KEITHLEY INSTRUMENTS

Model 7052 4 × 5 Matrix Card Instruction Manual

Contains Operating and Servicing Information

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SPECIFICATIONS

MODEL 7052 4 × 5 MATRIX CARD
CHANNEL CONFIGURATION: 4 × 5.
CONTACT CONFIGURATION: 3-pole Form A, High, Low and Guard.
CONNECTOR TYPE: Quick Disconnect screw terminals, No. 18 AWG maximum.
RELAY DRIVE CURRENT: 15mA (per relay).
SIGNAL LEVEL: 200V, 200mA or 10VA peak non-inductive load only.
CONTACT LIFE: 10^8 closures (cold switching); 10^7 closures (maximum signal level).
CONTACT RESISTANCE: <1Ω per contact to rated life.
CONTACT POTENTIAL: <20μV per any contact pair.
ACTUATION TIME: <2msec exclusive of mainframe.
CHANNEL ISOLATION: $>10^{12}\Omega$ and <5pF; 60dB into 50Ω @1MHz.
INPUT ISOLATION, DIFF: $>10^9\Omega$ and <50pF typical.
INPUT ISOLATION, CM: $>10^9\Omega$ and <100pF typical.
OFFSET CURRENT: <100pA.
COMMON MODE VOLTAGE: 200V peak.
ENVIRONMENTAL, OPERATING: 0° to 50°C, up to 35°C at 70% R.H.
ENVIRONMENTAL, STORAGE: −25° to +65°C.
DIMENSIONS, WEIGHT: 32mm high × 114mm wide × 227mm long (1¼'' × 4½'' × 10¾''). Net weight 0.61kg (21.5 oz.).

Specifications subject to change without notice

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 7052 is a configured 4 × 5 (*4 rows by 5 columns*) channel cross point matrix card wth 3-pole Form A (normally open) switching for HI, LO and GUARD. Designed for general purpose signal switching, the matrix switching scheme offers the flexibility to connect any one point to another. The card is field installable in an appropriate Keithley mainframe (eg. Model 705 or Model 706). The switching is accomplished in less than 2msec (exclusive of mainframe) and then specified relay life is 10^7 closures at maximum signal levels. Quick disconnect screw terminals (No. 18 AWG maximum) are used to facilitate input and output connections to the matrix scanner card. The scanner mainframe must be in the matrix mode (Program 6, number 0, available in B5 or later software for the Model 705) in order to operate the Model 7052 matrix card.

1.2 WARRANTY INFORMATION

Warranty information is stated on the inside front cover of the manual. If there is a need for service, contact the Keithley representative or authorized repair facility in your area. Check the back cover of this manual for addresses. The service form supplied at the end of the manual should be used to provide the repair facility with adequate information concerning any difficulty.

1.3 MANUAL ADDENDA

Improvements or changes to this manual will be explained on an addendum included with this manual.

1.4 SAFETY SYMBOLS AND TERMS

The symbol ⚠ on the instrument denotes that the user should refer to the operating instructions.

The symbol ⚡ denotes that a high voltage may be present on the terminal(s).

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

SECTION 2
OPERATION

2.1 INTRODUCTION

This section provides information needed to use the Model 7052 matrix card with an appropriate Keithley scanner mainframe (e.g. Model 705).

2.2 WIRING

Each crosspoint on the Model 7052 matrix card consists of one 3-pole Form A (normally open) switching relay. The 3-pole relays allow HI, LO and GUARD to be switched. The matrix of the relays on each card is configured with four rows and five columns hence, the 4 × 5 matrix. Each Model 705 mainframe can accomodate two cards and each Model 706 mainframe can accomodate 10 cards. By wiring the rows or columns of one card to the rows or columns of another card, the matrix can be increased to 4 × 10 or 8 × 5 depending on the wiring (refer to Figures 1 and 2). With the Model 706 much larger matrixes can be realized, such as 4 × 50, 8 × 25, 12 × 15, etc. All literature pertaining to the Model 7052 will refer to the matrixes by rows and columns. Where rows are the first number and columns are the second number.

Since the matrix card is configured as a 4 × 5 matrix, the input and output connections can be configured at the user's discretion (one input with many outputs, or many inputs with one output). Quick disconnect screw terminals (No. 18 AWG maximum) are used to facilitate the input and output connections.

