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Instruction Manual

**Model 7169-SIR**  
Switch Card

Contains Operating and Servicing Information

**KEITHLEY**

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# Model 7169-SIR Switch Card Instruction Manual

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Cleveland, Ohio, U.S.A.  
First Printing May 1995  
Document Number: 7169-SIR-901-01 Rev. A

# 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 7169-SIR-901-01) ..... May 1995

# Safety Precautions

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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.

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.**

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.

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.


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.


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 main. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the 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 #18 AWG or larger wire.

The  symbol on an instrument or accessory indicates that 1000V or more may be present on the terminals. Refer to the product manual for detailed operating information.

Instrumentation and accessories should not be connected to humans.

Maintenance should be performed by qualified service personnel. Before performing any maintenance, disconnect the line cord and all test cables.

# Specifications

**NUMBER OF CHANNELS:** 10.

**RELAY TYPE:** Position sensitive mercury wetted reed relay. Card is only for use inside the Model 7002 and 706 mainframe and must be used within 30° of vertical for relays to work properly.

**CONNECTOR TYPE:** Two 20 pin mass termination ELCO bulkhead connectors, mate with 7169-KIT connector.

**RELAY DRIVE CURRENT:** 30mA per relay typical.

**MAXIMUM SIGNAL LEVEL:** 500V peak, current limited by series resistors.

**CONTACT LIFE:**  $> 10^9$  closures.

**ACTUATION TIME:**  $< 3$ ms, exclusive of mainframe.

**OPEN CONTACT ISOLATION:**  $> 10^9 \Omega$ .

**PATH RESISTANCE:**

**MEAS to OUTPUT:**  $962k\Omega \pm 5\%$ .

**BIAS to OUTPUT:**  $962k\Omega \pm 5\%$ .

**COM to OUTPUT:**  $470k\Omega \pm 5\%$ .

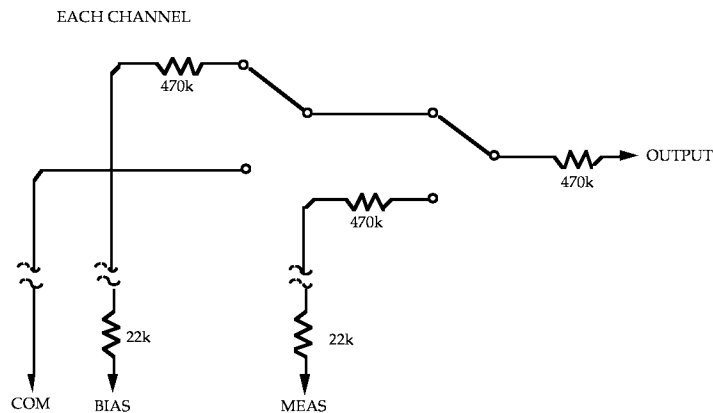
**COMMON MODE VOLTAGE:** 30V peak.

**OPERATING ENVIRONMENT:** 0° to 50°C, up to 35°C at 70% R.H.

**STORAGE ENVIRONMENT:** -25° to 65°C.

**DIMENSIONS, WEIGHT:** 32mm high  $\times$  114mm wide  $\times$  272mm deep (1.25 in  $\times$  4.5 in  $\times$  10.75 in).  
Weight 12 oz.

Specifications subject to change without notice.



# Table of Contents

---

## 1 General Information

1.1	Introduction .....	1-1
1.2	Warranty information .....	1-1
1.3	Manual addenda .....	1-1
1.4	Safety symbols and terms .....	1-1
1.5	Specifications .....	1-1
1.6	Unpacking and inspection .....	1-2
1.6.1	Inspection for damage .....	1-2
1.6.2	Shipping contents .....	1-2
1.6.3	Instruction manual .....	1-2
1.7	Repacking for shipment .....	1-2
1.7	Optional accessories .....	1-2

## 2 Operation

2.1	Introduction .....	2-1
2.2	Mainframe precautions .....	2-1
2.3	Equivalent circuit .....	2-1
2.4	Multi-card configurations .....	2-2
2.5	Mainframe control of switch card .....	2-2
2.5.1	Configure mainframe for Model 7169 .....	2-2
2.5.2	Relay control .....	2-3

## 3 Applications

3.1	Introduction .....	3-1
3.2	Surface insulation resistance testing .....	3-1

## 4 Service Information

4.1	Introduction .....	4-1
4.2	Handling and cleaning precautions .....	4-1
4.3	Mainframe precautions .....	4-1
4.4	Connections .....	4-2
4.4.1	Connections using the Model 7169-KIT .....	4-4
4.4.2	Connections using Model 7169-MTC cable .....	4-4
4.4.3	Shielded cables .....	4-5
4.5	Card installation and removal .....	4-5
4.5.1	Switch card installation .....	4-5

4.5.2	Switch card removal .....	4-6
4.6	Performance verification .....	4-6
4.6.1	Environmental conditions .....	4-6
4.6.2	Recommended equipment .....	4-6
4.6.3	Connector preparation .....	4-7
4.6.4	Input isolation tests .....	4-7
4.6.5	Path resistance tests .....	4-9

## 5 **Replaceable Parts**

5.1	Introduction.....	5-1
5.2	Parts list .....	5-1
5.3	Ordering information .....	5-1
5.4	Factory service.....	5-1
5.5	Component layout and schematic diagram.....	5-1



# List of Illustrations

---

## 2 Operation

Figure 2-1	Model 7169-SIR simplified schematic .....	2-1
Figure 2-2	Multicard configuration .....	2-2

## 3 Operation

Figure 3-1	Surface insulation resistance testing .....	3-1
------------	---	-----

## 4 Service Information

Figure 4-1	Connectors on switch card (pin side shown) .....	4-2
Figure 4-2	Switch card terminals .....	4-3
Figure 4-3	Female connector pin identification (terminal crimp side shown) .....	4-4
Figure 4-4	Model 7169-MTC-3 .....	4-4
Figure 4-5	Card installation in Model 7002 .....	4-6
Figure 4-6	Switch card terminals .....	4-8
Figure 4-7	Input isolation .....	4-9
Figure 4-8	Path resistance .....	4-10

# List of Tables

---

## **2      Operation**

Table 2-1	Model 7169-SIR card slot/channel .....	2-3
Table 2-2	Relay control .....	2-4

## **4      Service Information**

Table 4-1	Model 7169-MTC conductor identification .....	4-4
Table 4-2	Verification equipment .....	4-7

## **5      Replaceable Parts**

Table 5-1	Model 7169-SIR electrical parts	5-2
Table 5-2	Model 7169-SIR miscellaneous parts	5-2

# General Information

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## 1.1 Introduction

This section contains general information about the Model 7169-SIR Switch Card.

### 1.2 Warranty information

### 1.3 Manual addenda

### 1.4 Safety symbols and terms

### 1.5 Specifications

### 1.6 Unpacking and inspection

### 1.7 Repacking for shipment

### 1.8 Optional accessories

## 1.2 Warranty information


Warranty information is located on the inside front cover of this instruction manual. Should your Model 7169-SIR require warranty information, contact the Keithley representative or authorized repair facility in your area for further information. When returning the switch 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.


