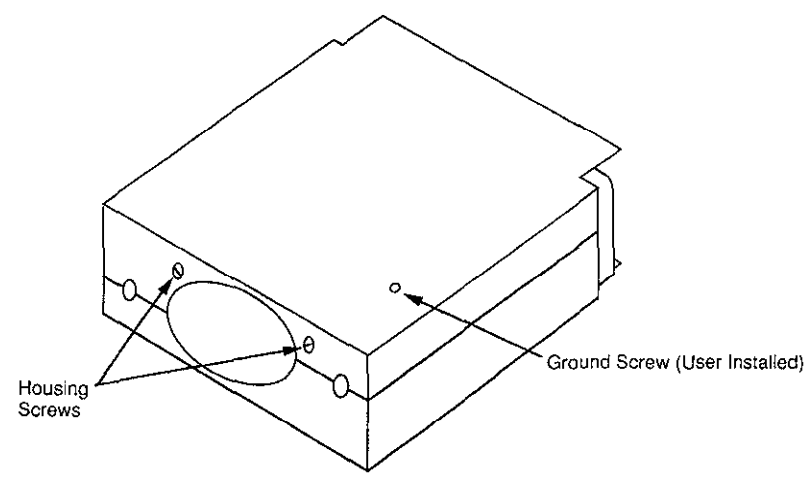
1. Cut the cable to the desired length.

NOTE
Refer to Figure 2-18 for cable preparation steps 2 through 5. These steps apply to all bundles except for the bundle with the brown and white wires, which will be connected to the plug housing shield.

2. Cut a 1" length of flexible plastic tubing with a 1/8" to 3/16" wall thickness, then place the tubing over the end of the cable, and push it out of way. This tubing will act as a strain relief bushing and give the cable clamp a better grip.



A. Front View



B. Rear View

Figure 2-21. 75-Pin Disassembly

3. Using a sharp knife, remove 1-3/4" of insulation from the end of the cable. Be careful not to cut into the insulated shield of any of the internal wire bundles.
4. Remove 1" of insulated shielding from each of the bundles of wires.
5. Insulate the bare guard wire of each bundle so that they do not short out to each other. The insulation must have a 200V UL rating.
6. Remove 1/8" of insulation from each of the insulated wires.
7. Using the Model 7074-HCT crimping tool, connect a wire crimp tail to each of the wires (except for the wires in the brown/white bundle). The wires are #24 gauge so be sure to use the slot labeled "20-24" on the tool.
8. Insulate the locking screws of the plug with shrink tubing as shown in Figure 2-22.
9. Orient the cable to the plug as shown in Figure 2-22. Using Figure 2-23 as a guide, insert the wire crimp tails into the plug.

NOTE

Figure 2-23 shows where the wires of each bundle belong. The wires in each bundle have a unique color combination that is different from the color combination of any other bundle. The plug is shown from the cable side.

10. Remove 1/8" of insulation from the insulated wires in the brown/white bundle, then twist all three wires from the brown/white bundle together. Crimp a screw lug onto the end of the twisted wires
11. Strip 1/8" of insulation from each end of three #22-24 gauge wires , then twist one end of the three

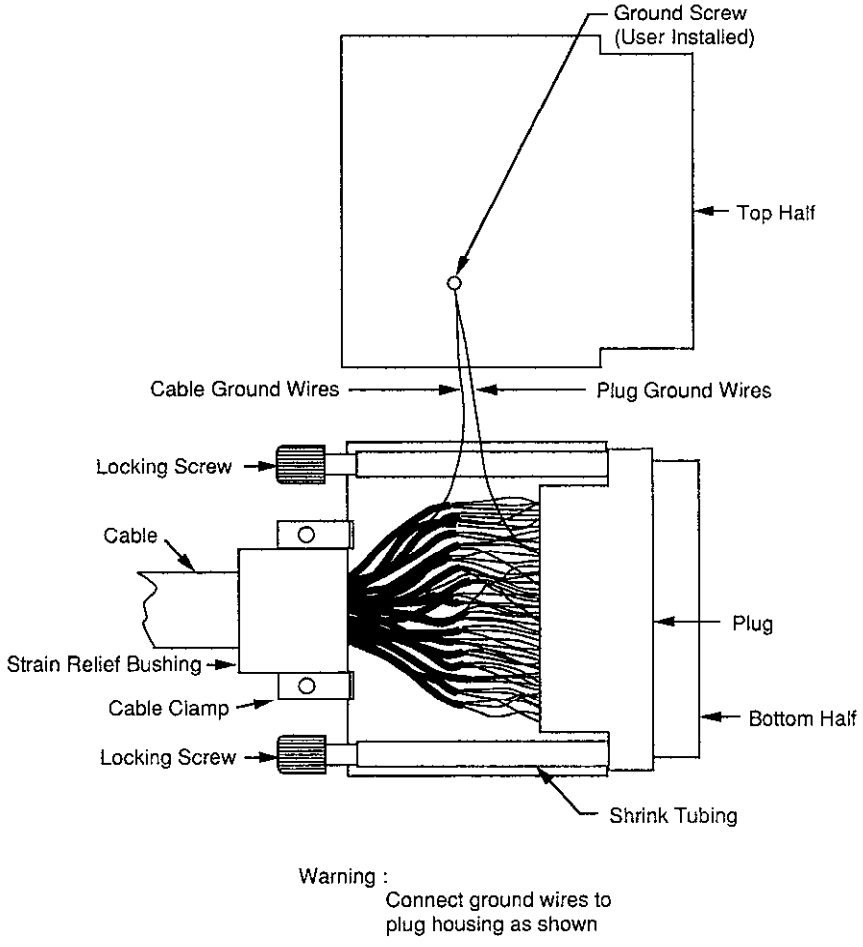
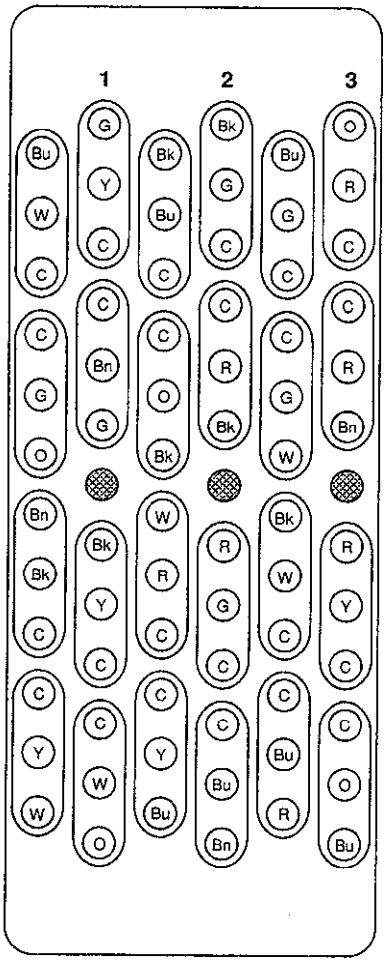


Figure 2-22. 75-Pin Plug Cable Positions



Color Key

C = Clear (Bare wire)
Bn = Brown
R = Red
Bu = Blue
Bk = Black
Y = Yellow
G = Green
W = White
O = Orange

Warning :

= Ground terminals
Connect these terminals and brown/white bundle wires from cable to plug shell (See text).

Figure 2-23. 75-Pin Plug (7074-KIT) Wire Color Colding

wires together, and crimp a screw lug onto the end of the twisted wires. Install wire crimp tails on the other ends of the three wires, then install the crimp tails into the chassis ground locations of the plug (see Figure 2-23).

12. Connect both sets of ground wires from steps 9 and 10 to the user-installed ground screw on the upper half of the housing (see Figure 2-22).

WARNING

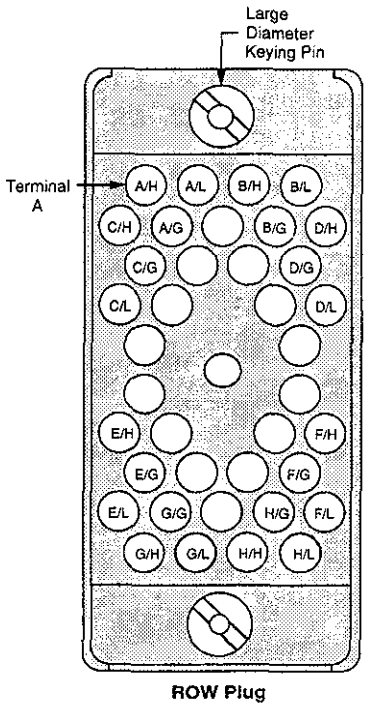
The cable and plug ground wires must be connected to the plug housing in order to ensure continued protection against a possible shock hazard.

13. Reassemble the housing on the plug body, put the bushing in place, then tighten the cable clamp screws around the bushing.

ROW A-H Plug Custom Cable Wiring

Use the procedure below to connect your own cable or groups of cables to the Model 7078-KIT plugs. Contact assignments for the Model 7078-KIT (ROW A-H) plug are shown in Figure 2-24.

1. Feed one end of the cable(s) through the plug housing. Slide the housing far enough down the cable to set it out of the way.



ROW Plug

Note : Use this drawing to connect custom cable to plug.

Contact	Row / Terminal
A/H	Bank A/High Terminal
A/L	Bank A/Low Terminal
A/G	Bank A/Guard Terminal
B/H	Bank B/High Terminal
B/L	Bank B/Low Terminal
B/G	Bank B/Guard Terminal
C/H	Bank C/High Terminal
C/L	Bank C/Low Terminal
C/G	Bank C/Guard Terminal
D/H	Bank D/High Terminal
D/L	Bank D/Low Terminal
D/G	Bank D/Guard Terminal

Contact	Row / Terminal
E/H	Bank E/High Terminal
E/L	Bank E/Low Terminal
E/G	Bank E/Guard Terminal
F/H	Bank F/High Terminal
F/L	Bank F/Low Terminal
F/G	Bank F/Guard Terminal
G/H	Bank G/High Terminal
G/L	Bank G/Low Terminal
G/G	Bank G/Guard Terminal
H/H	Bank H/High Terminal
H/L	Bank H/Low Terminal
H/G	Bank H/Guard Terminal

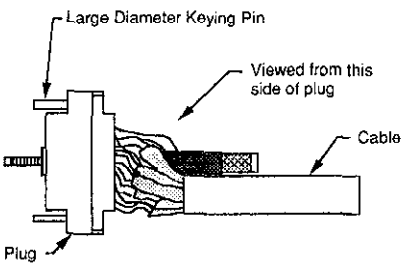


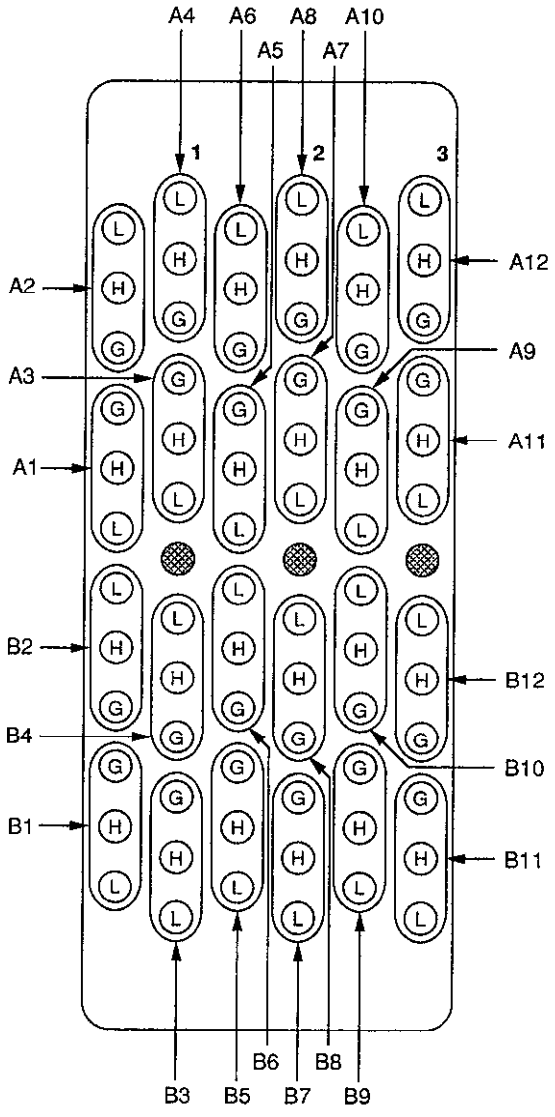
Figure 2-24. Model 7078-Kit (ROW A-H) Plug Contact Assignments

2. Using a sharp knife, remove 1-3/4" of insulation from the end of each cable. For shielded cables, be careful not to cut into the insulated shield of any of the internal wire bundles.
3. Remove 1" of insulated shielding from each of the cables or bundles of wires.
4. If you are using shielded cables, insulate the bare guard wire of each bundle so that they do not short out to each other. The insulation must have a 200V UL rating.
5. Remove 1/8" of insulation from each of the insulated wires.
6. Using the Model 7078-HCT crimping tool, connect a wire crimp tail to each of the wires. Be sure to use the correct slot for the gauge of the wire you are using.
7. Insulate the locking screw of the plug with shrink tubing as shown in Figure 2-19.
8. Using Figure 2-24 as a guide, insert the wire crimp tails into the plug.
9. Slide the housing over the plug and install the four screws that secure the housing to the plug.
10. Tighten the two cable clamp screws on the housing.

BANK Plug Custom Cable Wiring

Use the procedure below to connect your own cable or groups of cables to the Model 7074-KIT plugs. Contact assignments for the Model 7074-KIT (BANK) plug are shown in Figure 2-25. Figure 2-21 and Figure 2-22 show the plug configurations and assembly.

1. Disassemble the plug housing (see Figure 2-21), then slide the cable end(s) through the cable clamp.
2. Using a sharp knife, remove 1-3/4" of insulation from the end of each cable. For shielded cables, be careful not to cut into the insulated shield of any of the internal wire bundles.



NOTES

1. H=HI, L=LO, G=GUARD
2. A refers to Bank A; also applies to Banks C, E, and G.
3. B refers to Bank B, also applies to Banks D, F, and H.
4. Plug is viewed from wiring side.

WARNING :

= Chassis ground. Connect to plug shell and grounding wires in cable. (See text).

Figure 2-25. Model 7074-KIT (Bank) Plug Contact Assignments

3. Remove 1" of insulated shielding from each of the cables or bundles of wires.
4. If you are using shielded cables, insulate the bare guard wire of each bundle so that they do not short out to each other. The insulation must have a 200V UL rating.
5. Remove 1/8" of insulation from each of the insulated wires.
6. Using the Model 7074-HCT crimping tool, connect a wire crimp tail to each of the wires. Be sure to use the correct slot for the gauge of the wire you are using.
7. Insulate the locking screws of the plug with shrink tubing as shown in Figure 2-22.
8. Using Figure 2-25 as a guide, insert the wire crimp tails into the plug.
9. Remove 1/8" of insulation from three insulated wires in your cable then twist all three wires together. Crimp a screw lug onto the end of the twisted wires. Note that these three wires are to be dedicated ground wires and must not be used as signal lines. At the DUT or instrument end, these wires should be connected to chassis ground.

10. Strip 1/8" of insulation from each end of three 2-1/2" #22-24 gauge wires, then twist one end of the three wires together, and crimp a screw lug onto the end of the twisted wires. Install wire crimp tails on the other ends of the three wires, then install the crimp tails into the chassis ground locations of the plug (see Figure 2-25).
11. Connect both sets of ground wires (via the screw lugs) from steps 9 and 10 to the user-installed ground screw on the upper half of the housing (see Figure 2-22).

WARNING

The ground wires must be connected to the plug housing in order to ensure continued protection against shock hazards.

12. Reassemble the plug housing on the plug, then tighten the screws on the cable clamp.

2.6.4 Wiring Receptacles (Models 7074-MTR and 7078-MTR)

The Models 7074-MTR and 7078-MTR receptacle kits contain "rack and panel" receptacles that are intended to mate with the MTC cable plugs as well as the plugs in the KIT connector kits. The Model 7074-MTR mates with BANK cables plugs, and the Model 7078-MTR mates with ROW A-H cable plugs. These receptacles provide a convenient way to connect the multiplexer card to test fixtures and instruments on your test setup.

Follow the general procedure below to connect wires to one of the "rack and panel" receptacles. Note that special crimp and insertion tools are recommended for this procedure (see Table 2-1).

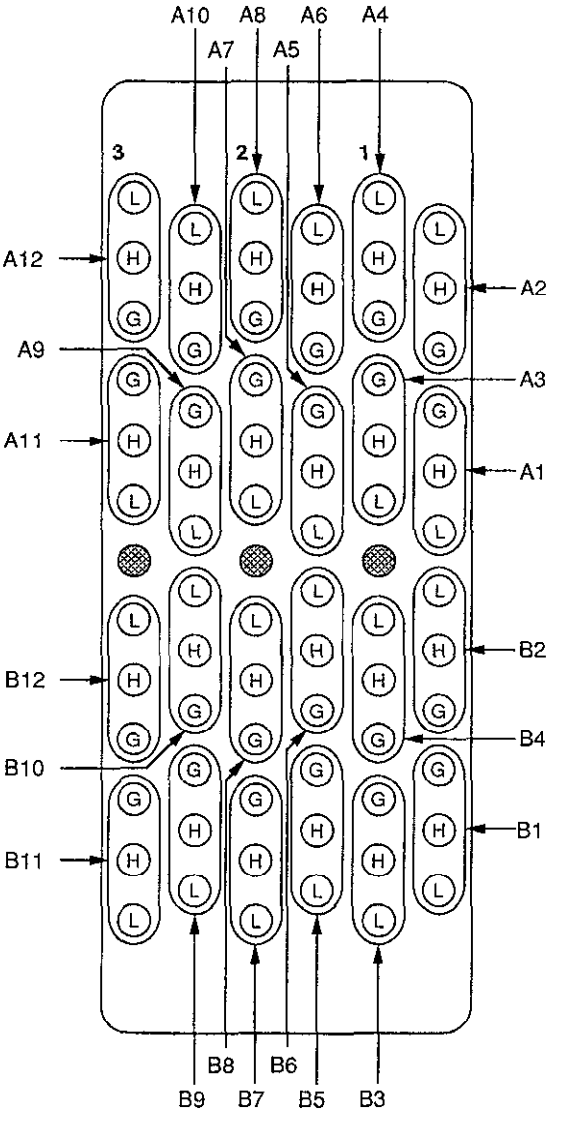
1. Remove 1/8"of insulation from the wires that are to be connected to the receptacle.
2. Using the Model 7074-HCT or 7078-HCT crimping tool, connect a wire crimp tail to each of the wires.
3. Figure 2-26 provides contact identification for BANK (input) receptacles, and Figure 2-27 illustrates ROW A-H receptacles. Using these illustrations as a guide, insert the wire crimp tails into the receptacle. Use the 7078-CIT insertion tool to push each wire crimp tail completely into the receptacle. No insertion tool is required for the Model 7074-MTR receptacles. Contacts may be inserted by hand or with needle nose pliers.

WARNING

The three ground terminals on 75-pin (BANK) receptacles must be connected to DUT test fixture or instrument chassis ground to ensure continued protection against possible shock hazards.

NOTE

Figure 2-26 and Figure 2-27 show the receptacles as viewed from the wiring side of the receptacles.

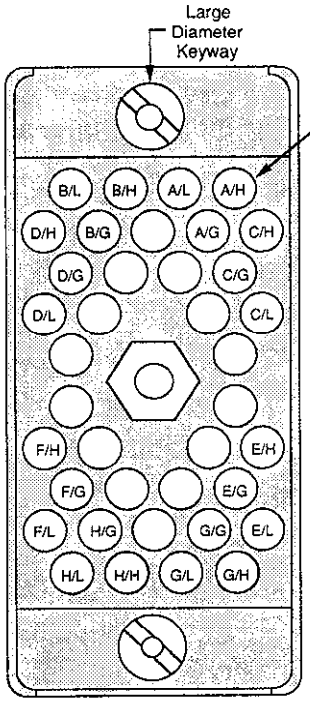


NOTES

1. Receptacle viewed from wiring side.
2. H=HI, L=LO, G=GUARD
3. A refers to Bank A; also applies to Banks C, E, and G.
4. B refers to Bank B, also applies to Banks D, F, and H.
5. Number = input number (e.g. A12 = Bank A, input 12)

WARNING : Shaded dots indicate connection for earth ground. Connect these terminals to instrument or test fixture chassis ground.

Figure 2-26. Bank Receptacle Connector (Wiring side view)



Row Receptacle

Contact	Row / Terminal
A/H	Row A/High Terminal
A/L	Row A/Low Terminal
A/G	Row A/Guard Terminal
B/H	Row B/High Terminal
B/L	Row B/Low Terminal
B/G	Row B/Guard Terminal
C/H	Row C/High Terminal
C/L	Row C/Low Terminal
C/G	Row C/Guard Terminal
D/H	Row D/High Terminal
D/L	Row D/Low Terminal
D/G	Row D/Guard Terminal

Contact	Row / Terminal
E/H	Row E/High Terminal
E/L	Row E/Low Terminal
E/G	Row E/Guard Terminal
F/H	Row F/High Terminal
F/L	Row F/Low Terminal
F/G	Row F/Guard Terminal
G/H	Row G/High Terminal
G/L	Row G/Low Terminal
G/G	Row G/Guard Terminal
H/H	Row H/High Terminal
H/L	Row H/Low Terminal
H/G	Row H/Guard Terminal

Note : Viewed from wiring side of receptacle

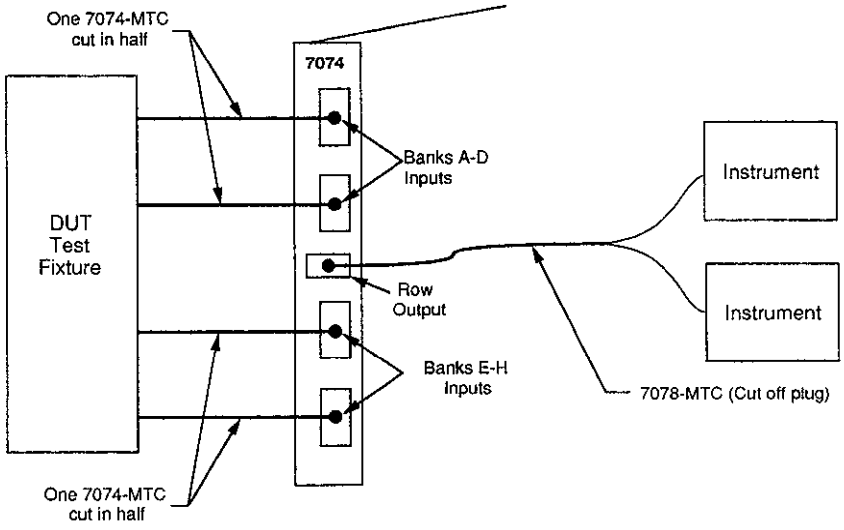
Figure 2-27. ROW A-H Receptacle Connector

2.7 TYPICAL CONNECTION SCHEMES

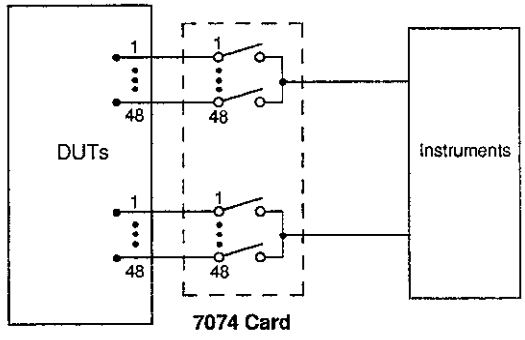
The following paragraphs discuss typical schemes to connect Model 7074 cards to other instrumentation. Single card and multiple-card systems are discussed as are typical connections to a Model 7071 or 7071-4 General Purpose Matrix Card.

2.7.1 Single Mainframe, Single Multiplexer Card System

Figure 2-28 shows typical connections for a single multiplexer card system. In this example, the instruments are connected to the row outputs, and the DUTs are connected to the bank inputs. This configuration would allow you to test a large number of devices with the same instrument or group of instruments.



A. Connections



B. Simplified Equivalent Circuit

Figure 2-28. Single Card System Example

Note that Model 7074-MTC cables cut in half are used for the DUT connections (two such cables cut in half provide four connecting cables). A single Model 7078-MTC cable with one plug cut off is used to connect the instruments to the bank outputs. As an alternative to this arrangement, you could wire a Model 7078-MTR receptacle and then connect the MTC cable to that receptacle.

2.7.2 Expanding the Multiplexer Using Multiple Cards

The number of input channels on the multiplexer can be expanded by adding more Model 7074 cards to the system. For example, three Model 7074 cards, properly configured, will give you one of the following configurations of 3-pole switching:

- One 1 × 288 multiplexer
- Two 1 × 144 multiplexers
- Four 1 × 72 multiplexers
- Eight 1 × 36 multiplexers

Figure 2-29 shows a typical system using three Model 7074 Multiplexer Cards. In this instance, the DUTs are connected to the multiplexer inputs, while the instruments are connected to the row outputs. This arrangement provides one 1 × 288 multiplexer.

In addition to the connections shown, the backplane jumpers on each card must be installed for each set of banks to be paralleled (note that no external bank jumpering is required because the banks are automatically connected together through the 3-pole general purpose backplane when appropriate backplane jumpers are installed). Also, you must install the bank jumpers for the desired bank configuration.

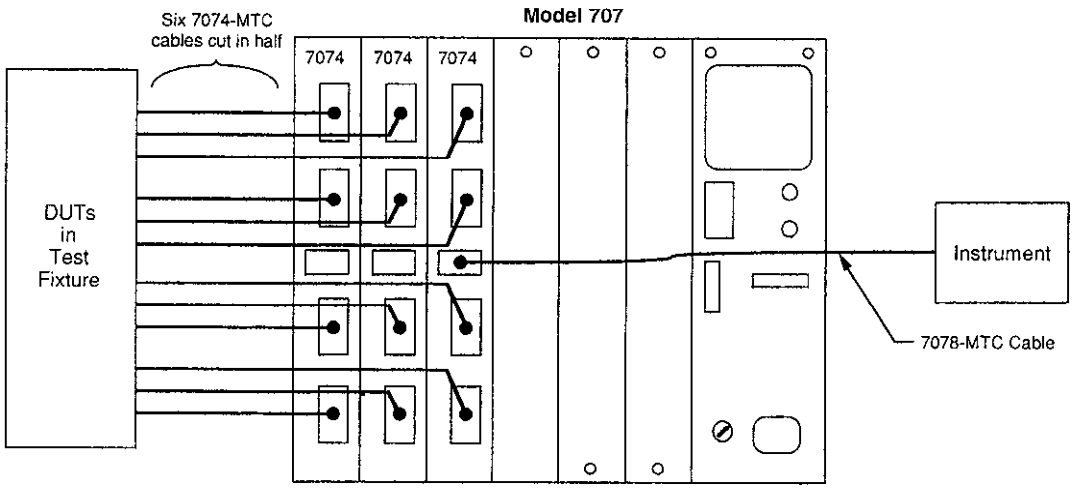
2.7.3 Using the Multiplexer with Matrix Cards

The Model 7074 can be used in conjunction with Model 7071 or Model 7071-4 Matrix cards to add additional switching capabilities to their matrices. As shown in Figure 2-30, connections from the row outputs of the multiplexer card to the rows of the Model 7071 Matrix Card can be made internally through the 3-pole general purpose backplane by installing the backplane jumpers on the multiplexer card.

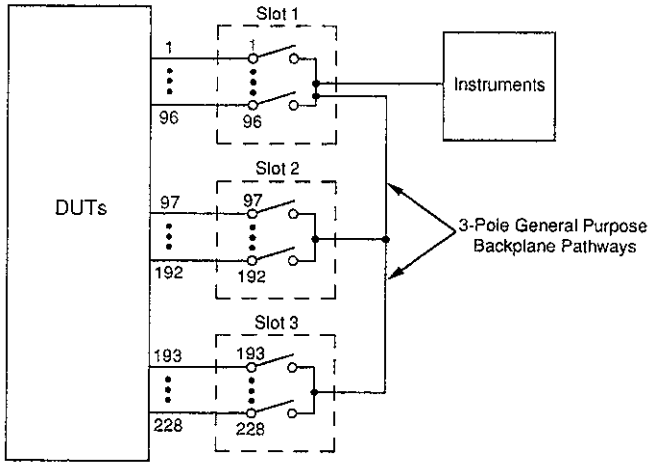
If the two cards are located in different mainframes, the necessary connections between the two cards can be made by using a Model 7078-MTC cable, as shown in Figure 2-31. In this example, the multiplexer card is being used with a Model 7071-4 Dual 4 × 12 Matrix Card, which is configured as a 4 × 24 matrix using on-card jumpers (the Model 7071-4 can also be used as one 8 × 12 or two separate 4 × 12 matrices). Note that Model 7074 ROW A-H is connected to the ROW receptacle on the Model 7071-4 using a Model 7078-MTC cable.

CAUTION

If any bank-to-bank jumpers are installed, the corresponding matrix card rows may be shorted together if the same backplane jumpers are installed. Similarly, rows can be shorted through a Model 7078-MTC cable connected between Model 7074 ROW A-H and Model 7071 or 7071-4 ROW. To avoid shorting matrix card rows, remove all Model 7074 bank-to-bank jumpers.