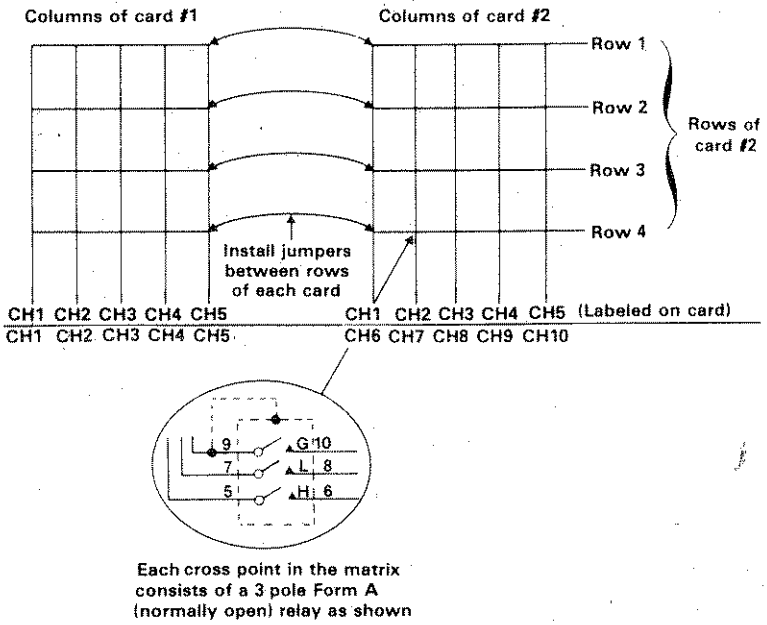


Figure 1. Simplified Schematic of a 4 × 10 Matrix

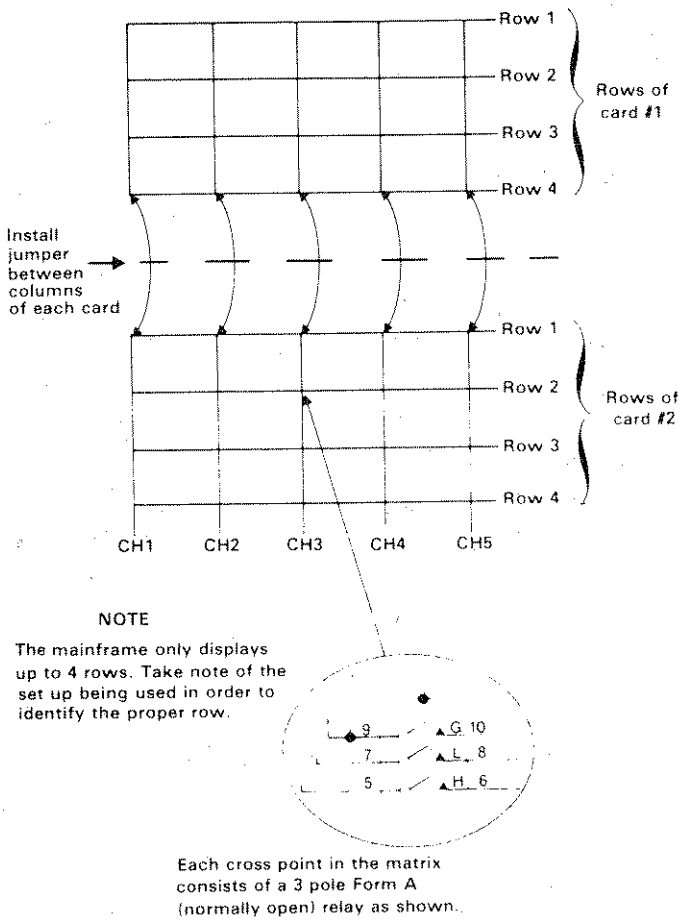


Figure 2. Simplified Schematic of a 8 × 5 Matrix

2.3 INSTALLATION

Refer to the scanner mainframe instruction manual for installation instructions.

NOTE

The matrix card will operate only in Model 705s with B5 and above software. A1 software and above with Model 706 scanners.

WARNING

Always turn the power off to all instruments connected to the scanner card and also turn off the mainframe's power before removing or installing the scanner card.

2.4 OPERATING CONSIDERATIONS

There are a number of operating parameters to take into consideration before operating the Model 7052 matrix card. They are listed below:

Signal Levels—The normal signal levels that the Model 7052 matrix card operates at are 10V (200V maximum)/10mA (200mA maximum). The load should only be resistive and 10VA is the maximum switching level with a resistive load. The contact life of the relays with normal signal levels is 10^8 closures. At maximum signal levels the number of closures is degraded by a factor of 10.

WARNING

When switching signals greater than 30V rms or 42.4V peak take care to prevent contact with live circuits which could cause an electrical shock resulting in injury or death.

NOTE

Reactances in the system will cause switching transients. These transients should not exceed the rating specified. If they do, the transients can degrade the relay life.

External Considerations—The Model 7052 specifications are based on a resistive load; however, external circuit capacitances and reactances can cause excessive currents and voltages to appear across the relay contacts. The currents and voltages must be limited to within the contact ratings.