## 1.3 Manual addenda

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

## 1.4 Safety symbols and terms

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

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

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

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

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

## 1.5 Specifications

Model 7169-SIR specifications may be found at the front of this manual. These specifications are exclusive of the Model 7002 mainframe specifications.

## 1.6 Unpacking and inspection

### 1.6.1 Inspection for damage

The Model 7169-SIR is packaged in a resealable bag to protect it from contamination that could degrade performance. Before removing the card from the bag, observe the following precautions on handling.

1. Always grasp the card by the side edges. Do not touch the edge connector, board surfaces or components.
2. When not installed in the mainframe, keep the card in the bag and store in the original packing carton. After removing the card from the bag, inspect it 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.

### 1.6.2 Shipping contents

The following items are included with every Model 7169-SIR order:

- Model 7169-SIR Switch Card
- Model 7169-SIR Instruction Manual
- Additional accessories as ordered.

### 1.6.3 Instruction manual

If an additional instruction manual is required, order the manual package, Keithley part number 7169-SIR-901-00. The manual package includes an instruction manual and any pertinent addenda.

## 1.7 Repacking for shipment

Should it become necessary to return the Model 7169-SIR for repair, carefully pack the unit in its original packing carton or the equivalent, and include the following information:

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

## 1.8 Optional accessories

The following accessories are available from Keithley for use with the Model 7169-SIR:

**Model 7169-MTC-3** — The Model 7169-MTC-3 is a 10-foot cable that allows connection between the 7169-SIR and the mating connection (7169-KIT).

**Model 7169-KIT** — The Model 7169-KIT consists of a 20-pin connector body and 20 contacts for assembly of custom cables to mate with the Model 7169-SIR switch card connectors. It requires the use of crimping pliers, such as the Model 7078-HCT, for assembly. Also useful is the Model 7078-CIT contact insertion and extraction tool kit.

**Model 7169-MTR** — The Model 7169-MTR consists of a 20-pin female receptacle body and 20 contacts for assembly of bulkhead connectors that mate to the Model 7169-MTC-3 cable. Assembly requires the use of crimping pliers (Model 7078-HCT) and a contact insertion/extractor tool kit (Model 7078-CIT).

# 2

## Operation

### 2.1 Introduction

This section contains information on switch card operation and is arranged as follows:

- 2.2 Mainframe precautions — Lists precautions about the mercury wetted reed relays of the Model 7169-SIR.
- 2.3 Equivalent circuit — Provides the simplified switch card circuit for the Model 7169-SIR.
- 2.4 Multi-card configurations — Illustrates multi-card configurations.
- 2.5 Mainframe control of switch card — Covers operating aspects specific to the Model 7169-SIR.

### 2.2 Mainframe precautions

The mercury wetted reed relays of the Model 7169-SIR are position sensitive. The relay must be oriented within 30° of vertical. If it is not vertical, the normally-open contact may short to the common or to the normally-closed contact.

The Model 7169-SIR can only be used in the Model 7002 mainframe. The Model 7002 cannot be used on its side.

#### WARNING

Refer installation and removal of switch cards and cables to qualified service personnel only. Failure to recognize and observe normal safety precautions could result in personal injury or death due to hazardous voltages.

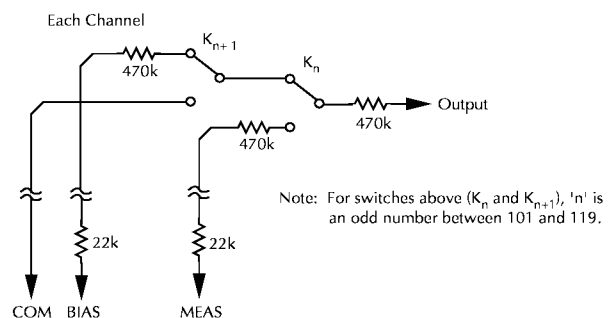
The top of every relay on the Model 7169-SIR has an arrow showing the direction of “UP”.

To prevent possible shorting of relay contacts (and causing unintended operation of external circuitry), all cables must be disconnected from the Model 7169-SIR before removing it from the Model 7002.

### 2.3 Equivalent circuit

Figure 2-1 shows the equivalent circuit of the Model 7169-SIR.

Each channel consists of a pair of single-pole, double throw (1-Form C) isolated switches and limiting resistor.

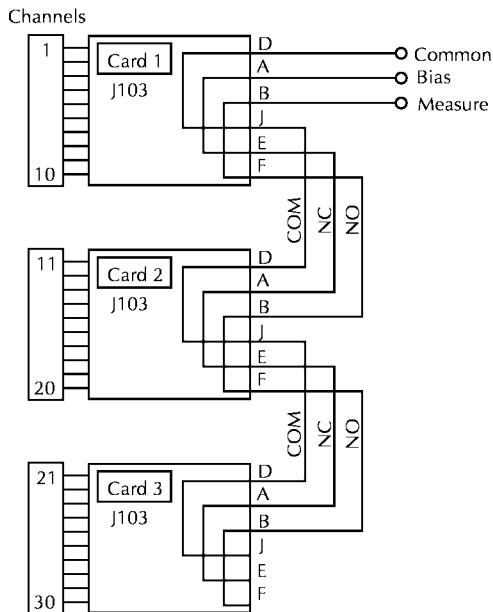


Each channel consist of two single-pole, double throw (Form C) isolated switches and limiting resistors.

Figure 2-1  
Model 7169-SIR simplified schematic

## 2.4 Multi-card configurations

Configure multi-card systems by connecting one or more of the terminal blocks of all cards together. An example of this is shown in Figure 2-2, which connects the bias, common, and measure pins of a three-card system together. This configuration allows a single piece of equipment to operate all 30 channels of the example.



**Figure 2-2**  
Multicard configuration

## 2.5 Mainframe control of switch card

The information in the following paragraphs deal with programming a Model 7002 mainframe to control Model 7169-SIR switch cards. Refer to the Model 7002 Instruction Manual for operation details of the mainframe.

### CAUTION

The Model 7169-SIR card can only be used in the Model 7002 mainframe because the mercury wetted reed relays of the card are position sensitive. The switch card must be oriented within 30° of vertical or the pool of mercury shorts the relay contacts.

### 2.5.1 Configure mainframe for Model 7169

Use of the Model 7169-SIR switching card requires that the matrix mode be selected. Configure mainframe for the Model 7169 using the following information.

#### Card configuration

The CARD CONFIG MENU of the Model 7002 Switch System configures the card slots. Press the CARD CONFIGURATION key to display the following:

```
CARD CONFIG MENU
TYPE #-OF-POLES CARD-PAIR ►
◀ DELAY READ-I/O-CARD
```

#### TYPE

Use TYPE to assign a model number for each Model 7169-SIR card installed in the mainframe. The model number assignment determines the relay settling time and front panel relay status display. From the CARD CONFIG MENU, perform the following steps to assign a model number to a slot:

1. With the ◀ and ► keys, place the cursor on TYPE and press ENTER. The model number for the presently selected slot is displayed. For example:

```
SET CARD TYPE NONE
SLOT-#1 #2 #3 #4 #5 ►
◀ SLOT-#6 #7 #8 #9 #10
```

A flashing “#5” would indicate that slot 5 is assigned to be empty (NONE). To check assignments for other slots, simply use ◀ or ►.

