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Model 7056
General Purpose Scanner Card

Instruction Manual

Contains Operating and Servicing Information

KEITHLEY

Document Number: 7056-901-01 Rev. D

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

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

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

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

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Model 7056
General Purpose Scanner Card
Instruction Manual

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Safety Precautions

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

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

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.**

As described in the International Electrotechnical Commission (IEC) Standard IEC 664, digital multimeter measuring circuits (e.g., Keithley Models 175A, 199, 2000, 2001, 2002, and 2010) are Installation Category II. All other instruments' signal terminals are Installation Category I and must not be connected to mains.

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.

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

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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.

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SPECIFICATIONS

7056 GENERAL PURPOSE SCANNER CARD

CHANNELS PER CARD: 10 in 2-pole mode, 20 in 1-pole mode.

CONTACT CONFIGURATION: 2-pole Form A, includes Model 7055 Quick Disconnect Card. HI or LO switched to a separate output for 1-pole mode, common guard connection.

CONNECTOR TYPE: Screw terminal, No. 18 AWG maximum wire size. Terminals mounted on 7055 quick disconnect potion of 7056.

RELAY DRIVE CURRENT: 24mA per relay typical.

MAXIMUM SIGNAL LEVEL: 150V, 250mA, 10VA peak (resistive load).

CONTACT LIFE: 10^8 closures (cold switching); 10^7 closures (at maximum signal level).

CONTACT RESISTANCE: <2Ω to rated life.

CONTACT POTENTIAL: <100μV per contact pair input to output with copper leads (<50μV typical).

ACTUATION TIME: <2ms, exclusive of mainframe.

CHANNEL ISOLATION: $>10^9\Omega$, <20pF typical; 50dB into 50Ω @ 1MHz.

INPUT ISOLATION:

Differential: $>10^9\Omega$ and <50pF typical.

Common Mode: $>10^9\Omega$ and <150pF typical.

COMMON MODE VOLTAGE: <150V peak.

ENVIRONMENT:

Operating: 0° to 50°C, up to 35°C at 70% RH.

Storage: –25°C to 65°C.

DIMENSIONS, WEIGHT: 32mm high × 114mm wide × 272mm long (1.25 in. × 4.5 in. × 10.75 in.). Net weight 0.27kg (9.5 oz.).

Specifications subject to change without notice.

NOTE

Because of high impedance of the board special care should be taken in both handling and using the board to prevent degradation of performance. Handle the board by the edges when using it and keep it free of body oils, dirt and contaminants. To clean the board use distilled water and a clean cotton swab or soft brush. Thoroughly scrub the board and then remove all water residue with dry nitrogen gas. After the board is clean bake for five hours at 50°C and low relative humidity.

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 7056 is a general purpose relay scanner plug-in card which is field-installable in an appropriate Keithley scanner mainframe (e.g. Model 705). The Model 7056 will switch up to 10 channels. The card can be used as a voltage scanner, independent relay card or a matrix card. The 2-pole switching is accomplished in less than 2ms and the expected relay life is 10^8 closures at the maximum contact ratings. Barrier strips are used to facilitate input and output connections to the relay scanner plug-in card. The plug-in card can easily be removed through the rear panel of the scanner mainframe. The Model 7055 provides the connection to the individual channels via the screw clamp type terminal strips.

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 ADDENDUM

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

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SECTION 2
OPERATION

2.1 INTRODUCTION

This section provides information needed to use the Model 7056 with an appropriate scanner mainframe.

2.2 WIRING AND INSTALLATION

1. Wiring Configuration—Each channel on the Model 7056 card consists of 10-2 Form A relays and 2-1 Form A relays for one pole mode. The card can be wired as a voltage scanner card, independent relay card, or a matrix card. Channel 1, on the component designation, shows the terminal locations which are similar to Channels 1 through 5. Channel 10 shows the terminal locations typical for Channels 5 through 10.
   A. Voltage Scanner Card—The Model 7056 can be used as a voltage scanner card. Figure 1 shows a typical channel in the voltage scanner mode. When the Model 7056 card is used in a Model 705 scanner mainframe, one of 10 channels can be switched to the output at a time. When scanning, the relay contacts of one channel will break before the relay contacts on a second channel will make, ensuring isolation between channels.
   B. Independent Relay Card—The Model 7056 plug-in card can be used as an independent relay card. The relay switching is still controlled by the scanner mainframe. When using the circuit, do not exceed the maximum contact ratings.
   C. Matrix Card—The Model 7056 can be used as a 1 by 10 or a 2 by 5 matrix card. The Model 7056 should be first set up as a voltage scanner card. To use it as a 1 by 10 matrix card, the output HI or output LO can be used to switch to any of the 10 input HIs or input LOs. For use as a 2 by 5 matrix card, refer to Figure 2. This allows the user to switch the output HI or output LO to any of five inputs. Figure 2 shows the 2 by 5 matrix setup.