1. **Capacitance**—Charged capacitance in the circuit can cause excessive currents (surge currents) to flow through the contacts, if the source is shorted out or the output is switched to capacitance loads. This excessive current can weld the relay contacts together. Therefore, use series resistors where needed to limit the maximum current that can flow. For example, a DC power supply specification may indicate that the output current is limited to 10mA. However, because of internal capacitors connected across the power supply output, high surge currents can easily flow through the relay contacts. If they are shorted or when switched to reactive loads a surge may result. The surge current can be very high and may be only a few microseconds in duration but they can still weld the relay contacts together. The currents must be limited to within the contact ratings of the relay which are given in the specifications.
2. **Inductance**—The inductance of cables can produce high voltage and arcing across the relay contacts when switching. The peak transients must be limited to within the contact ratings which are given in the specifications.
3. **Cables**—Shielded cables should be used with the Model 7052 card when switching signals greater than 50V. The shield should be connected to the circuit LO or GUARD. This helps prevent excessive radiation from the cables from interfering with any equipment.

2.5 MAINFRAME FRONT PANEL OPERATION

Using the Model 7052 matrix card with an appropriate Keithley mainframe (e.g. Model 705 or Model 706) requires that the matrix mode be activated. To activate the matrix mode, press the following buttons on the mainframe's front panel:

1. Press PRGM, 6
2. Press 0, ENTER

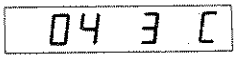
After the ENTER button is presed, the mainframe is placed in the matrix mode. In the matrix mode the display uses the following format:

nn m O or C (Model 705 display)

where the Model 705 display is:
nn = two digit number displaying the column, card and unit number.
m = the row from 1 to 4
O or C denotes crosspoint is open or closed
nnn m o or c (Model 706 display)
where the Model 706 display is:
nnn = three digit number displaying the column, card and unit number.
m = the row from 1 to 4
o or c denotes the crosspoint is open or closed.

2.5.1 Model 705 Matrix Operation

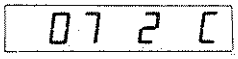
For example the following display on the Model 705 means:



where:
04 denotes first unit (01—10 denotes unit #1)
04 also denotes first card (01—05 denotes card #1, top card)
04 also denotes fourth column of above card (01—05 denotes columns of card #1)
3 denotes third row
C denotes the crosspoint is closed

Therefore, the display 04 3 C means that the crosspoint on unit #1, card #1, column #4, row #3 is closed.

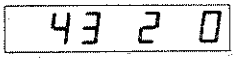
As another example, the following display on the Model 705 means:



where:
07 denotes first unit (01—10 denotes unit #1)
07 also denotes second card (06—10 denotes card #2, bottom card)
07 also denotes second column (06—10 denotes columns of card #2)
2 denotes second row
C denotes crosspoint is closed

Therefore, the display 07 2 C means that the crosspoint on unit #1, card #2, column #2, row #2 is closed.

As another example, assume there are five daisy chained Model 705s and each unit has two matrix cards. In this case the following display means:



where:
43 denotes fifth unit (41—50 denotes unit #5)
43 also denotes card #1 (top card) (41—45 denotes card #1)
43 also denotes column #3 (41—45 denotes columns of card #1)
2 denotes row #2
O denotes the crosspoint is open

Therefore, the display 43 2 O means that the crosspoint of unit #5, card #1, column #3, row #2 is open.

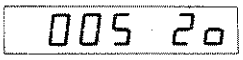
NOTE

In the example of the five daisy chained Model 705s the display is taken from the master unit of the daisy chain configuration. Refer to the mainframe's instruction manual for complete details of daisy chain operation.

To select the desired crosspoint press the digit corresponding to the desired unit, card, column and row. To open the selected crosspoint press the OPEN button. To close the selected crosspoint press the CLOSE button. For complete front panel mainframe operation refer to the mainframe's instruction manual.

2.5.2 Model 706 Matrix Operation

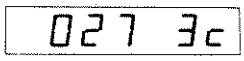
As an example of the Model 706 matrix display consider the following display.



where:
005 denotes unit #1 (001—050 denotes unit #1) Refer to Table 2-19 of Model 706 Instruction Manual.
005 also denotes card slot #1 (001—010 denotes card slot #1) Refer to Table 2-20 of Model 706 Instruction Manual.
005 also denotes column #5 (001—005 denotes columns of card #1)
2 denotes row #2
o denotes the crosspoint is open

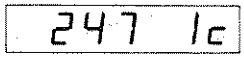
Therefore, the Model 706 display 005 2 o means that the crosspoint of unit #1, card slot #1, column #5, row #2 is open.