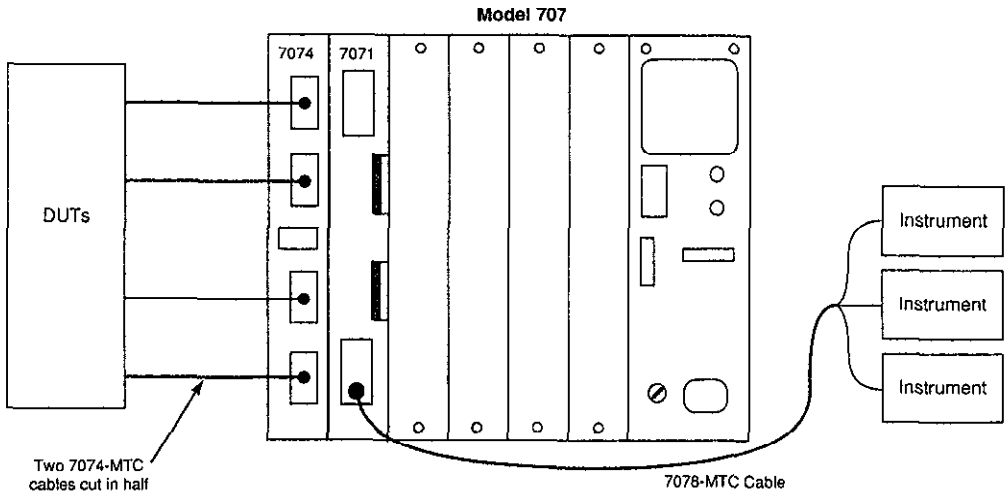


A. Connections

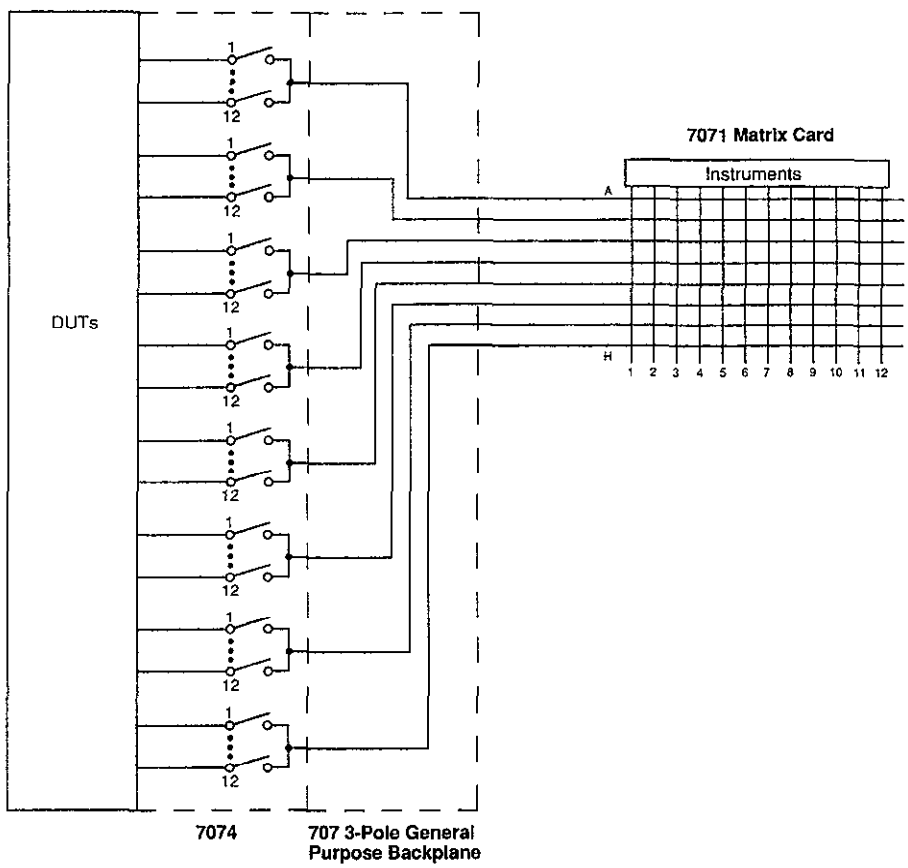


B. Simplified Equivalent Circuit

Figure 2-29. Multiple Card System Example



A. Connections



B. Equivalent Circuit

Figure 2-30. Using the Multiplexer with a Model 7071 Matrix Card

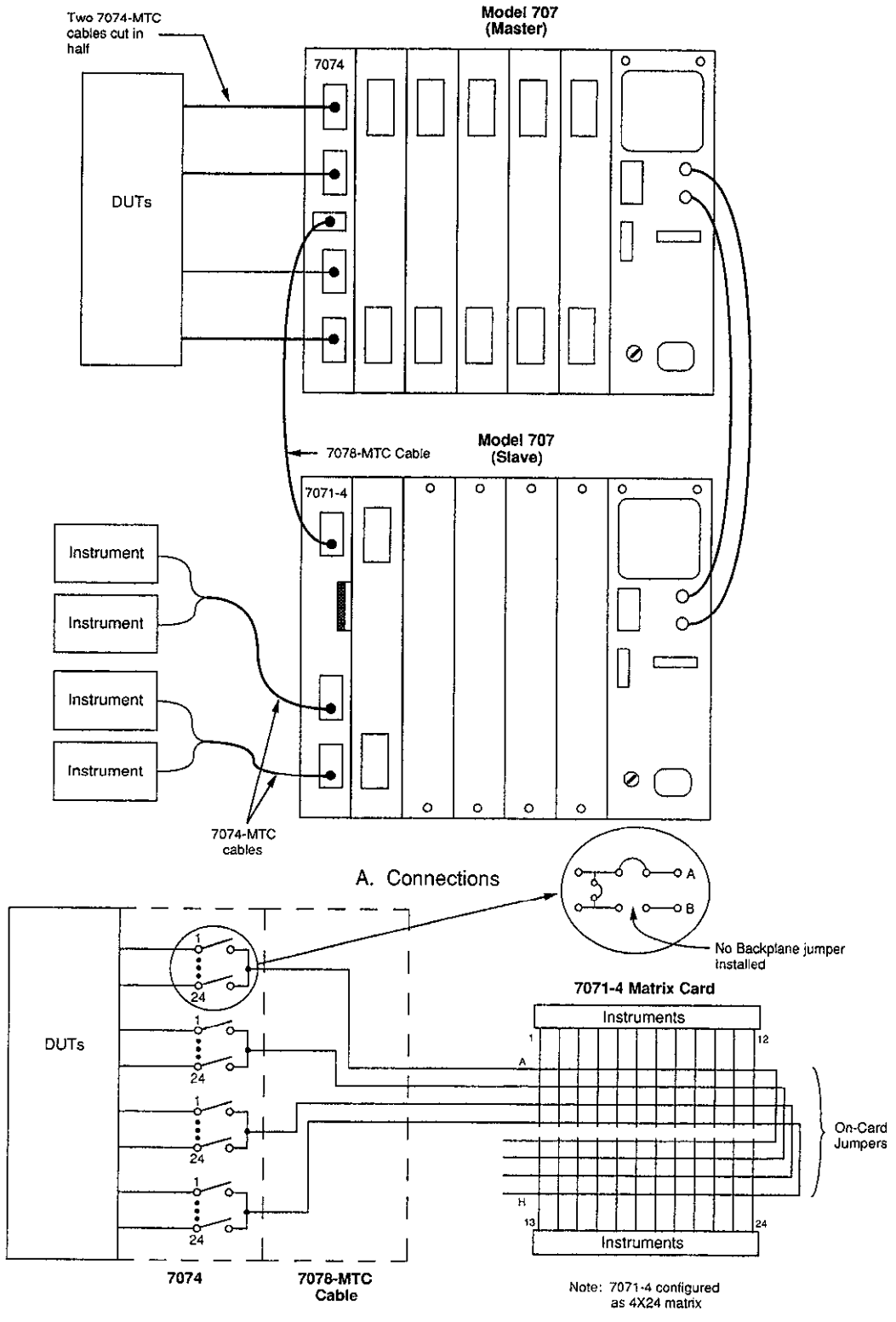


Figure 2-31. Using the Multiplexer with a Model 7071-4

2.8 MULTIPLEXER PROGRAMMING

Use the following general procedure to program the multiplexer card from the Model 707 Switching Matrix, either from the front panel, or over the IEEE-488 bus. For detailed programming information, refer to the Model 707 Instruction Manual.

2.8.1 Banks and Rows

As discussed in paragraph 2.4.2, the Model 7074 is configured as eight banks of multiplexers, each of which has 12 inputs. The banks are in rows A through H, and the inputs are 1 through 12 inclusive.

When programming the multiplexer card from the Model 707 Switching Matrix, keep in mind that bank rows on the Model 7074 correspond to rows on the mainframe. Similarly, bank inputs on the multiplexer correspond to columns on the mainframe. For example, assume that you wish to close the bank D, input 8 relay. You would then select row D, column 8 for closure on the mainframe.

2.8.2 Front Panel Multiplexer Programming Procedure

Follow the general procedure below to manually close and open specific bank, input relays. For automatic sequencing from the front panel, store each bank and input as a setup in successive memory locations; see the Model 707 Instruction Manual for complete details.

1. Press RESET to return the Model 707 to default operating conditions.
2. Select AUTOMATIC relay operation.
3. Using the front panel buttons, key in the desired bank and input, then press the CLOSE key. For example, to close bank A, input 12, press: A 1 2 CLOSE. Note that the mainframe displays the closed bank and input in row-column format on the front-panel display.
4. To open the presently selected bank and input, simply press the OPEN key.
5. Repeat steps 3 and 4 for all required bank inputs and rows in the desired sequence.

2.8.3 IEEE-488 Bus Programming

Send the commands in the sequence below to close specific bank inputs and rows on the Model 7074. Refer to Section 4 of the Model 707 Instruction Manual for detailed IEEE-488 programming information.

1. Send the command "R0X" to return the Model 707 to default operating conditions.
2. Send the command letter "C" followed by the row, input combination to be closed. For example, to close row A, input 11, send the command string "CA11X". Note that relay will close when the command is received.
3. To open the relay, use the "N" command followed by the row and input. For example, send "NA12X" to open row A, input 12. The relay will open when the command is received by the mainframe.

Example Program 1: Single-bank Scanning

The program below demonstrates the basic techniques for scanning through all 12 channels of a specific bank (bank A in this example). The program, which is written in Hewlett-Packard BASIC 4.0, incorporates a fixed delay of one second for settling time. Typically, code for the measurement instrument would be placed immediately after the WAIT statement used for the delay.

PROGRAM		COMMENTS
10	REMOTE 718	Put 707 in remote.
20	OUTPUT 718 ;"R0X"	Reset 707.
30	FOR I = 1 TO 12	Loop for all 12 channels.
40	OUTPUT 718 ;"CA";I;"X"	Close row A, input I.
50	WAIT 1	One second settling time.
60	REM USER'S MEASUREMENT CODE	Insert measurement code here.
70	OUTPUT 718 ;"NA";I;"X"	Open row A, input I.
80	NEXT I	Loop back for next channel.
90	END	

Example Program 2: Multiple-bank Scanning

The program below, which is also written in HP BASIC 4.0, demonstrates how to scan through all 96 channels in sequence. The sequence starts with bank A, scans through all 12 inputs, and then continues with banks B through H in sequence. Again, a fixed settling time of one second is included after the relay is closed. Code for the measurement instrument would typically be added im-

mediately after the WAIT statement that defines the settling time.

PROGRAM		COMMENTS
10	REMOTE 718	Put 707 in remote.
20	FOR I = 65 TO 72	Loop for A-H ASCII values.
30	FOR J = 1 TO 12	Loop for all 12 inputs.
40	OUTPUT 718 ; "C";CHR$(I);J;"X"	Close row CHR$(I), input J.
50	WAIT 1	Wait one second settling time.
60	REM USER'S MEASUREMENT CODE	Insert measurement code here.
70	OUTPUT 718 ;"N";CHR$(I);J;"X"	Open row CHR$(I), input J.
80	NEXT J	Loop back for next channel.
90	NEXT I	Loop back for next bank.
100	END	

2.9 MEASUREMENT CONSIDERATIONS

Many measurements made with the Model 7074 are subject to various types of noise that can affect measurement accuracy. The following paragraphs discuss possible noise sources that might affect these measurements and ways to minimize their effects.

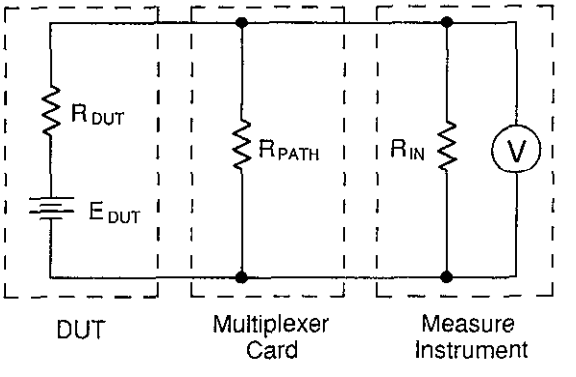
2.9.1 Path Isolation

The path isolation is simply the equivalent impedance between any two test paths in a measurement system. Ideally, the path isolation should be infinite, but the actual resistance and distributed capacitance of cables and connectors results in less than infinite path isolation values for these devices.

Path isolation resistance forms a signal path that is in parallel with the equivalent resistance of the DUT, as shown in Figure 2-32. For low-to-medium device resistance values, path isolation resistance is seldom a consideration; however, it can seriously degrade measurement accuracy when testing high-impedance devices. The voltage measured across such a device, for example, can be substantially attenuated by the voltage divider action of the device source resistance and path isolation resistance, as shown in Figure 2-33. Also, leakage currents can be generated through these resistances by voltage sources in the system.

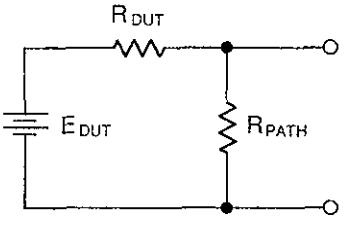
Any differential isolation capacitance affects dc measurement settling time as well as ac measurement accuracy. Thus, it is often important that such capacitance be kept as low as possible. Although the distributed capacitance of the multiplexer card is generally fixed by design, there is one area where you do have control over the capacitance in your test system: the connecting cables. To minimize capacitance, keep all cables as short as possible.

The effects of path resistance and capacitance can be minimized by using guarding whenever possible. Paragraph 2.9.7 discusses guarding in more detail.



R_{DUT} = Source Resistance of DUT
E_{DUT} = Source Resistance of DUT
R_{PATH} = Path Isolation Resistance
R_{IN} = Input Resistance of Measuring Instrument

Figure 2-32. Path Isolation Resistance



$$E_{OUT} = \frac{E_{DUT} R_{PATH}}{R_{DUT} + R_{PATH}}$$

Figure 2-33. Voltage Attenuation by Path Isolation Resistance

2.9.2 Magnetic Fields

When a conductor cuts through magnetic lines of force, a very small current is generated. This phenomenon will frequently cause unwanted signals to occur in the test leads of a switching matrix system. If the conductor has sufficient length, even weak magnetic fields can create sufficient signals to affect low-level measurements. Although such effects can occur with dc signals when conductors are moved, they are usually more pronounced with ac sources.

Two ways to reduce these effects are: (1) reduce the lengths of the test leads, and (2) minimize the exposed circuit area. In extreme cases, magnetic shielding may be required. Special metal with high permeability at low flux densities (such as mu metal) are effective at reducing these effects.

Even when the conductor is stationary, magnetically-induced signals may still be a problem. Fields can be produced by various signals such as the ac power line voltage. Large inductors such as power transformers can generate substantial magnetic fields, so care must be taken to keep the switching and measuring circuits a good distance away from these potential noise sources.

At high current levels, even a single conductor can generate significant fields. These effects can be minimized by using twisted pairs, which will cancel out most of the resulting fields.

2.9.3 Electromagnetic Interference (EMI)

The electromagnetic interference characteristics of the Model 7074 General Purpose Multiplexer Card comply with the electromagnetic compatibility (EMC) requirements of the European Union as denoted by the CE mark. However, it is still possible for sensitive measurements to be affected by external sources. In these instances, special precautions may be required in the measurement setup.

Sources of EMI include:

- radio and television broadcast transmitters
- communications transmitters, including cellular phones and handheld radios
- devices incorporating microprocessors and high speed digital circuits
- impulse sources as in the case of arcing in high-voltage environments

The effect on instrument performance can be considerable if enough of the unwanted signal is present.

The equipment and signal leads should be kept as far away as possible from any EMI sources. Additional shielding of the multiplexer card, signal leads, measuring instruments, and sources will often reduce EMI to an acceptable level. In extreme cases, a specially constructed screen room may be required to sufficiently attenuate the troublesome signal. Connecting unused shields to ground may also help.

Many instruments incorporate internal filtering that may help to reduce RFI effects in some situations. In some cases, external filtering may also be required. Such filtering, however, may have detrimental effects on the desired signal.

2.9.4 Ground Loops

When two or more instruments are connected together, care must be taken to avoid unwanted signals caused by ground loops. Ground loops usually occur when sensitive instrumentation is connected to other instrumentation with more than one signal return path such as power line ground. As shown in Figure 2-34, the resulting ground loop causes current to flow through the instrument LO signal leads and then back through power line ground. This circulating current develops a small but undesirable voltage between the LO terminals of the two instruments. This voltage will be added to the source voltage, affecting the accuracy of the measurement.

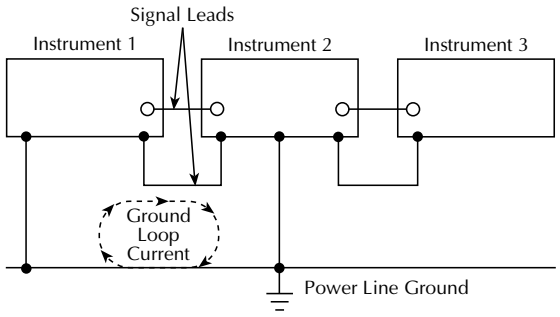


Figure 2-34. Power Line Ground Loops

Figure 2-35 shows how to connect several instruments together to eliminate this type of ground loop problem. Here, only one instrument is connected to power line ground.

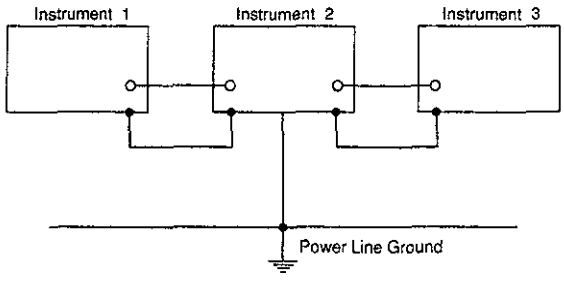


Figure 2-35. Eliminating Ground Loops

Ground loops are not normally a problem with instruments having isolated LO terminals. However, all instruments in the test setup may not be designed in this manner. When in doubt, consult the manual for each instrumentation in the test setup.

2.9.5 Keeping Connectors Clean

As is the case with any high-resistance device, the integrity of connectors can be damaged if they are not handled properly. If the connector insulation becomes contaminated, the insulation resistance will be substantially reduced, affecting high-impedance measurement paths.

Oils and salts from the skin can contaminate connector insulators, reducing their resistance. Also, contaminants present in the air can be deposited on the insulator surface. To avoid these problems, never touch the connector insulating material. In addition, the multiplexer card should be used only in clean, dry environments to avoid contamination.

If the connector insulators should become contaminated, either by inadvertent touching, or from air-borne deposits, they can be cleaned with a cotton swab dipped in clean methanol. After thorough cleaning, they should be allowed to dry for several hours in a low-humidity environment before use, or they can be dried more quickly using dry nitrogen.

2.9.6 Shielding

Proper shielding of all signal paths and devices under test is important to minimize noise pickup in virtually any switching system. Otherwise, interference from such noise sources as line frequency and RF fields can seriously corrupt a measurement.

In order for shielding to be effective, the shield surrounding HI and LO signal paths should be connected to signal LO at the test instrument (or chassis ground for instruments without isolated LO terminals). Figure 2-36 shows an example of shielding. Note, however, that the shield should not be connected to LO or ground if the shield is to be driven at guard potential; guarding is discussed in the following paragraph. Also, shields should not be allowed to float, even if signal leads are not connected.

2.9.7 Guarding

Guarding is important in high-impedance circuits where leakage resistance and capacitance could have degrading

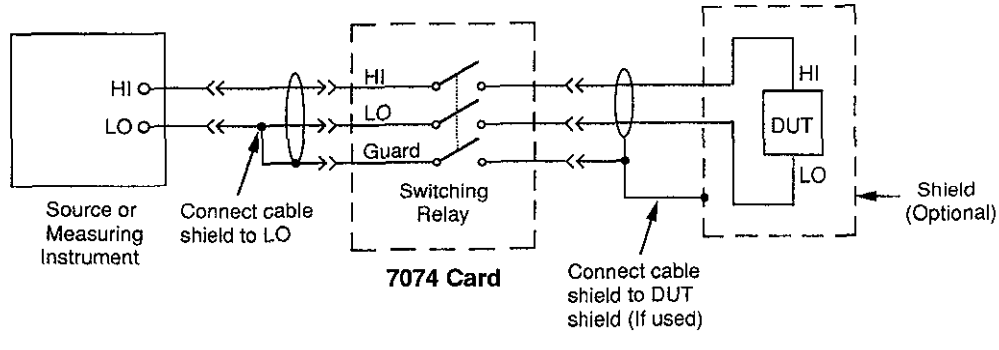


Figure 2-36. Shielding Example

effects on the measurement. Guarding consists of using a shield surrounding the conductors that are carrying the high-impedance signal. This shield is driven by a low-impedance amplifier to maintain the shield at signal potential. For the mass terminated cables, the shield that surrounds each twisted pair can be separately guarded.

Guarding minimizes leakage resistance effects by driving the cable shield with a unity-gain amplifier, as shown in Figure 2-37. Since the amplifier has a high input impedance, it minimizes loading on the high-impedance signal lead. Also, the low output impedance ensures that the shield remains at signal potential, so that virtually no leakage current flows through the leakage resistance, RL.

In a similar manner, guarding also reduces the effective cable capacitance, resulting in much faster measurements on high-impedance circuits. If instrument zero check is enabled before measurement, any distributed capacitance is charged through the low impedance of the buffer amplifier rather than by the source, settling times are shortened considerably by guarding.

In order to use guarding effectively with the Model 7074, the cable shield for the signal pair to be guarded should be connected to the guard output of the sourcing or measuring instrument. Figure 2-38 shows typical connections. Guard should be properly carried through as close as possible to the device under test to be completely effective. Typically, a guard shield around the DUT is used, as shown in Figure 2-38.

WARNING

Be sure that all cable shields carrying guard are properly insulated to avoid possible personal contact with hazardous guard voltages. If a guard shield around the DUT is used, an earth-grounded safety shield, surrounding guard, must be provided to avoid a possible shock hazard.

2.9.8 Multiple Card Considerations

Several cards installed in one mainframe can be connected together to expand the multiplexer or to add multiplexing capability to Model 7071 Matrix Cards. When properly configured with the backplane jumpers, the banks of these cards are routed through the 3-pole general purpose backplane of the mainframe.

Since connecting two or more cards together effectively parallels the pathways, some degradation in card specifications can be expected when connecting two or more cards together to expand a multiplexer or matrix, as the case may be. For that reason, the specifications for the Model 7074 given at the front of this manual are applicable only with one card that uses the same backplane pathways installed in the mainframe.

2.9.9 AC Frequency Response

The AC frequency response of the Model 7074 is important to those who are switching AC signals. The following paragraphs discuss a test configuration for determin-

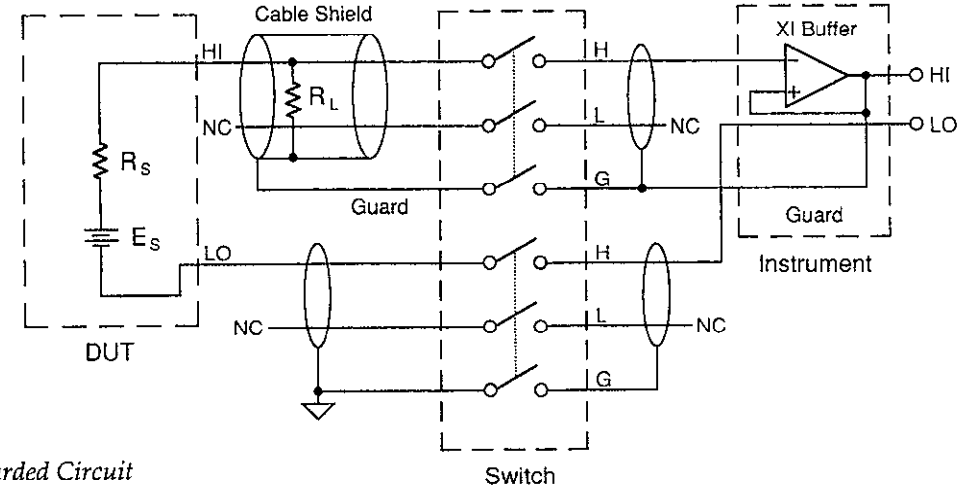
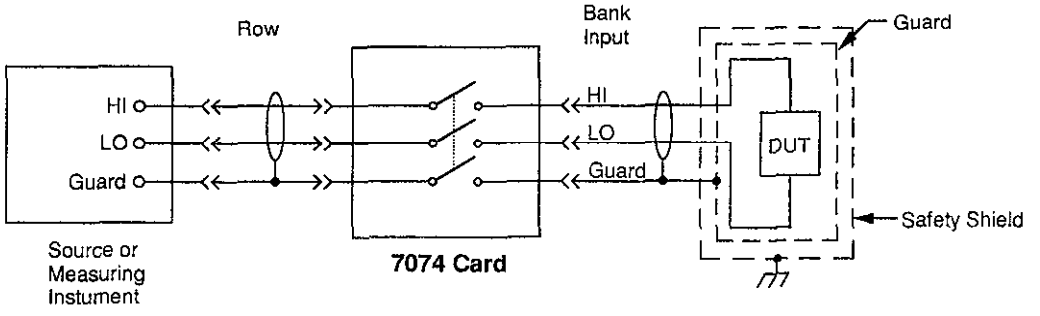


Figure 2-37. Guarded Circuit



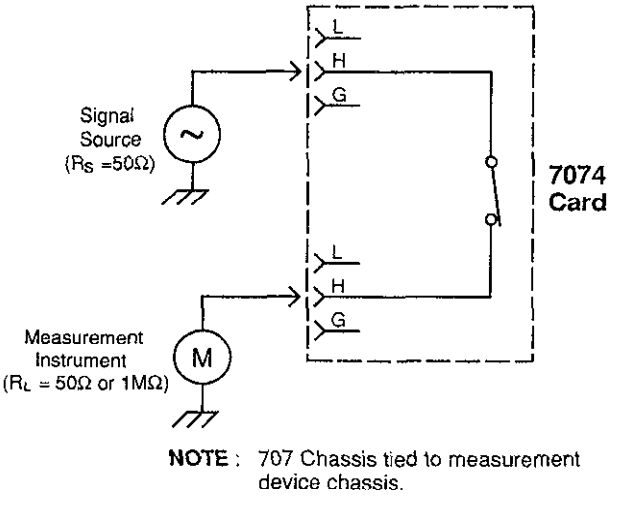
Warning :
Hazardous voltages may be present on GUARD.
Insulate cable shields and install earth-grounded safety shield to avoid contact.

Figure 2-38. Typical Guarded Signal Connections

ing AC frequency and also give typical response with different load resistance and card configurations.

Test Configuration

Figure 2-39 shows the test configuration for measuring AC frequency response of the Model 7074. The signal source is assumed to have a source resistance, R_S, of 50Ω in all cases. Note that the load resistance, R_L, is either 50Ω or 1MΩ depending on test conditions.



NOTE : 707 Chassis tied to measurement device chassis.

Figure 2-39. AC Frequency Response Test Configuration

Cable Capacitance Considerations

All test results discussed here are exclusive of cable capacitance effects. If you are connecting long cables to the multiplexer card, the effects of distributed capacitance of the cables, could reduce the bandwidth considerably. The approximate -3dB point can be calculated as follows:

$$f_{-3dB} \approx \frac{1}{2\pi RC}$$

Here, R is the effective parallel resistance (R_L or R_S), and C is the effective distributed capacitance.

For example, assume a resistance of 1MΩ and a distributed capacitance of 100pF. The approximate -3dB point is:

$$f_{-3dB} \approx \frac{1}{2\pi\,(1\times10^{6})(100\times10^{-12})}$$

$$f_{-3dB} \approx 1{,}590\text{Hz}$$

1 × 96 Configuration Response Curves

Typical AC response curves with the card configured for 1 × 96 operation are shown in Figure 2-40 and

Figure 2-41. Figure 2-40 shows the results with a 1MΩ load, and Figure 2-41 shows results with a 50Ω load.

1 × 12 Configuration Response Curves

Figure 2-42 and Figure 2-43 show typical results with the card configured as eight 1 × 12 multiplexers. Figure 2-42 shows response with a 50Ω load, and Figure 2-43 shows response with a 1MΩ load.