2. Move the cursor to the desired slot number and press ENTER. An example display follows:

```
SLOT 5 CARD: NONE
```

3. Assign a model number to the slot. For example, if a Model 7169-SIR card is installed in slot 5, use ◀ or ► to scroll to “7169”.
4. With the model number assignment displayed, press ENTER.
5. When finished, use EXIT to back out of the menu structure. Note that the relay status display changes to show the channel or crosspoint configuration of the card.

## 2.5.2 Relay control

In general, controlling the Model 7169-SIR consists of determining the desired circuit path and closing (or opening) the corresponding relay(s). When programming the Model 7002, designate the slot in which the card is installed. This, when combined with the card channel, provides the CHANNEL assignment for the mainframe. The relays are controlled through slot and channel programming in the following format:

S!C where; S is the slot number (1-10)  
C is the channel number (1-20 for the Model 7169-SIR card)

The slot and card channel are separated by an exclamation point (!). Table 2-1 provides information for all ten slots and 20 controlling channels of the Model 7002 Mainframe when using the Model 7169-SIR card.

### NOTE

Although the Model 7169-SIR Card is usually used in slots 6 through 10 of the Model 7002 mainframe, slots 1 through 5 are listed below for non-standard installations.

**Table 2-1**  
*Model 7169-SIR card slot/channel*

Mainframe Channel	1	2	3	4	5	6	7	8	9	10
Slot 1	1!1	1!2	1!3	1!4	1!5	1!6	1!7	1!8	1!9	1!10
Slot 2	2!1	2!2	2!3	2!4	2!5	2!6	2!7	2!8	2!9	2!10
Slot 3	3!1	3!2	3!3	3!4	3!5	3!6	3!7	3!8	3!9	3!10
Slot 4	4!1	4!2	4!3	4!4	4!5	4!6	4!7	4!8	4!9	4!10
Slot 5	5!1	5!2	5!3	5!4	5!5	5!6	5!7	5!8	5!9	5!10
Slot 6	6!1	6!2	6!3	6!4	6!5	6!6	6!7	6!8	6!9	6!10
Slot 7	7!1	7!2	7!3	7!4	7!5	7!6	7!7	7!8	7!9	7!10
Slot 8	8!1	8!2	8!3	8!4	8!5	8!6	8!7	8!8	8!9	8!10
Slot 9	9!1	9!2	9!3	9!4	9!5	9!6	9!7	9!8	9!9	9!10
Slot 10	10!1	10!2	10!3	10!4	10!5	10!6	10!7	10!8	10!9	10!10
Mainframe Channel	11	12	13	14	15	16	17	18	19	20
Slot 1	11!1	11!2	11!3	11!4	11!5	11!6	11!7	11!8	11!9	11!10
Slot 2	12!1	12!2	12!3	12!4	12!5	12!6	12!7	12!8	12!9	12!10
Slot 3	13!1	13!2	13!3	13!4	13!5	13!6	13!7	13!8	13!9	13!10
Slot 4	14!1	14!2	14!3	14!4	14!5	14!6	14!7	14!8	14!9	14!10
Slot 5	15!1	15!2	15!3	15!4	15!5	15!6	15!7	15!8	15!9	15!10
Slot 6	16!1	16!2	16!3	16!4	16!5	16!6	16!7	16!8	16!9	16!10
Slot 7	17!1	17!2	17!3	17!4	17!5	17!6	17!7	17!8	17!9	17!10
Slot 8	18!1	18!2	18!3	18!4	18!5	18!6	18!7	18!8	18!9	18!10
Slot 9	19!1	19!2	19!3	19!4	19!5	19!6	19!7	19!8	19!9	19!10
Slot 10	20!1	20!2	20!3	20!4	20!5	20!6	20!7	20!8	20!9	20!10

**NOTE**

There are ten channels on the Model 7169-SIR switching card which are controlled by twenty channels on the Model 7002. These twenty channels control twenty Model 7169-SIR relays (K101 through K120).

The following table (Table 2-2) is a cross-reference from the mainframe's channel number to actual relay circuit designation. Also included is the Model 7169-SIR Cards Channel number.

Refer to Model 7002 Switch System Instruction Manual (7002-901-00) for further information.

**Table 2-2**  
*Relay control*

Mainframe control channel	Relay	Closed	Open	Model 7169-SIR channel
1	K101	Bias	Meas	1
2	K102	Bias	Com	1
3	K103	Bias	Meas	2
4	K104	Bias	Com	2
5	K105	Bias	Meas	3
6	K106	Bias	Com	3
7	K107	Bias	Meas	4
8	K108	Bias	Com	4
9	K109	Bias	Meas	5
10	K110	Bias	Com	5
11	K111	Bias	Meas	6
12	K112	Bias	Com	6
13	K113	Bias	Meas	7
14	K114	Bias	Com	7
15	K115	Bias	Meas	8
16	K116	Bias	Com	8
17	K117	Bias	Meas	9
18	K118	Bias	Com	9
19	K119	Bias	Meas	10
20	K120	Bias	Com	10



# 3

## Applications

### 3.1 Introduction

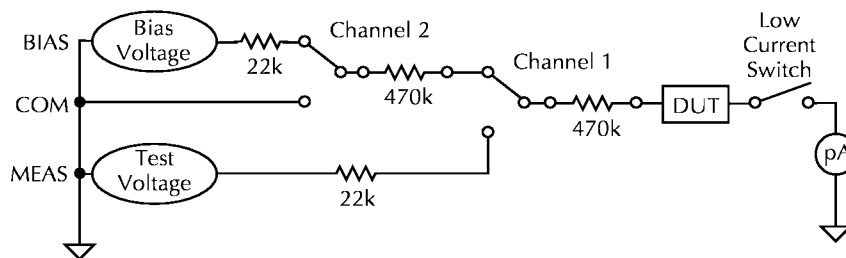
This section provides the intended application for the Model 7169-SIR Switch Card.

### 3.2 Surface insulation resistance testing

Standard test procedures for printed circuit board surface resistance testing often call for biasing and testing at a different high voltage levels. Figure 3-1 shows pairs of two relays configured for different bias and test voltage sources as well as provision for shorting the DUT to reference after testing for safety.

With both channels open, a bias voltage is applied through current limit resistor R1. To apply the test voltage, channel 2 is closed and then channel 1 is closed. After taking the test reading, channel 1 can be opened to discharge the capacitance of the DUT and cabling. Then channel 2 is opened to return to the bias condition.

Each Model 7169-SIR allows ten DUTs to be tested using this setup. The two on-card buses can also be used to bus the bias and test voltages so that only two external connections are needed for each source instead of two for each channel.



**Figure 3-1**  
*Surface insulation resistance testing*

# 4

## Service Information

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### 4.1 Introduction

#### WARNING

The procedures in this section are intended only for qualified service personnel. Do not perform these procedures unless qualified to do so. Failure to recognize and observe normal safety precautions could result in personal injury or death.

This section contains information necessary to service the Model 7169-SIR and is arranged as follows:

- 4.2 **Handling and cleaning precautions** — Discusses handling procedures and cleaning methods for the switch card.
- 4.3 **Mainframe precautions** — Lists precautions about the mercury wetted reed relays of the Model 7169-SIR.
- 4.4 **Connections** — Explains the various methods and techniques that can be used to make connections to the switch card.
- 4.5 **Card installation and removal** — Describes the installation and removal of the card in a Model 7002 mainframe.
- 4.6 **Performance verification** — Covers the procedures necessary to determine if the card is operating properly.