As another example of the Model 706 matrix display consider the following display.



where:
027 denotes unit #1 (001—050 denotes unit #1) Refer to Table 2-19 of Model 706 Instruction Manual.
027 also denotes card slot #6 (026—030 denotes card slot #6) Refer to Table 2-20 of Model 706 Instruction Manual.
027 also denotes column #2 (026—030 denotes columns of card #6)
3 denotes row #3
c denotes the crosspoint is closed

Therefore, the Model 706 display 027 3 c means that the crosspoint of unit #1, card slot #6, column #2, row #3 is closed.
As another example of the Model 706 matrix display assume that there are five daisy chained Model 706s. The following display is defined as:



where:
247 denotes unit #5 (201—250 denotes unit #5) Refer to Table 2-19 of the

Model 706 Instruction Manual.
247 also denotes card slot #10 (246—250 denotes card #10) Refer to Table 2-20 of Model 706 Instruction Manual.
247 also denotes column #2 (246—250 denotes columns of card #10)
1 denotes row #1
c denotes the crosspoint is closed

Therefore, the Model 706 display 247 1 c means that the crosspoint of unit #5, card slot #10, column #2, row #1 is closed.

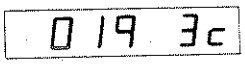
NOTE

In the example of the five daisy chained Model 706s, the display is taken from the master unit of the daisy chain configuration. Refer to the mainframe's instruction manual for complete details of daisy chain operation.

To select the desired crosspoint press the digit corresponding to the desired unit, card, column and row. To open the selected crosspoint press the OPEN button. To close the selected crosspoint press the CLOSE button. Refer to the mainframe's instruction manual for complete front panel operation.

The previous examples of matrix crosspoints are defined by the architecture of the mainframes and cards. They are not a representation of the user's custom matrix set up. The user must keep track of which card is which and where in his custom matrix does it appear in the mainframes architecture. Refer to the Model 706 Instruction Manual for Tables 2-19 and 2-20 for matrix unit and card number display assignment.

If larger matrixes are required, it is recommended to configure them using blocks of four rows by five columns. In this way the larger matrixes would be consistent with the Model 7052s layout, and therefore, coincide with the mainframe's display. Consider Figure 3. The figure is showing a 8 × 10 matrix (8 rows by 10 columns). To set up this matrix using the Model 705 (2 card scanner) requires that two Model 705s be daisy chained together. To set up this matrix using the Model 706 (10 card scanner) requires four of the 10 card slots. The mainframe's display shows the crosspoints of the matrix set up. For example, in the figure there is a crosspoint that is circled. This crosspoint is depicted on the Model 706 display as shown:



where:
019 denotes mainframe #1 (001—050 denotes mainframe #1) Refer to Table 2-19 in the Model 706 Instruction Manual.
019 also denotes card slot #4 (016—020 denotes card slot #4) Refer to Table 2-20 in the Model 706 Instruction Manual.
019 also denotes column #4 (016—020 denotes the columns of the card)
3 denotes row #3
c denotes the crosspoint is closed

This same crosspoint in the Model 705 set up would be:

where:
19 denotes mainframe #2 (11-20 denotes mainframe #2)
19 also denotes bottom card (16-20 denotes bottom card)
19 also denotes column #4 (16-20 denotes the columns of the card)
3 denotes row #3
C denotes the crosspoint is closed

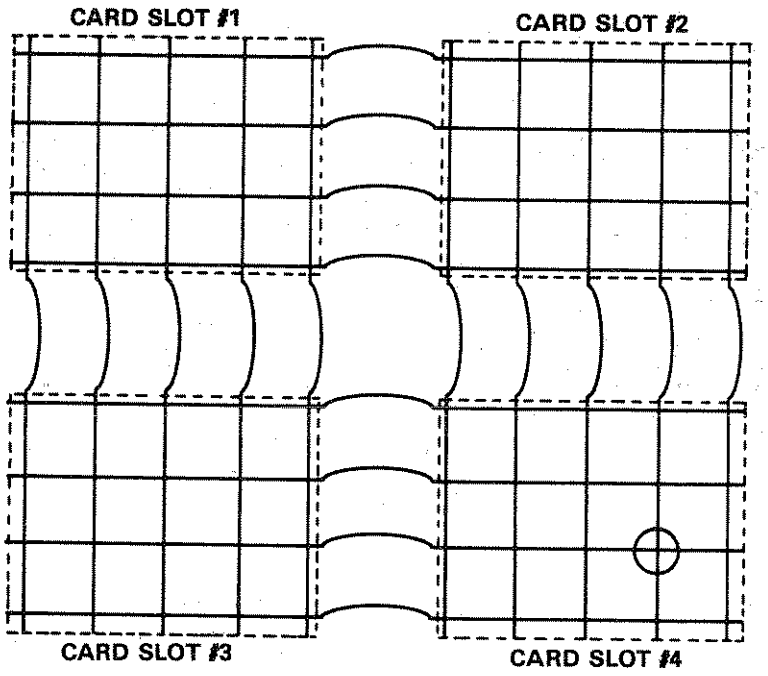


Figure 3. 8 × 10 Matrix

2.6 IEEE BUS OPERATION WITH THE MODEL 7052 MATRIX CARD

Operating the Model 7052 matrix card over the IEEE bus uses all the commands listed in the mainframe's instruction manual. The device-dependent command that enables the matrix mode is A0. In normal operation the command letter is sent first followed by a three digit number that denotes the crosspoint the command is to act upon. For matrix operation in the Model 705, the command letter is sent first followed by a two digit number then by a single digit number. The format is as follows:

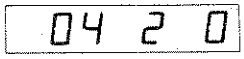
nn:m (Colon optional)

where:
nn is a two digit number corresponding to which unit, card and column.
m is the row from 1 to 4

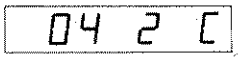
For example: To program the mainframe into the matrix mode, display and close the crosspoint of the first unit, first card, fourth column, second row enter the following statements into the HP-85:

```
REMOTE 717 (END LINE)
OUTPUT 717; "A0X" (END LINE)
OUTPUT 717; "B042X" (END LINE)
OUTPUT 717; "C042X" (END LINE)
```

When the END LINE key is pressed after the A0X statement the mainframe is placed in the matrix mode. When the END LINE key is pressed after the B042X statement, the crosspoint of the first unit, first card, fourth column, second row is displayed on the mainframe with the following display:



When the END LINE key is pressed after the C042X statement the crosspoint of the first unit, first card, fourth column, secnd row is closed. The following is then displayed:



For matrix operation in the Model 706, the command letter is sent first followed by a three digit number then by a single digit number. The format is as follows:

nnn:m (colon optional)

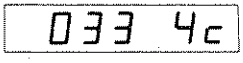
where:
nnn is a three digit number corresponding to which unit, card and column
m is the row from 1 to 4

For example: To program the mainframe into the matrix mode, display and close the crosspoint of the first unit, card #7, column #3, row #4 enter the following statements into the HP-85:

```
REMOTE 718 (END LINE)
OUTPUT 718; "A0X" (END LINE)
OUTPUT 718; "B0334X" (END LINE)
OUTPUT 718; "C0334X" (END LINE)
```

When the END LINE key is pressed after the A0X statement the Model 706 is placed in the matrix mode. When the END LINE key is pressed after the B0334X statement, the crosspoint of the first unit, card #7, column #3, row #4 is displayed on the Model 706 with the following display:

When the END LINE key is pressed after the C0334X statement, the crosspoint of the first unit, card #7, column #3, row #4 is closed and the following is displayed:



where:
033 denotes unit #1 (001—050 denotes unit #1) Refer to Table 2-19 in the Model 706 Instruction Manual.
033 also denotes card slot #7 (031—035 denotes card slot #7) Refer to Table

2-20 in the Model 706 Instruction Manual.
033 also denotes column #3 (031—035 denotes columns of card #7)
4 denotes row #4
c denotes the crosspoint is closed

2.7 SWITCH TERMINOLOGY

Throughout this manual the terminology Form A is used. The term Form A is used in switch terminology and is described as follows:

1. Form A—is simply a single pole normally open (SPNO) switch (refer to Figure 4). A 2-pole switch normally open is classified as a 2 Form A.
2. Form B is similar to Form A except that its contacts are normally closed (refer to Figure 4). A 2-pole switch normally closed is classified as a 2 Form B.
3. Form C is shown in Figure 4 as a single pole double throw switch. It could also be a multipole switch as a 2-pole which would be classified as a 2 Form C.

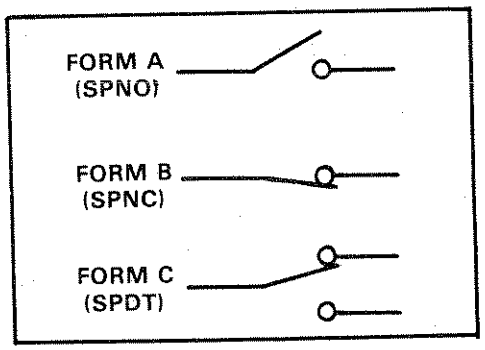


Figure 4. Switch Terminology

SECTION 3
SERVICING INFORMATION

3.1 INTRODUCTION

This section contains a performance verification procedure. Since there are no calibration adjustments, no recalibration is necessary. Recommended maintenance would include inspection of the scanner plug-in card and card edge connector to ensure good electrical contact. The verification procedure should be performed upon receiving the Model 7052 or at the time maintenance is performed on the mainframe.

3.2 HANDLING AND CLEANING PRECAUTIONS

Because of the high impedance of the card ($10^{12}\Omega$ channel isolation, $10^{9}\Omega$ input isolation) care should be taken in both handling and using the card to prevent degradation of performance. The following steps point out precautionary measures to prevent degradation of performance.

1. Handle the PC board only by the edges whenever possible. Avoid touching any components not directly associated with the repair.
2. Do not store or operate the card in an environment where dust could settle on the board. In some instances, this could affect the card's performance. Use dry nitrogen gas to clean the card when necessary.
3. If it is necessary to use solder on the circuit board, remove the flux from the board when repair is complete. Use Freon® TMS or TE or equivalent to remove the flux. Clean cotton swabs or a clean soft brush may be used to help remove the flux. Once all the flux is 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 two hours to allow all traces of moisture to evaporate before resuming use of the card.