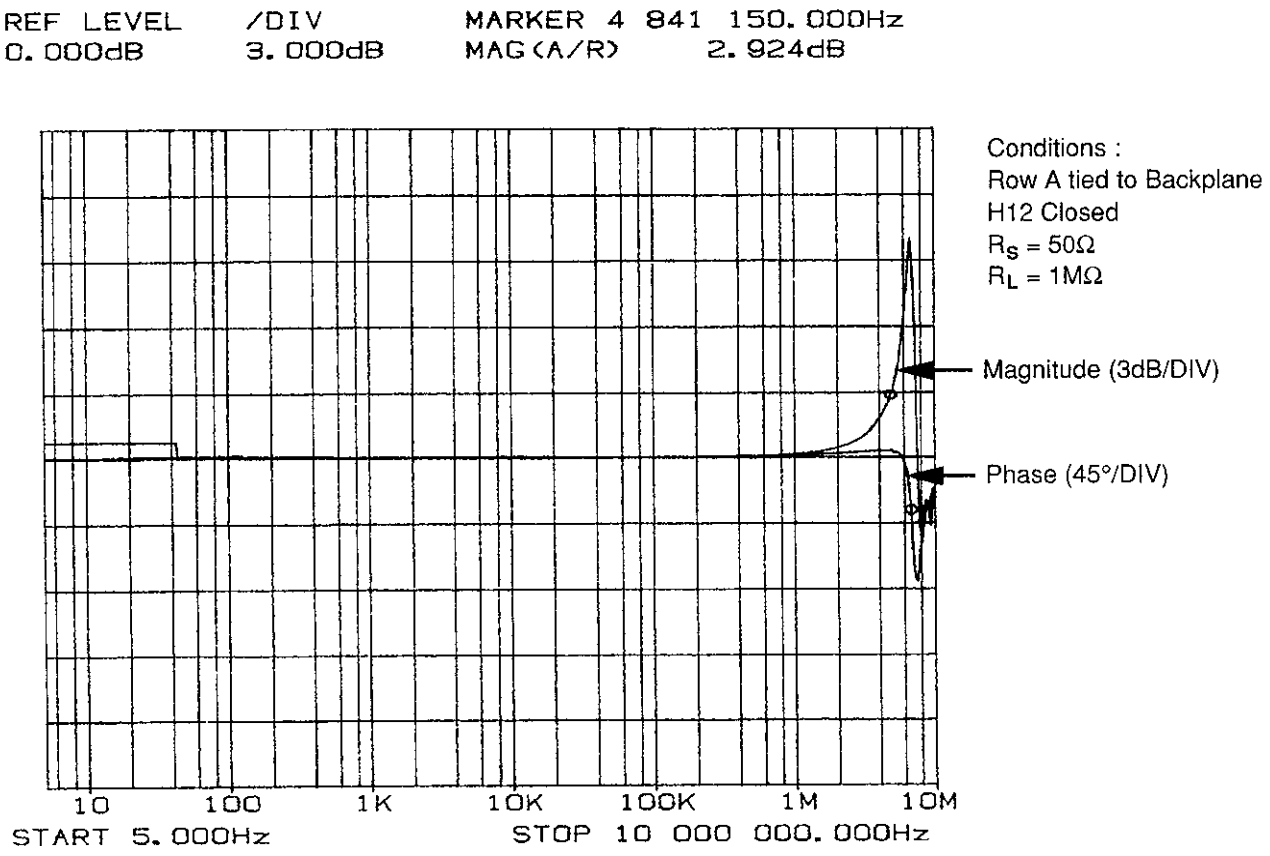


Figure 2-40. Model 7074 Frequency Response (R_L = 1MΩ, 1 × 96 Configuration)

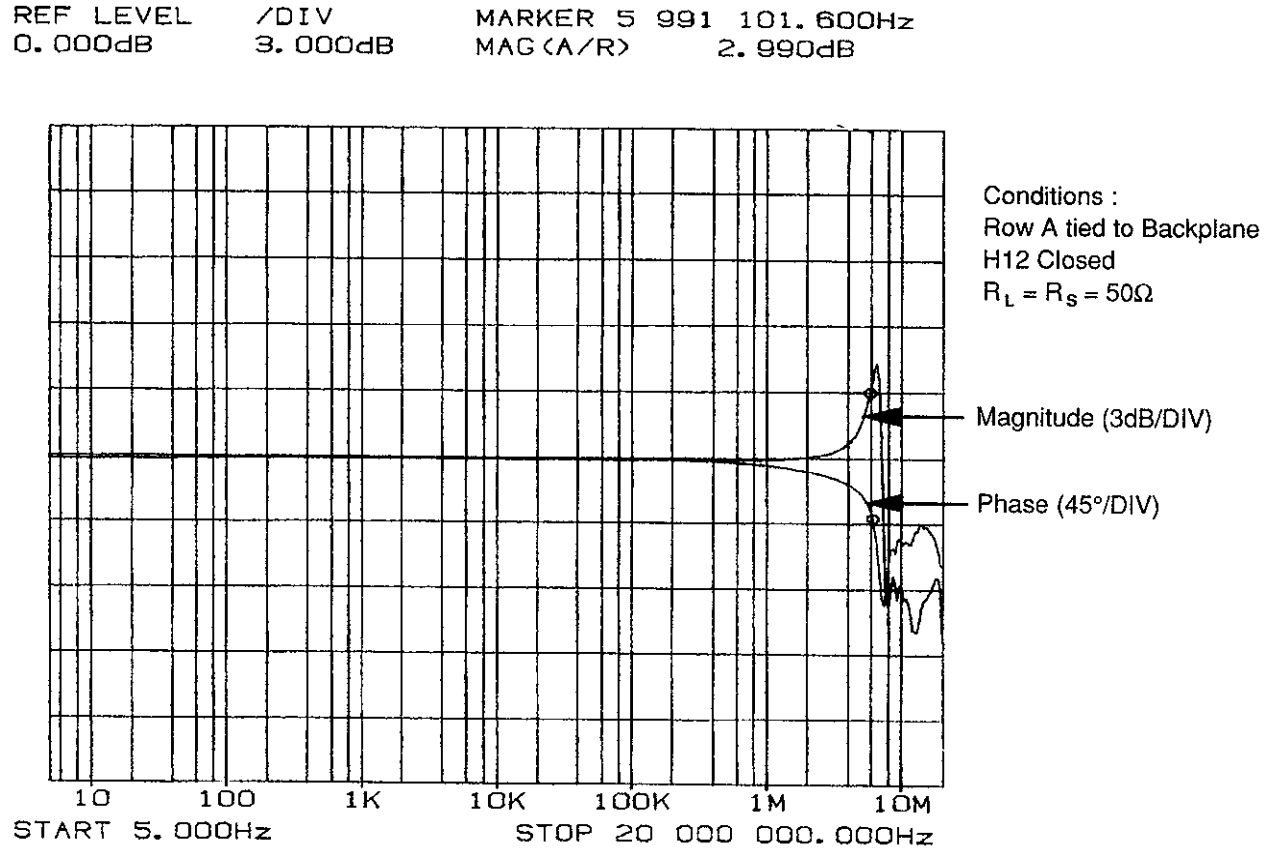


Figure 2-41. Model 7074 Frequency Response ($R_L = 50\Omega$, 1 × 96 Configuration

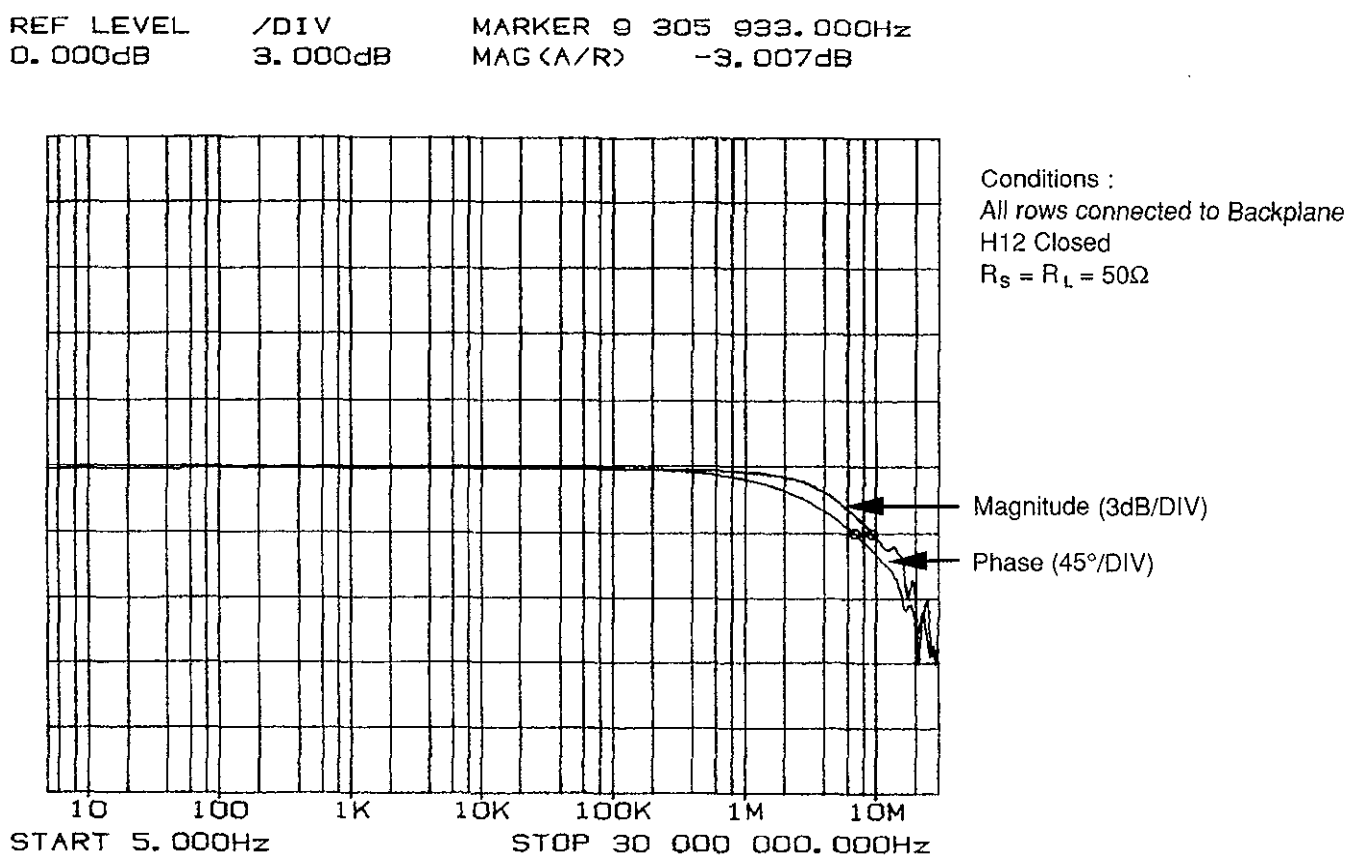


Figure 2-42. Model 7074 Frequency Response ($R_L = 50\Omega$, Eight 1 × 12 Configuration

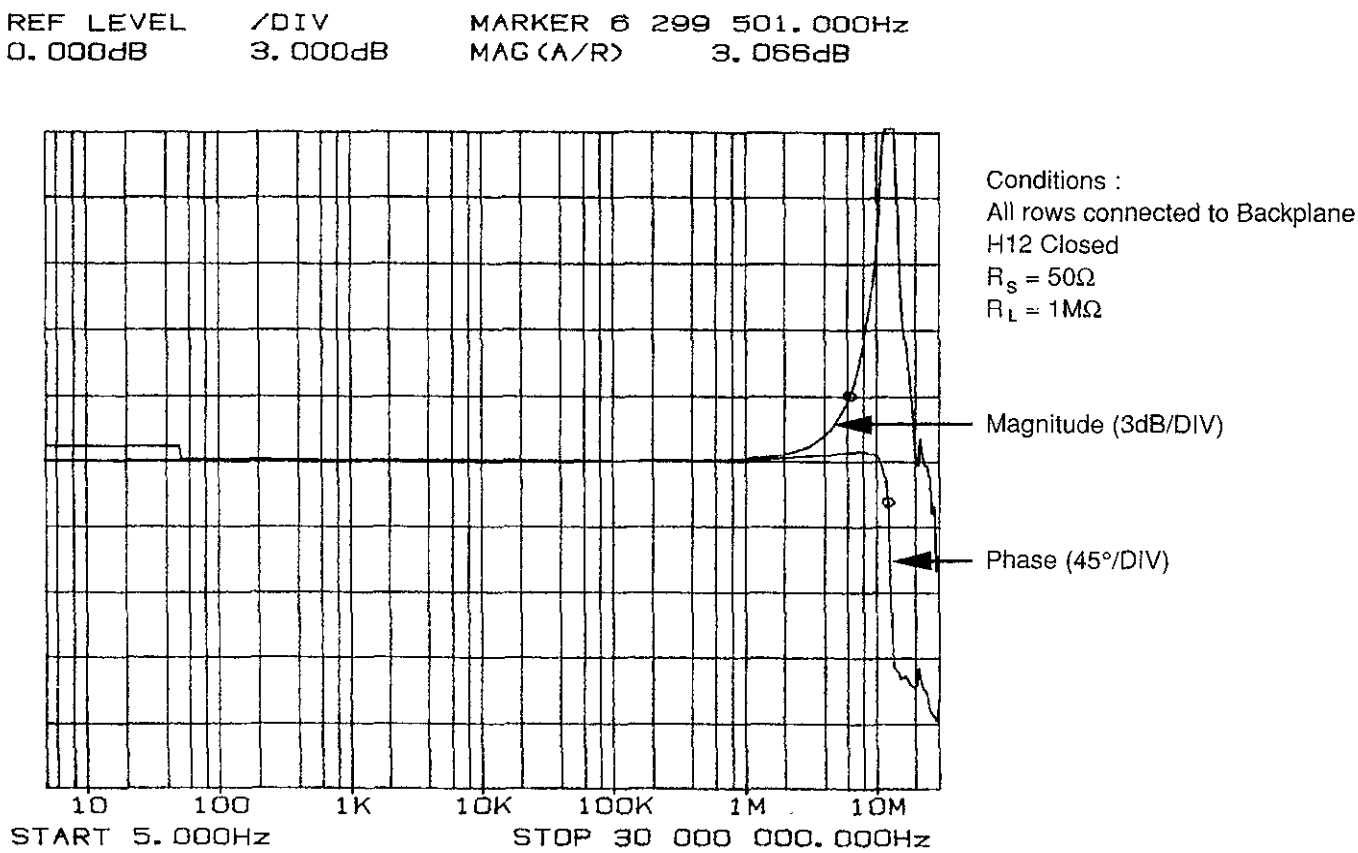


Figure 2-43. Model 7074 Frequency Response (R_L = 50Ω, Eight 1 × 12 Configuration

SECTION 3
Applications

3.1 INTRODUCTION

Applications for the Model 7074 Multiplexer Card will depend on your particular needs. This section presents some typical applications for the Model 7074, and it is arranged as follows:

3.2 **Resistor Testing:** Outlines three types of resistor tests, including 2-wire and 4-wire DMM tests, and low-resistance tests using a separate current source and nanovoltmeter.

3.3 **Transistor Testing:** Covers typical transistor tests such as current gain and common-emitter characteristics.

3.4 **Testing with Matrix Cards:** Shows how to use the Model 7074 with matrix cards like the Model 7071 to enhance test system capabilities.

Several example application programs, which are written in Hewlett-Packard BASIC 4.0, are included in this section. These programs are included only as examples to demonstrate fundamental programming techniques, and are not intended to suit specific needs.

The mercury reed (Model 7074-M) and dry-reed (Model 7074-D) versions of the card may affect these applications differently. The dry reed version has lower offset voltage, but shorter contact life. See the specifications for card differences.

3.2 Resistor Testing

The Model 7074 can be used to test a large number of resistors using only one test instrument or group of instruments. Such tests include 2-wire and 4-wire resistance measurements using a DMM, and low-resistance measurements using a current source and nanovoltmeter, as discussed in the following paragraphs.

3.2.1 2-Wire Resistance Tests

Figure 3-1 shows a typical test setup for making 2-wire resistance measurements. The Model 7074 Card provides the switching function, while the resistance measurements are made by a Model 199 DMM. Since only 2-pole switching is required for this application, one Model 7074 Card can be used to switch up to 96 resistors (additional multiplexer banks can be added, if desired, by connecting cards together).

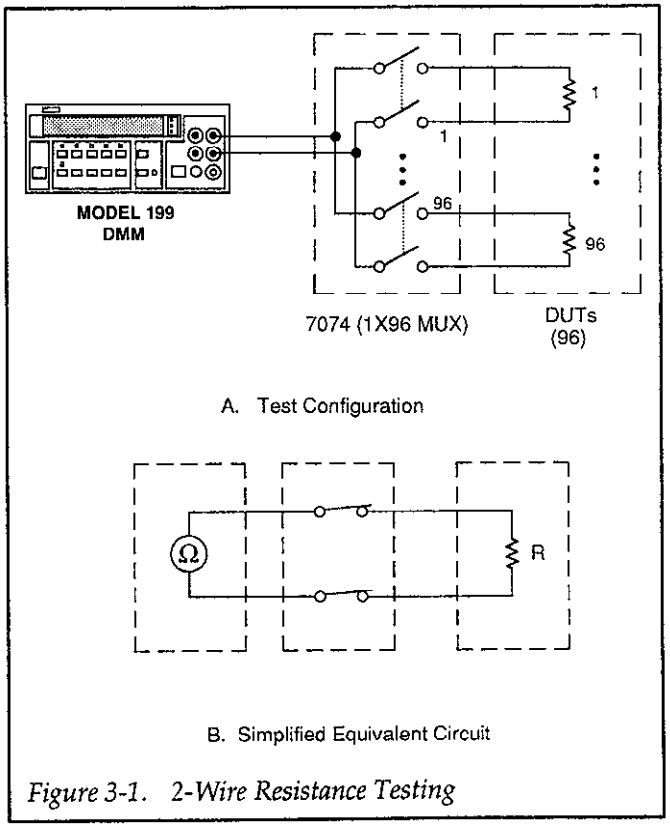


Figure 3-1. 2-Wire Resistance Testing

Short runs of #18 AWG or larger wire are recommended to minimize errors due to connecting wires. Various other techniques such as shorting one multiplexer input with heavy wire can be used to correct for nominal path resistance. With the shorted channel closed, enable the

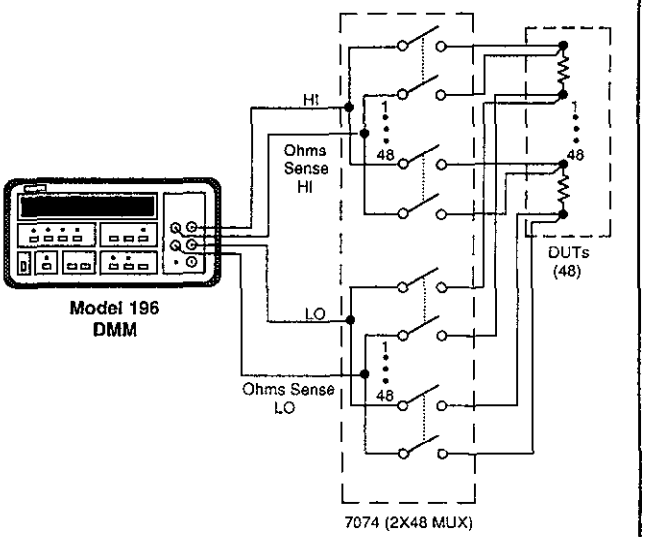
DMM zero feature, and leave zero enabled while making measurements.

3.2.2 4-Wire Resistance Tests

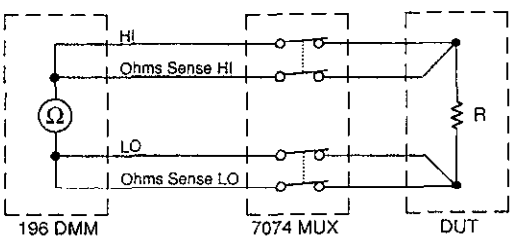
More precise measurements over a wider range of system and DUT conditions can be obtained by using the 4-wire measurement scheme shown in Figure 3-2. Here, separate sense leads from the Model 196 DMM are routed through the multiplexer to the resistor under test. The extra set of sense leads minimizes the effects of voltage drops across the test leads. Note, however, that an extra two poles of switching are required for each resistor to be tested. For that reason, only 48 resistors per card can be tested using this configuration.

Although the 4-wire connection scheme does minimize problems caused by voltage drops, there is one other potentially troublesome area associated with low resistance measurements: thermal EMFs caused by the relay contacts. In order to compensate for thermal EMFs, the offset-compensated ohms feature of the Model 196 DMM should be used. To use this feature, short the HI and LO terminals of one of the bank inputs, (at the card BANK connector) then close the relay. Enable zero on the Model 196, then select offset-compensated ohms.

For even lower resistance measurements, use the Model 580 Micro-ohmmeter. This instrument can make resistance measurements with 10μΩ resolution.



A. Test Configuration



B. Simplified Equivalent Circuit

Figure 3-2. 4-Wire Resistance Testing

3.2.3 Low-Level Resistance Measurements

Many times, it is necessary to make resistance measurements with either lower voltage sensitivity or higher currents than are available with ordinary DMMs. Examples of cases where low-level resistance measurements may be necessary include the testing of PC board traces, contacts, bus bars, and low-resistance shunts.

Figure 3-3 shows a typical test configuration for a switching system capable of testing a number of low-resistance devices. The Model 220 Current Source forces current through the device under test, while the Model 181 Nanovoltmeter measures the resulting voltage across the device.

Since low voltage levels are being measured, thermal EMF offsets generated by relay and connector contacts will have a detrimental effect on measurement accuracy unless steps are taken to avoid them. Thermal EMF effects can be virtually eliminated by taking two voltage measurements, E_1 and E_2, the first with the current, I, flowing in one direction, and the second with a current, I, of the same magnitude flowing in the opposite direction. The resistance can then be calculated as follows:

$$R = \frac{E_2 - E_1}{2I}$$

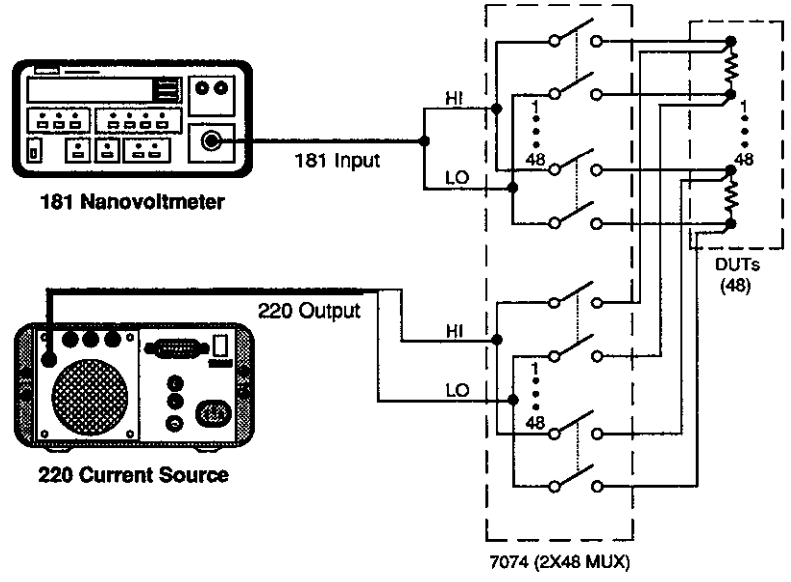


Figure 3-3. Low Resistance Testing

Note that simply reversing the current source polarity will result in a 2X accuracy specification change. To avoid this problem, matrix switching could be added to the test system to reverse the current. See paragraph 3.4.

3.2.4 Example Resistor Test Program

The example program below demonstrates programming techniques for testing resistors using the 2-wire test configuration shown in Figure 3-1. The program assumes that the Model 7074 is located in slot 1 of the mainframe, and that all 96 inputs are to be used for testing. The program sequences through all 96 inputs, taking a resistance reading on each channel and displaying the results. A one-second delay is incorporated into the program for settling.

```
PROGRAM                                          COMMENTS
 10  REMOTE 718                                  Put 707 in remote.
 20  REMOTE 726                                  Put 199 in remote.
 30  OUTPUT 718 ;"R0X"                           Reset 707.
 40  OUTPUT 726 ;"F2R0G1T3X"                     199ohms, autorange, one-shot trig-
                                                 ger.
 50  FOR I = 65 TO 72                            Loop for A-H ASCII values.
 60  FOR J = 1 TO 12                             Loop for all 12 inputs.
 70  OUTPUT 718 ; "C";CHR$(I);J;"X"              Close row CHR$(I), input J.
 80  WAIT 1                                      Wait one second settling time.
 90  TRIGGER 726                                 Trigger 199 reading.
100  ENTER 726 ;A$                               Get 199 resistance reading.
110  PRINT "BANK ";CHR$(I);"                     Display  row, input, reading
     CHANNEL";J;"READING: ";A$
120  OUTPUT 718;"N";CHR$(I);J;"X"                Open bank CHR$(I), input J.
130  NEXT J                                      Loop back for next input.
140  NEXT I                                      Loop back for next row.
150  END
```

3.3 TRANSISTOR TESTING

Typical transistor tests that can be performed with the aid of the Model 7074 include current gain tests, leakage tests, as well as tests to determine the common-emitter characteristics of the device. The following paragraphs discuss these tests and give typical equipment configurations for the tests.

3.3.1 Current Gain Tests

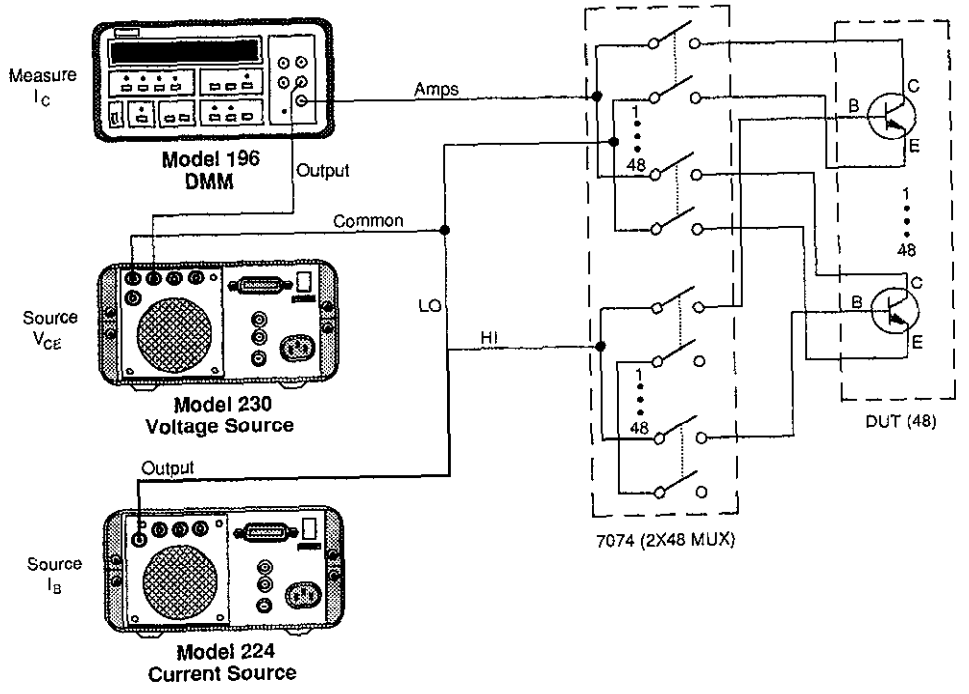
The dc or static common-emitter current gain of a transistor can be determined by biasing the transistor for a specific value of collector current, I_C, and then measuring the base current, I_B. The dc common-emitter current gain, β, of the transistor is then determined as follows:

$$\beta = \frac{I_C}{I_B}$$

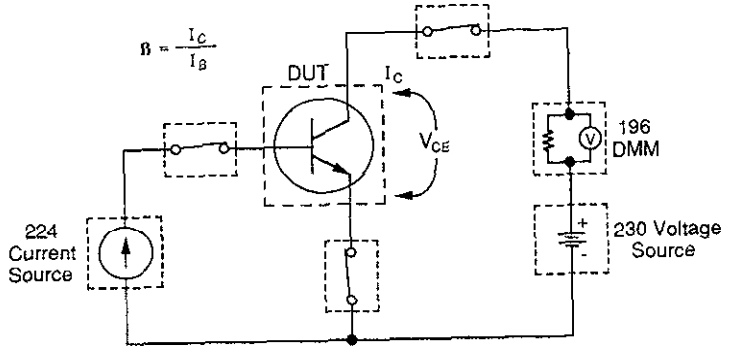
Figure 3-4 shows the test configuration and equivalent circuit for the current gain test. The Model 224 Current Source is used to source the base current, I_B. The Model 230 Voltage Source supplies the collector-emitter voltage, V_{CE}, and the collector current, I_C, is measured by the Model 196 DMM. Switching among the transistors being tested is, of course, performed by the Model 7074 Multiplexer Card.

In order to perform the current gain test, the voltage source is first set to the desired value of V_{CE}. The current source is then set to a base current value that will result in the desired value of I_C as measured by the DMM. The current gain can then be calculated as outlined above.

In order to reduce errors caused by voltage burden, use a higher current range on the Model 196 DMM. Doing so will result in the loss of one or two decades of resolution, but 3 1/2 or 4 1/2 digit resolution will probably be adequate for most situations.



A. Test Configuration



B. Simplified Equivalent Circuit

Figure 3-4. Configuration for Current Gain and Common-Emitter Tests

3.3.2 Common-Emitter Characteristic Tests

Common-emitter characteristics are determined by setting the base current, I_B, to specific values. At each I_B value, the collector-emitter voltage, V_{CE}, is swept across the desired range at specific intervals, and the collector current, I_C, is then measured. When the data are plotted, the result is the familiar family of common-emitter curves (Figure 3-5).