### 4.2 Handling and cleaning precautions

Because of the high impedance circuits on the Model 7169-SIR, care should be taken when handling or servicing the card to prevent possible contamination, which could degrade performance. The following precautions should be taken when handling and cleaning the switch card.

1. Do not store or operate the card in an environment where dust could settle on the circuit board. Use dry nitrogen gas to clean dust off the card if necessary.
2. Handle the card only by the side edges. Do not touch any board surfaces or components associated with the repair. When servicing the card, wear clean, cotton gloves.
3. When making repairs on the circuit board, use aqua core solder and OA-based (organic activated) flux. Use warm water 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, 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.

### 4.3 Mainframe precautions

The mercury wetted reed relays of the Model 7169-SIR are position sensitive. The relay must be oriented within 30° of vertical. If it is not vertical, the normally-open contact may short to the common or to the normally-closed contact.

The Model 7169-SIR can only be used in the Model 7002 mainframe. The Model 7002 cannot be used on its side.

The top of every relay on the Model 7169-SIR has an arrow showing the direction of "UP".

To prevent possible shorting of relay contacts (and causing unintended operation of external circuitry), all cables must be disconnected from the Model 7169-SIR before removing it from the Model 7002.

## 4.4 Connections

### WARNING

User-supplied lethal voltage may be present on PC board and connectors.

### CAUTION

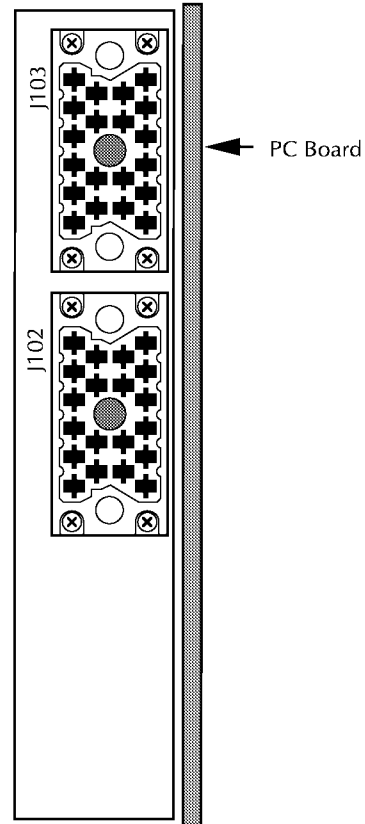
To prevent possible shorting of relay contacts (and causing unintended operation of external circuitry), make cable connections to the Model 7169-SIR only when it is installed in a Model 7002 mainframe.

Figure 4-1 shows the connectors on the switch card. Figure 4-2 shows switch card terminals to connector pins and channel numbers.

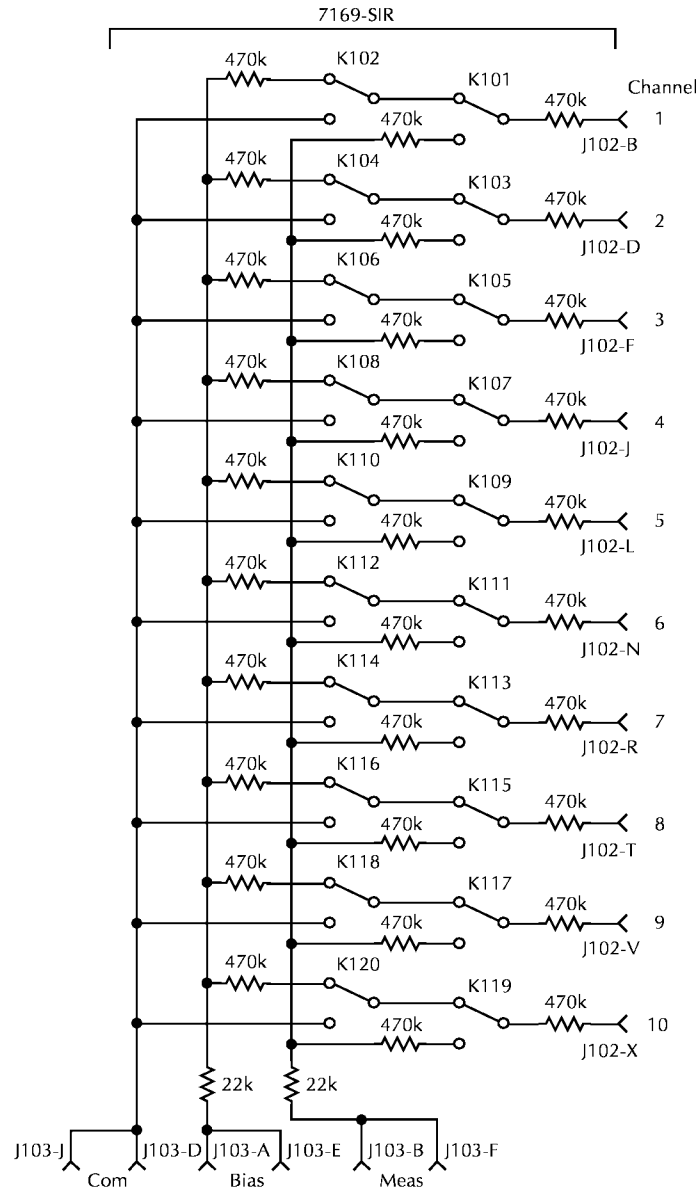
The connector on the switch card will mate to either a connector (Model 7169-KIT) or to an optional mass terminated cable (Model 7169-MTC-3).

The following procedure explains how to mate the connector to the Model 7169-SIR.

1. Mate the female connector to the male connector on the PC board.
2. Tighten the jackscrew finger tight. This is the locked position and secures the connectors together.



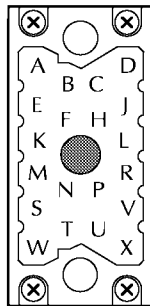
**Figure 4-1**  
*Connectors on switch card (pin side shown)*



**Figure 4-2**  
Switch card terminals

### 4.4.1 Connections using the Model 7169-KIT

The Model 7169-KIT is a connector that mates to the connector on the back panel of the Model 7169-SIR. Cabling from instrumentation and DUTs can be crimped directly to the pins that fit into the 7169-KIT connector. The terminals of this connector will accommodate up to #18 AWG wire. Figure 4-3 shows the pinout of the male connector for both terminal blocks. Figure 4-2 can be used to identify switch card terminals.



**Figure 4-3**  
Female connector pin identification (terminal crimp side shown)

### 4.4.2 Connections using Model 7169-MTC cable

The Keithley Model 7169-MTC-3 (see Figure 4-4) is a 20-conductor, 10-foot cable terminated with male connectors on both ends.