3.3 REQUIRED TEST EQUIPMENT

Recommended test equipment for performance verification is given in Table 1. Test equipment other than that which is recommended may be substituted if the alternate equipment's specifications are at least equal the specifications stated in Table 1.

Table 1. Recommended Test Equipment

Item	Description	Specifications	Mfr.	Model
A	Ohmeter-DMM	4 terminal resistance measurement <1Ω sensitivity	Keithley	195
B	Kelvin Test Lead Set	—	Keithley	1641
C	Scanner Mainframe	—	Keithley	705

3.4 PERFORMANCE VERIFICATION

The procedures necessary to verify that the Model 7052 matrix card is operating within its specifications are given in this section. The test should be carried out in environment stated in the specifications.

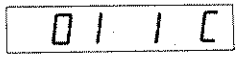
Signal Path Resistance (Open and Close Test)

1. Set Up—Connect a short piece (1" or less) of copper wire (No. 18 AWG maximum) to each of the HI, LO and Guard terminals of one row and one column.
2. Turn the Model 195 on and select the ohms function. Connect the Model 1641 Kelvin test lead set to the OHMS SENSE and VOLTS OHMS terminals of the Model 195. Zero the Model 195 with the leads shorted.
3. After the Model 195 is zeroed, connect the OHMS SENSE LO and the VOLTS OHMS LO to the wire connected to the HI terminal of the row to be tested. Connect the OHMS SENSE HI and the VOLTS OHMS HI to the wire connected to the HI terminal of the column to be tested.
4. Insert the Model 7052 into the mainframe and turn it on. Using the mainframe's front panel controls, open the crosspoint that has been selected for this test. For example; to open the crosspoint of the first unit, first card, first column, first row press the following buttons:

   A. PRGM, 6 (Selects Program Mode)
   B. 0, ENTER (Selects Matrix Mode)
   C. 0, 1, 1, OPEN (Selects unit, card, column, row and opens that crosspoint.

   After the buttons are pressed the mainframe's display should be:

5. The reading on the Model 195 should indicate an open circuit.
6. Use the mainframe's front panel controls to close the crosspoint. Since the crosspoint is already selected, simply press the CLOSE button to close the crosspoint.



7. The reading on the Model 195 should be less than 1Ω.
8. Repeat steps 3 through 7 for the LO terminal of the crosspoint and the GUARD of the crosspoint.
9. Repeat steps 3 through 8 for the remaining columns on the Model 7052 card.
10. Repeat steps 3 through 9 for the remaining rows on the Model 7052 card.

NOTE

For steps 8, 9 and 10 the mainframe does not need to be reprogrammed into the matrix mode. Increment the row or column to be tested.

SECTION 4
REPLACEABLE PARTS

4.1 INTRODUCTION

This section contains replacement parts information, a schematic diagram and component layout for the Model 7052 matrix card.

4.2 REPLACEABLE PARTS

Parts are listed alpha-numerically in order of their circuit designation. Table 2 contains the replaceable electrical parts and Table 3 contains the replaceable mechanical parts.

4.3 ORDERING INFORMATION

To place an order or to obtain information concerning replacement parts, contact your Keithley representative or the factory. See the back cover for addresses. When ordering include the following information.

1. Instrument Model Number
2. Instrument Serial Number
3. Part Description
4. Circuit Description (if Applicable)
5. Keithley Part Number

4.4 FACTORY SERVICE

If the instrument is to be returned to the factory for service, please complete the service form which follows this section and return it with the instrument.

4.5 COMPONENT LAYOUT AND SCHEMATIC DIAGRAM

A component layout of the Model 7052 is contained in Figure 4, while Figure 5 contains a schematic diagram of the Model 7052.

Table 2. Model 7052 Electrical Replaceable Parts

Circuit	Description	Keithley Part No.
C101	Capacitor, 10μF, 25V, Aluminum Electrolytic	C-314-10
C102	Capacitor, 10μF, 25V, Aluminum Electrolytic	C-314-10
CR101	Silicon Diode, 1N914	RF-28
CR102	Silicon Diode, 1N914	RF-28
J1001	3 pin terminal strip	CS-457-1
J1003	3 pin terminal strip	CS-457-1
J1005	3 pin terminal strip	CS-457-1
J1007	3 pin terminal strip	CS-457-1
J1009	3 pin terminal strip	CS-457-1
J1011	3 pin terminal strip	CS-457-1
J1013	3 pin terminal strip	CS-457-1
J1015	3 pin terminal strip	CS-457-1
J1017	3 pin terminal strip	CS-457-1

Table 2. Model 7052 Electrical Replaceable parts (Cont.)