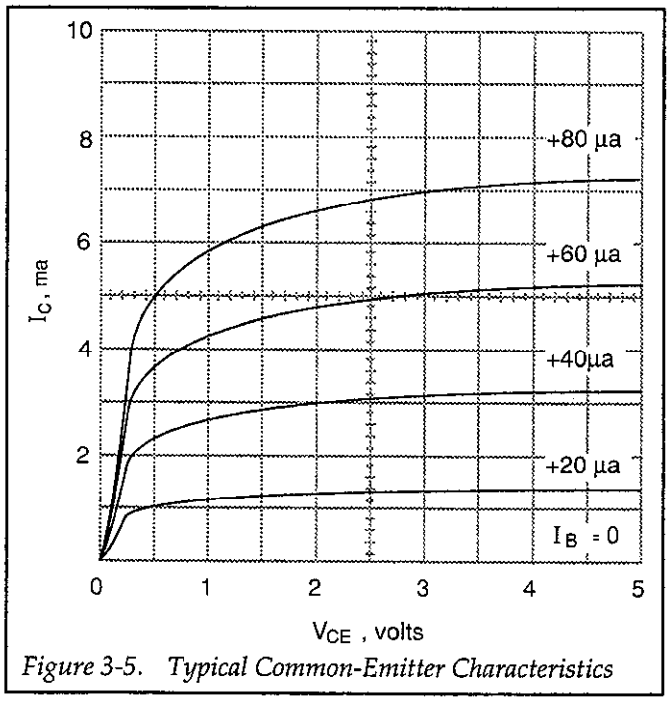


Figure 3-5. Typical Common-Emitter Characteristics

The same test configuration that is used for current gain tests can be used for measuring common-emitter characteristics (Figure 3-4). The Model 224 is used to set the base current, I_B, to the desired values. The Model 230 Voltage Source provides the collector-emitter voltage, V_{CE}, and the Model 196 DMM measures the collector current, I_C.

3.3.3 Example Transistor Test Program

The example program below shows general techniques for performing current gain tests using the test setup shown in Figure 3-4 (note that the Model 224 Current Source must be equipped with the optional Model 2243 IEEE-488 interface). The program will allow the operator to type in the desired voltage source (V_{CE}) and current source (I_B) values.

Note that the program assumes that the Model 7074 is located in slot 1 of the mainframe, and that 48 transistors are to be tested for current gain. Because of the switching configuration used, two bank-input combinations must be closed simultaneously. For example, Row A, Input 1, and Row E, Input 1 will be closed at the same time.

PROGRAM		COMMENTS
10	REMOTE 718	Put 707 in remote.
20	REMOTE 713	Put 230 in remote.
30	REMOTE 719	Put 224 in remote.
40	REMOTE 707	Put 196 in remote.
50	CLEAR 7	Clear instruments.
60	OUTPUT 718 ;"R0X"	Reset 707.
70	OUTPUT 713 ;"I2X"	230 20mA current limit.
80	OUTPUT 719 ;"V10X"	224 10V compliance limit.
90	OUTPUT 707 ;"F3R0G1T3X"	196 DCA,autorange,one-shot trigger.
100	INPUT "VCE VALUE (0-101V)", Vce	Input VCE value.
110	IF ABS(Vce) >101 THEN GOTO	Check voltage limits.
120	OUTPUT 713 ;"V";Vce;"X"	Program 230 voltage.
120	INPUT "IB VALUE (0-101MA)",Ib	Input IB value.
130	IF ABS(Ib) >101E-3 THEN GOTO 120	Check current limits.
140	OUTPUT 719 ;"I";Ib;"X"	Program 224 current.
150	IF ABS(Vce)> 30 THEN PRINT "WARNING: HAZARDOUS VOLTAGE WILL BE APPLIED TO DEVICE DURING TEST"	Display hazard warning.
160	INPUT "PRESS ENTER TO BEGIN",A$	Pause for start signal from operator.
170	OUTPUT 719 ;"F1X"	Turn on 224 output.
180	OUTPUT 713 ;"F1X"	Turn on 230 output.
190	FOR I=65 TO 68	Loop for ASCII A-D values.
200	C1$=CHR$(I)	Define row A-D command letter.
210	C2$=CHR$(I+4)	Define row F-H command letter.
220	FOR J=1 TO 12	Loop for all 12 inputs in bank.
230	OUTPUT 718 ;"C";C1$;J;"X"	Close row A-D, input J.
240	OUTPUT 718 ;"C";C2$;J;"X"	Close row E-H, input J.
250	WAIT 1	Wait one second for settling.
260	TRIGGER 707	Trigger 196 reading.
270	ENTER 707 ;Ic	Get 196 current reading (Ic).
280	PRINT "BANK ";C1$;" CHANNEL"; J;"DEVICE CURRENT GAIN:"; Ic/Ib	Display row A-D, input J reading.
290	OUTPUT 718 ;"N";C1$;J;"X"	Open row A-D, input J.
300	OUTPUT 718 ;"N";C2$;J;"X"	Open row E-H, input J.
310	NEXT J	Loop back for next input.
320	NEXT I	Loop back for next row.
330	OUTPUT 713 ;"F0X"	Turn off 230 output.
340	OUTPUT 719 ;"F0X"	Turn off 224 output.
350	END	

3.4 TESTING WITH MATRIX CARDS

The Model 7074 can be added to a matrix switching system to enhance the test capabilities of that system. The following paragraphs discuss an overall multiplexer/matrix switching system and also briefly outline a typical test that can be made with such a system.

3.4.1 Multiplexer and Matrix Card Connections

Figure 3-6 shows a typical system using Model 7071 and 7074 cards together. In this instance, the multiplexer card is configured as eight 1 x 12 multiplexers. Note that rows A through H of the card are connected to rows A through H of the matrix through the backplane of the mainframe; no external wiring is necessary to connect the two cards together.

In this application, the DUTs are connected to the bank inputs on the multiplexer card, allowing a large number of DUTs to be switched through the matrix card. Also, the instruments are connected to the columns on the matrix card. This particular configuration is best suited for applications requiring a large number of DUTs to be connected to a several instruments. In other cases, the test configuration may call for a large number of instruments and few DUTs. In those situations, the instruments would be connected to the multiplexer inputs, and the DUTs would be connected to the columns.

3.4.2 Resistivity Tests

The general test configuration shown in Figure 3-7 can be used to perform resistivity tests on semiconductors. Such tests can yield important information such as doping concentration.

As shown in Figure 3-7, the Model 7074 switches a large number of samples for the test. The Model 7071 Matrix Card allows any device test node to be connected to any instrument terminal. The Model 220 Current Source forces a current through the DUT, and the Model 196 DMM measures the voltage across the device. In order to minimize errors caused by sample loading, the Model

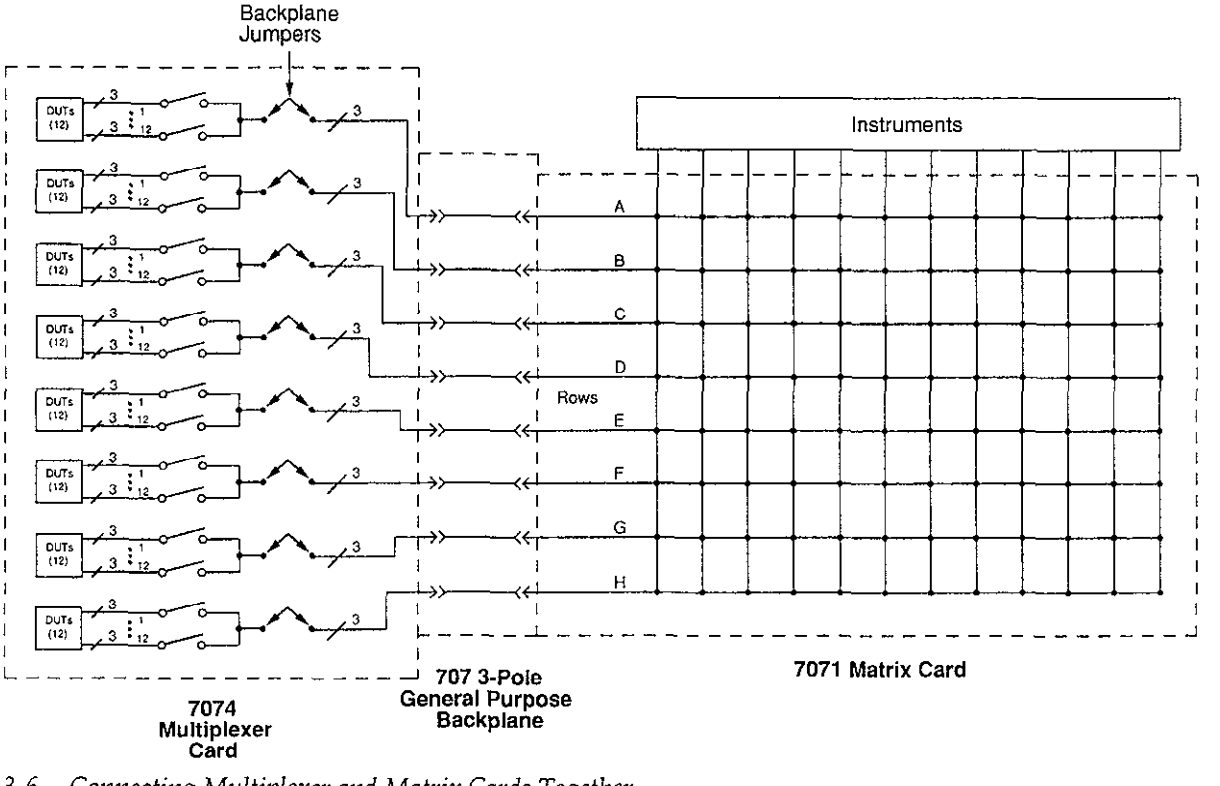
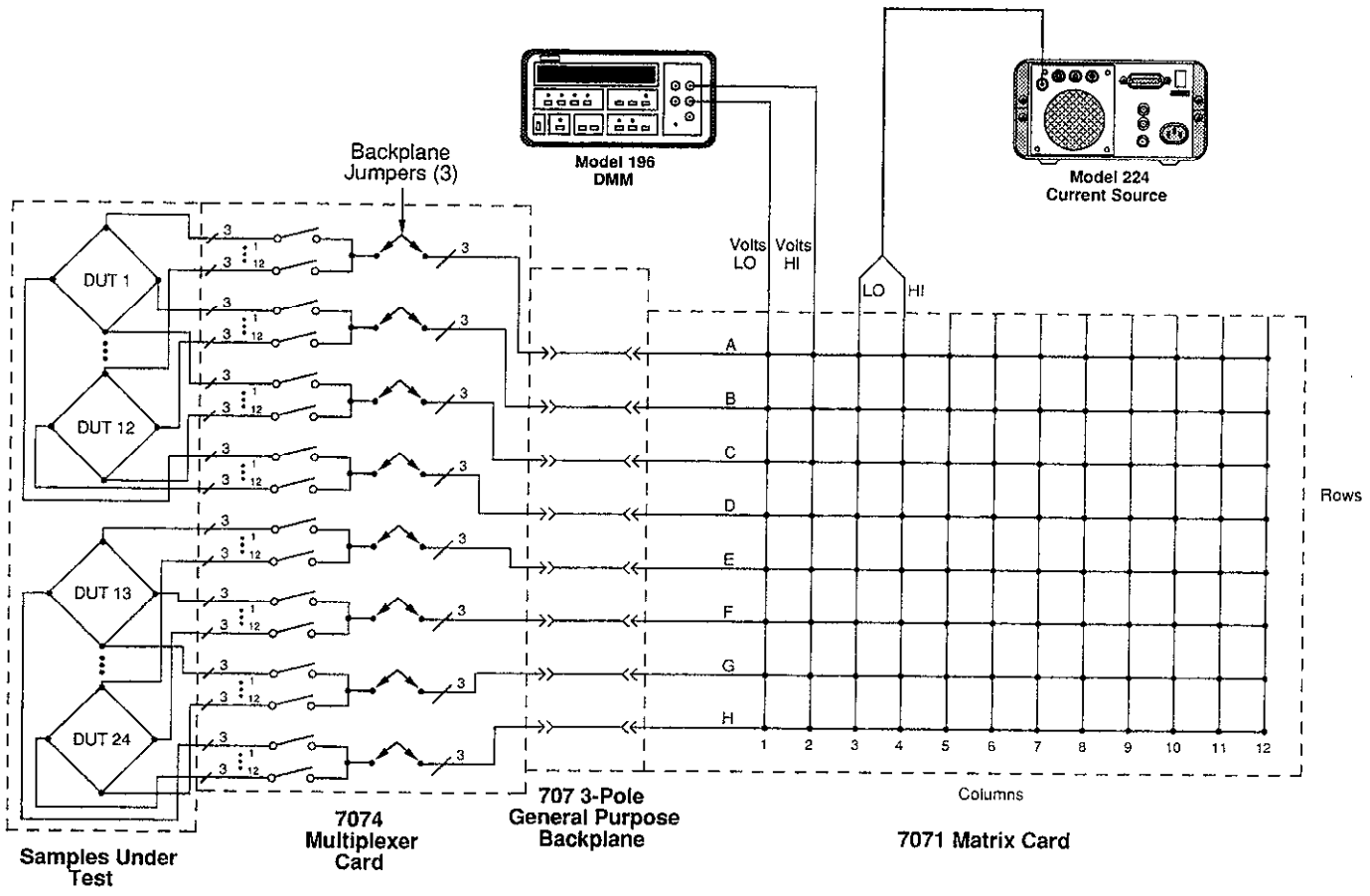
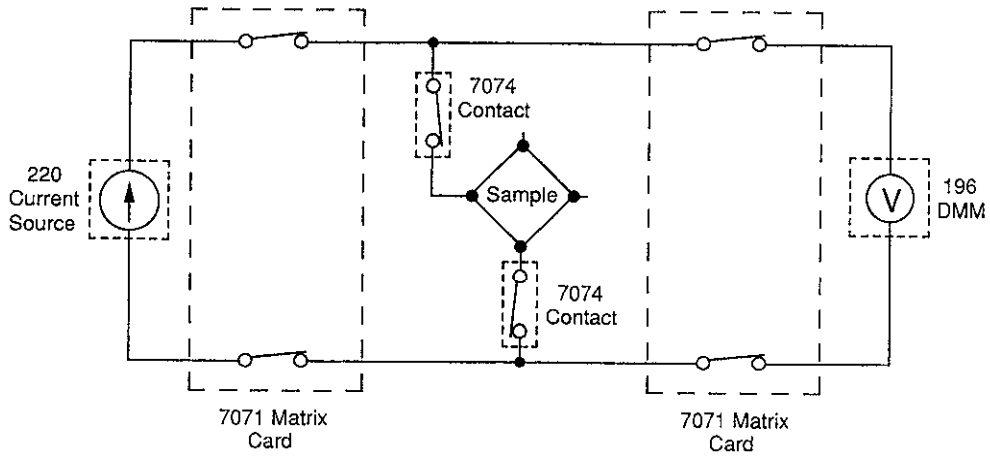


Figure 3-6. Connecting Multiplexer and Matrix Cards Together



A. Connections



B. Simplified Equivalent Circuit (One measurement leg shown)

Figure 3-7. Resistivity Test Configurations

196 should be used on the 300mV or 3V ranges. Also, resistance values should be 1MΩ or less.

In order to perform the tests, a current (from the Model 220) is applied to two terminals, and the voltage is measured (by the Model 196) across the two opposite terminals. A total of eight such measurements are required, as shown in Figure 3-8.

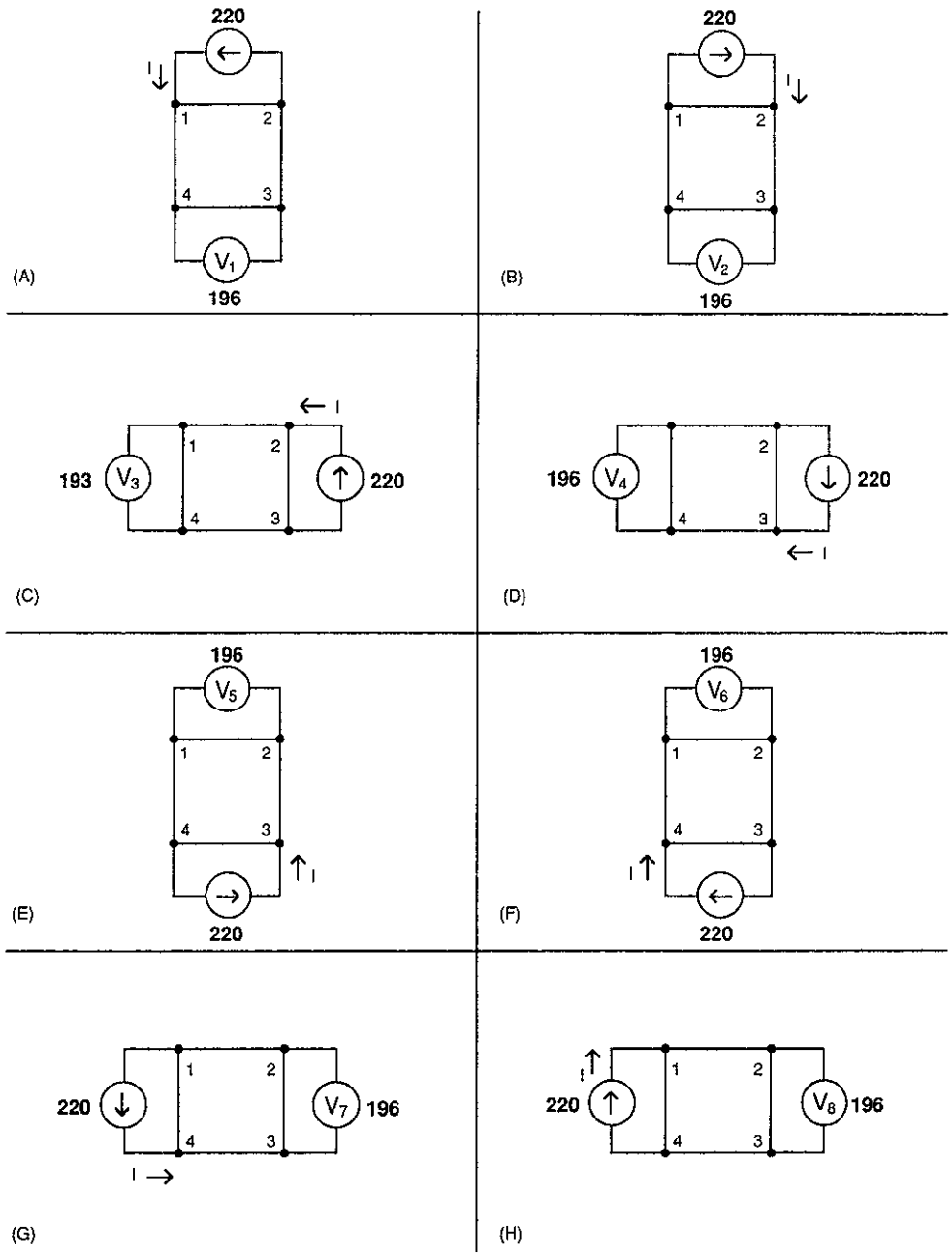


Figure 3-8. Measurement Required for Resistivity Test

Once the measurements have been taken, the resistivity can be calculated. Two values of resistivity, σ_A and σ_B, are initially computed as follows:

$$\sigma_A = \frac{1.1331\, f_A t_S (V_2 + V_4 - V_1 - V_3)}{I}$$

$$\sigma_B = \frac{1.1331\, f_B t_S (V_6 + V_8 - V_5 - V_7)}{I}$$

Where:

σ_A and σ_B are the resistivities in Ω-cm,
t_S is the sample thickness in cm,
V_1 through V_8 are the voltages measured by the Model 196,
I is the current through the sample in amperes,
f_A and f_B are geometrical factors based on sample symmetry ($f_A = f_B = 1$ for perfect symmetry).

Once σ_A and σ_B are known, the average resistivity, σ_{AVG}, can be determined as follows:

$$\sigma_{AVG} = \frac{\sigma_A + \sigma_B}{2}$$

3.4.3 Example Resistivity Test Program

The program shown below demonstrates programming fundamentals for making resistivity tests using the test setup shown in Figure 3-7. The program assumes that the Model 7074 is located in slot 1, and the Model 7071 is located in slot 2 of the mainframe. Also note that the Model 196 is connected to columns 1 and 2, while the Model 220 is connected to columns 3 and 4. The test is restricted to the first 12 4-terminal samples (DUT 1 to DUT 12) for the sake of simplicity.

PROGRAM		COMMENTS
10	DIM A(12,8)	Dimension reading array.
20	REMOTE 718	Put 707 in remote.
30	REMOTE 707	Put 196 in remote.
40	REMOTE 712	Put 220 in remote.
50	CLEAR 7	Clear instruments.
60	OUTPUT 707 ;"F0R0G1X"	196 DCV, auto range, data format.
70	OUTPUT 712 ;"V30X"	220 30V compliance.
80	OUTPUT 718 ;"R0X"	Reset 707.
90	INPUT "220 CURRENT (<=101mA)",I1	Input 220 current.
100	I1 = ABS(I1)	Use positive current only.
110	IF I1 >101E-3 THEN GOTO 90	Check current limits.
120	OUTPUT 712 ;"I";I1;"X"	Program 220 current.
130	INPUT "PRESS ENTER TO START",A$	Pause for operator signal.
140	FOR I = 1 TO 12	Loop for all 12 DUTs.
150	OUTPUT 718 ;"CA";I; ",B";I; ",C";I;",D";I;"X"	Close 7074 inputs..
160	RESTORE	Restore data pointer.
170	FOR J = 1 TO 8	Loop for all eight readings.
180	READ C$	Read 7071 command string.
190	OUTPUT 718 ;"C";C$;"X"	Close 7071 crosspoints.
200	WAIT 1	Wait one second for settling.
210	OUTPUT 707 ;"Z1X"	Zero the 196.
220	WAIT 1	One second settling time.
230	OUTPUT 712 ;"F1X"	Turn on 220 output.
240	WAIT 1	One second settling time.
250	ENTER 707 ; A(I,J)	Get 196 reading,store in array.
260	OUTPUT 712 ;"F0X"	Turn off 220 output.
270	OUTPUT 707 ;"Z0X"	Turn off 196 zero.
280	OUTPUT 718 ; "N";C$;"X"	Open 7071 crosspoints.
290	NEXT J	Loop back and make next measurement.
300	OUTPUT 718 ;"NA";I;",B"; I; ",C";I;",D";I;"X"	Open 7074 inputs.
310	NEXT I	Loop back and measure next DUT.
320	INPUT "ENTER SAMPLE THICKNESS (CM)",T	Input sample thickness.
330	FOR I=1 TO 12	Loop for all 12 devices.
340	Pa=1.1331*T/I1*(A(I,2)+A (I,4) -A(I,1)-A(I,3))	Compute A.
350	Pb=1.1331*T/I1*(A(I,6)+A (I,8) -A(I,5)-A(I,7))	Compute B.
360	Pavg=(Pa+Pb)/2	Compute average resistivity.
370	PRINT "DEVICE";I;"RESI TIVITY="; Pavg;"OHM-CM"	Display average resistivity.
380	NEXT I	Loop back for next device
390	DATA "A16,B15,C13,D14"	7071 command strings.
400	DATA "A15,B16,C13,D14"	
410	DATA "A14,B16,C15,D13"	
420	DATA "A14,B15,C16,D13"	
430	DATA "A13,B14,C16,D15"	
440	DATA "A13,B14,C15,D16"	
450	DATA "A15,B13,C14,D16"	
460	DATA "A16,B13,C14,D15"	
470	END	

SECTION 4
Service Information

4.1 INTRODUCTION

This section contains information necessary to service the Model 7074 Multiplexer Card and is arranged as follows:

4.2 Handling and Cleaning Precautions: Discusses handling precautions and methods to clean the card should it become contaminated.

4.3 Relay Test Program Setup: Explains how to connect the multiplexer card to the mainframe for the relay test program.

4.4 Performance Verification: Covers the procedures necessary to determine if the card meets stated specifications.

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

4.6 Disassembly: Details disassembly of the Model 7074 and also outlines important reassembly points.

4.7 Troubleshooting: Presents some troubleshooting tips for the Model 7074 including relay replacement precautions.

4.8 Principles of Operation: Briefly discusses circuit operation.

WARNING

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

4.2 HANDLING AND CLEANING PRECAUTIONS

Because of the high-impedance areas on the Model 7074, care should be taken when handling or servicing the card to prevent possible contamination. The following precautions should be taken when servicing the card.

1. Handle the card only by the edges and handle. Do not touch any board surfaces or components not associated with the repair. Do not touch areas adjacent to electrical contacts. When servicing the card, wear clean, cotton gloves.
2. 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 board if necessary.
3. Should it become necessary to use solder on the circuit board, use a flux that is rosin RMA based. Remove the flux from the work areas when the repair has been completed. Use Freon® TMS or TE or the equivalent along with clean cotton swabs or a clean, soft brush 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.
4. After cleaning, the card should be placed in a 50°C low-humidity environment for several hours before use.

4.3 RELAY TEST PROGRAM SETUP

The relays on Model 7074 can be tested using the test software supplied with the Model 707 Switching Matrix. The following paragraphs discuss the test equipment and connections. For detailed information on using the test software, consult Section 6 of the Model 707 Instruction Manual.

If your copy of the test software does not support the Model 7074, contact the Sales Department for a free upgrade. Model numbers are:

for IBM PC/XT/AT: 7078-RTS-1
for HP Series 200/300: 7078-RTS-2

4.3.1 Recommended Equipment

- Model 707 Switching Matrix
- Model 7074-RTC Relay Test Connector (75-pin) plug (available accessory)
- Model 7078-KIT 38-pin plug (1)
- 20-24 gauge stranded hook-up wire
- Relay test software (supplied with Model 707)
- IBM PC compatible or Hewlett-Packard Series 200 or 300 compu'er
- Relay test terminal block (supplied with Model 707)

4.3.2 Connections

The test cable should be prepared using the information shown in Figure 4-1. The relay connector should be connect to the ROW A-H plug using 2-foot lengths of stranded hook-up wire. Use the crimp and insertion tools to make connections to the plugs (see Table 2-1 in Section 2).

Figure 4-2 shows how to connect the prepared test cable to the Model 7074. Connect the 38-pin plug to the ROW A-H connector, and be sure to connect the test connector to the RELAY TEST jack on the rear panel of the Model 707.

The Model 7074-RTC relay test connector plug should be connected to BANK A-B to begin the test.

4.3.3 Running the Test

Follow the instructions given in the Model 707 Instruction Manual to perform the relay test. The computer will advise you as to which relay, if any, fails to pass the test. After testing banks A and B, you must move the jumper plug to the next bank receptacles and repeat the test until all banks are tested.

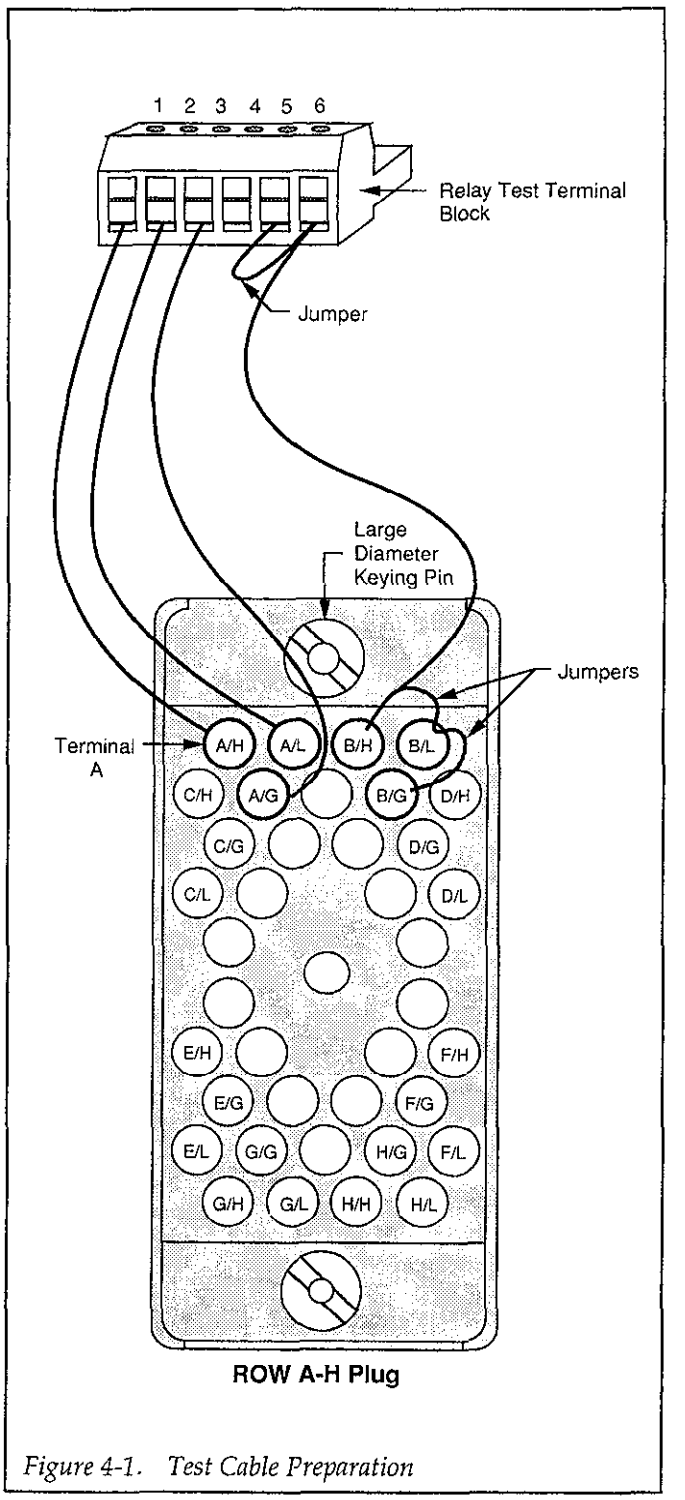


Figure 4-1. Test Cable Preparation

4.4 PERFORMANCE VERIFICATION

The following paragraphs discuss performance verification procedures for the Model 7074, including path resistance, offset current, contact potential, and isolation.