If the cable is to be used, a 7169-MTR becomes part of the user's test fixture with instrumentation and DUTs connected

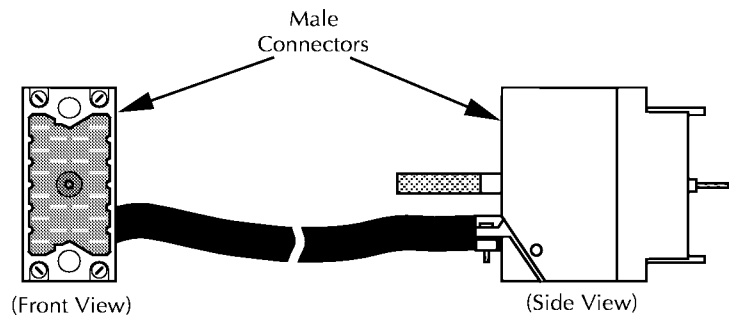
directly to its terminal pins. The Model 7169-MTR is the same connector that is used on the panel of the Model 7169-SIR. Its pins will accommodate up to #18 AWG wire.

Another way to use the cable is to remove one of the connectors (by cutting the cable). In this situation, the opposite end of the cable is mated to the switch card, while the unterminated end is hard-wired to instrumentation and DUT. Table 4-1 provides terminal identification for the cable.

When used as is, each conductor of the 10-foot Model 7169-MTC-3 cable adds approximately 700mΩ to the “contact resistance” specification of the switch card.

**Table 4-1**  
Model 7169-MTC conductor identification

Pin	Conductor	Color
A	1	Black
B	2	White
C	3	Red
D	4	Green
E	5	Orange
F	6	Blue
H	7	White/Black
J	8	Red/Black
K	9	Green/Black
L	10	Orange/Black
M	11	Blue/Black
N	12	Black/White
P	13	Red/White
R	14	Green/White
S	15	Blue/White
T	16	Black/Red
U	17	White/Red
V	18	Orange/Red
W	19	Blue/Red
X	20	Red/Green



**Figure 4-4**  
Model 7169-MTC-3

### 4.4.3 Shielded cables

RFI can be generated when high voltages are switched. Shielded cables are one way to reduce the amplitude of the emissions. If a shielded cable is used along with a Model 7169-KIT to connect to the Model 7169-SIR, the shield should be connected to earth at one end of the cable. Connect the shield externally to earth ground.

Any cabling used with the Model 7169-SIR should have a working voltage specification of at least 500V.

## 4.5 Card installation and removal

The following procedures explain how to install and remove the Model 7169-SIR switch card with the Model 7002 mainframe.

### WARNING

To prevent electrical shock which could result in injury or death, turn off the mainframe power and disconnect the line cord before installing or removing cards. Also ensure no voltage is applied from user circuits.

### CAUTIONS

Contamination will degrade the performance of the switch card. To avoid contamination, always grasp the card by the side edges. Do not touch the board surfaces or components.

The mercury wetted reed relays of the Model 7169-SIR are position sensitive. The switch card must be oriented within 30° of vertical or the pool or mercury

shorts the relay contacts. The Model 7169-SIR card can only be used in the Model 7002 mainframe. The Model 7002 cannot be used on its side.

To prevent possible shorting of relay contacts (and causing unintended operation of external circuitry), make cable connections to the Model 7169-SIR only when it is installed in a Model 7002 mainframe.

### 4.5.1 Switch card installation

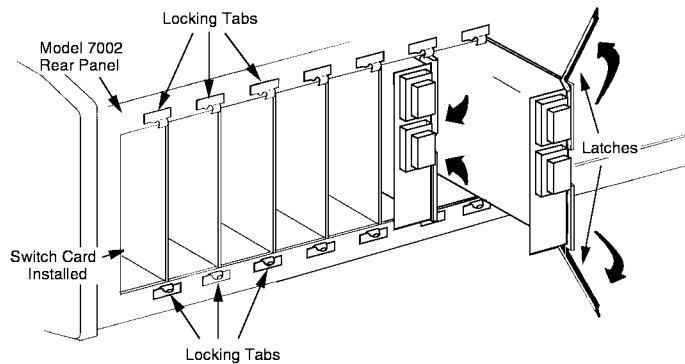
Perform the following procedure to install the Model 7169-SIR switch card in the Model 7002 mainframe. Refer to Figure 4-5.

1. Slide the card into the desired slot as shown in the appropriate illustration. Make sure the card edges of the board are properly aligned with the grooves in the receptacle.
2. Once the card is almost all the way in the slot, and you encounter resistance, push firmly on the edge of the card to seat it in the edge connector.

### WARNING

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

3. Once the card is fully seated, lock the card in place by placing the latches in the locked position.



**Figure 4-5**  
*Card installation in Model 7002*

#### 4.5.2 Switch card removal

##### WARNING

Make sure all power has been removed from the switch card. Failure to isolate the switch card from power may result in personal injury or death due to electric shock.

To remove the switch card, first remove all cables. Then unlock the card by pulling the latches outward, grasping the end of the card at the edges, and pulling the card out of the scanner mainframe.

#### 4.6 Performance verification

The following paragraphs discuss performance verification procedures for the Model 7169-SIR, including isolation and path resistance. The performance verification procedures should be performed with the switch card installed in the Model 7002 mainframe to protect it from contamination and allow it to operate in its normal environment.

##### CAUTION

Contamination will degrade the performance of the scanner card. To avoid contamination, always grasp the card by the side edges. Do not touch the board surfaces or components.

##### NOTE

Failure of any performance verification test may indicate that the switch card is contaminated. See paragraph 4.2 to clean the card.

#### 4.6.1 Environmental conditions

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

#### 4.6.2 Recommended equipment

Table 4-2 summarizes the equipment necessary for performance verification, along with an application for each unit.

**Table 4-2**  
Verification equipment

Description	Keithley Model	Specifications	Application
Electrometer	6517	100nA; 0.1%	Isolation
DMM	2000	100V Source; 0.06%	Path resistance
Male connector	7169-KIT	—	Connections to card

### 4.6.3 Connector preparation

For the test procedures, a connector (7169-KIT) is used to make circuit connections to the switch card. These connectors are available as an accessory.

Prepare two 7169-KIT connectors as follows:

1. Using clean #18-24 AWG copper wire, crimp wires (ten wires for J102 and three wires for J103) to the terminals. Each wire should be approximately six inches long.
2. Insert each terminal into a connector, labeling the wire with the pin location letter.
3. Assemble the connector body.
4. Mate the two connectors to J102 and J103 on the Model 7169-SIR.

### 4.6.4 Input isolation tests

These tests check the resistance (isolation) between the N.C. and N.O. terminals of every switch card 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 6517 functions as a voltage source and an ammeter. In the V/I function, the Model 6517 internally calculates the resistance from the known voltage and measured current levels and displays the resistance value.