Circuit	Description	Keithley Part No.
K101	3-pole Form A relay	RL-67
K102	3-pole Form A relay	RL-67
K103	3-pole Form A relay	RL-67
K104	3-pole Form A relay	RL-67
K105	3-pole Form A relay	RL-67
K106	3-pole Form A relay	RL-67
K107	3-pole Form A relay	RL-67
K108	3-pole Form A relay	RL-67
K109	3-pole Form A relay	RL-67
K110	3-pole Form A relay	RL-67
K111	3-pole Form A relay	RL-67
K112	3-pole Form A relay	RL-67
K113	3-pole Form A relay	RL-67
K114	3-pole Form A relay	RL-67
K115	3-pole Form A relay	RL-67
K116	3-pole Form A relay	RL-67
K117	3-pole Form A relay	RL-67
K118	3-pole Form A relay	RL-67
K119	3-pole Form A relay	RL-67
K120	3-pole Form A relay	RL-67
Q101	NPN Bipolar Transistor	TG-163
R102	Resistor, 10k, 5%, ¼W, Composition	R-76-10k
R103	Resistor, 10k, 5%, ¼W, Composition	R-76-10k
R104	Resistor, 10k, 5%, ¼W, Composition	R-76-10k
U101	Darlington Transistor Array ULN2003A	IC-206
U102	8 Stage Shift Register 4094	IC-251
U103	Quad Two Input Nand 4011	IC-102

Table 3. Model 7052 Replaceable Mechanical Parts

Description	Qty	Keithley Part Number
Handle	2	FA-119
Standoff	4	ST-19
Clamp Assembly, Upper	1	7055-303-04
a. Clamp, Upper	1	7055-305
b. Strip, Rubber	1	26621
Clamp Assembly, Lower	1	705-308
a. Clamp, Lower	1	7055-307
b. Strip, Rubber	1	26621
Cover	1	7052-302
#6-32 × 5/16 Phillips Pan Head Screw	2	
#6-32 × 1⅛ Phillips Pan Head Screw	2	
#2-56 × 3/16 Lg. Phillips Pan Head Screw	4	

4.6 SPECIAL HANDLING OF STATIC SENSITIVE DEVICES

MOS devices are designed to function at high impedance levels. Normal static charges can destroy these devices. Table 4 lists all of the static sensitive devices of the Model 7052. Steps 1 through 7 provide instruction on how to avoid damaging these devices:

1. Devices should be handled and transported in protective containers, antistatic tubes or conductive foam.
2. Use a properly grounded work bench and a grounding wriststrap.
3. Handle devices by the body only.
4. PC boards must be grounded to the bench while inserting the devices.
5. Use an antistatic solder remover.
6. Use grounded tip soldering irons.
7. After devices are soldered or inserted into sockets they are protected and normal handling may resume.