The procedures in this section are rather lengthy due to the large number of bank and channel 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 below standards.

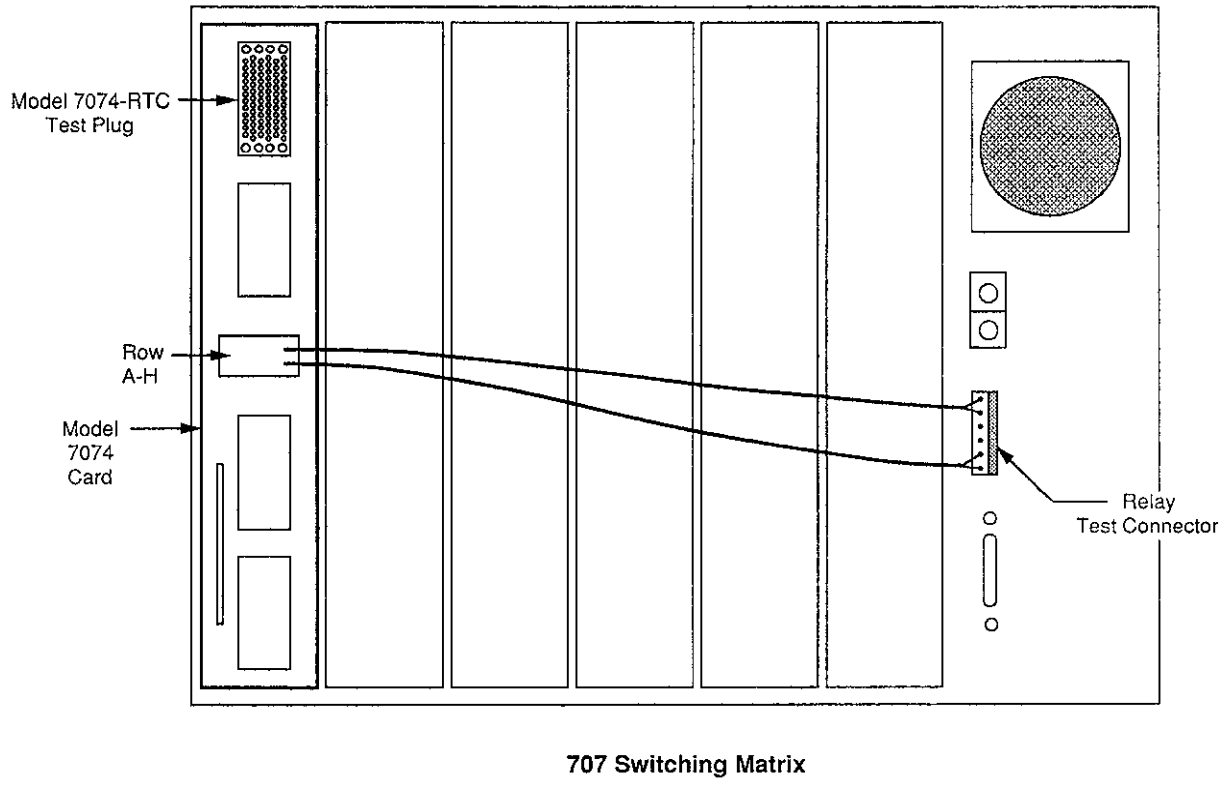


Figure 4-2. Connecting the Test Cable to the Model 7074

The procedures in this section make external equipment connections to the multiplexer at the receptacles. Connection techniques to "rack and panel" receptacles are covered in paragraph 4.3.2.

The performance verification procedures must be performed with only one multiplexer card (the one being checked) installed in the Model 707 mainframe. Also, the Model 707 must not be daisy-chained to another Model 707.

CAUTION

Contamination will degrade the performance of the multiplexer 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 "rack and panel" connector blocks, do not touch areas adjacent to the electrical contacts.

NOTE

Failure of any performance verification test may indicate that the multiplexer card is contaminated. See paragraph 4.2 to clean the card. If the test still fails after cleaning, 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 0°C and 35°C and at a relative humidity of less than 70%. If the multiplexer card has been subjected to temperature or humidity extremes, allow the card to environmentally stabilize for at least one hour before performing any tests.

4.4.2 Recommended Test Equipment

Table 4-1 summarizes the equipment necessary to make the performance verification tests, along with the application for each item.

Table 4-1. Recommended Verification Equipment

Description	Model	Specifications	Application
DMM	Keithley 196	300Ω ; 0.01%	Path resistance
Electrometer w/ voltage source	Keithley 617	10pA, 100pA; 1.6% 100V source; 0.2%	Offset current isolation
Nanovoltmeter	Keithley 181	2mV; 0.015%	Contact potential
Triax cable (unterminated)	Keithley 7025	—	Offset current isolation
Low thermal cable (unterminated)	Keithley 1484	—	Contact potential
BANK contact*	Part # CS-676	—	All
ROW A-H contact**	Part # CS-426	—	All

* 20 required
** 36 required

NOTE
Do not connect the Model 7074 to the mainframe using a Model 7070 extender card; the Model 7074 must be installed within the mainframe for the performance verification tests. Also, no other cards can be installed in the mainframe during testing.

4.4.3 Performance Record

The results of the various performance verification tests can be recorded in Table 4-2 for future reference. Space has been provided for additional information such as date and operator's name.

4.4.4 Initial Preparation

Bank and Backplane Jumpers

All of the performance verification tests require that the internal bank and backplane jumpers be removed. See paragraph 2.4 for complete details.

Test Connections

In order to complete the verification tests, it will be necessary for you to connect the equipment test leads to the BANK and ROW A-H receptacles on the rear panel of the card. The most convenient way to do so is to attach a crimp tail contact to the end of each test lead, then place a small length of heat-shrink tubing over the wire-contact junction. After crimping, insert the contact into the appropriate terminal on the BANK or ROW A-H receptacle. Figure 4-3 shows an example of how to connect these contacts to the receptacles. Use the Model 7074-HCT (BANK) or 7078-HCT (ROW A-H) for crimping. Crimp tail contacts can be ordered from Keithley: order CS-426 for the OUT connector, CS-676 for the BANK connectors.

Receptacle Contact Assignments

Figure 4-4 shows the contact assignment for ROW A-H receptacle, and Figure 4-5 shows the contact assignment for the BANK receptacles. These two drawings should be used as reference for making connections for all the verification tests.

NOTE
The receptacles shown in Figure 4-4 and Figure 4-5 are viewed from the rear panel of the multiplexer card.

Table 4-2. Performance Record

Date: _____ Performed By: _____

Time: _____ Serial Number: _____

Pathway(s)	Path Resistance	Offset Current	Contact Potential	Path Isolation	Differential Isolation	Common-mode Isolation

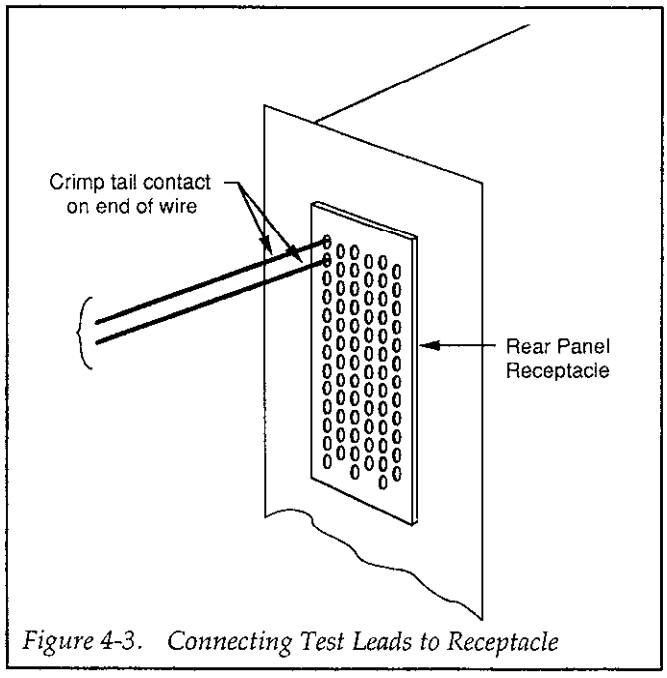


Figure 4-3. Connecting Test Leads to Receptacle

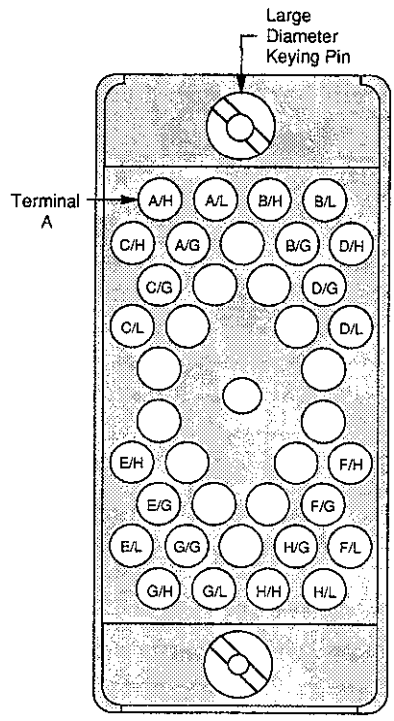
Input Jumpers

Some of the tests require that additional channel or bank terminals be jumpered together. Use clean #20 to #24 gauge copper wire for the jumpers. Each jumper should be no more than a couple of inches in length to minimize path resistance. The Keithley Model 7074-HCT or 7078-HCT Hand Crimping Tool can be used to attach the crimp tails to the copper wires. After crimping, insert the contacts into the receptacle where indicated.

4.4.5 Path Resistance Tests

Perform the following steps to verify that each contact of every relay is closing properly and that the resistance is within specification.

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

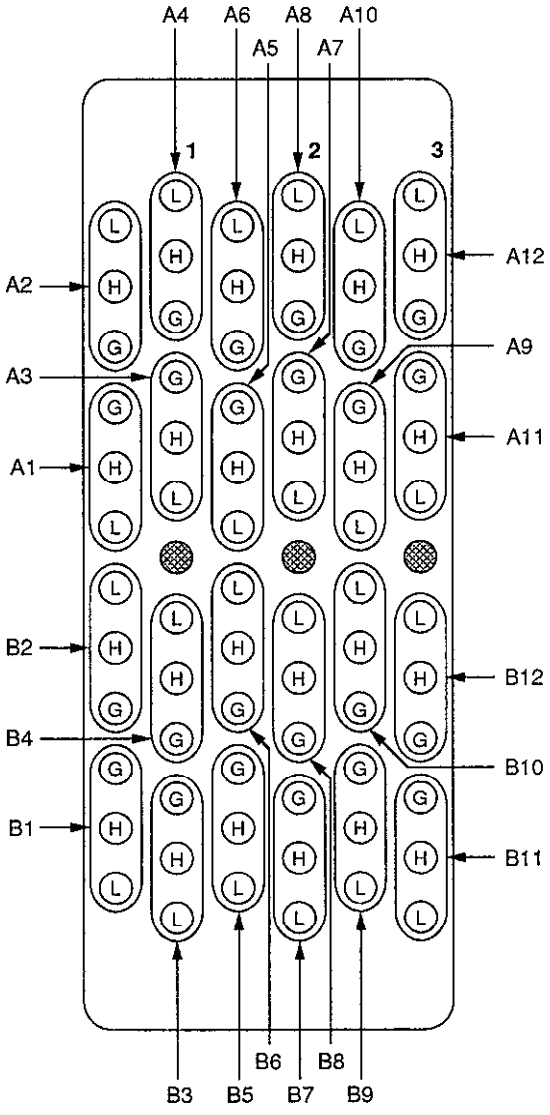


ROW A-H Receptacle
(Rear panel view)

Contact	Row / Terminal
A/H	Bank A/High Terminal
A/L	Bank A/Low Terminal
A/G	Bank A/Guard Terminal
B/H	Bank B/High Terminal
B/L	Bank B/Low Terminal
B/G	Bank B/Guard Terminal
C/H	Bank C/High Terminal
C/L	Bank C/Low Terminal
C/G	Bank C/Guard Terminal
D/H	Bank D/High Terminal
D/L	Bank D/Low Terminal
D/G	Bank D/Guard Terminal

Contact	Row / Terminal
E/H	Bank E/High Terminal
E/L	Bank E/Low Terminal
E/G	Bank E/Guard Terminal
F/H	Bank F/High Terminal
F/L	Bank F/Low Terminal
F/G	Bank F/Guard Terminal
G/H	Bank G/High Terminal
G/L	Bank G/Low Terminal
G/G	Bank G/Guard Terminal
H/H	Bank H/High Terminal
H/L	Bank H/Low Terminal
H/G	Bank H/Guard Terminal

Figure 4-4. ROW A-H Receptacle Contact Assignments (Rear Panel View)



NOTES

1. H=HI, L=LO, G=GUARD
2. A refers to Bank A; also applies to Banks C, E, and G.
3. B refers to Bank B, also applies to Banks D, F, and H.
4. Plug is viewed from wiring side.

= Chassis ground

Figure 4-5. Bank Receptacle Assignments (Rear Panel View)

1. Turn the Model 707 off if it is on.
2. Turn on the Model 196, and allow it to warm up for one hour before making measurements.
3. Install the Model 7074 in the mainframe, and secure it with the mounting screws. Turn on the Model 707 power after installation.
4. Using the prepared jumper wires, connect all terminals of the Bank A multiplexer inputs together to form one common terminal, as shown in Figure 4-6. See Figure 4-4 for contact identification.
5. Set the Model 196 to the 300Ω range, and connect four test leads to the OHMS and OHMS SENSE input jacks.
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 (jumper on the BANK A receptacle). It is recommended that the physical connections be made at inputs 1 and 12 of Row A, as shown in Figure 4-6.
8. Connect OHMS LO and OHMS SENSE LO to the HI (H) terminal of Input 1, on the BANK A receptacle.
9. From the front panel of the Model 707, close the Bank A, Channel 1 relay. Verify that the resistance of this path is <1.6Ω (Model 7074-D) or <0.6Ω (Model 7074-M).
10. Open Row A, Input 1, and close Row A, Input 2. Verify that the resistance of this path is within the limits given in step 9.
11. Using the basic procedure of steps 9 and 10, check the resistance of Row A HI (H) terminal paths for Inputs 3 through 12 of Row A.
12. Move the OHMS LO and OHMS SENSE LO test leads to the LO (L) terminal of Row A, Input 1.
13. Repeat steps 9 through 11 to check the LO (L) terminal paths of Row A.
14. Move the OHMS LO and OHMS SENSE LO test leads to the guard (G) terminal of Row A, Input 1.
15. Repeat steps 9 through 11 to check the guard (G) terminal paths of Row A.
16. Repeat the basic procedure in steps 1 through 15 for Rows B through H.

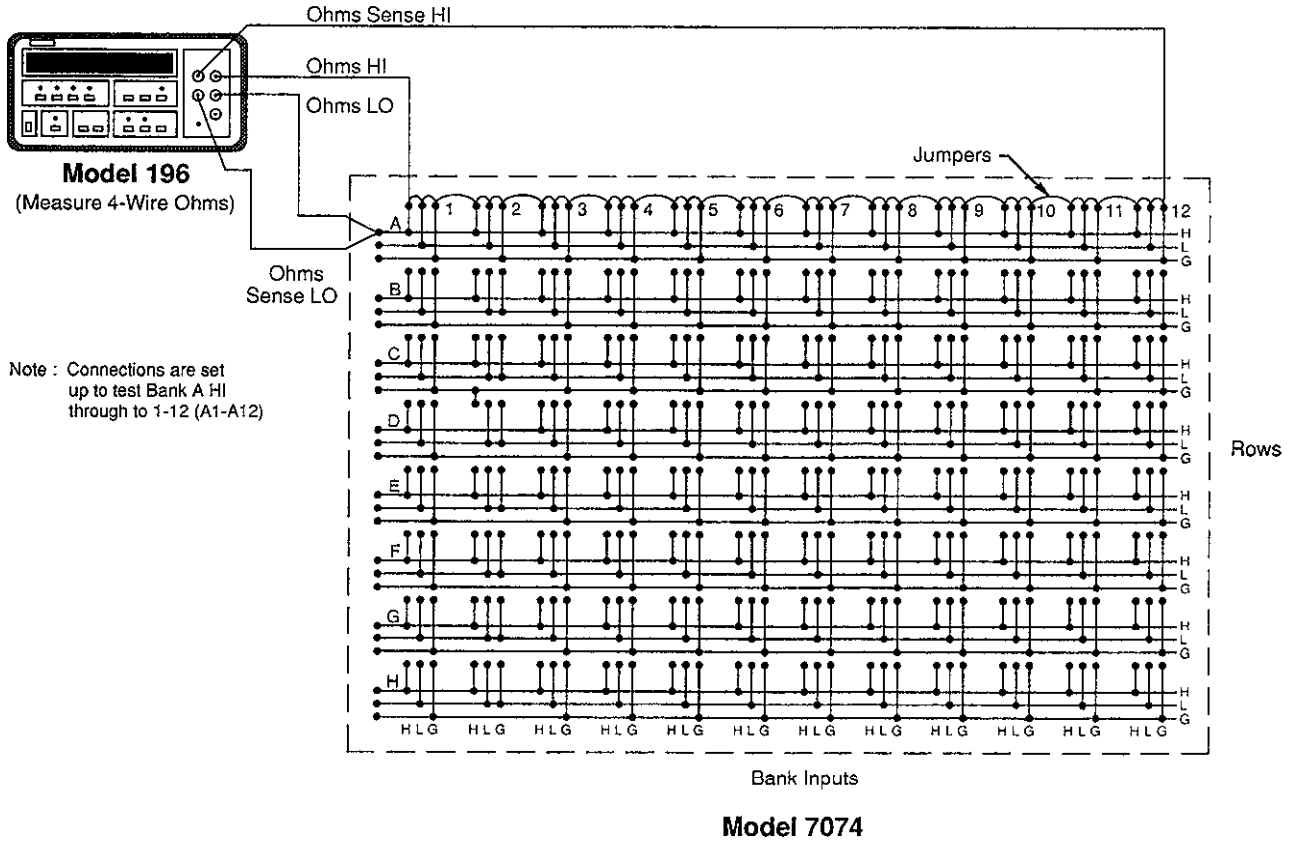


Figure 4-6. Connections for Path Resistance Test

4.4.6 Offset Current Tests

These tests check leakage current between HI (H) and LO (L) (differential offset current) and from HI and LO to guard (G) (common mode offset current) of 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 the leakage current. Test connections are shown in Figure 4-7.

Perform the following procedure to check offset current:

1. Turn the Model 707 off if it is on, and remove any jumpers or wires attached to the BANK or ROW A-H receptacles.
2. Connect the triax cable to the Model 617, and install a crimp tail contact on the HI (red) and LO (black) wire of the triax cable. Do not connect the triax cable to the multiplexer card at this time.
3. If not already installed, place the multiplexer card in slot 1 of the Model 707, then tighten the mounting screws securely.
4. Turn on the Model 617, and allow the unit to warm up for two hours before testing. After warmup, select the 200pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure. Also, be certain that V-Ω, GUARD is OFF.
5. Connect the triax cable to Row A HI and LO, as shown in Figure 4-7. Use the contact assignment layout shown in Figure 4-5 as a guide.
6. Turn on the Model 707, then program the unit to close Row A, Input 1.
7. On the Model 617, disable zero check, and allow the reading to settle. Verify that that the reading is <100pA. This specification, which is the offset (leakage) current of the pathway, applies to both the Model 7074-D and the Model 7074-M.
8. Enable zero check on the Model 617, and open Row A, Input 1 from the front panel of the Model 707.
9. Repeat the basic procedure in steps 6 through 8 to check the rest of the pathways (Row A, Inputs 2 through 12) of the row.
10. Change the electrometer connections to Row B, and repeat the basic procedure in steps 6 through 9 to check Row B, Inputs B1 through B12.

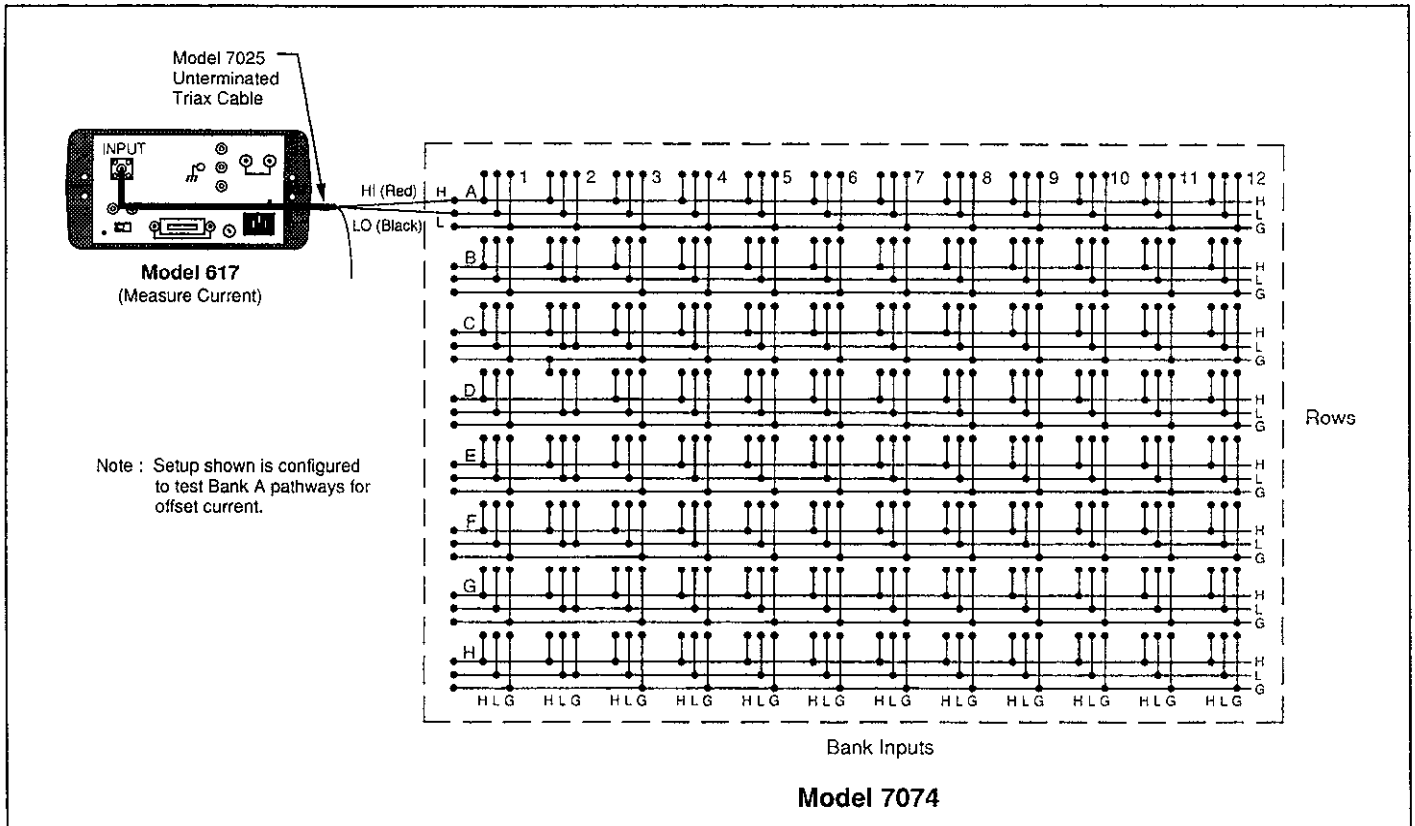


Figure 4-7. Differential Offset Current Test Connections

11. Repeat the basic procedure in steps 6 through 10 for the remaining rows (Rows C through H).
12. Change the electrometer connections, as shown in Figure 4-8. Note that electrometer HI is connected to HI and LO of the Row A output, which are jumpered together. Electrometer LO is connected to the guard terminal.
13. Repeat steps 6 through 12 to check common mode offset current.

4.4.7 Contact Potential Tests

These tests check the EMF generated by each relay contact pair (H and L) 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. Using 12 prepared jumper wires, short HI to LO of all 12 multiplexer inputs at the BANK A receptacle as shown in Figure 4-9. Terminal identification is provided in Figure 4-5.
2. Turn on the Model 181, and allow the unit to warm up for four hours for rated accuracy.
3. Select the 2mV range on the Model 181, short the input leads, and press ZERO to null out internal offsets. Leave ZERO enabled for the entire procedure.
4. If not already installed, insert the Model 7074 in slot 1 of the mainframe, and secure it with the mounting screws.
5. Turn on the Model 707.
6. Program the Model 707 to close Row A, Input 1.
7. After settling, verify that the reading on the Model 181 is <5μV (Model 7074-D), or <10μV (Model 7074-M). This measurement represents the contact potential of the pathway, and should be taken less than one minute after actuation.
8. From the Model 707, open Row A, Input 1.
9. Repeat the basic procedure in steps 6 through 8 to check the rest of the pathways (Row A, Inputs 2 through 12) of the row.
10. Change the nanovoltmeter to Row B, and repeat the basic procedure in steps 6 through 9 to check Row B, Inputs 1 through 12.
11. Repeat the basic procedure in steps 6 through 10 for the remaining rows (Rows C through H).

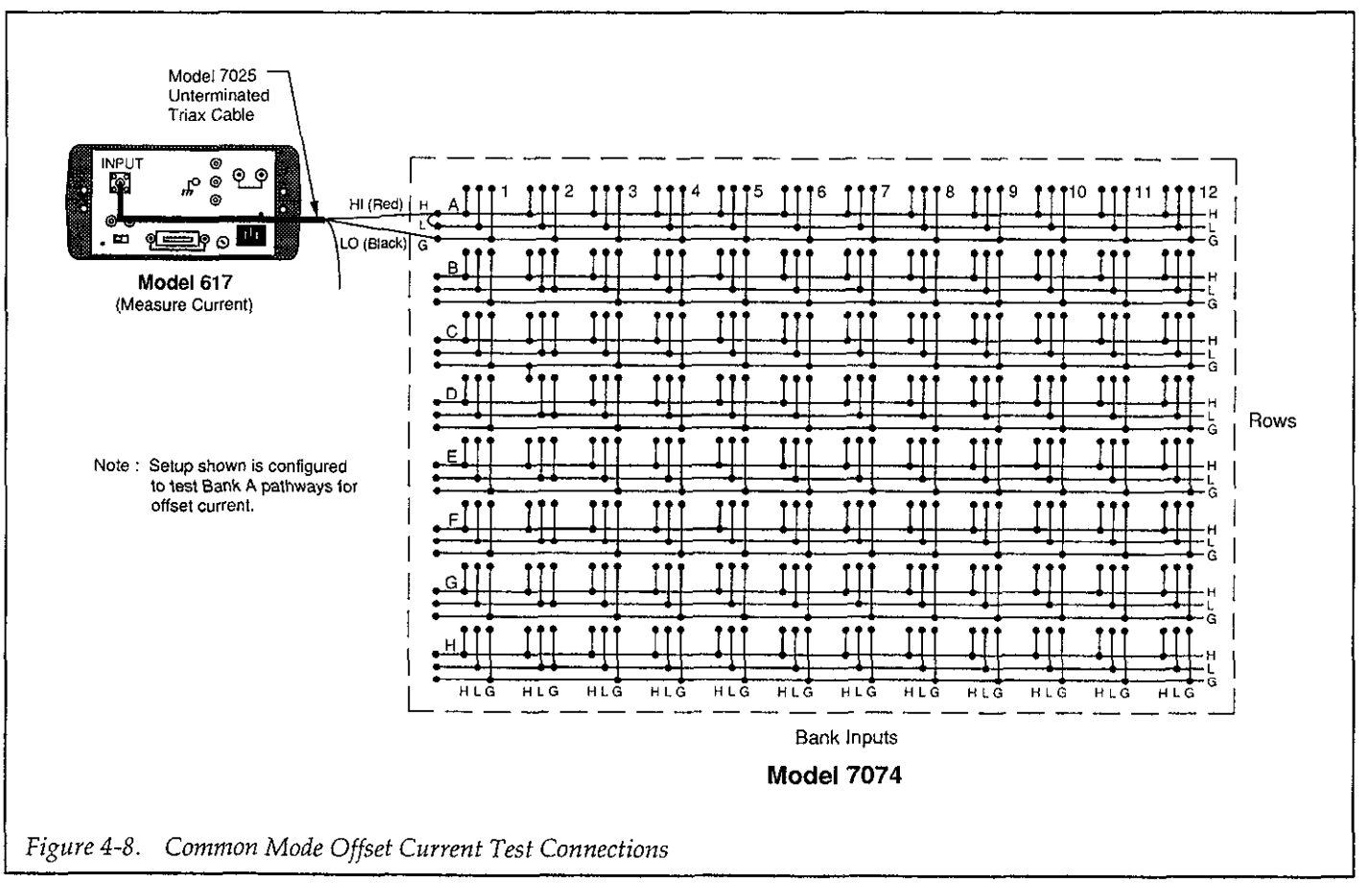


Figure 4-8. Common Mode Offset Current Test Connections

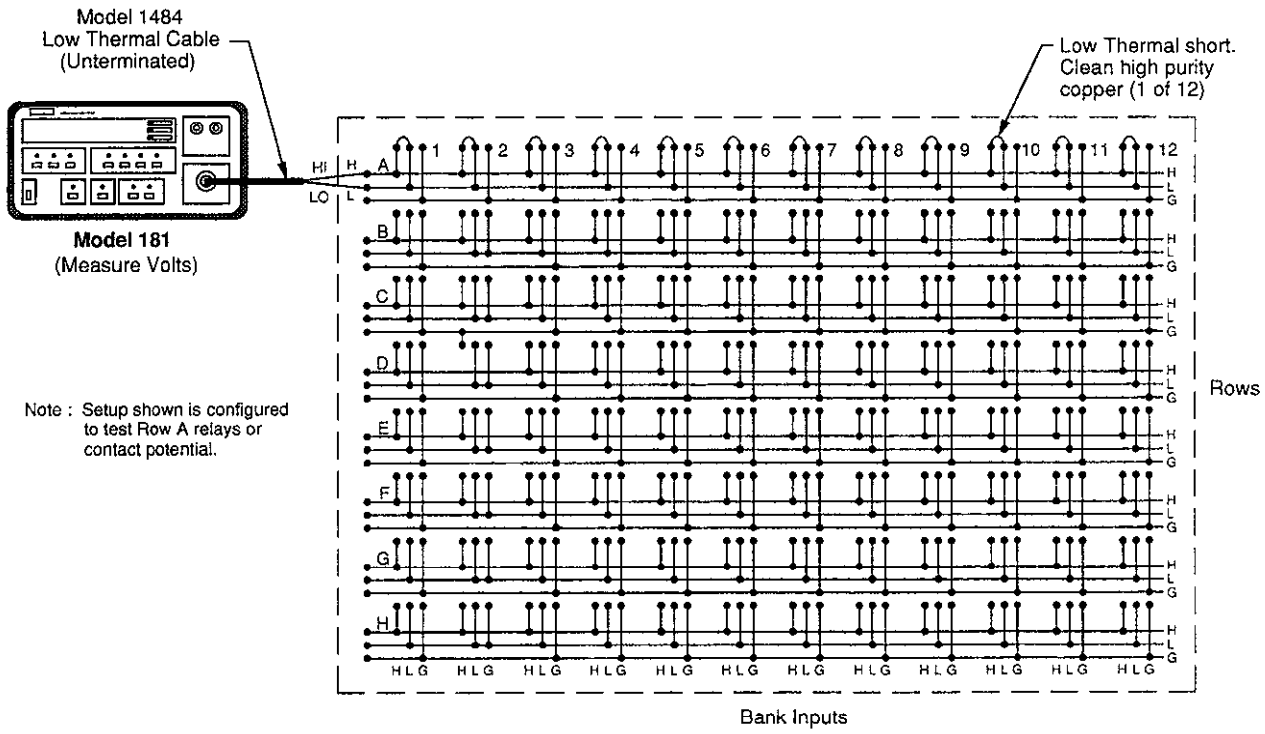


Figure 4-9. Contact Potential Test Connections

4.4.8 Path Isolation Tests

These tests check the leakage resistance (isolation) between adjacent paths. A path is defined as the HI (H), LO (L), guard (G) circuit from a bank to a channel that results by closing a particular relay. 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 resistive value.