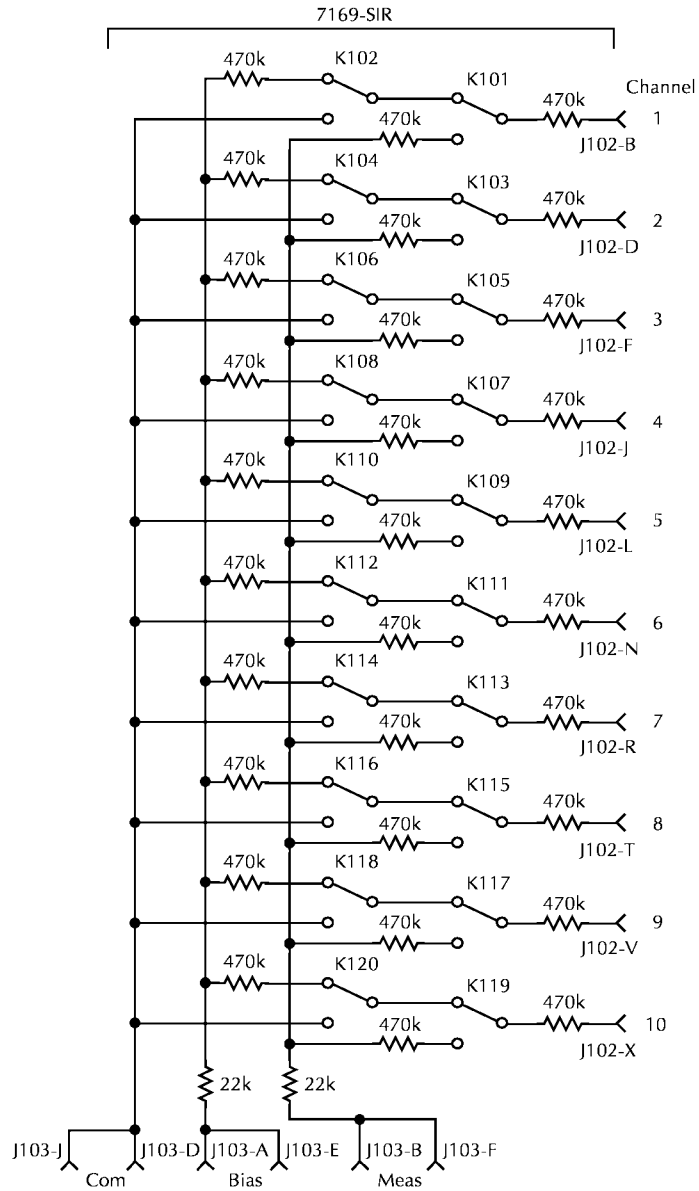
Referring to Figures 4-6 and 4-7, perform the following procedure to check differential input isolation:

### WARNING

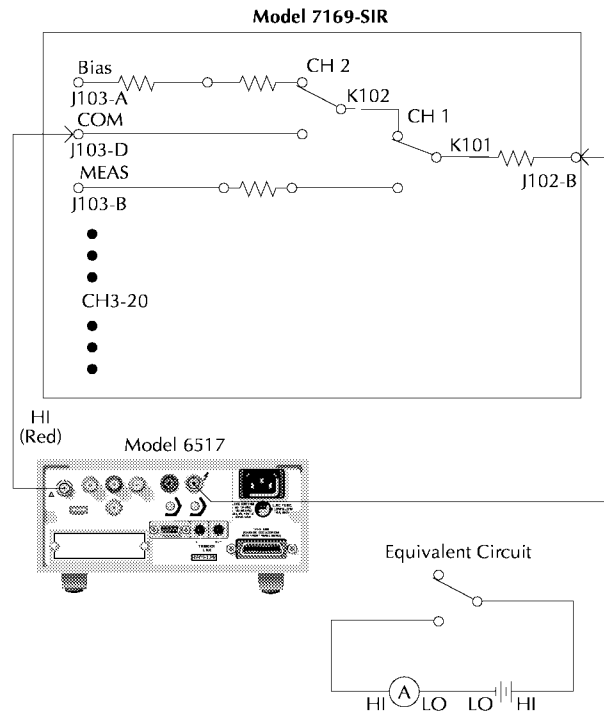
**The following steps use high voltage (100V). Be sure to remove power from the circuit before making connection changes.**

1. Using Figure 4-6 to identify switch card terminals, connect the Model 6517 to the switch card as shown in Figure 4-7. Then close all Model 7169-SIR relays. (Figure 4-7 shows relays in open position.)
2. On the Model 6517, select the 2pA range, and enable zero check and zero correct in that order. Leave zero correct enabled for the entire procedure.
3. On the Model 6517, manually set the voltage source for +100V, and select the 200nA current range. Make sure the voltage source is still in standby.
4. Place the Model 6517 in the V/I measurement function.
5. On the Model 6517, press OPERATE (a voltage source key) to source 100V and then disable zero check.
6. After allowing the reading on the Model 6517 to settle, verify that it is  $>1G\Omega$ .
7. Enable zero check on the Model 6517 and then place voltage source in standby.
8. Repeat the basic procedure in steps 5 through 7 for all even relays. Use Figure 4-6 to identify switch card terminals.
9. Connect the electrometer input HI lead to J103-B (meas).
10. Repeat the basic procedure in steps 5 through 7 for all odd relays.





**Figure 4-6**  
Switch card terminals



**Figure 4-7**  
Input isolation

#### 4.6.5 Path resistance tests

Referring to Figure 4-8, perform the following steps to verify that the contacts of each relay are closing properly and the resistance is within specification.

1. Connect leads to Model 2000 Multimeter input as shown in Figure 4-8. Select auto-ranging (auto) and two-wire ohms measurement ( $\Omega$ 2).
2. Using Figure 4-6 to identify switch card terminals, connect the Model 2000 to the switch card.
3. From the mainframe, close relay K102. The reading on the Model 2000 should be  $470k\Omega \pm 5\%$ .
4. Open relay K102 and verify the Model 2000 indicates an open circuit ( $>300M\Omega$ ).
5. Move the lead from J103-D to J103-A. The reading on the Model 2000 should be  $962k\Omega \pm 5\%$ .
6. Close relay K102 and verify the Model 2000 indicates an open circuit ( $>300M\Omega$ ).
7. Move the lead from J103-A to J103-B.
8. Close relay K101. The reading on the Model 2000 should be  $962k\Omega \pm 5\%$ .
9. Open relay K101 and verify the Model 2000 indicates an open circuit ( $>300M\Omega$ ).
10. Repeat the same basic procedure (steps 2 through 9 above) to test path resistance of the remaining channels.

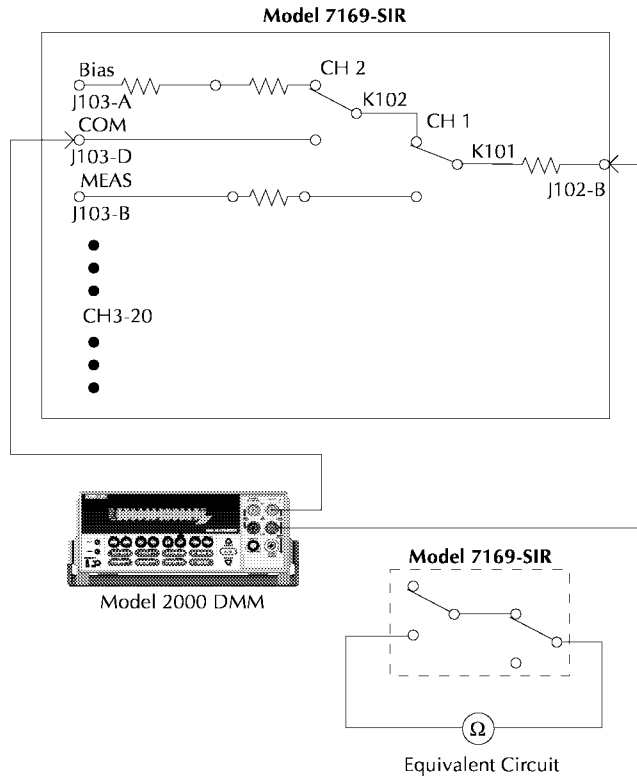


Figure 4-8  
Path resistance

# 5

## Replaceable Parts

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### 5.1 Introduction

This section contains a list of replaceable electrical and mechanical parts for the Model 7169-SIR, as well as a component layout drawing and schematic diagram of the card.