2. Installation—Refer to the Model 705 Instruction Manual for installation instructions.

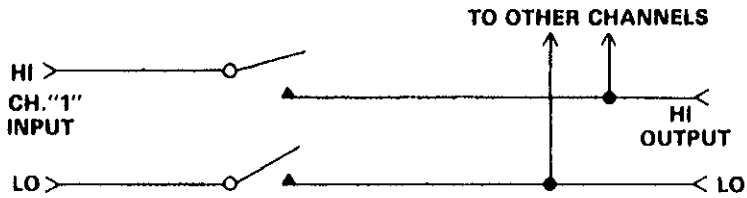


Figure 1. Typical Channel, Voltage Scanner Mode

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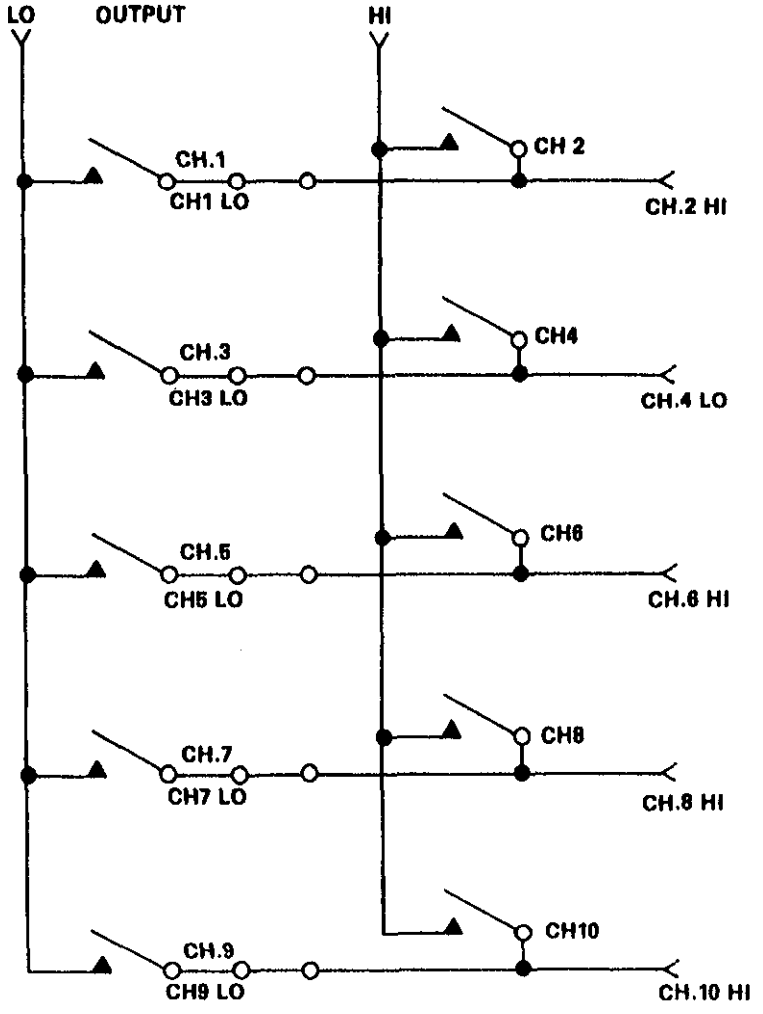


Figure 2. 2 by 5 Matrix

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2.3 OPERATING CONSIDERATIONS

1. Signal Levels—The signal levels that the Model 7056 operates at are 10V (150V maximum)/10mA (250mA 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 10^6closures. At maximum signal levels, the number of closures is degraded by a factor of 10.

NOTE

Reactances in the system will cause switching transients during switching. These transients should not exceed the ratings given. If they do, the transients can degrade the relay contact life.

2. External Considerations—The Model 7056 specifications are for a resistive load; however, external circuit capacitances and inductances can cause excessive currents and voltages across the relay contacts. The currents and voltages must be limited to within the contact ratings.