NOTE
Refer to Figure 4-10 for the following procedure.

1. Turn the Model 707 off if it is on, and remove any jumpers or test leads installed on the receptacles.
2. Turn on the Model 617, and allow the unit to warm up for two hours before testing.
3. If not already installed, place the multiplexer card in slot 1 of the Model 707, and secure it with the mounting screws.
4. Turn on the Model 707.

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. Connect the electrometer to the Model 7074, as shown in Figure 4-10. Be sure to include the jumpers where indicated on the diagram.

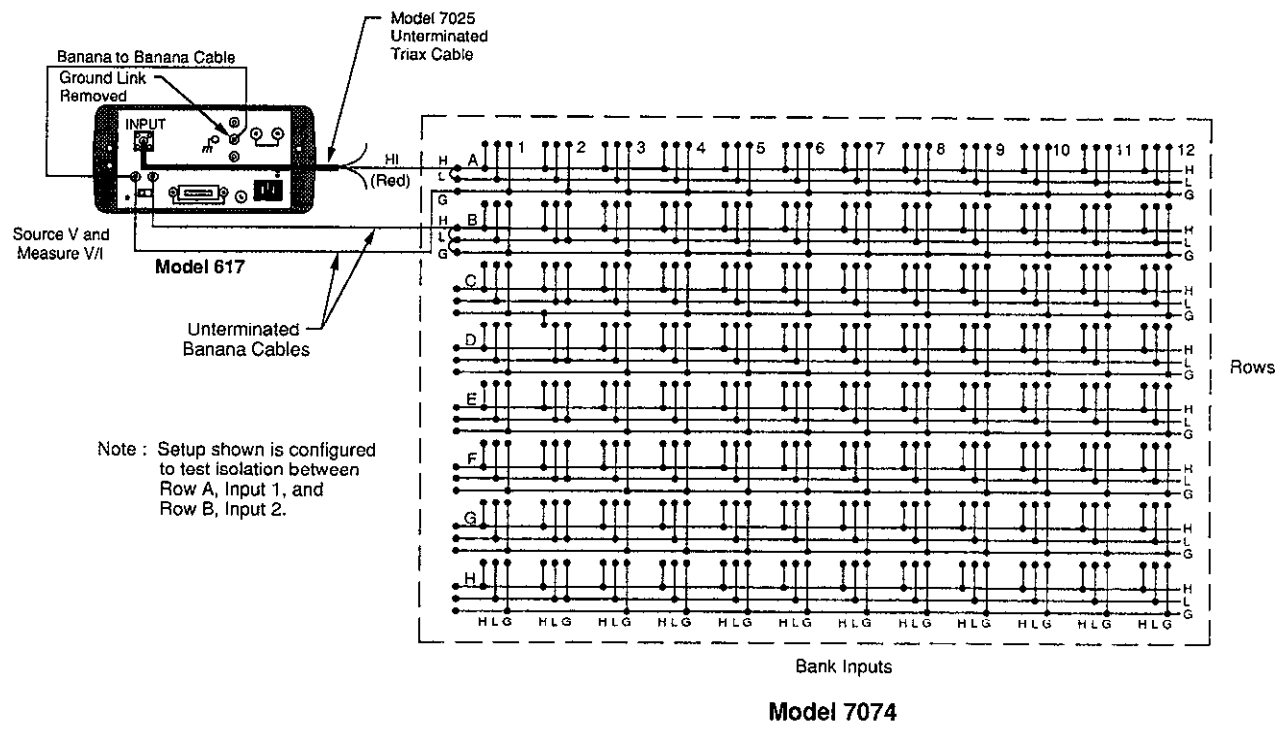


Figure 4-10. Path Isolation Test Connections

7. On the Model 617, select the 20pA range and release zero check.
8. On the Model 617, press SUPPRESS to cancel offset current, then enable zero check.
9. On the Model 617, set the voltage source for +100V, and select the 20nA current range. Make sure the voltage source is in standby.
10. Place the Model 617 in the V/I measurement function by pressing SHIFT OHMS.
11. Program the Model 707 to close Row A, Input 1 and Row B, Input 2.
12. On the Model 617, disable zero check and press OPERATE to source +100V.
13. After allowing the reading on the Model 617 to settle, verify that it is >10GΩ (10^{10}). This measurement is the leakage resistance (isolation) between Row A, Input 1 and Row B, Input 2.
14. Place the Model 617 voltage source in standby, and enable zero check.
15. Change the electrometer connections so that it is connected to Rows B and C.
16. Program the Model 707 to close Row B, Input 2 and Row C, Input 3.
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 (10^{10}).
19. Using Table 4-3 as a guide, repeat the basic procedure of steps 15 through 19 for the rest of the path pairs (test numbers 3 through 11 in the table).

4.4.9 Differential and Common Mode Isolation Tests

These tests check the leakage resistance (isolation) between HI (H) and LO (L) (differential), and from HI and LO to guard (G) (common mode) of every bank and channel. 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 and remove any jumpers and test leads installed on the receptacles.

Table 4-3. Path Isolation Test Summary

Test Number	Path Isolation	Test Equipment Location	Relays Closed*
1	Row A, Input 1 to Row B, Input 2	Row A and Row B	A1 and B2
2	Row B, Input 2 to Row C, Input 3	Row B and Row C	B2 and C3
3	Bank C, Input 3 to Row D, Input 4	Row C and Row D	C3 and D4
4	Row D, Input 4 to Row E, Input 5	Row D and Row E	D4 and E5
5	Row E, Input 5 to Row F, Input 6	Row E and Row F	E5 and F6
6	Row F, Input 6 to Row G, Input 7	Row F and Row G	F6 and G7
7	Row G, Input 7 to Row H, Input 8	Row G and Row H	G7 and H8
8	Row G, Input 8 to Row H, Input 9	Row G and Row H	G8 and H9
9	Row G, Input 9 to Row H, Input 10	Row G and Row H	G9 and H10
10	Row G, Input 10 to Row H, Input 11	Row G and Row H	G10 and H11
11	Row G, Input 11 to Row H, Input 12	Row G and Row H	G11 and H12

* Row and input, programmed as Row and Column on mainframe.

2. If not already installed, place the multiplexer card in slot 1 of the Model 707, and secure it with the mounting screws.

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

3. Turn on the Model 617, and allow the unit to warm up for two hours for rated accuracy.
4. 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.
5. 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.
6. Place the Model 617 in the V/I measurement function by pressing SHIFT OHMS.
7. With the Model 617 in standby, connect the electrometer to Row A of the multiplexer card, as shown in Figure 4-11.
8. Make sure all the relays are open (press RESET on the Model 707).
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 (10^9). This measurement is the differential leakage resistance (isolation) of Row A.
11. Place the Model 617 in standby, and enable zero check.
12. Program the Model 707 to close Row A, Input 1.
13. On the Model 617, disable zero check and press OPERATE to source +100V.
14. After allowing the reading on the Model 617 to settle, verify that it is also >1GΩ (10^9). This measurement checks the differential isolation of Input 1.
15. Using Table 4-4 as a guide, repeat the basic procedure of steps 8 through 14 for the rest of the inputs and rows (test numbers 3 through 20 of the table).
16. Turn off the voltage source, and change the electrometer connections, as shown in Figure 4-12.
17. Repeat steps 4 through 15 to check common mode isolation. Verify that each reading is >500MΩ (5×10^8) for the common mode isolation tests only.

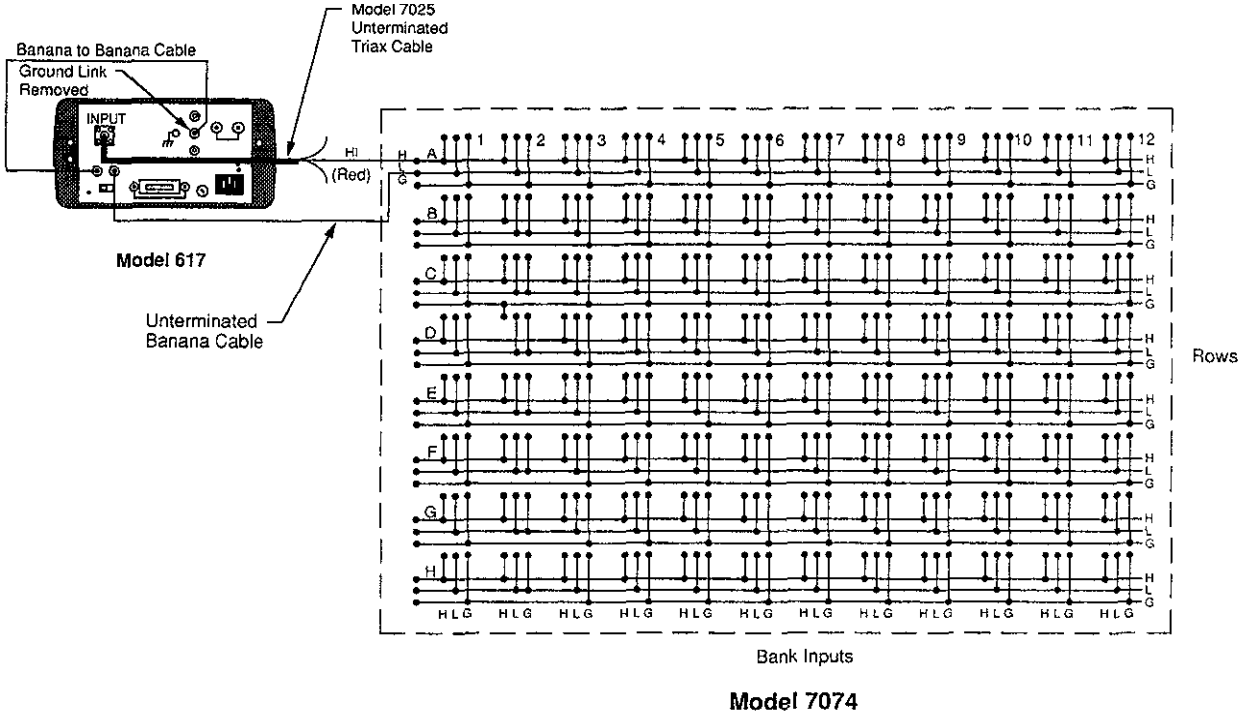


Figure 4-11. Differential Isolation Test Connections

Table 4-4. Differential and Common Mode Isolation Test Summary

Test No.	Differential or Common Mode Test	Relay(s)* Closed
1	ROW	None
2	1	A1
3	2	A2
4	3	A3
5	4	A4
6	5	A5
7	6	A6
8	7	A7
9	8	A8
10	9	A9
11	10	A10
12	11	A11
13	12	A12
14	ROW	A1 and B1
15	ROW	A1 and C1
16	ROW	A1 and D1
17	ROW	A1 and E1
18	ROW	A1 and F1
19	ROW	A1 and G1
20	ROW	A1 and H1

* Row and Input, programmed as Row and Column on mainframe.

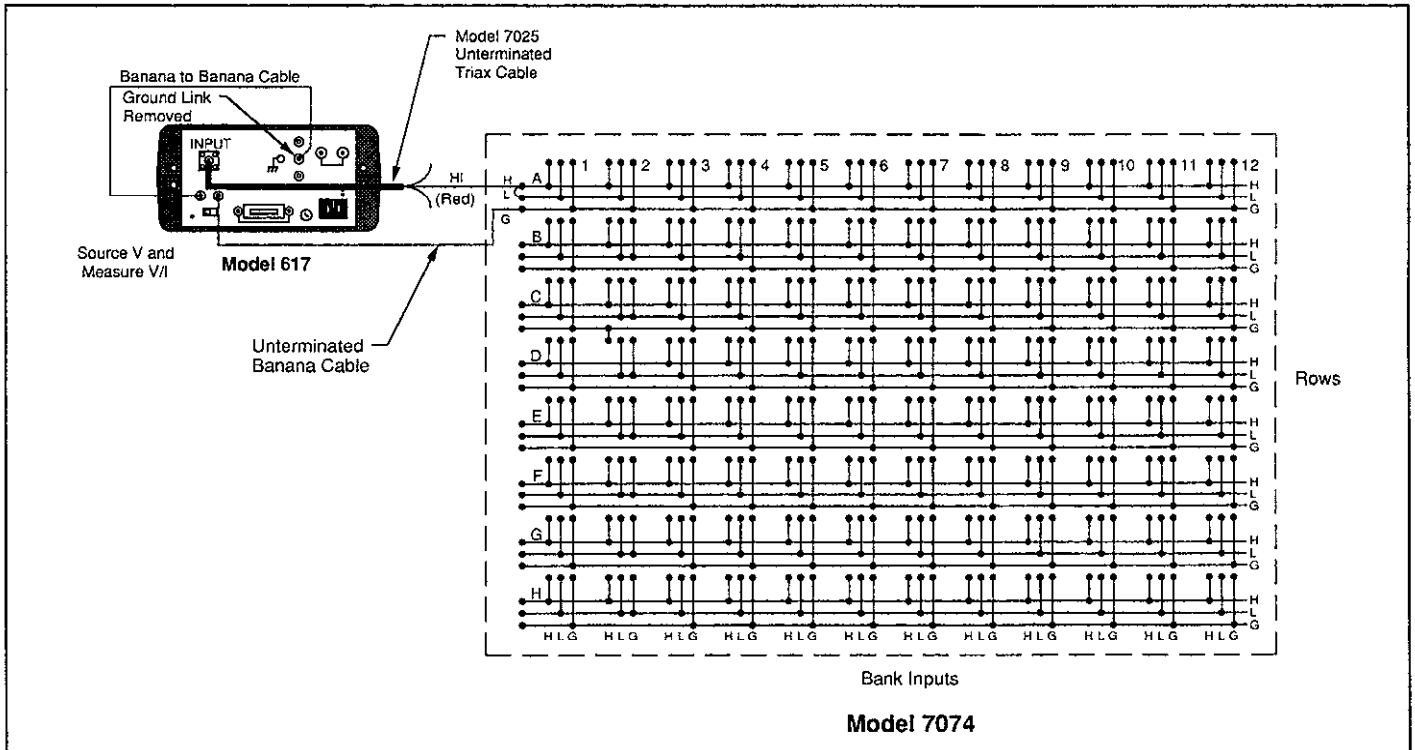


Figure 4-12. Connections for Common Mode Isolation Tests

4.5 SPECIAL HANDLING OF STATIC-SENSITIVE DEVICES

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

NOTE
In order to prevent damage, assume that all parts are 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 or use.
2. Remove the devices from their protective containers only at a properly-grounded work station. Also ground yourself with an appropriate wrist strap while working with these devices.
3. Handle the devices only by the body; do not touch the pins or terminals.
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.

4.6 DISASSEMBLY

CAUTION
When disassembling or reassembling the card, be careful not to touch circuit board surfaces or areas around electrical connections to avoid possible contamination.

4.6.1 Disassembly

Refer to Figure 4-13, and disassemble the Model 7074 as follows.

1. Remove the screws that secure the top shield, then remove the shield.
2. If the PC board is to be separated from the rear panel, first tag the wires and wire bundles for identification, then unplug the connecting wires from the circuit board.
3. Remove the four screws that secure the PC board to the rear panel, and separate the circuit board from the rear panel.
4. To remove one of the connectors, first remove all the mounting nuts, then pull the connector out from the rear while guiding the attached wires through the holes.

In general, the card can be reassembled by reversing the above procedure. When reassembling, be careful not to pinch the wires between the top shield and the standoffs. Also, note that the edge of the top shield without the lip should be oriented towards the rear panel.

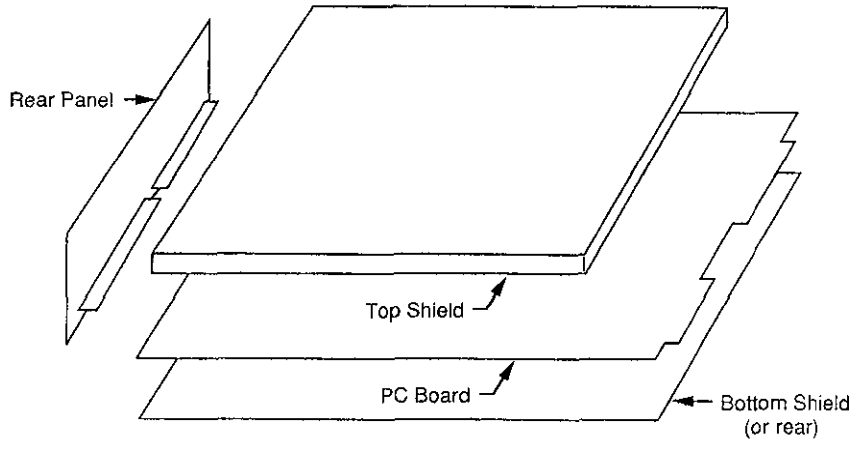


Figure 4-13. Card Disassembly

4.6.2 Rear Shield Removal and Replacement

A copper-cladded shield is located on the rear side of the PC board in order to provide protection from static discharge. The copper shield is electrically connected to chassis ground of the multiplexer card through one of the standoffs.

In order to service the multiplexer card, it may be necessary to remove the rear shield. Referring to Figure 4-14, perform the following procedure to remove and install the rear shield:

1. Remove the top shield, as discussed in paragraph 4.6.1.
2. Remove the eight screws that secure the rear shield to the PC board, then remove the shield from the PC board.
3. To reinstall the shield, reverse the above procedure. Make sure the metal side of the shield is facing outward.

CAUTION

Make sure all screws are installed and secured properly to ensure good mechanical integrity and electrical contact.

4.7 TROUBLESHOOTING

4.7.1 Recommended Equipment

Table 4-5 summarizes the recommended equipment for general troubleshooting.

4.7.2 Using the Extender Card

In order to gain access to the test points and other circuitry on the Model 7074, the card must be plugged into the Model 7070 Universal Adapter Card used as an extender card, which, in turn, must be plugged into the desired slot of the mainframe. The Model 7070 must be configured as an extender card by placing the configuration jumper in the EXTEND position. See the documentation supplied with the Model 7070 for complete details on using the card.

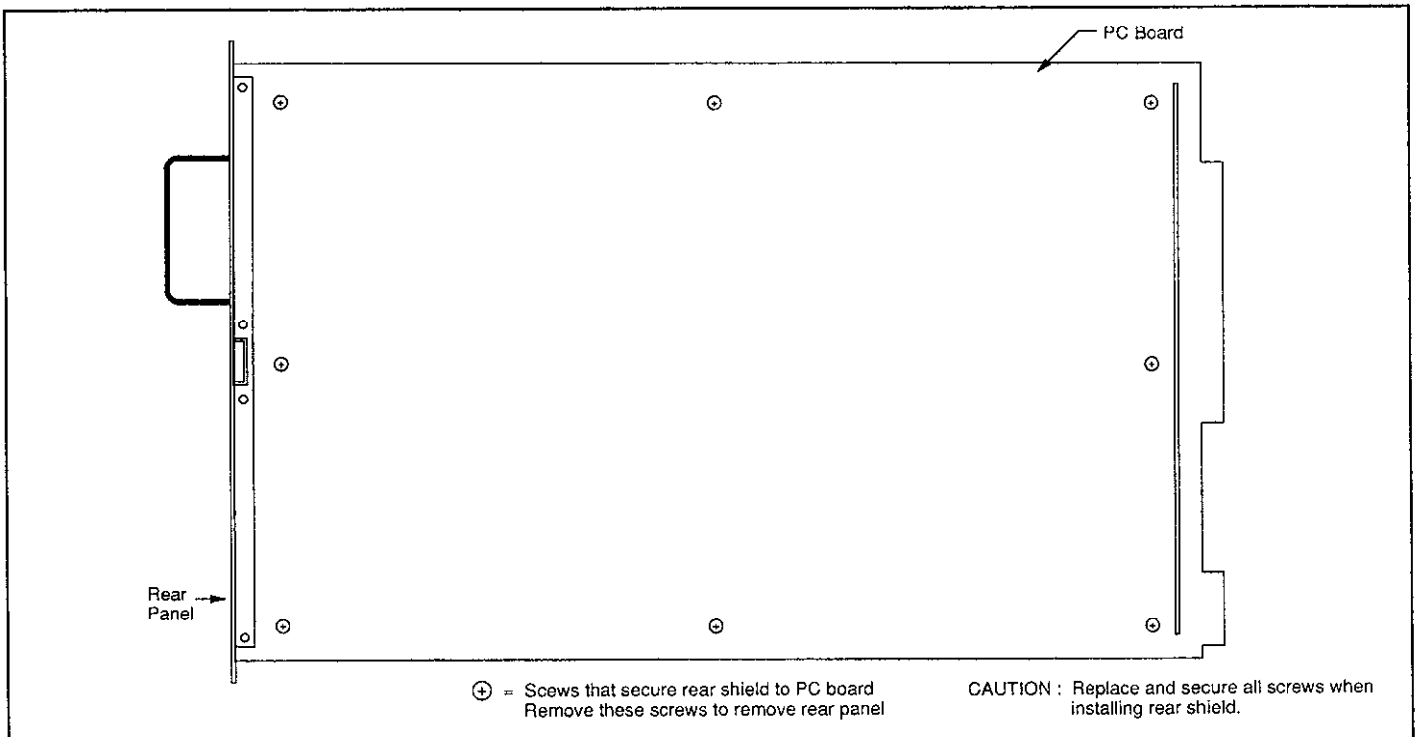


Figure 4-14. Rear Shield Location

Table 4-5. 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

NOTE
Use the extender card only for troubleshooting; do not use the extender card for performance verification tests.

4.7.3 Input/Output Connections

For some troubleshooting steps, it may be necessary to connect test instruments to the BANK or ROW A-H receptacles on the rear panel. General instructions for making connections, including BANK and ROW A-H receptacle contact assignments, are located in paragraph 4.4.3.

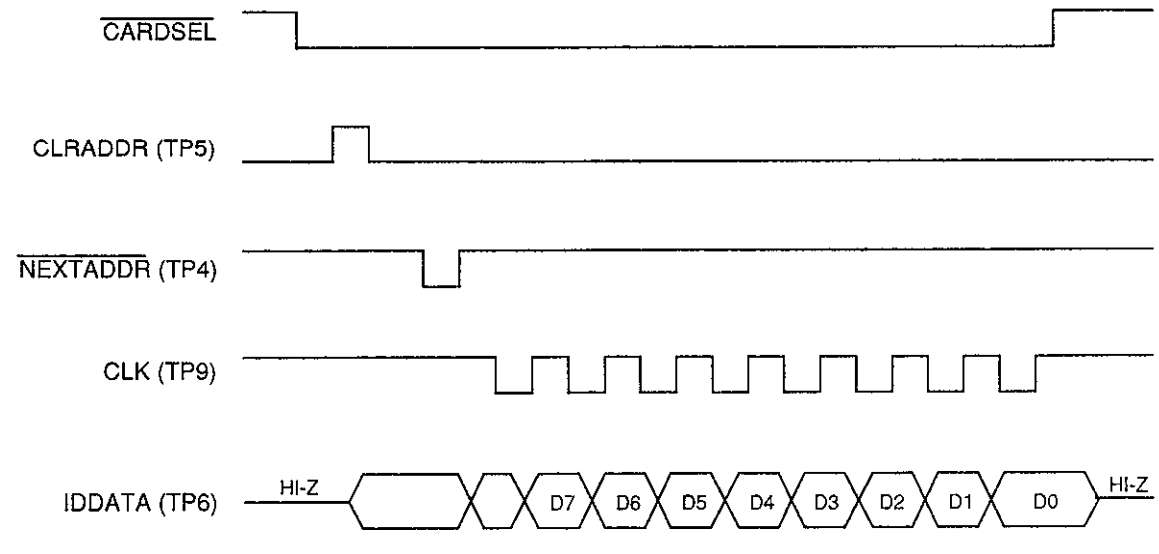
4.7.4 Troubleshooting Procedure

Table 4-6 summarizes the troubleshooting procedure for the multiplexer card. Some of the troubleshooting steps refer to the ID data timing diagram shown in Figure 4-15. In addition to the procedure shown, the relay tests outlined in paragraph 4.3.3 can be used to aid in troubleshooting. Also, refer to paragraph 4.6 for an overview of operating principles.

Table 4-6. Troubleshooting Procedure

Step	Item/Component	Comment	Required Condition*
1	TP1	+6V supply	+6V dc
2	TP3	+5V supply	+5V dc
3	TP5	CLR ADDR line**	High logic pulse at beginning of each card identification byte transfer sequence (upon power up).
4	TP4	$\overline{\text{NEXT ADDR}}$ line**	Low logic pulse before each byte transfer.
5	TP9	CLK line	1.79MHz clock
6	TP6	IDDATA line**	Card identification logic pulse train (on power up).
7	TP10	Power up safeguard	Remains high during power up.
8	TP8	RELAY DATA line	Logic pulse train to load relay configuration registers.
9	TP7	STROBE line	High logic pulse to strobe relay configuration registers.
10	U30 thru U41, pins 11 thru 18	Relay Drivers	+6V for open relays ≈0V for closed relays.

* All measurements referenced to digital common (TP2)
** See Figure 4-15.



Note : ID data sequence occurs on power-up only.
CLRADDR pulse occurs only once.

Figure 4-15. ID Data Timing

4.7.5 Relay Replacement Precautions

A typical failure mode for switching cards is for a number of relay coils to burn out simultaneously. This situation results in the desoldering of a large number of pins, with a good chance of pulling up traces on the PC board. To prevent such damage, use extreme care when replacing relays.

In order to remove relays or other components, first remove all the solder using solder wick or other desoldering aid. Be careful not to apply too much heat, as doing so may result in lifted traces. Once all solder has been removed, carefully remove the relay by hand. DO NOT pry up on the relay body with a screwdriver because the resulting force could lift the surrounding trace.

Because of the necessity of these precautions, only skilled technical personnel should attempt to replace relays. If no qualified technicians are available, it is recommended that you return the card to the Keithley repair department for repair.

4.8 PRINCIPLES OF OPERATION

The following paragraphs discuss the basic operating principles for the Model 7074. A schematic diagram of the multiplexer card may be found in drawing number 7074-106, located at the end of Section 5.

4.8.1 Block Diagram

Figure 4-16 shows a simplified block diagram of the Model 7074. Key elements include the buffer (U44), ID data circuits (U27, U43, and U44), relay drivers (U30-U41) and relays (K1-K96), and power-on safe guard (U42). The major elements are discussed below.