### 5.2 Parts list

Electrical parts are listed in order of circuit designation in Table 5-1. Table 5-2 summarizes miscellaneous parts.

### 5.3 Ordering information

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

1. Switch card model number (7169-SIR)
2. Card serial number
3. Part description
4. Circuit description, if applicable
5. Keithley part number

### 5.4 Factory service

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

1. Call the Repair Department at 1-800-552-1115 for a Repair Authorization (RMA) number.
2. Complete the service form at the back of this manual and include it with the card.
3. Carefully pack the card in the original packing carton.
4. Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.

#### NOTE

Do not return the scanner mainframe with the card.

### 5.5 Component layout and schematic diagram

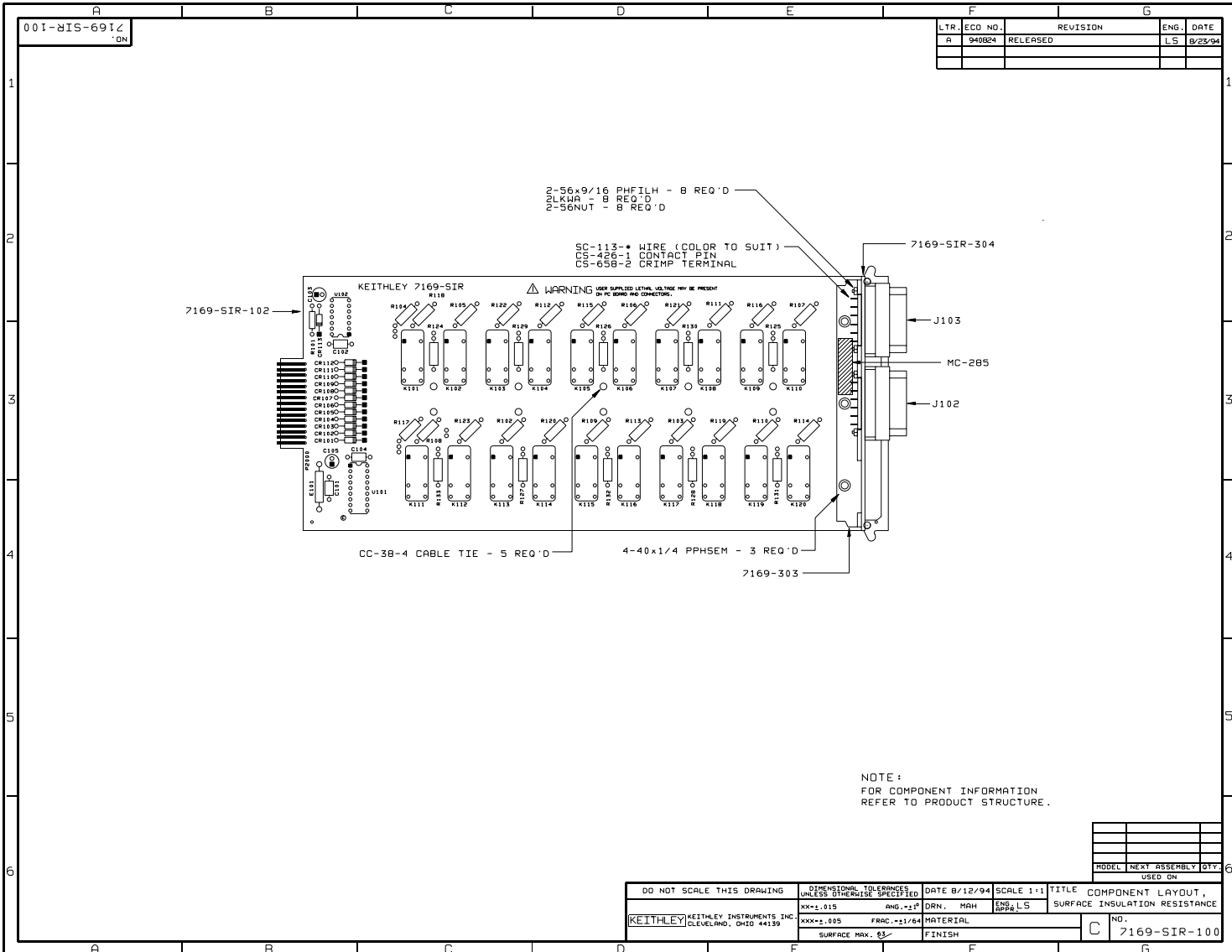
Tables 5-1 and 5-2 list the spare parts for a Model 7169-SIR. The component layout and schematic diagram follows.

**Table 5-1**  
*Model 7169-SIR electrical parts*

Circuit Desig.	Description	Keithley part no.
C101, 102, 104 C103 C105	CAP, .1UF, 20%, 50V, CERAMIC CAP, 22UF, -20 +100%, 25V, ALUM ELEC CAP, 10UF, -20 +100%, 25V, ALUM ELEC	C-365-.1 C-314-22 C-314-10
CR101-113	DIODE, SILICON, IN4148 (D0-35)	RF-28
E101	BEAD, FERRITE	CT-9
K101-120	RELAY, REED	RL-161
R101 R102, 103, 105-116, 118-133 R104, 117	RES, 40.2K, 1%/ 1.8W, METAL FILM RES, 470k, 5%, 1W, FLAME-PROOF RES, 22K, 10%, 1/2W, COMPOSITION	R-88-40.2K R-439-470K R-1-22K
U101 U102	IC, 8-BIT SERIAL-IN LATCH DRIVER, 5841A IC, DUAL D-TYPE FLIP FLOP, 74HC74	IC-536 IC-337

**Table 5-2**  
*Model 7169-SIR miscellaneous parts*

Description	Keithley part no.
BRACKET, REAR PANEL	7169-303
CABLE CLAMP	CC-38-4
HANDLE AND RIVET	FA-119
PANEL, REAR	7169-SIR-304A
RIVET	FA-121