   A. Capacitance—Charged capacitances in the circuit can cause excessive currents (surge currents) to flow through the relay contacts, if the source is shorted out or the output is switched to capacitive loads. This excessive current can weld the relay contacts together. Therefore, use series resistors where needed to limit the maximum current that can flow, to within the contact ratings. 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 (such as the input to a voltmeter), a surge may result. The surge current can be very high and may only be 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. The limits are stated in paragraph 2.3.1.

   B. 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. The limits are stated in paragraph 2.3.1.

   C. Cables—Shielded cables should be used with the Model 7056 card when switching above 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.

   D. 1-Pole Configuration—The Model 705 can be used in the 1-pole configuration by utilizing front panel program number 6 on the Model 705 mainframe. Refer to the Model 705 instruction manual for information concerning the front panel programs. Generally, the 1-pole configuration is used for applications where a user can use a single common ground in the measurement. The channel numbering for the 1-pole configuration is shown in Figure 3. The 1-pole output is taken from the 1P connector to ground on the Model 7056.

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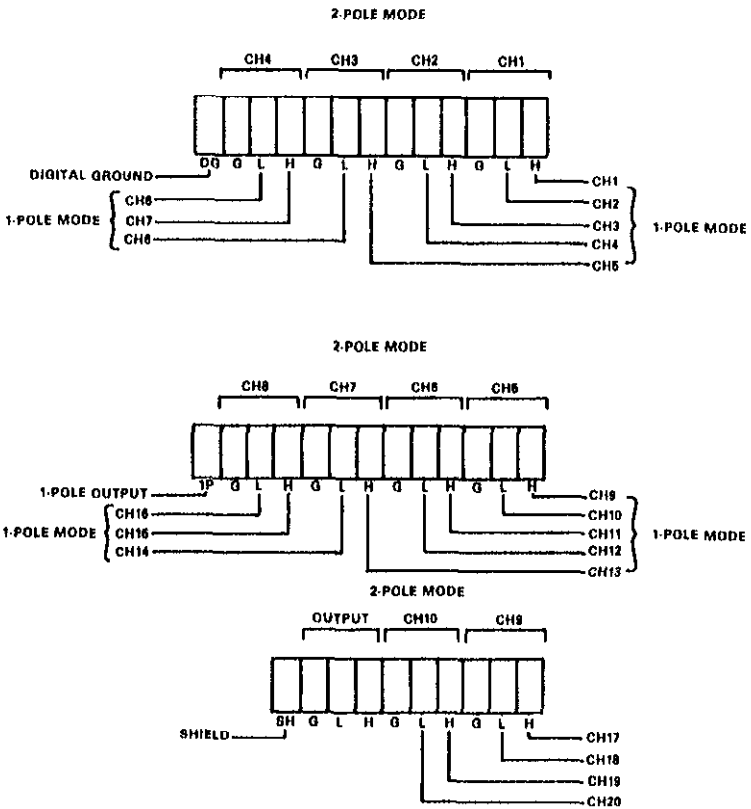


Figure 3. 1-Pole Mode Channel Numbering

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SECTION 3
SERVICING INFORMATION

3.1 INTRODUCTION

The following section contains a performance procedure. Since there are no calibration adjustments, no recalibration is necessary. Recommended maintenance would include inspection of the scanner plug-in board and card edge connector to ensure good electrical contact.

3.2 REQUIRED TEST EQUIPMENT

Recommended test equipment is given in Table 1. Test equipment other than recommended may be substituted if specifications equal or exceed the stated characteristics.

Table 1. Recommended Test Equipment

Item	Description	Minimum Specifications	Mfr.	Model
A	Microvoltmeter	Zero drift less than .5μV.	KI	177
B	Chart Recorder	1V Full Scale Sensitivity	HP	7035B
C	Signal Generator	TTL compatible square wave to 10Hz, and 1 pulse per 30 minutes.	HP	3310B
D	Scanner Mainframe		KI	705
E	Oscilloscope	Triggered Sweep	TEK	7000 series
F	Electrometer	10^{9}A Sensitivity	KI	619 or 614
G	Accessory Triax Cable	Triaxial, with clip leads.	KI	6011
H	Power Supply	10VDC, 100VDC	KI	230

3.3 PERFORMANCE VERIFICATION

This section gives the procedures needed to verify that the operation of the Model 7056 is within specifications. For the following tests, the Model 7056 should be set up in the voltage scanning mode.

NOTE

The following test procedure is used for the Model 7056 card when used in the Model 705 scanner mainframe.