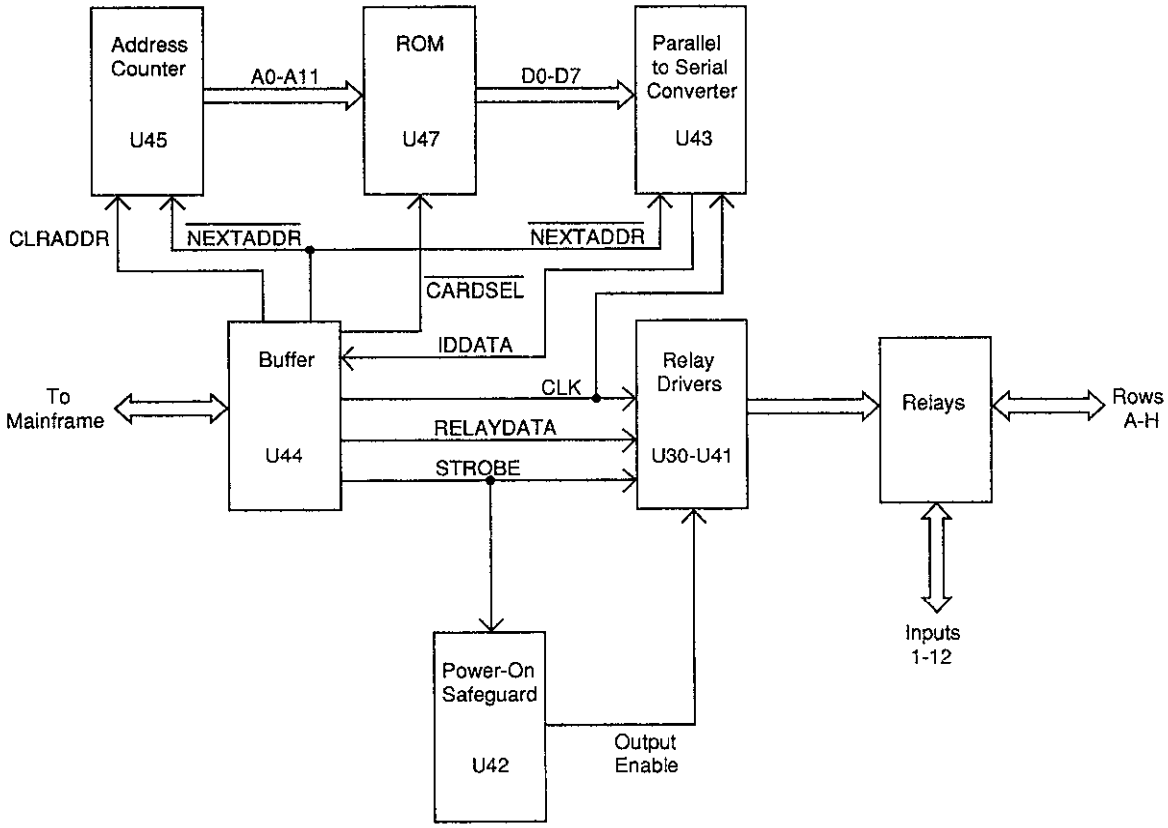


Figure 4-16. Model 7074 Block Diagram

4.8.2 ID Data Circuits

Upon power up, the card identification data information from each card is read by the mainframe. This ID data includes such information as card ID, hardware settling time for the card, and a relay configuration table, which tells the mainframe which relays to close for a specific crosspoint.

ID data is contained within an on-card ROM, U27. In order to read this information, the sequence below is performed upon power up. Figure 4-15 shows the general timing of this sequence.

1. The CARDSEL line is brought low, enabling the ROM outputs. This line remains low throughout the ID data transmission sequence.
2. The CLRADDR line is pulsed high to clear the address counter and set it to zero. At this point, a ROM address of zero is selected. This pulse only occurs once.
3. The NEXTADDR line is set low. NEXTADDR going low increments the counter and enables parallel loading of the parallel-to-serial converter. NEXTADDR is kept low long enough for the counter to increment and for the ROM outputs to stabilize. This sequence functions because the load input of the parallel-to-serial converter is level sensitive rather than edge sensitive. The first ROM address is location 1, not 0.
4. The CLK line clocks the parallel-to-serial converter to shift all eight data bits from the converter to the mainframe via the IDDATA line.

The above process repeats until all the necessary ROM locations have been read. A total of 498 bytes of information are read by the mainframe during the card ID sequence.

4.8.3 Relay Control

The relays are controlled by serial data transmitted via the RELAYDATA line. A total of 16 bytes for each card

are shifted in serial fashion into latches located in the 12 relay drivers, U30-U41. The serial data is fed in through the DATA lines under control of the CLK signal. As data overflows one register, it is fed out the Q'S line of that register to the next IC down the chain.

Once all 16 bytes have been shifted into the card, the STROBE line is set high to latch the relay information into the Q outputs of the relay drivers, and the appropriate relays are energized (assuming the driver outputs are enabled, as discussed below). Logic convention is such that the corresponding relay driver output must be low to energize the associated relay, while the output is high when the relay is de-energized.

4.8.4 Power-on Safeguard

A power-on safeguard circuit, made up of U42 and associate components, ensures that relays do not randomly energize upon power-up. The two AND gates, U42, make up an R-S flip-flop. Initially, the Q output of the flip-flop (pin 3 of U42) is set high upon power up. Since the OEN terminals of the relay drivers U30-U41 are held high, their outputs are disabled, and all relays remain de-energized regardless of the relay data information present at that time.

The first STROBE pulse that comes along (in order to load relay data) clears the R-S flip-flop, setting the OEN lines of U30-U41 low to enable their outputs. This action allows the relays to be controlled by the transmitted relay data information.

A hold-off period of approximately 470msec in included in the safeguard circuit to guard against premature enabling of the relays. The time constant of the hold-off period is determined by the relative values of R1 and C20.

SECTION 5
Replaceable Parts

5.1 INTRODUCTION

This section contains a list of replaceable electrical and mechanical parts for the Model 7074, as well as a component layout drawing and schematic diagram of the multiplexer card.

5.2 PARTS LISTS

Electrical parts for the card are listed in order of circuit designation in Table 5-1. Table 5-2 summarizes mechanical parts.

5.3 ORDERING INFORMATION

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

1. Card model number (7074)
2. Card serial number
3. Part description
4. Circuit designation, if applicable
5. Keithley part number

5.4 FACTORY SERVICE

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

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

Note that it is not necessary to return the matrix mainframe with the card.

5.5 COMPONENT LAYOUT AND SCHEMATIC DIAGRAM

Figure 5-1 is the component layout for the circuit board. Figure 5-2 shows a schematic diagram of the board.

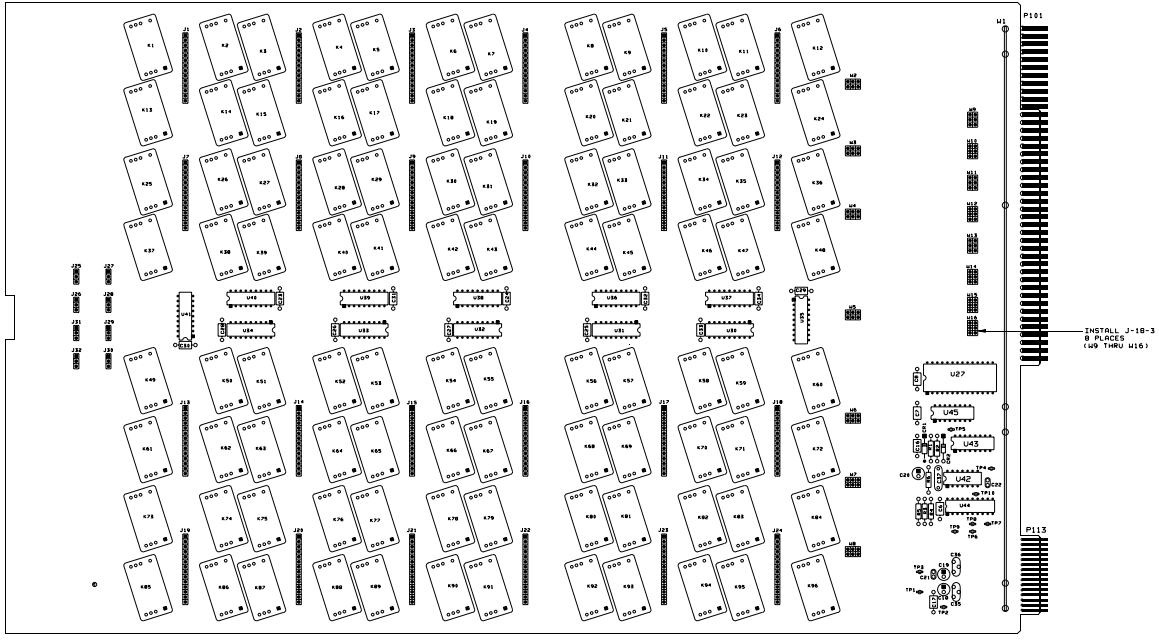
MODEL 7074, PARTS LIST

CIRCUIT DESIG.	DESCRIPTION	KEITHLEY PART NO.
	BRACKET, REAR PANE	7074-309
	CABLE ASSEMBLY,INPUT	7074-306
	CORNER SOCKET	CS-692
	EXTRUSION,REAR PANEL	707-318
	FIXED JACKSCREW (FEMALE)	CS-66
	FIXED JACKSCREW (MALE)	CS-660
	SHIELD, BOTTOM	7074-308
	SHIELD,TOP	7074-307
	HANDLE	HH-36-1
	REAR PANEL ASSEMBLY	7074-030
	RECEPTACLE 14-PIN	CS-371-14
	SOCKET,CONTACT	CS-676
	CONNECTOR,PIN SOCKET	CS-236
	CONTACT	CS-426
	STANDOFF	ST-137-4
	POUCH	PO-9-3
	SOCKET	SO-69
C18,C19	CAP,10uF,-20+100%,25V,ALUM ELEC	C-314-10
C20	CAP,47uF,10%,16V,ALUM ELEC	C-321-47
C21,C22	CAP,.01uF,20%,50V,CERAMIC	C-237-.01
C35,C36	CAP,270pF,20%,100V,CERAMIC/FERRITE	C-386-270P
C37	CAP,.01uF,10%,1000V,CERAMIC	C-64-.01
C6..C8,C16,C17	CAP,.1uF,20%,50V,CERAMIC	C-365-.1
CR1	DIODE,SILICON,1N4148 (DO-35)	RF-28
CR2	DIODE,SCHOTTKY,1N5711	RF-69
J1..J24	CONN,MALE 14-PIN	CS-681-14
J25..J32	CONN,MALE 3-PIN	CS-681-3
J48,49,51,52	RECEPTACLE, CONNECTOR	CS-678
J50	SOCKET,CONNECTOR	CS-593
K1..K96	RELAY (7074D)	RL-67
K1..K96	RELAY (7074M)	RL-127
R1	RES,47K,5%,1/4W,COMPOSITION OR FILM	R-76-47K
R2	RES,10K,5%,1/4W,COMPOSITION OR FILM	R-76-10K
R3	RES,4.7K,5%,1/4W,COMPOSITION OR FILM	R-76-4.7K
R4	RES,11K,5%,1/4W,COMPOSITION OR FILM	R-76-11K
R5	RES,910,5%,1/4W,COMPOSITION OR FILM	R-76-910
R6	RES,200,5%,1/4W,COMPOSITION OR FILM	R-76-200
TP1..TP10	CONN,TEST POINT	CS-553

U27	PROGRAMMED ROM	7074-D-800
U30..U41	IC,8-BIT SERIAL IN-LTCH DRIVE,UNC-5841A	IC-536
U42	IC,QUAD 2 INPUT NAND,74HCT00	IC-399
U43	IC,8 BIT PARALLEL TO SERIAL,74HCT165	IC-548
U44	IC, LINE DRVR,W/3-STATE OUTPUT,74HC244	IC-489
U45	IC,12 STAGE BINARY COUNTER,74HCT4040	IC-545
W1	STIFFENER,BOARD	J-16
W2-W16	CONN,DUAL 3 PIN	CS-672-3

NO. 7074-100

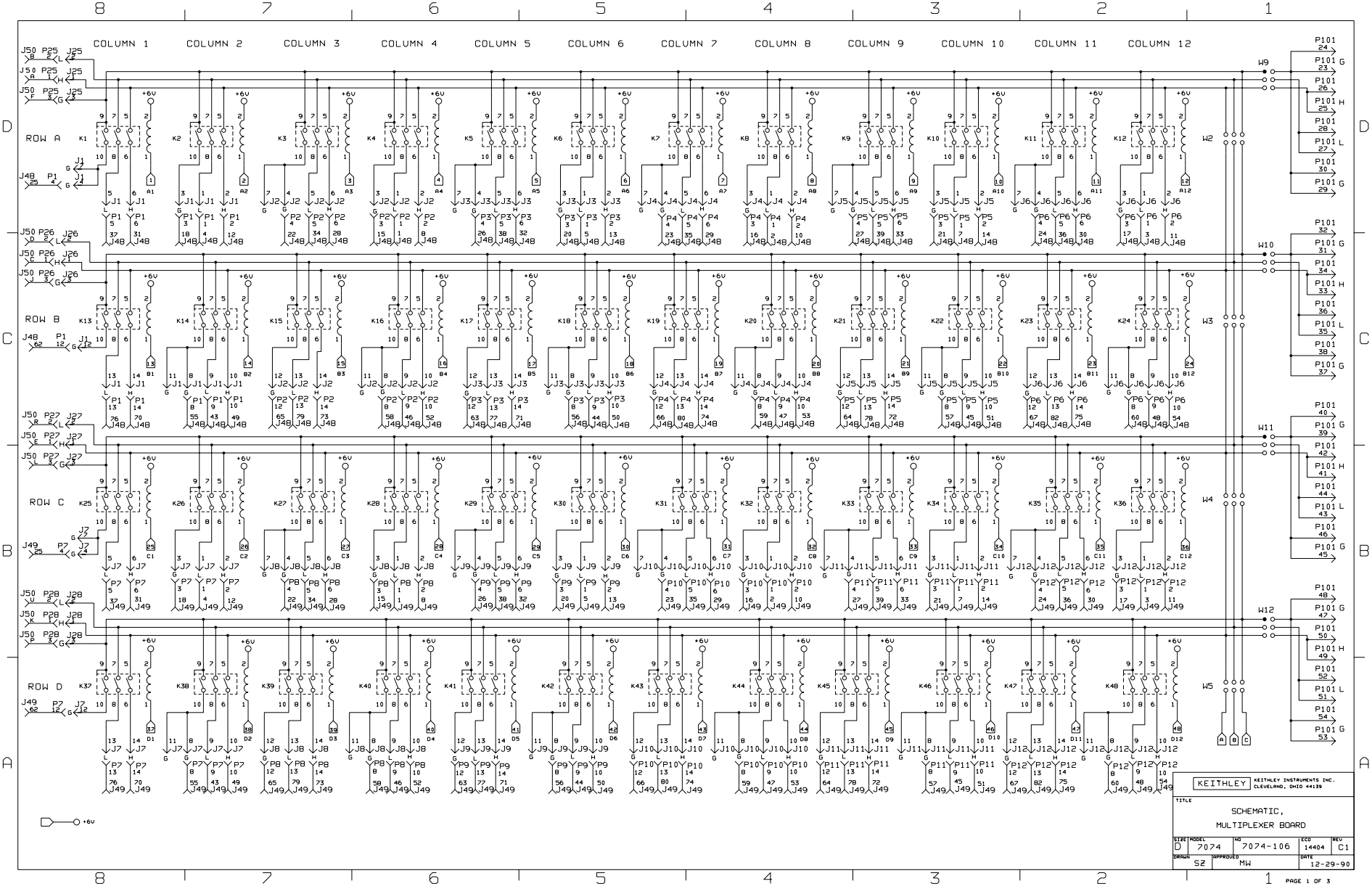
LTR.	ECO NO.	REVISION	ENG.	DATE
B	13035	RELEASED		10-3-88
C	13253	REVISED	SZ	2-24-89

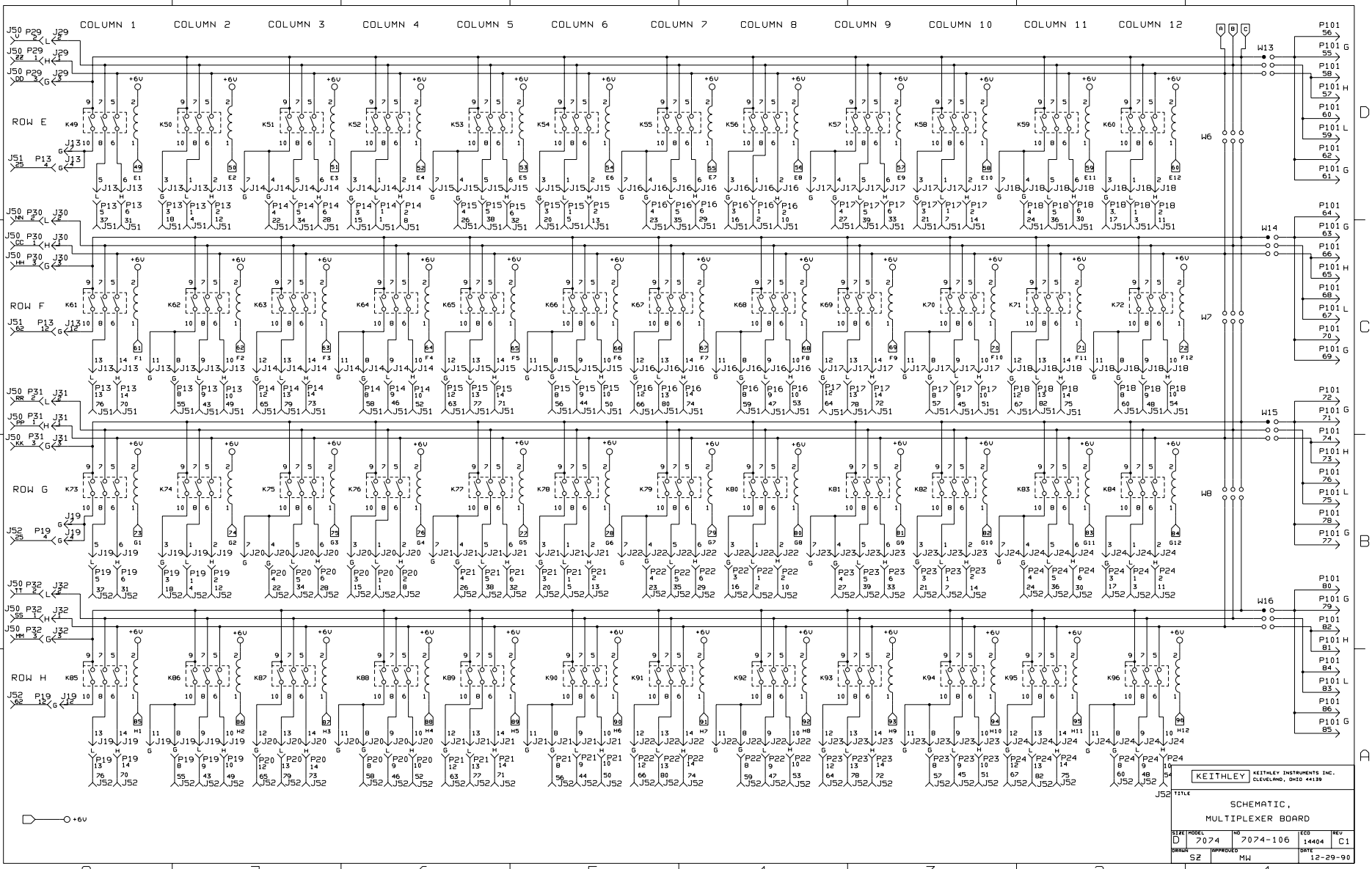


NOTE:
FOR COMPONENT INFORMATION,
REFER TO BILLS OF MATERIAL
(7074D-000-00) OR (7074M-000-00).

7074 MODEL	NEXT ASSEMBLY	QTY. USED ON

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 9-1-88	SCALE 1:1	TITLE COMPONENT LAYOUT GENERAL PURPOSE MULTIPLEXER CARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.015 ANG.=±1°	DRN. SZ	APP.	
	XXX=±.005 FRAC.=±1/64	MATERIAL		D NO. 7074-100
	SURFACE MAX. 63	FINISH		


COLUMN 1
COLUMN 2
COLUMN 3
COLUMN 4
COLUMN 5
COLUMN 6
COLUMN 7
COLUMN 8
COLUMN 9
COLUMN 10
COLUMN 11
COLUMN 12
ROW A
ROW B
ROW C
ROW D
+6V
W9
W10
W11
W12
W2
W3
W4
W5
KEITHLEY
KEITHLEY INSTRUMENTS INC.
CLEVELAND, OHIO 44139
SCHEMATIC,
MULTIPLEXER BOARD
SIZE D
MODEL 7074
NO 7074-106
ECO 14404
REV C1
DRAWN SZ
APPROVED MW
DATE 12-29-90
PAGE 1 OF 3


COLUMN 1
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COLUMN 8
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COLUMN 10
COLUMN 11
COLUMN 12
ROW E
ROW F
ROW G
ROW H
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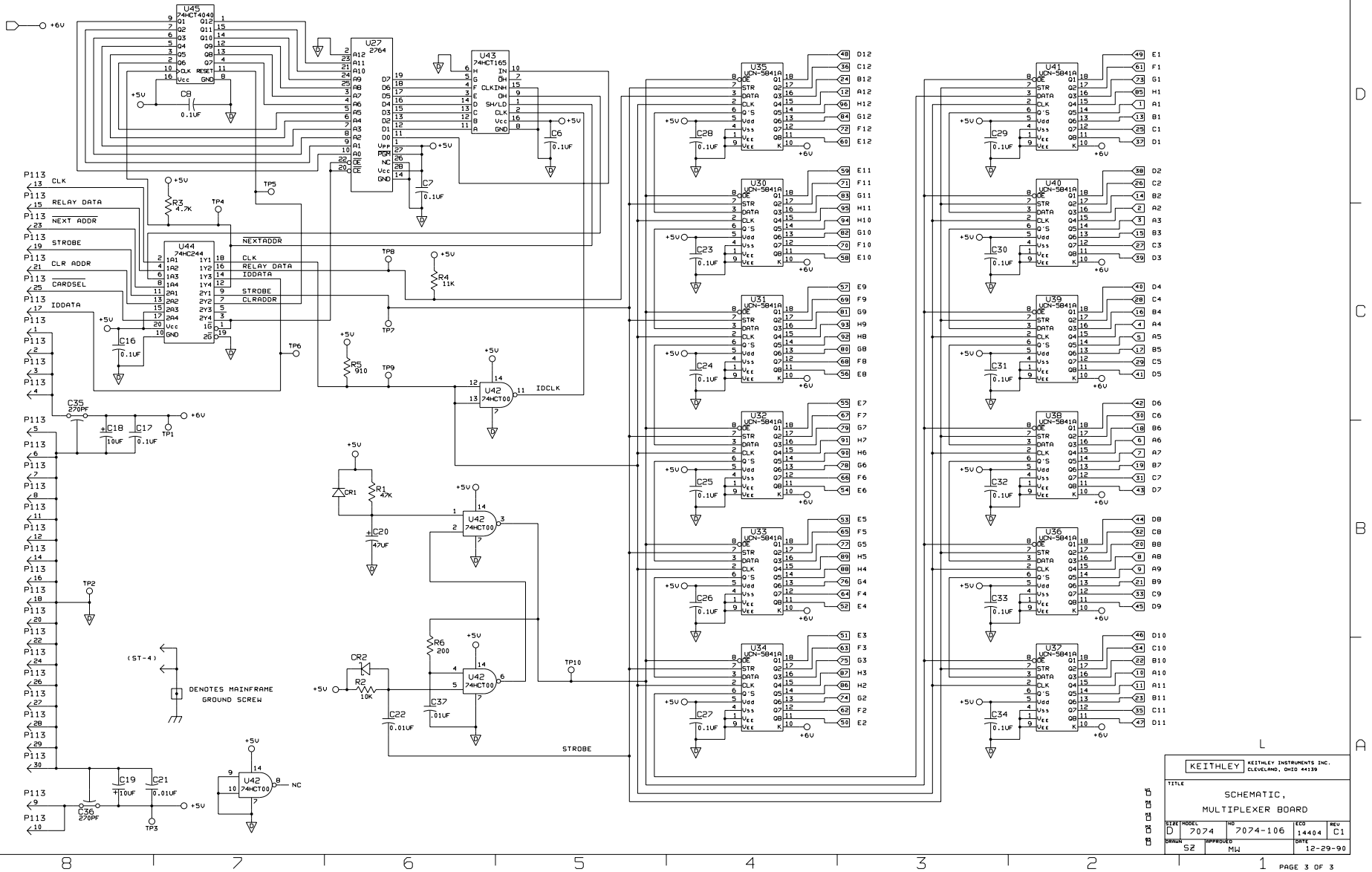
W13
W14
W15
W16
W6
W7
W8
P101
J50 P29
J50 P30
J50 P31
J50 P32
J51 P13
J52 P19
J52
KEITHLEY
KEITHLEY INSTRUMENTS INC.
CLEVELAND, OHIO 44139
SCHEMATIC,
MULTIPLEXER BOARD
SIZE D
MODEL 7074
NO 7074-106
ECO 14404
REV C1
DRAWN SZ
APPROVED MW
DATE 12-29-90
PAGE 2 OF 3



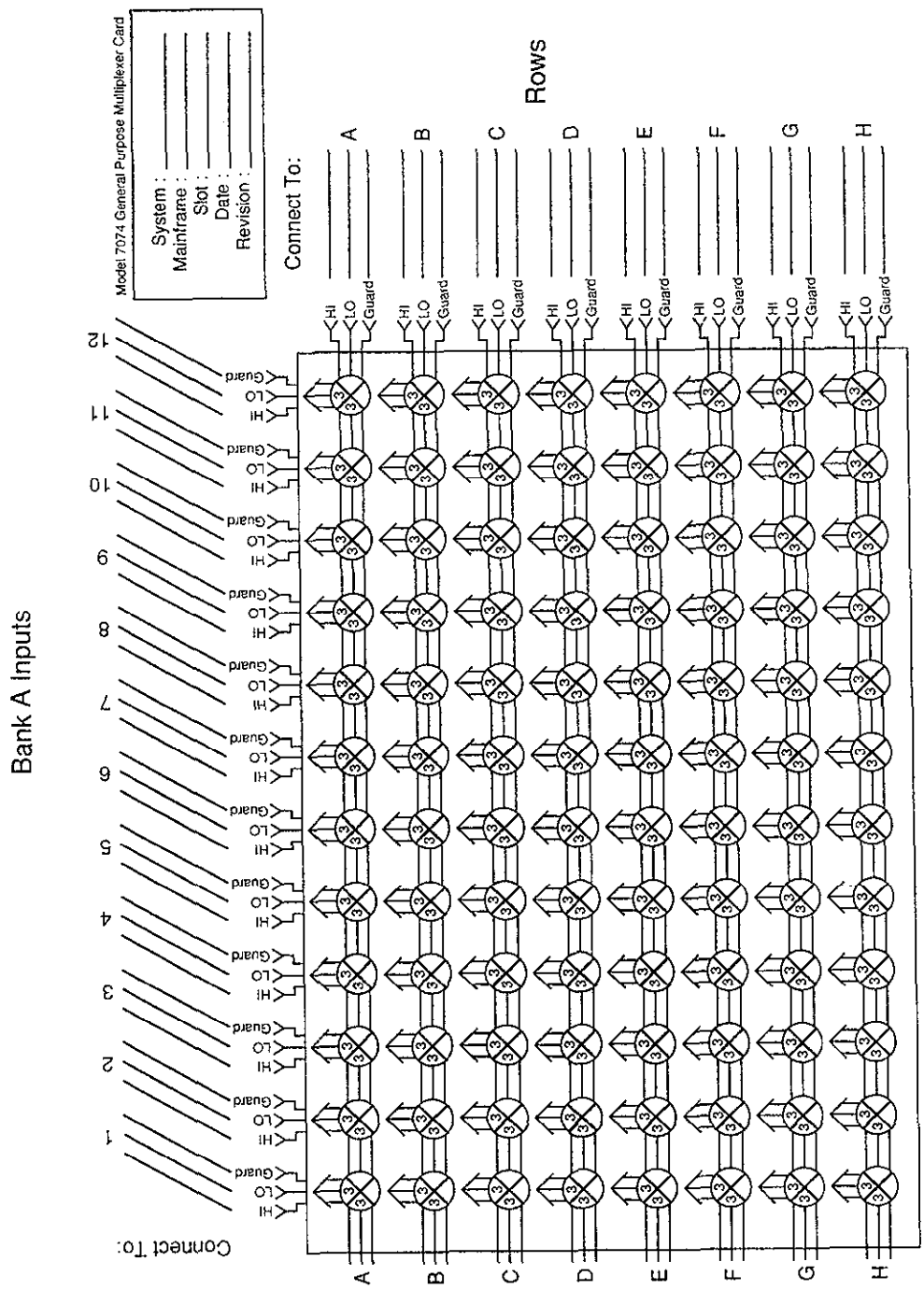
KEITHLEY — KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139