001-RIS-691Z  
ON

LTR.	ECD NO.	REVISION	ENG.	DATE
A	940824	RELEASED	LS	8/23/94

2-56x9/16 PHFILM - 8 REQ'D  
2-1/4x1/4 - 8 REQ'D  
50NUT - 8 REQ'D

SC-113-# WIRE (COLOR TO SUIT)  
CS-426-1 CONTACT PIN  
CS-658-2 CRIMP TERMINAL

**WARNING** USER SUPPLIED LETHAL VOLTAGE MAY BE PRESENT ON PC BOARD AND CONNECTORS.

KEITHLEY 7169-SIR

CC-3B-4 CABLE TIE - 5 REQ'D

4-40x1/4 PPHSEM - 3 REQ'D

7169-SIR-304

J103

MC-285

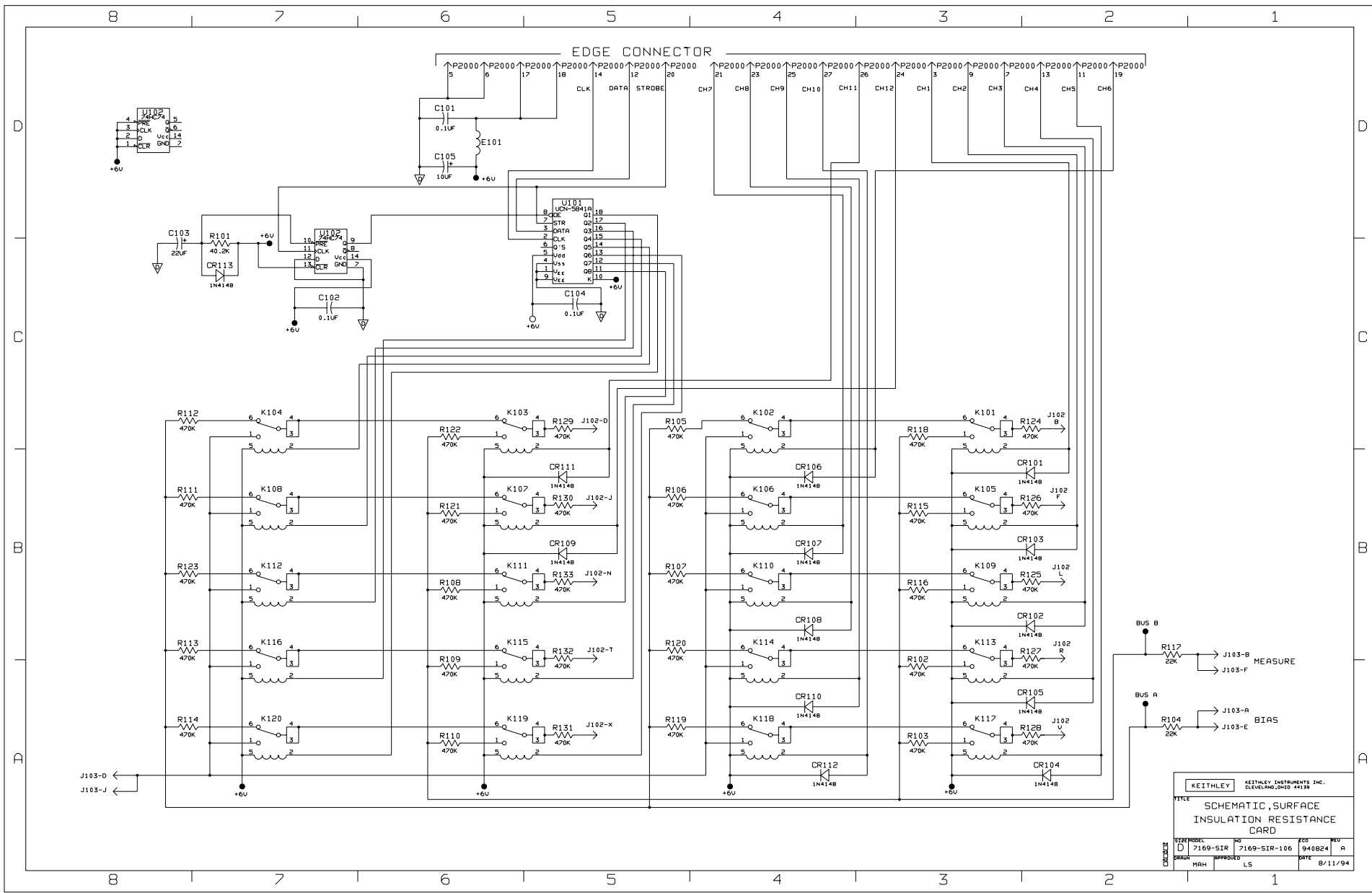
J102

7169-303

NOTE:  
FOR COMPONENT INFORMATION  
REFER TO PRODUCT STRUCTURE.

MODEL	NEXT ASSEMBLY	QTY.

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 8/12/94	SCALE 1:1	TITLE COMPONENT LAYOUT, SURFACE INSULATION RESISTANCE
KEITHLEY KEITHLEY INSTRUMENTS INC CLEVELAND, OHIO 44139	XXX+/- .015 ANG. +/- 1°	DRN. MAH	ENG. LS	NO. 7169-SIR-100
	XXX+/- .005 FRACTION +/- 1/64	MATERIAL	FINISH	
	SURFACE MAX. Q3			



KEITHLEY		KEITHLEY INSTRUMENTS INC.	
CLEVELAND, OHIO 44139			
TITLE SCHEMATIC, SURFACE INSULATION RESISTANCE CARD			
SIZE	PROJ.	NO.	REV.
D	7169-SIR	7169-SIR-106	940824 A
DESIGNER	APPROVED	DATE	
MAH	LS	8/11/94	

# Index

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## A

Applications 3-1

## C

Card installation and removal 4-5  
Component layout and schematic diagram 5-1  
Configure mainframe for Model 7169 2-2  
Connections 4-2  
Connections using the Model 7169-KIT 4-4  
Connections using the Model 7169-MTC cable 4-4  
Connector preparation 4-7

## E

Environmental conditions 4-6

## F

Factory service 5-1

## H

Handling and cleaning precautions 4-1

## I

Input isolation tests 4-7  
Inspection for damage 1-2  
Instruction manual 1-2

## M

Mainframe control of switch card 2-2  
Mainframe precautions 4-1  
Manual addenda 1-1  
Multi-card configurations 2-2

## O

Operation 2-1  
Optional accessories 1-2  
Ordering information 5-1

## P

Parts list 5-1  
Path resistance tests 4-9  
Performance verification 4-6

## R

Recommended equipment 4-6  
Relay control 2-3  
Repacking for shipment 1-2  
Replaceable parts 5-1

## S

Safety symbols and terms 1-1  
Service information 4-1  
Shielded cables 4-5  
Shipping contents 1-2  
Specifications 1-1  
Surface insulation resistance testing 3-1  
Switch card installation 4-5  
Switch card removal 4-6

## U

Unpacking and inspection 1-2

## W

Warranty information 1-1





# 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. \_\_\_\_\_

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> Intermittent            | <input type="checkbox"/> Analog output follows display   | <input type="checkbox"/> Particular range or function bad; specify |
| <input type="checkbox"/> IEEE failure            | <input type="checkbox"/> Obvious problem on power-up     | <input type="checkbox"/> Batteries and fuses are OK                |
| <input type="checkbox"/> Front panel operational | <input type="checkbox"/> All ranges or functions are bad | <input type="checkbox"/> Checked all cables                        |

Display or output (check one)

- |                                   |  |
|-----------------------------------|--|
| <input type="checkbox"/> Drifts   | <input type="checkbox"/> Unable to zero              |
| <input type="checkbox"/> Unstable | <input type="checkbox"/> Will not read applied input |
| <input type="checkbox"/> Overload |  |

- |   |  |
|---|--|
| <input type="checkbox"/> Calibration only | <input type="checkbox"/> Certificate of calibration required |
| <input type="checkbox"/> Data 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**

**Test Instrumentation Group**  
**Keithley Instruments, Inc.**  
28775 Aurora Road  
Cleveland, Ohio 44139

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