1. Thermal Offset Test
   A. Figure 4 shows the test setup for the thermal offset test. The Model 177 should be set to DCV and the 20mV range. The Model 177 should be allowed to stabilize for two hours. During this time the analog output should be connected to the chart recorder and a recording made to establish a baseline for the voltage measurements.
   B. The 10 input connections on the Model 7056 plug-in card should be shorted together between HI and LO with a length of #14 to #22 AWG solid copper wire, i.e., all 20 screws should be tied together. With a cable attached to the output, the plug-in card should then be inserted into the

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Model 705 mainframe and power applied to the mainframe. Connect the cable from the Model 7056 output to the input of the Model 177.

C. After the warm-up time has elapsed and a stable baseline is visible on the chart recorder, set the Model 705 scanner mainframe's interval time to 15 minutes. Also set the Model 705 to the Channel mode and the Step mode. Scan each channel at the programmed interval rate (15 minutes). This is accomplished by pressing the START/STOP button on the Model 705 once for each channel. Once the START/STOP button is activated for one channel, the Model 705 closes that channel for the programmed interval rate (15 minutes) then opens that channel and advances to the next channel. To scan the next channel press the START/STOP button.

The thermal EMFs generated in each channel will be visible as a deflection from the baseline on the recording. The maximum deflection should be no more than $\pm 100\mu V$ from the baseline for any channel, exclusive of switching spikes. The ambient temperature should be kept at 23°C ±3°C for this test.

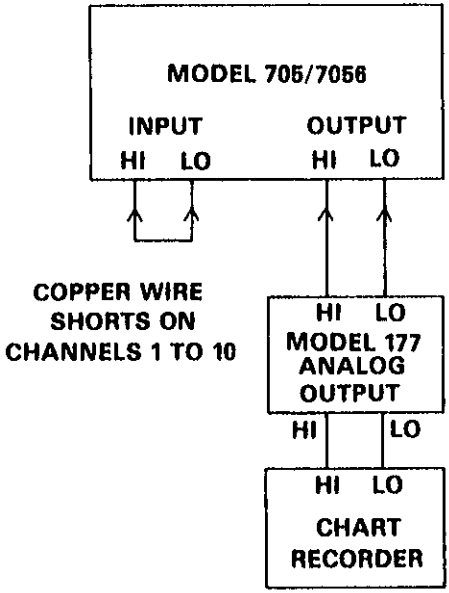


Figure 4. Model 7056 Thermal Offset Test In Model 705

2. Relay Contact Timing Test

A. The 10 input connections and the output should be shorted together between HI and LO with short pieces of wire, on the Model 7056 card. Do not connect each channel together; just connect the individual HI and LO of each channel.

B. Figure 5 shows the equipment setup for this test. Select Channel 1.

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C. The signal generator should be set to a 10Hz square wave output. The scanner should be selecting the desired channel when the signal generator's output is a 1 and all off when the generator is 0.

D. The oscilloscope should be set to trigger on the signal generator's output. The oscilloscope should be set as follows:

SWEEP: 0.5ms per division.

VERTICAL SENSITIVITY: 5V per division.

TRIGGER: External

E. With the oscilloscope on (+) trigger, the typical time to the first contact (a transition from 10V to 0V) should be 0.3ms or more. The contacts should settle in less than 2ms.

F. Turn the oscilloscope to (-) trigger. The typical release time for a 0 to 10V transition is less than 0.25ms.

G. Test all 10 channels as described in steps A through F.

NOTE

A series resistor (R_S) must be used with the power supply output HI. The resistor should be 1kΩ or larger.

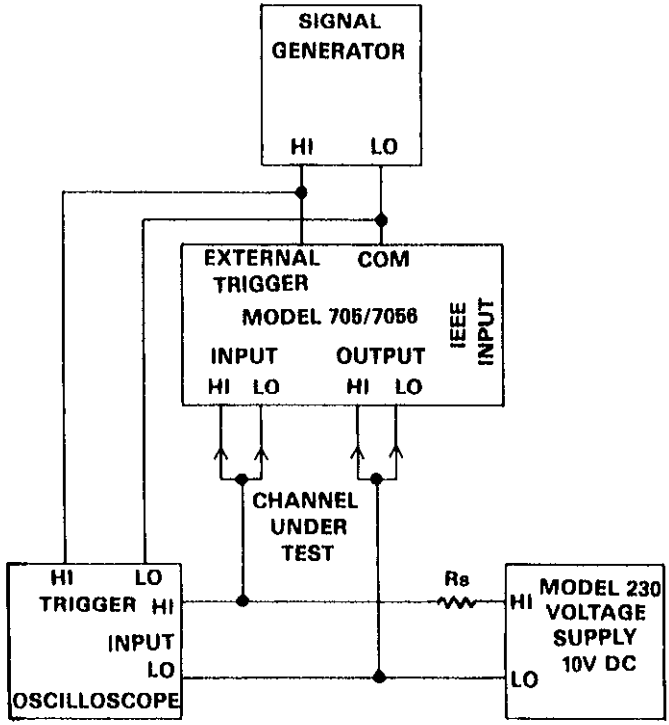


Figure 5. Model 7056 Timing Test In Model 705

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3. Isolation Tests

Input Isolation Common Mode

A. This test measures the common mode input isolation which is the leakage resistance between the signal lines and power line ground. Figure 6 shows the test setup for this test.