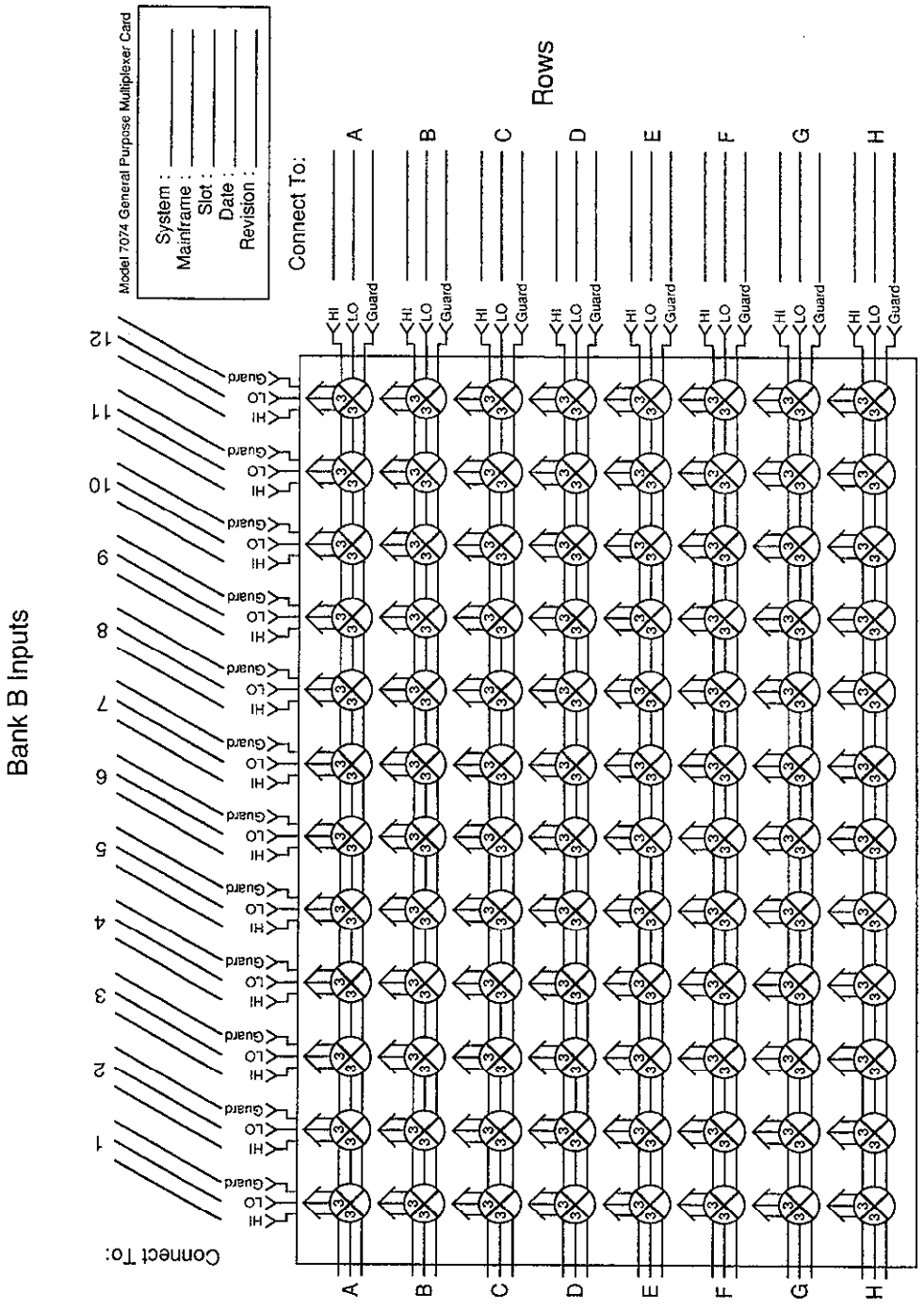
TITLE: SCHEMATIC, MULTIPLEXER BOARD

SIZE	MODEL	NO	ECO	REV
D	7074	7074-106	14404	C1

DRAWN	APPROVED	DATE
SZ	MW	12-29-90

Appendix A
Configuration Worksheet




Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
Slot :
Date :
Revision :
Connect To:
Rows
A
B
C
D
E
F
G
H
HI
LO
Guard
Bank B Inputs
1
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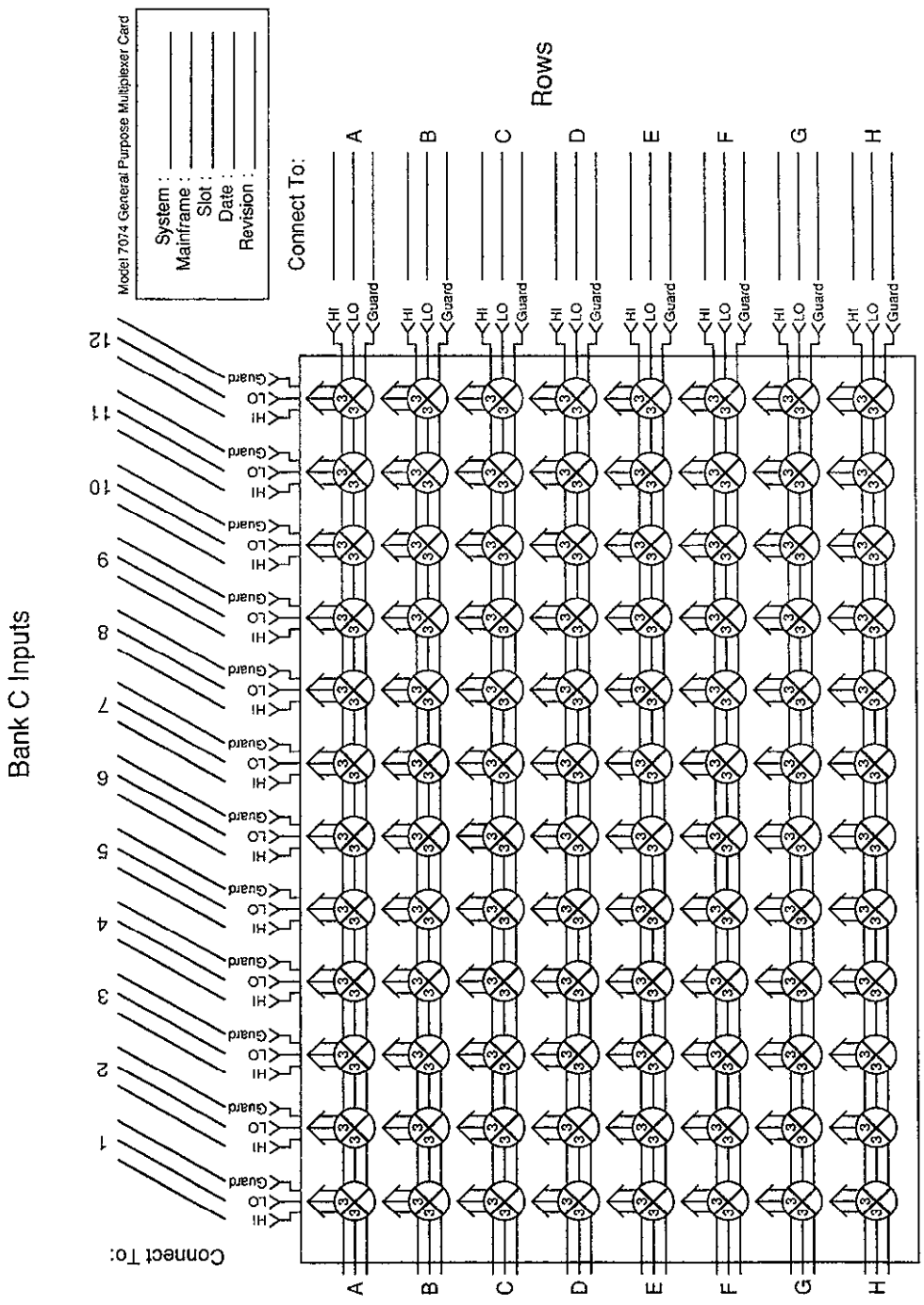
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
Slot :
Date :
Revision :
Connect To:
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Bank C Inputs
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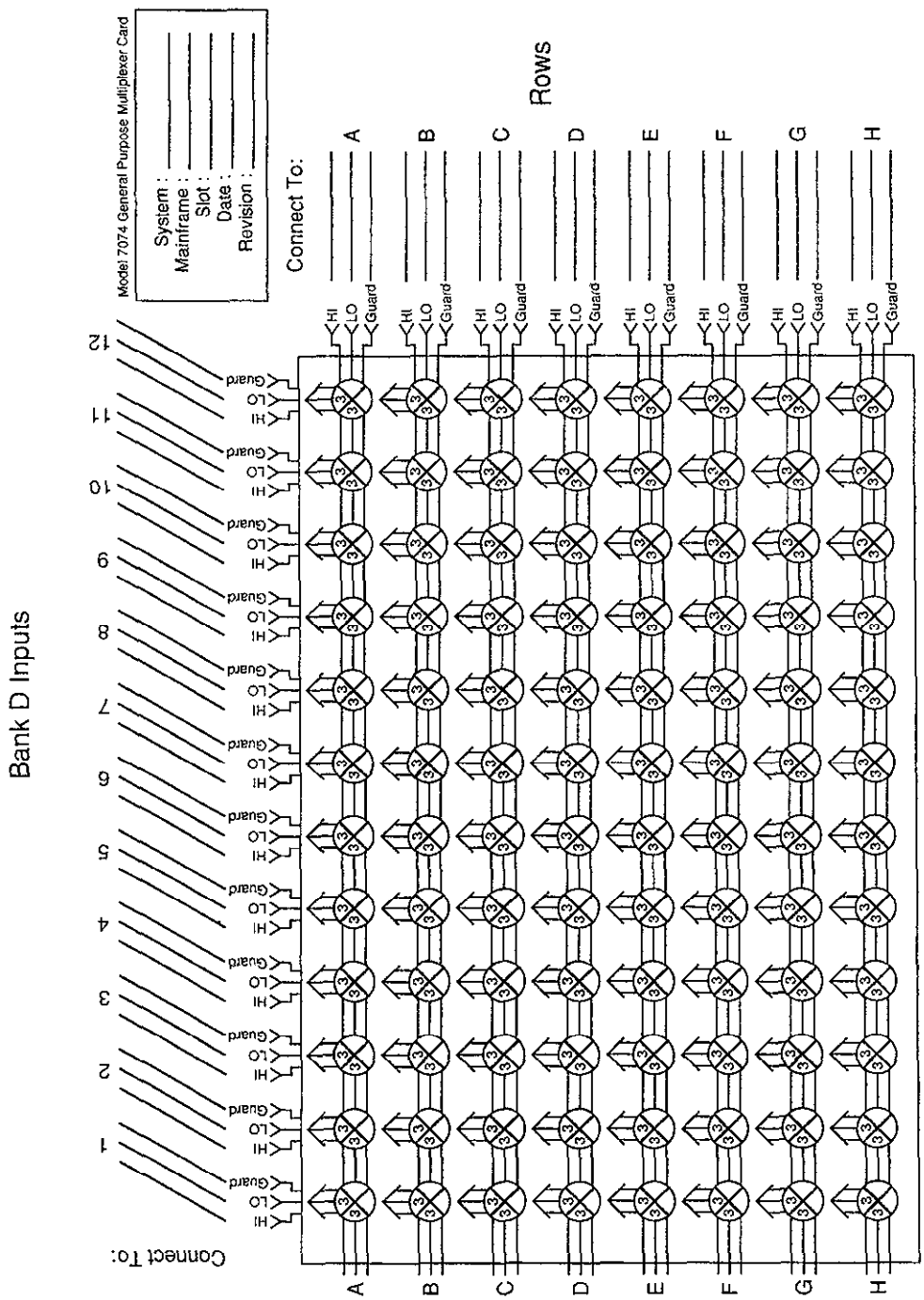
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
Slot :
Date :
Revision :
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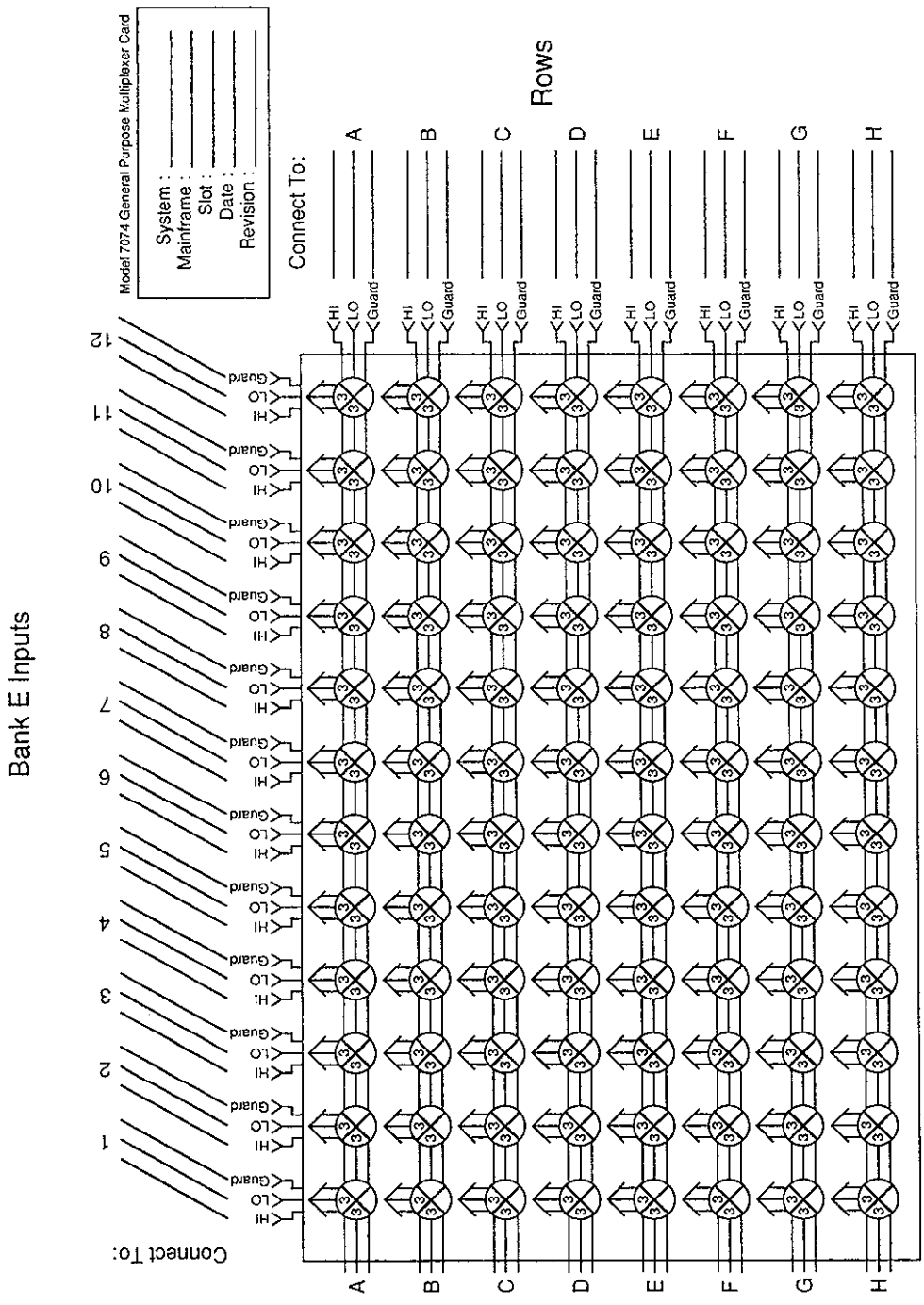
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
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Revision :
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Bank E Inputs
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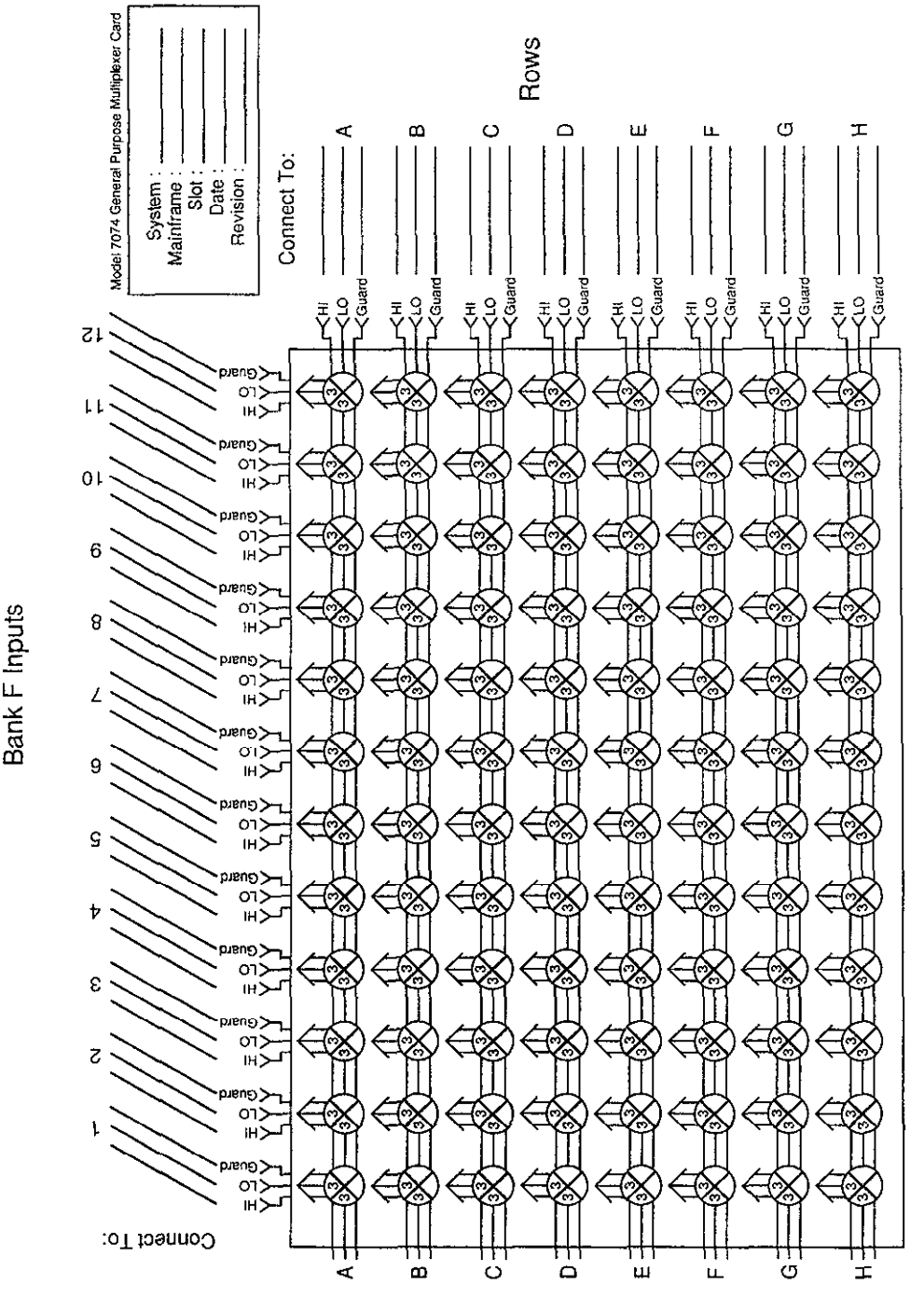
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
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Revision :
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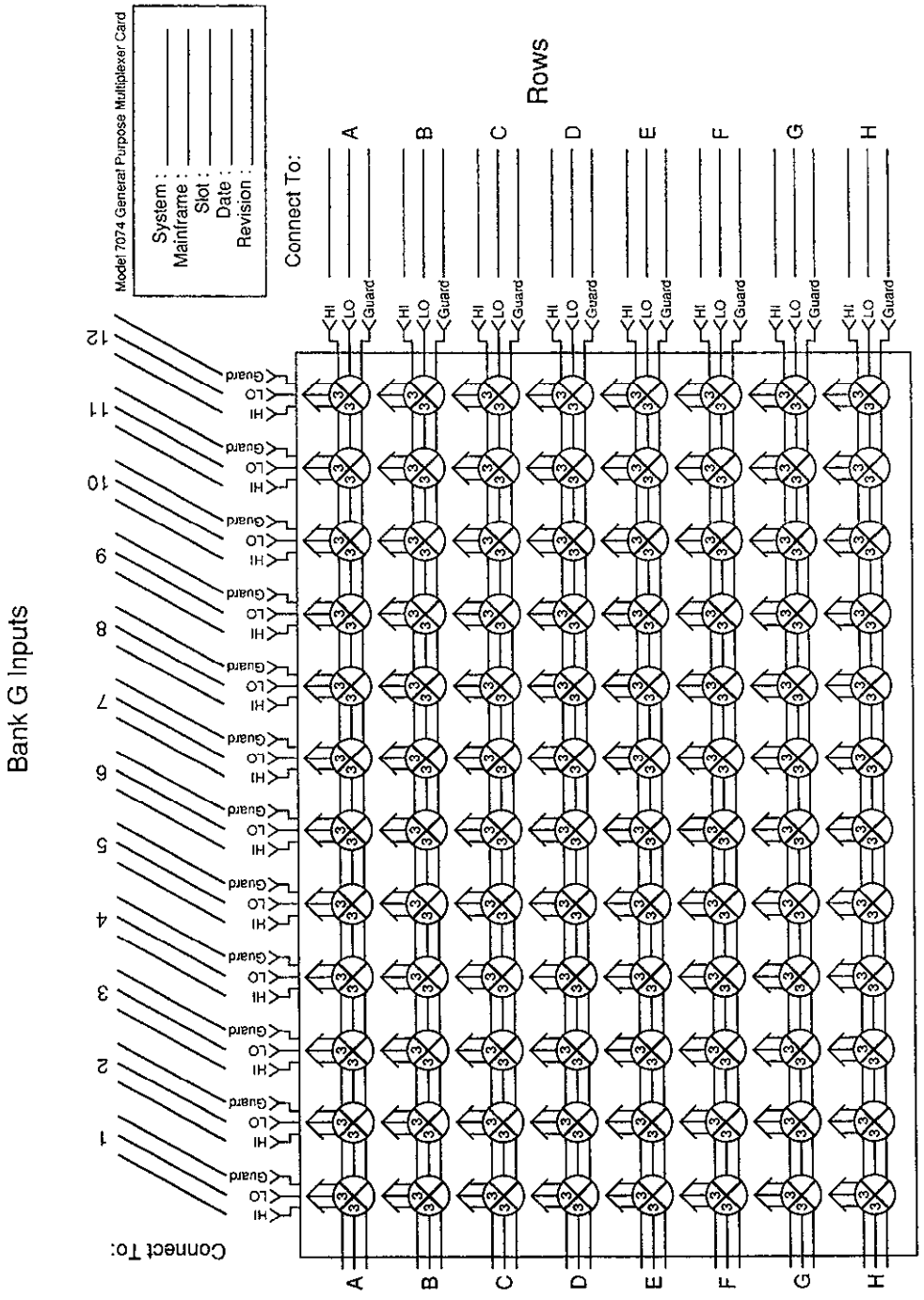
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
Slot :
Date :
Revision :
Connect To:
Rows
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HI
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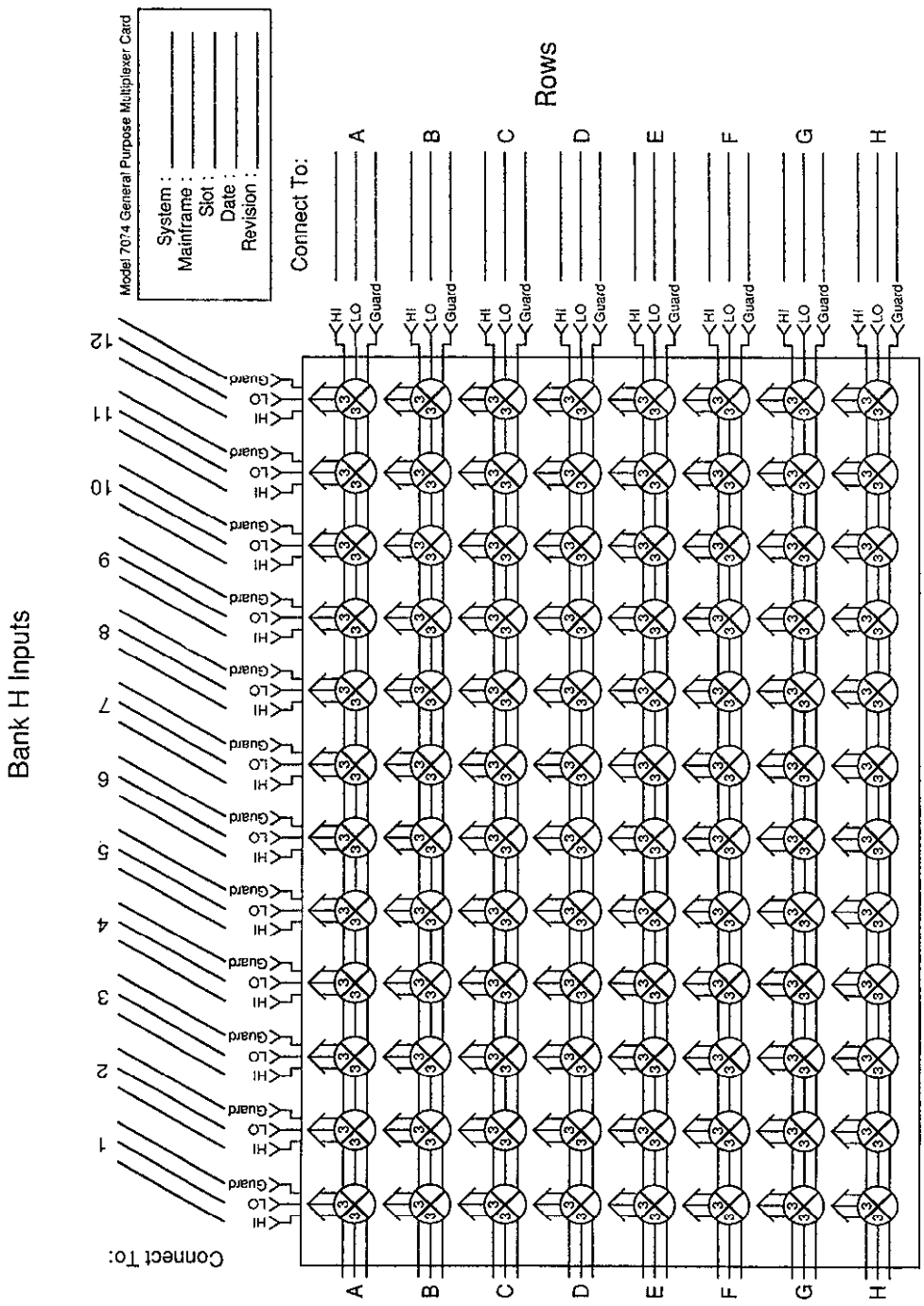
Connect To:


Model 7074 General Purpose Multiplexer Card
System :
Mainframe :
Slot :
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Revision :
Connect To:
Rows
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Guard
Bank H Inputs
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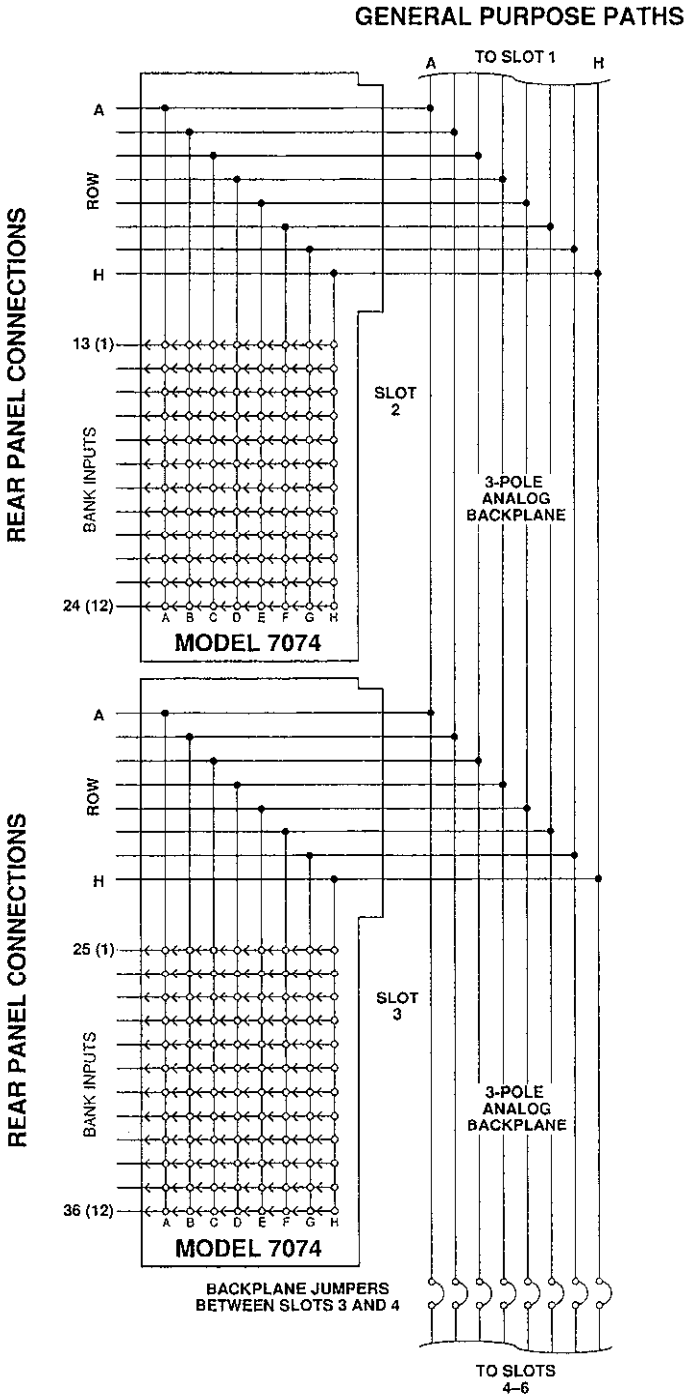
Connect To:

APPENDIX B

Actual Configuration of 7074 Card and Backplane



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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.

KEITHLEY

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1-888-KEITHLEY (534-8453) www.keithley.com

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FRANCE:	**Keithley Instruments Sarl**	3, allée des Garays • 91127 Palaiseau Cédex • 01 64 53 20 20 • Fax: 01 60 11 77 26
GERMANY:	**Keithley Instruments GmbH**	Landsberger Strasse 65 • D-82110 Germering • 089/84 93 07-40 • Fax: 089/84 93 07-34
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No. 2193
2/2000