Table 4. Model 7052 Static Sensitive Devices

Reference Designation	Keithley Part Number
U102	IC-251
U103	IC-105

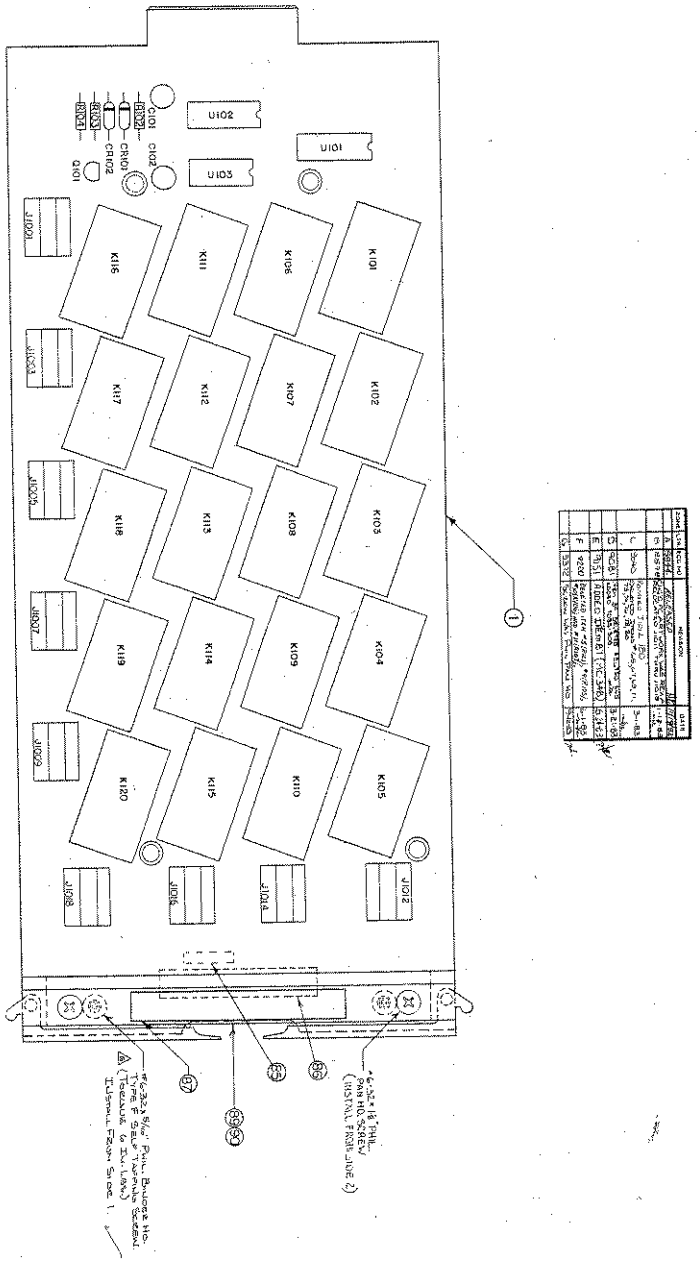


Figure 4. Model 7052 Component Layout

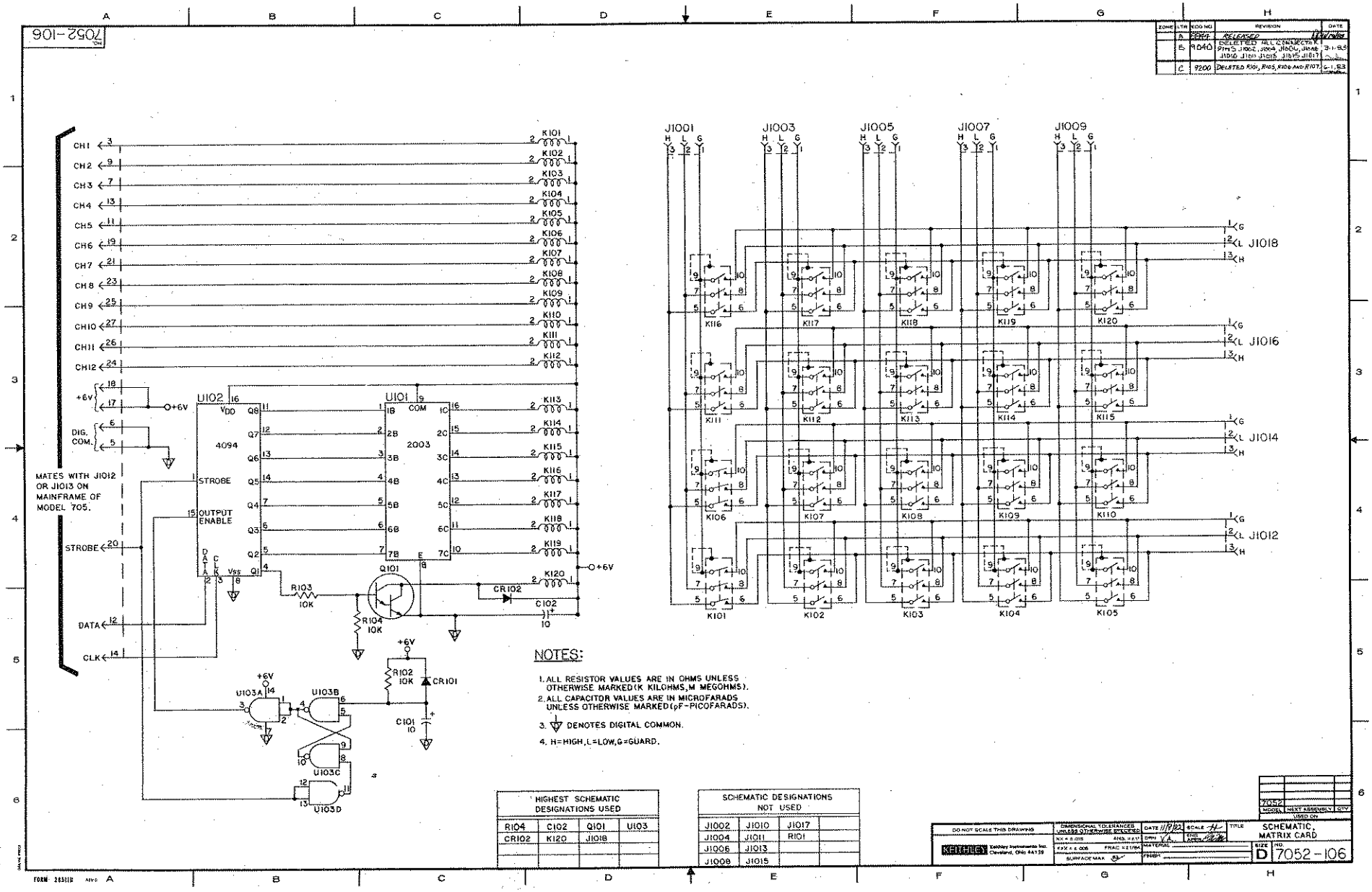


Figure 5. Model 7052 Schematic Diagram