B. Short the output HI and LO connections together on the Model 7056 with a short piece of wire.

C. Set up the test circuit shown in Figure 6.

D. Insert the Model 7056 into the mainframe and set the Model 705 to STEP (see Model 705 Instruction Manual)and Channel 1.

E. Set the Model 230 for 100V DC and set the electrometer to 10^{-7}A range.

F. Program the Model 230 output to operate and take the electrometer out of the ZERO CHECK position.

G. Take the reading and manually scan from Channel 1 through 10. The readings for each channel should be less than 1×10^{-7}A. Using Ohms Law calculate the input isolation. $R = E/I = 100V/10^{-7}A = 10^{9}\Omega$. Due to the capacitance of the circuit, the offset current may be high until the capacitance is charged up. Wait until the reading settles out.

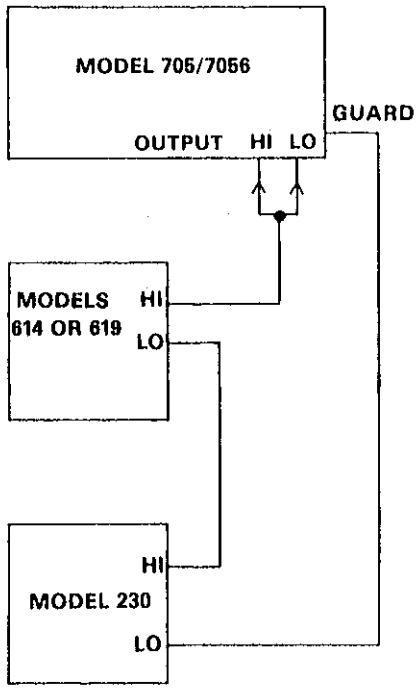


Figure 6. Model 7056 Isolation Test In Model 705

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Input Isolation, Differential (Guarded)

A. This test measures the differential input isolation which is the leakage resistance between a guarded channel HI and LO. Set up the test circuit shown in Figure 7.

B. Set the Model 705 to Channel 1 and the Step mode. Program the Model 230 to output 100V, set the electrometer to Amps and take it out of zero check.

C. Take the reading on the electrometer and manually scan from Channel 1 through 10. The reading for each channel should be less than 1×10^{-7}A. Using Ohms Law calculate the input isolation $R = E/I = 100V/10^{-7}A = 10^{9}\Omega$. Due to the capacitance of the circuit, the offset current may be high until the capacitance is charged up. Wait until the readings settle out.

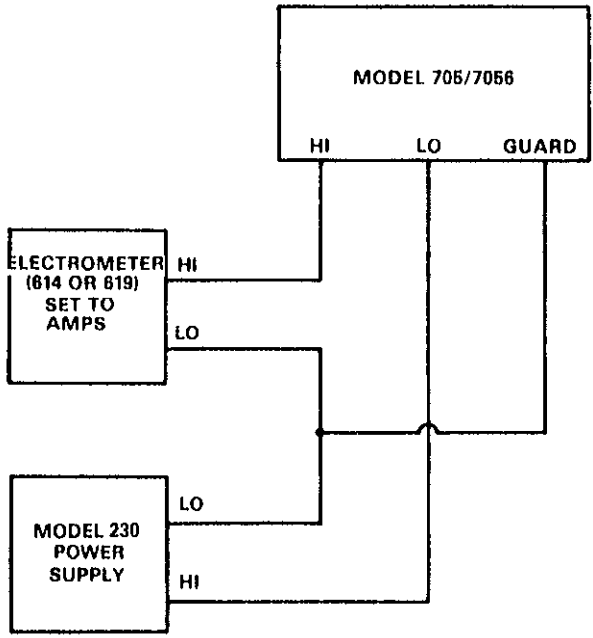


Figure 7. Differential Input Isolation (Guarded) Test Set Up

Channel Isolation

A. This test measures the channel isolation which is the isolation between channels. Set up the circuit shown in Figure 8.

B. Short the HI and LO connections of each channel on the Model 7056.

C. Set the Model 705 to Channel 1 and the Step mode. Program the Model 230 to output 100V, set the electrometer to Amps and take it out of Zero Check. Program Channel 1 as open and the other channels as closed.

D. Take the reading on the electrometer and manually scan from Channel 1 through 10. The reading for each set of channels should be less than 10^{-7}A. Using Ohms Law calculate the channel isolation for each set of channels. $R = E/I = 100V/10^{-7}A = 10^{9}\Omega$. Due to the capacitance of the circuit the offset current may be high until the capacitance of the circuit is charged up. Wait until the readings settle out.

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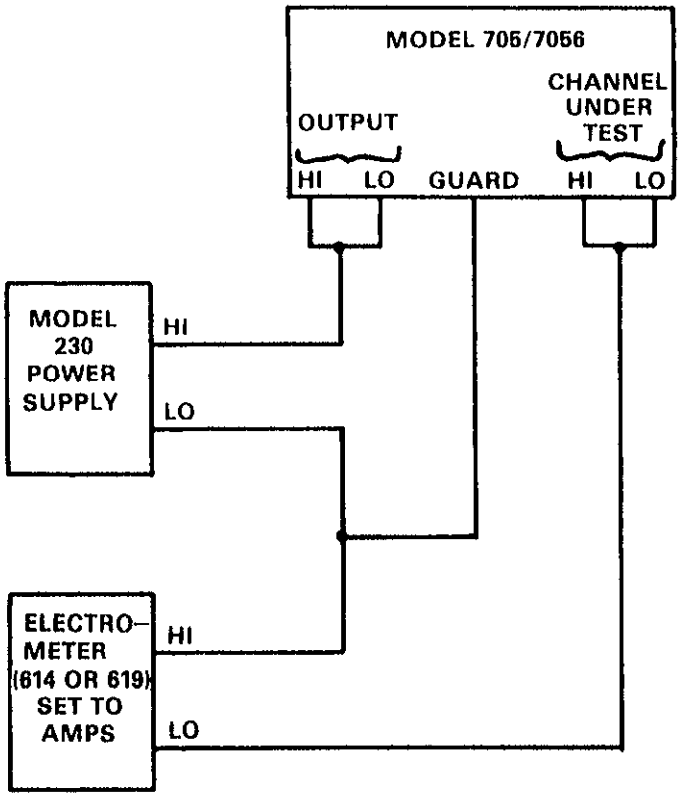


Figure 8. Channel Isolation Test Set Up

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SECTION 4
REPLACEABLE PARTS

4.1 INTRODUCTION

This section contains replacement parts information, a schematic diagram and a component layout for the Model 7056.

4.2 REPLACEABLE PARTS

Parts are listed alpha-numerically in order of their circuit designation. Table 3 contains parts list information for the Model 7056.

4.3 ORDERING INFORMATION

To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the factory. See the inside front 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

Figure 9 contains a component layout for the Model 7055, and Figure 10 contains the component layout for the Model 7056. A schematic diagram of the General Purpose Scanner Card is contained in Figure 11.

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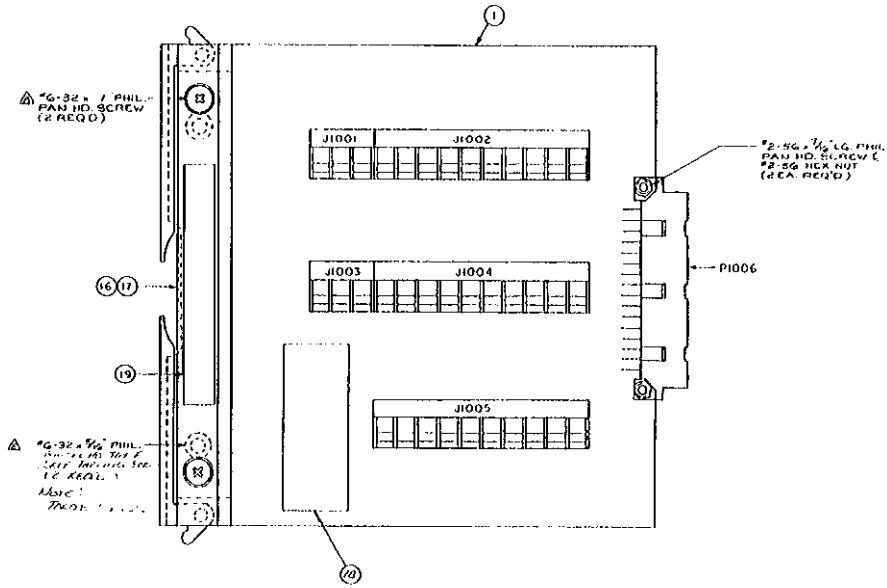
Table 2. Model 7055 Replaceable Parts

Circuit Desig.	Description	Keithley Part No.
—	Handle	FA-119
—	Rivet	FA-121
J1001	Connector	CS-457-1
J1002	Connector	CS-457-2
J1003	Connector	CS-457-1
J1004	Connector	CS-457-2
J1005	Connector	CS-457-2
P1006	Connector, Male (mates for CS-455)	CS-456
	#2-56 × 7/16 Phillips Pan Head Screw	
	#2-56 Hex Nuts	
	Clamp Assembly, Upper	7055-303-1
	a. Clamp, Upper	7055-305
	b. Strip, Rubber	26621
	Clamp Assembly, Lower	7055-308
	a. Clamp, Lower	7055-307
	b. Strip Rubber	26621
	#6-32 × 5/16 Phillips Pan Head Screw	
	#6-32 × 1 Phillips Pan Head Screw	

Table 3. Model 7056 Replaceable Parts

Circuit Desig.	Description	Keithley Part No.
C101	Capacitor, 10μF, 25V, Aluminum Electrolytic	C-314-10
J1006	Connector, Female	CS-455
	#2-56 y 7/16 Phillips Pan Head Screw	
	#2-56 Hex Nuts	
K101–K112	Relay	RL-130
	Interconnect Board	7055

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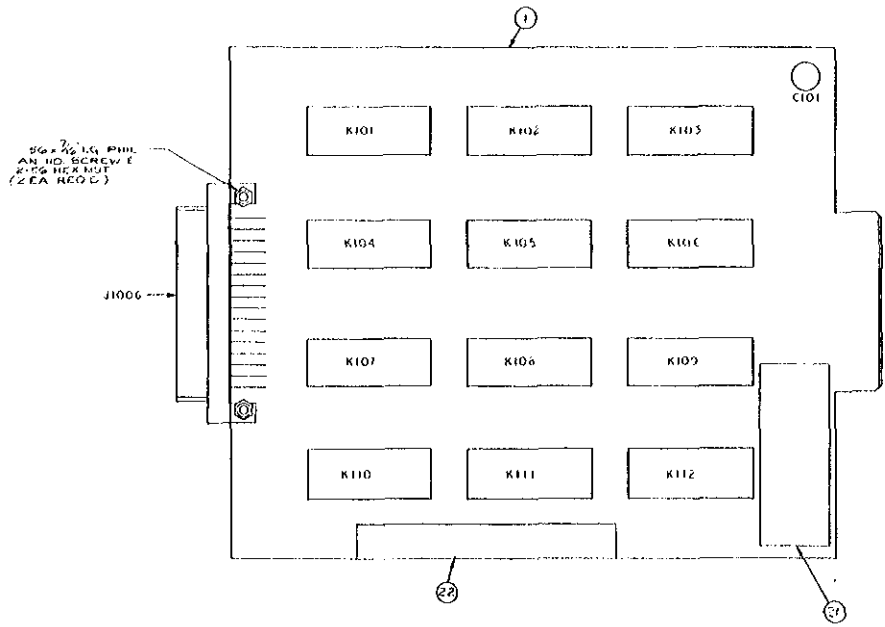


ITEM	PART NO.	SCHEM. DESIG.	ZONE
1	7055-101	STAKING	D1
2			
3			
4	CS-467-1	J1001	C2
5	CS-467-2	J1002	D2
6	CS-467-1	J1003	C2
7	CS-467-2	J1004	D2
8	CS-467-2	J1005	D3
9			
10			
11			
12			
13	CS-456	P1006	E2
14			
15			

ITEM	PART NO.	SCHEM. DESIG.	ZONE	
16	7055-303-01	——	B3	
17	7055-308	——	B3	4
18	MC-285	——	C4	
19	MC-348	——	B3	6

Figure 9. Model 7055 Component Location Drawing

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ITEM	PART NO.	SCHEM. DESIG	ZONE
1	7056-102	HOLE SIZE	C1
2			
3			
4	C-314-10	C101	D1
5			
6			
7			
8			
9	RL-130	K101	B2
10	"	K102	C2
11	"	K103	D2
12	"	K104	B2
13	"	K105	C2
14	"	K106	D2
15	"	K107	B3
16	"	K108	C3
17	"	K109	D3
18	"	K110	B3
19	"	K111	C3
20	"	K112	D3

ITEM	PART NO.	SCHEM. DESIG	ZONE
21	MC-285	—	D4
22	MC-348	—	C4
23	CS-1159	J1006	A2

Figure 10. Model 7056 Component Location Drawing

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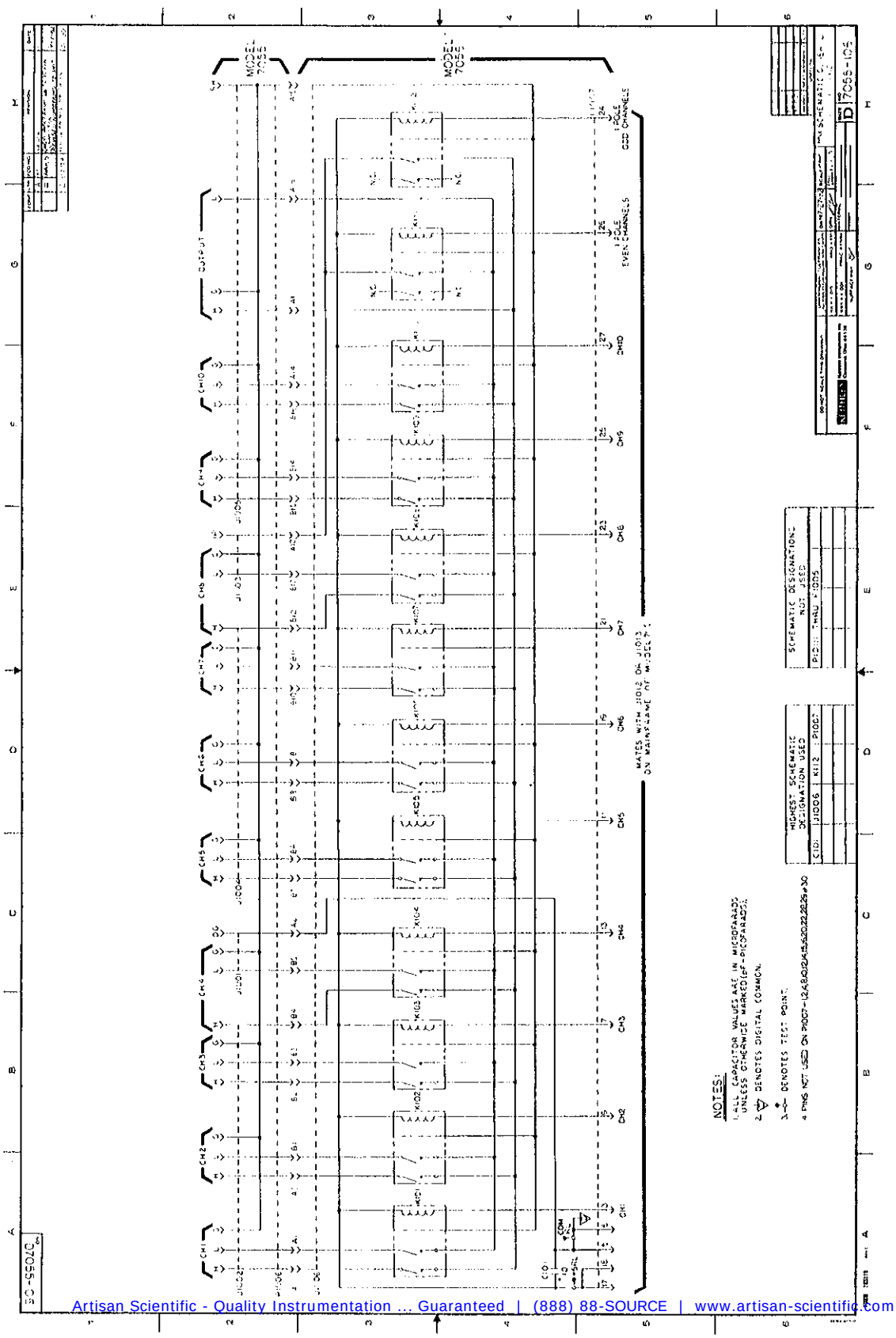


Figure 11. General Purpose Scanner Card, Schematic Diagram

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KEITHLEY

Service Form

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

Name and Telephone No. _____

Company _____

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

_____

_____

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

Display or output (check one)

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

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

(attach any additional sheets as necessary)

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

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

_____

_____

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

Relative humidity? _____ Other? _____

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

_____

_____

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

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